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JUN 2013

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MAY 29 2013

Mr. John Kieling, Manager
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Dear Mr. Kieling

In response to your *Second Notice of Disapproval (NOD), Draft Site Investigation Work Plan, EOD Hill, June 2010* dated 28 October 2010, Kirtland Air Force Base (AFB) is submitting a revised Site Investigation Work Plan, EOD Hill as required by the NOD. The revised Site Investigation Work Plan also includes an updated Conceptual Site Model (CSM) as required per the NOD.

If you have any questions with regard to this submittal, please contact Cole Crosgrove at (505) 853-3098 or at cole.crosgrove@kirtland.af.mil.

Sincerely

JOHN C. KUBINEC, Colonel, USAF
Commander

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KAFB4007

SITE INVESTIGATION WORK PLAN
EOD HILL

KIRTLAND AIR FORCE BASE
ALBUQUERQUE, NEW MEXICO

Prepared for
AFCEC/TDV and KirtlandAir Force Base, Albuquerque

Prepared by
AECOM Technical Services, Inc.
San Antonio, Texas

CONTRACT NO. FA8903-08-D-8770
TASK ORDER NO. 165

Under Contract to
Department of the Air Force
Air Force Civil Engineer Center/Technical Division
3515 S. General McMullen, Bldg 171
San Antonio, Texas 78226-2018

April 2013

KAFB4007

REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, Virginia 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, D.C. 20503.			
1. AGENCY USE ONLY	**2. REPORT DATE** August 2012	**3. REPORT TYPE AND DATES COVERED**	
4. TITLE AND SUBTITLE Kirtland Air Force Base, New Mexico for the EOD Hill SWMU 106			**5. FUNDING NUMBERS** USAF Contract No. FA8903-08-D-9770 Task Order No. 0123
6. AUTHOR(S) AECOM			
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) AECOM 10 Patewood Drive, Building IV, Suite 500 Greenville, SC 29615			**8. PERFORMING ORGANIZATION REPORT NUMBER**
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) Air Force Center for Engineering and the Environment (AFCEC) Environmental Restoration Division (AFCEC/ERD) 3300 Sidney Brooks Brooks City-Base, Texas 78235-5344 COR: Ms. Kristi Doll			**10. SPONSORING / MONITORING AGENCY REPORT NUMBER**
11. SUPPLEMENTARY NOTES			
12a. DISTRIBUTION/AVAILABILITY STATEMENT			**12b. DISTRIBUTION CODE**
13. ABSTRACT (Maximum 200 words)			
14. SUBJECT TERMS			**15. NUMBER OF PAGES** xxx
			16. PRICE CODE
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	**18. SECURITY CLASSIFICATION OF THIS PAGE** UNCLASSIFIED	**19. SECURITY CLASSIFICATION** UNCLASSIFIED	**20. LIMITATION OF ABSTRACT** SAR

NSN 7540-01-280-5500

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

40 CFR 270.11
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APRIL 2013

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JOHN C. KUBINEC, Colonel, USAF
Commander, 377th Air Base Wing

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KIRTLAND AIR FORCE BASE
377th ABW Public Affairs

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Acronyms and Abbreviations

µg/L	micrograms per liter
AFB	Air Force Base
AFCEC	Air Force Center for Engineering and Environment
ARCH	Air Rotary Casing Hammer
ASTM	American Society for Testing and Materials
bgs	below ground surface
BH	Borehole
CCTA	Central Coyote Test Area
CE2	CE2 Corporation
ClO_4	Perchlorate
COPC	Contaminant of Potential Concern
CSM	Conceptual Site Model
DMP	Data Management Plan
DOD	Department of Defense
DOE	Department of Energy
DQCRs	Daily Quality Control Summary Reports
DQOs	Data Quality Objectives
DWEL	Drinking Water Exposure Limit
EOD	Explosive Ordinance Disposal
ERP	Environmental Restoration Program
FCR	Field Change Request
FSP	Field Sampling Plan
ft	feet
GMR-REF	Generalized Reciprocal Method Refraction
GPS	Global Positioning System
GWQB	Ground Water Quality Bureau
HASP	Health and Safety Plan
HE	High Explosives
HWB	Hazardous Waste Bureau
IDW	Investigative derived waste
IP/DCRES	Induced Polarization/Direct Current Resistivity
MCL	Maximum Contaminant Level
MG	million gallons
mg/kg	milligrams per kilogram
mg/L	micrograms per liter
MSDS	Material Safety Data Sheets
MSL	mean sea level
NMED	New Mexico Environmental Department

NMED/OB	New Mexico Environmental Department Oversight Bureau
NOD	Notice of Deficiency
OSE	Office of the State Engineer
PID	photo ionization detector
ppm	parts per million
PVC	polyvinyl chloride
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Project Plan
RCRA	Resource Conservation and Recovery Act
RES	resistivity
SI	Site Inspection
SNL/NM	Sandia National Laboratories New Mexico
SOP	Standard Operating Procedures
SWHC	Site Wide Hydrogeological Characterization
SWMU	Solid Waste Management Unit
UFP	Uniform Federal Policy
USACE	United States Army Corps of Engineers
USAF	United States Air Force
USEPA	United States Environmental Protection Agency
VOCs	Volatile Organic Compounds
WMP	Waste Management Plan
WQCC	Water Quality Control Commission

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1 INTRODUCTION

This work plan identifies activities to be completed as part of a site investigation (SI) of potential groundwater impacts of perchlorate at Kirtland Air Force Base (AFB), Albuquerque, New Mexico, at the area unofficially known as the Explosive Ordnance Disposal (EOD) Hill site. Specifically, this new work plan is intended to address comments on deficiencies contained in the October 28,2010, letter from the New Mexico Environmental Department (NMED) Hazardous Waste Bureau (HWB) to the Air Force.

The EOD Hill area is a topographic high located in the southeastern portion of Kirtland AFB, approximately one mile west of the EOD Range (Figure 1-1). The Department of Energy (DOE) previously conducted activities in the EOD Hill area, which included the advancement of a borehole on EOD Hill to a depth of 248 feet (ft) below ground surface (bgs). For the purpose of this work plan, the EOD Hill well is designated as EOD-BH and is currently being utilized as a monitoring well from which groundwater samples are periodically collected.

Groundwater analytical results of samples collected from EOD-BH have indicated perchlorate concentrations ranging from less than 0.96 micrograms per liter (µg/L) in 2001 to 4,500 µg/L in 2004 (Copland, 2005). Based on these results, the NMED has requested that the Kirtland AFB define the nature and extent of perchlorate contamination in the vicinity of the EOD Hill site.

1.1 Objectives and Scope

Based on past activities conducted in the study area, this Site Investigation Work Plan was developed to provide rationale and decision logic for delineating the nature and extent of perchlorate contamination in soils and groundwater at the EOD Hill site, specifically in the vicinity of the EOD Hill. Specifically this plan includes the following elements in accordance with the Notice of Disapproval (NOD) requirements of October 28, 2010. Additional field work was conducted prior to the resubmission of this work plan as requested by NMED. The additional field work consisted of: the geologic mapping of the EOD Hill area within a radius of approximately ¾ mile from EOD-BH; the excavation of a 200 foot long exploratory trench in the vicinity of the chaotic blocks area to expose any potential fault at that location; and execution of geophysical surveys immediately east of EOD Hill to delineate any potential faults that run through this area.

This new work plan includes:

- An improved initial conceptual site model (CSM) based on existing geologic maps covering the EOD Hill area (included in Work Plan) and newly acquired data from the additional field work;
- Proposed installation of five additional monitoring wells based on the revised CSM, including the collection of geophysical borehole logs, samples or cores at 5-foot intervals, along with a detailed geologic field log of each hole, with well screens placed as required in the NOD;
- Proposed collection of surface soil samples from the craters located adjacent to EOD-BH for determination of perchlorate and High Explosives (HE).
- Proposed quarterly groundwater sampling and reporting until a different schedule is agreed upon by Air Force and NMED. Allowances for two years of quarterly sampling (eight events) are included in this Work Plan.
- Provisions for an SI report, and a schedule of activities.

This work plan is intended to fulfill the following broad characterization items:

- Define the nature and horizontal extent of groundwater contamination;
- Determine the contaminant fate and transport properties, including migration rates;

- Document the geology and hydrogeology at and below the water table;
- Measure the groundwater flow direction and velocity.

This work plan also defines/and includes the following:

- Construction details, locations, and depths of proposed groundwater monitoring wells;
- Field procedures;
- Sampling, analysis and related quality control protocols (shall be included in Uniform Federal Policy for Quality Assurance Project Plans (UFPQAP)) to be submitted by the contractor conducting the investigation;
- Data analysis and reporting procedures;
- Proposed schedule for completion of SI activities.

1.2 Approach and Implementation

This Site Investigation Work Plan presents a phased approach (Phase 1 and 2) to the identification of potential contaminant source(s) and the delineation of the nature and extent of contamination of perchlorate in the vicinity of the EOD Hill site. The work plan recognizes that the extent of contamination at the site will largely be controlled by the site's unique geological features, e.g., the fault zone that runs on the east side of EOD Hill, and that these features control groundwater movement and, ultimately determine contaminant migration at the site.

Phase 1 field work shall consist of the drilling and installation of five groundwater monitoring wells at the site at locations agreed upon by the Air Force and NMED. The five monitoring wells include a replacement of the EOD-BH well which was not constructed as a proper compliance point because the well was originally installed for experiments conducted by Sandia National Laboratories.

Rock cores from all borings advanced for the purpose of well installation shall be collected and lithologically logged. Cores shall be collected from the depth that rock is encountered to the terminus of the borings. The boreholes shall also be video logged so that the core can be oriented. The video logs shall then be used to orientate the rock cores from each well. After installation, the groundwater monitoring wells shall be sampled and a report submitted summarizing the results of the SI.

If the Phase 1 work does not fully define the nature and extent of contamination at the site, additional monitoring wells will be installed during Phase 2. The number of additional wells required will be determined by groundwater flow information and contaminant concentration data collected during Phase 1 activities. The number and location of the monitoring wells will be agreed upon by NMED and the Air Force prior to commencing Phase 2 activities.

Once wells are installed, groundwater samples shall be collected quarterly for a period of two years.

1.3 Background Issues

1.3.1 Regulatory Requirements

1.3.1.1 Regulatory Framework

Based on the groundwater sampling data obtained from EOD-BH, Kirtland AFB is initiating this SI to determine the nature and extent of contamination that may have occurred as a result of Air Force and/or DOE activities, define the present source area of that contamination, and determine potential environmental impacts, if any, associated with the contamination. The findings from this SI will define whether remediation will be required and under what authority the remediation will occur. This work plan

shall be provided to the NMED HWB, and the United States Environmental Protection Agency (USEPA) Region 6.

Groundwater monitoring wells installed as part of this SI shall be installed in compliance with applicable regulations of the NMED, the New Mexico Office of the State Engineer (OSE), and the requirements of the NOD. Changes from NMED and/or OSE monitoring well installation or construction guidelines are stated in this work plan.

1.3.2 Other Issues

On October 28, 2010, a letter was posted to Kirtland AFB from the NMED HWB notifying Kirtland AFB that a second NOD had been issued for the EOD Hill Site Investigation Work Plan, submitted on July 4, 2010. The Work Plan was reviewed by NMED and on October 28, 2010 a NOD was sent out listing deficiencies in the work plan that were identified by NMED. This Site Investigation Work Plan is prepared in response to NMED's letter.

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2 BACKGROUND AND SETTINGS

2.1 Background

The Kirtland AFB EOD Hill is a 50-foot high limestone ridge located roughly one mile west of Kirtland AFB's EOD Range and approximately 0.8 miles southeast of the intersection of Lovelace Road and the unpaved Coyote Springs Road. Figure 1-1 and Figure 2-1 show the location of the site. Situated on top of EOD Hill is a single borehole that is unofficially called the EOD Hill well but is referred to in the KAFB and regulatory agency databases as EOD-BH. EOD-BH was drilled by Sandia National Laboratories, New Mexico (SNL/NM), in the early 1970s as a "geotechnology test hole" (Copland, 2005).

Previous groundwater samples collected by DOE and the NMED/Oversight Bureau (OB) from EOD-BH have contained detections of the compound perchlorate at concentrations ranging from 0.96 µg/L to 4,500 µg/L. Figure 2-2 illustrates perchlorate concentrations over time beginning with the initial sampling event conducted in 2001 through the most recent sampling event conducted in 2011. Perchlorate is a compound of concern often associated with explosives contamination in the environment. Various agencies have conducted activities in the general vicinity of EOD-BH over the last several decades that could be a source, or sources, of perchlorate impacts to groundwater. It is also possible that some portion of perchlorate may come from natural sources. For example, Rajagopalan et. al. (2006), found naturally occurring perchlorate in groundwater in 56 counties in northwest Texas and eastern New Mexico to range from <4 µg/L to 200 µg/L; however, their study did not include the EOD Hill area.

2.2 Site Description

The EOD Hill covers approximately 13 acres in a remote area of Kirtland AFB. The hill is surrounded by a rarely used, narrow, two-track dirt road. The hill is capped by a well-exposed sequence of Madera Group limestone. A small amount of test debris is scattered across the hill. No buildings have been constructed at the EOD Hill (Copland, 2005).

2.3 Operational History

A variety of operations have been conducted from 1957 to the present by Kirtland AFB, SNL/NM, the New Mexico School of Mines, the Defense Threat Reduction Agency, and possibly other organizations in the multi-use area encompassing the EOD Hill and the adjacent EOD Range. Historical events for the EOD Hill area were compiled by CE2 Corporation (CE2) and are discussed in Copland (2005). The listed events, which occurred starting in the 1940s (Copland, 2005), include

- Mining of prospect pits (probably hand-dug during the 1940s).
- Rocket motor testing.
- Project 56/Moonlight Shot residual collection.
- Vortman cratering tests.
- Ground shock study.
- Witness plate tests.
- Downhole geophysics.
- Well survey.
- Hydrogeochemical investigation.
- Central Coyote Test Area (CCTA) study.

- Site Wide Hydrogeological Characterization (SWHC) geologic mapping.
- Military compass training.
- Video logging for determining well construction details.
- Groundwater monitoring.

Explosives, some possibly containing perchlorate, may have been associated with some of these events (see Section 2.5.1).

2.4 Site Setting

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 information below synopsizes relevant information.

2.4.1 Geology and Hydrogeology

Kirtland AFB spans a segment of the eastern flank of the Albuquerque basin and the uplifted basin margins (Van Hart, 2003). The basin is a segment of the Rio Grande rift, a linear extensional feature extending from southern Colorado to Mexico and West Texas. On Kirtland AFB, the structural scenario is quite complex, but it can be simplified as consisting of four tectonic provinces (Van Hart, 2003). These provinces, which are shown on Figure 2-3, include the following:

- The eastern part of the Calabacillas sub-basin of the Albuquerque basin, where bedrock is deeply buried below late Tertiary, Santa Fe Group Alluvium.
- The uplifted basin margins, where bedrock generally outcrops and forms rugged topography, e.g., elevated blocks of Manzano Base and Manzanita Mountains.
- The Hubble bench, which occupies an intermediate structural position between the Albuquerque basin and the uplifts. Bedrock in this province is generally buried by less than 200 ft of alluvium. The EOD Hill area is included in this province.
- The Travertine basin, which developed within a zone of Tertiary, Laramide-age shear on the western rim of the Hubble bench.

The stratigraphic section preserved on Kirtland AFB varies with province and is controlled by the amount of uplift and the attendant depth of erosion (Van Hart, 2003). Geology beneath the study area generally includes a relatively thin layer of Younger Piedmont alluvium overlying Madera Formation limestone, overlying the Sandia Formation, which overlies Manzanita Granite (NMBGMR, 2002). The Younger Piedmont alluvium primarily consists of unconsolidated gravel and sand. The Madera Formation primarily consists of fossiliferous limestone. The Sandia Formation primarily consists of shales and siltstones grading down into basal quartz pebble conglomerates and up into thin bedded limestones. The Manzanita Granite primarily consists of a homogeneous quartz monzonite (granite). A geologic map of the study area, depicting geologic units and fault orientation, is shown on Figure 2-4 (NMBGMR, 2002). A geologic cross section of the study area, depicting geologic units, bedding attitudes, and major structures (including faults) is also shown on Figure 2 4. The location of the cross section line is shown on the geologic map. The section line has an east west orientation and runs along the north side of EOD Hill. The section line is roughly perpendicular to the strike of area faults.

The area surrounding EOD Hill is considered a Laramide-age "pop-up" structure associated with the Tijeras/EOD right-lateral wrench-fault system, caused by localized compression (Van Hart, 2003). A wrench fault is a type of strike-slip fault, which can be vertical or sub-vertical. The EOD Fault (EOD wrench fault zone) is depicted on Figure 2-5, which includes a schematic cross section through the zone.

Geologic mapping of the EOD Hill area was performed by AECOM personnel during January, February, and April 2011. The mapped area extends approximately 2,700 feet east to west and 2,600 feet north to south. Mapping results are summarized below and illustrated on Figures 2-6 and 2-7. Geology of the EOD Hills area, including the mapping, is included in Appendix E. A description of fractures in the EOD Hills is included in Appendix F.

The strata encountered in the area include Precambrian age igneous and metamorphic rocks, Middle Pennsylvanian Sandia Formation and Middle to Late Pennsylvanian Madera Group rocks.

Precambrian age rocks crop out at locations 500 feet north of EOD Hill and in the prominent hill directly north of EOD Hill. The Sandia Formation crops out in the north end of EOD Hill and in areas immediately northeast and northwest of EOD Hill. The Sandia Formation consists of medium to coarse-grained sandstone grading downward to coarse pebble conglomerate. The formation underlying the north end of EOD Hill consists of fine to coarse quartzose grains with calcareous cement, and is transitional with the Madera Group.

The Madera Group crops out on EOD Hill, and on small hills and ridges located west, northwest, east and northeast of EOD Hill. The lower part of the Madera Group is exposed on EOD Hill and consists principally of micritic limestone. The limestone occurs as massive and thin-bedded units. Sandstone and siltstone overlies the lower Madera Group limestone at locations in the northwestern part of the mapped area. The sandstone is predominantly medium to coarse-grained quartzose and feldspathic sandstone. The sandstone is overlain by Madera Group limestone. The uppermost Madera Group limestone unit crops out in the western and southwestern part of the mapped area. Alluvium and slope-wash colluvium overlies the bedrock surface in much of the mapped area.

Geologic structures such as strikes and dips of bedding planes were measured at several locations in the mapped area. The major geologic structure delineated by the measured strikes and dips is a south plunging anticline. EOD Hill is a western limb of the anticline.

The Sandia Formation and the Madera Group are exposed in the EOD Hill area. Formation exposures are weathered and fractured. Fracture types observed in the Sandia Formation are sharp, and typically open with vertical and sub-vertical dips. Fracture types observed in the Madera limestone include open hairline through open large aperture fractures, calcite-filled fractures, preferentially weathered/eroded open and closed fractures and grooves.

During February and April 2011, AECOM personnel oversaw the excavation of an investigative trench excavated across the location of the inferred EOD fault by Universal Constructors, Albuquerque, New Mexico. Trenching results are summarized below and illustrated on Figures 2-6 and 2-7. Geology of the EOD Hill area, including the investigative trench, is presented in Appendix E. A description of fractures in the EOD Hills is included in Appendix F.

The trench is approximately 210 feet long, and is 6 to 10 feet deep at most locations. Rock types encountered in the trench include limestone, shale, mudstone, siltstone, and sandstone. The bedrock units in the trench are dipping 13 to 18 degrees toward the southeast. A normal fault (down to the east) was observed in the western part of the trench, trending north 18 degrees west and dipping approximately 33 degrees east-northeast. It is concluded that this normal fault is part of the EOD Fault Zone, which also includes the chaotic blocks area.

During March and April 2011, AECOM personnel conducted geophysical surveys using multiple techniques as lines of evidence to evaluate the presence of faulted bedrock in the vicinity of the EOD Hill area. Geophysical survey results are summarized below and illustrated on Figure 2-8. Geophysical survey results are also discussed in the Technical Memorandum presented in Appendix G.

The geophysical survey included review of aerial photographic and Landsat TM data. The geophysical survey also included conducting EM-31, EM-34, VLF Wadi, Protem magnetometer and seismic refraction investigations.

Review of the aerial photographic data identified a linear feature, roughly corresponding to the location of the prospective EOD fault. Review of the satellite data proved ineffective for mapping faults underlying alluvial overburden. EM-31 and EM-34 terrain conductivity signatures appear to correlate to mapped geological units at the site. High conductivity zones imaged in areas mapped with alluvial overburden are interpreted to be responses from underlying bedrock and possibly deeper water-bearing zones or zones of mineralization (indirect indicators of fault systems). Anomalies identified in the VLF Wadi investigation generally show sharp contrast, which likely indicates a geological contact or altered/displaced rock. Review of magnetometer data appears to be inconclusive. Seismic data indicated sharp contrasts in velocity, which is consistent with the interpretation that a fault may be present in the transect locations.

In general, on the eastern side of Kirtland AFB, near the mountain fronts, groundwater occurs in fractured bedrock aquifers. These aquifers may be water table aquifers, semi-confined, or fully confined. In some cases, shallow water table aquifers may exist in surficial alluvium or decomposed bedrock while deeper aquifer zones are present in more competent fractured bedrock at depth. Local and regional faulting along the mountain fronts is known to have the potential to impede groundwater flow across the fault zones, in some cases resulting in dramatically differing depths to groundwater from one side of the inferred fault to the other.

Limited specific geologic and hydrogeologic data are available for the EOD Hill area. The existing EOD Range monitoring points (shown on Figure 2-1), EOD-BH, and the School House Mesa well (approximately 1.2 miles northeast of EOD Hill) were not originally intended as monitoring points and do not have installation records available. These wells are relevant to the study area because of their location at EOD Hill (EOD-BH) and proximity to the EOD Hill area (School House Mesa Well). Video logging that was conducted on the completed EOD-BH indicated that the bottom portion of the borehole is completed in limestone bedrock. However, because the borehole was not installed for the purposes of investigating the subsurface or hydrogeologic conditions in the area, nor for the purpose of environmental groundwater sampling, no information—such as lithologic logs, well development records, or aquifer testing data—is available. EOD-BH was installed in the early 1970s; the School House Mesa well was installed in the 1950s.

In 2005 the DOE measured the depth to groundwater in EOD-BH as being approximately 140 feet bgs. In 2010 URS measured the depth to groundwater in EOD-BH as being roughly 145 feet bgs. EOD-BH appears to have penetrated a confined aquifer in the limestone bedrock that is likely controlled by fracture patterns within the unit (CH2M HILL, 2009). EOD BH is located on a topographic high, some 50 feet above the surrounding area. The nature of fracture-controlled confined aquifers makes it difficult to predict the occurrence of water-bearing zones within the bedrock. The potential that hydrogeologic conditions are also influenced by fault zones present in the study area makes it difficult to predict the depth at which groundwater will be encountered. The groundwater flow direction in the vicinity of EOD Hill is believed to be east to west. A regional water table map is shown on Figure 2-6 of Appendix I.

2.4.2 Geochemistry

Geochemical conditions are one factor that influences the transport and transformation of perchlorate in the environment. Biodegradation can transform perchlorate to chloride and water if conditions are favorable. Microbial populations have been shown to degrade perchlorate when conditions are reducing in the presence of sulfur (Boles et al., 2010) and acetic acid (Leo et al., 2010). Vadose zone degradation has been demonstrated using liquefied petroleum gas and hydrogen (Lopez et al., 2010). Although most degradation of perchlorate occurs under anaerobic conditions, microbial degradation has also been reported when dissolved oxygen is present (Shrout and Parkin, 2006).

The pH may also influence perchlorate fate and transport. For example, microbiological reactions typically have optimal pH ranges. Also, perchlorate adsorption to common soil minerals, such as iron oxyhydroxides, aluminum oxyhydroxides, and kaolinite, is more likely to occur when conditions are somewhat acidic. Perchlorate (ClO4-) is negatively charged, so it sorbs poorly to most mineral surfaces at neutral pH values (Brown and Gu, 2006).

2.5 Nature and Extent of Contamination

2.5.1 Contaminant Sources

Perchlorate is the primary contaminant detected in groundwater samples from EOD BH. The source(s) of perchlorate contamination in EOD BH is not known; the perchlorate may be from an upgradient source(s) or may have resulted from activities on EOD Hill. It has been speculated that perchlorate could have been deliberately introduced in the well (in an act of -vandalism), although there is no direct evidence other than a plastic soda bottle that was pulled from EOD BH when it was video logged in 2005. Identifying the source of perchlorate is expected to be difficult given the complex geology and uncertain groundwater flow pattern present beneath the site.

Table 2-1 summarizes possible sources of perchlorate at EOD Hill and the surrounding area as reported by CE2 (Copland, 2005).

Table 2-1: EOD Hill Site Potential Sources of Perchlorate, Kirtland AFB

Potential Perchlorate Source	Responsible Organization
Kirtland AFB EOD Range (IRP Site OT-029)	Kirtland AFB
Vortman craters at EOD Hill (activity involving high explosives)	SNL/NM
Witness Plate Tests at EOD Hill (activity involving high explosives)	SNL/NM
Rocket Motors at EOD Hill (possible World War II-era rocket firing)	Unknown
Ongoing military training at EOD Hill	Kirtland AFB
Sandia National Laboratories SWMU 8 and 58 Coyote Canyon Blast Area and Dump (solid fuel rockets excavated 2 miles northeast of EOD Hill)	SNL/NM
Sandia National Laboratories SWMU 50 (Old Centrifuge site) near Tech Area II (solid fuel rocket motors used 4.8 miles northwest of EOD Hill)	SNL/NM
Sandia National Laboratories SWMU 64 – Gun Site Madera Canyon (solid fuel rocket tests 5.7 miles northeast of EOD Hill)	SNL/NM
Sandia National Laboratories SWMU 71 – Moonlight Shot (detonation site 2 miles southeast of EOD Hill)	SNL/NM
Sandia National Laboratories SWMU 81 – New Aerial Cable Site (solid fuel rocket tests 4.4 miles east of EOD Hill)	SNL/NM
Sandia National Laboratories SWMU 82 – Old Aerial Cable Site (solid fuel rocket test 2.8 miles east of EOD Hill)	SNL/NM
Sandia National Laboratories Sled Tracks - SWMUs 83 and 240 (tests with solid fuel rockets west of EOD Hill)	SNL/NM
Sandia National Laboratories SWMUs 93a, 93b, and 93c – Madera Canyon Rocket Launcher Pads (solid fuel rocket tests 4.8 miles east of EOD Hill)	SNL/NM
Lake Christian – Kirtland AFB IRP Site OT-46 (high explosives testing in lined impoundment 1.1 miles south of EOD Hill)	Kirtland AFB

The EOD Range is a RCRA-permitted open burning/open detonation (OB/OD) unit used for the destruction of ordnance (including explosives, propellants, pyrotechnics and munitions). According to CE2, thousands of pounds of HE material have been detonated in the last 40 years at the EOD Range (Copland, 2005). TNT has been the most commonly used HE material at the EOD Range. However, various types of HE, including undocumented research formulations, may have been used. Therefore, perchlorate concentrations of the HE materials are unknown.

CE2 was not able to determine if solid fuel rocket motors had been destroyed at the EOD Range. Historically, however, unwanted rocket motors at other U.S. OB/OD ranges were destroyed. CE2 indicates that rocket motor cases were typically ruptured with HE charges resulting in chunks of propellant being dispersed across the ground surface (Copland, 2005). Given the location of the EOD Hill directly west of the EOD Range, and prevailing wind direction at Kirtland AFB from the east during part of the year (NMED, 2007), it is possible that detonations within the EOD Range have resulted in perchlorate-containing material being deposited on the hill.

The different potential sources of perchlorate would result in different contaminant distribution patterns in groundwater. Possible perchlorate from the EOD Range would be distributed over a broad area of surface or near surface soil and transported to groundwater by infiltration following intense precipitation events that result in flow in washes and arroyos. This would likely produce a groundwater plume over a broad area. Possible perchlorate from EOD Hill sources would also be transported by precipitation infiltration, but the resulting plume would be more focused around the EOD Hill area. If perchlorate was directly placed in EOD-BH, contamination could be more concentrated than from other sources and more localized.

2.5.2 Contaminant Concentration

In 1990, SNL/NM began environmental monitoring (routine water level measurements) at EOD-BH. Perchlorate was first analyzed in EOD-BH groundwater in 2001 and has ranged from below the detection level (0.96 µg/L) to 4,500 µg/L. Available historical perchlorate concentrations for EOD BH are provided in Table 2-2.

The USEPA established a Drinking Water Exposure Limit (DWEL) for perchlorate of 24.5 µg/L in January 2006. On January 8, 2009, the EPA withdrew its 2006 perchlorate assessment guidance and issued an Interim Drinking Water Health Advisory for exposure to perchlorate at 15 µg/L in drinking water. The DoD has adopted the 15 µg/L as the PRG for perchlorate in its April 2009 Perchlorate Release management Policy (DoD, 2009). NMED has proposed a standard of 4 µg/L for this site.

The most recent groundwater samples collected from the EOD-BH well were collected in January 2010 and June 2011. The January 2010 sample was collected as an addition to the January 2010 groundwater compliance sampling event. The sample was collected in accordance with the Project Work Plan (June 2008). The samples were prepared and analyzed within the required holding times, and all quality control measures were met (URS, 2010). The perchlorate concentration detected in this sample was 2.7 µg/L which is lower than the Interim Drinking Water Health Advisory for exposure to perchlorate. The results from the entire suite of analyses at EOD-BH are presented in Table 2-3.

The perchlorate concentration in the EOD-BH well as sampled in June 2011 was 22 ug/L and 27ug/L (duplicate) and is shown in Table 2-2. This result is above the Interim Drinking Water Health Advisory for exposure to perchlorate. The results from the entire suite of analyses at EOD-BH are presented in Table 2-3. Sample collection details and field water quality parameters associated with the sampling are compiled in Appendix D.

A perchlorate primary drinking water standard maximum contaminant level (MCL) has not yet been established. Likewise, the NMED has not established a drinking water standard for perchlorate, nor has a

background concentration for perchlorate in groundwater been established at Kirtland AFB. However, the WQCC has classified perchlorate as a toxic pollutant/regulated contaminant (Copland, 2005).

Table 2-2: Perchlorate Concentrations in Groundwater at EOD-BH, Kirtland AFB

Date Sample Collected	Results (µg/L)		
	Initial Sample	Re-analysis/Duplicate	Sample Owner
5-30-01	<0.96[1]	--	SNL/NM
6-25-03*	4	--	NMED DOE
7-20-04*	**4,300**	**4,500**	NMED DOE
11-17-04*	**680**	**620**	NMED DOD
11-17-04	**755**	---	NMED DOE
11-17-04	**748**	**699**[1]	SNL/NM
3-13-06*	**1,300**	**1,000**	KAFB
3-13-06	**1,390**	**1,050**	KAFB
1-10-10	**2.70**	--	KAFB
6-1-11	**22**	**27**	KAFB

Sources: CE2 Corporation, 2005; DOE & NMED/OB, 2006; and URS, 2010.
* - Severn Trent Laboratories; others analyzed by General Engineering Laboratories, Charleston, except January 2010 sample.
[1] - Analysis by Method 314.0 (ion chromatography); others by 8321A (liquid chromatography/mass spectrometry/mass spectrometry) except January 2010 sample by method SW6850.
EPA issued Interim Drinking Water Health Advisory for exposure to perchlorate of 15 µg/L in water.
Bold values indicate exceedance of regulatory standard.

Previous groundwater sampling and analysis events have been conducted for volatile organic compounds (VOCs), metals, radionuclides, cyanide, phenols, and general chemistry, in addition to perchlorate (Copland, 2005). More recently (June 2011), herbicides and pesticides were analyzed and not detected (Table 2 3). The sampling has demonstrated that, except for perchlorate, no groundwater contamination has been detected with the following exceptions:

- Acetone concentrations ranging from 5.74 to 23 µg/L, likely due to analytical laboratory contamination. No other VOCs have been detected.
- Arsenic concentration of 0.0299 mg/L (May 1999); however, the concentration in later samples were 0.00908 mg/L (July 2003) and 0.01 mg/L (January 2010), which do not exceed the MCL (0.01 mg/L).
- Chloride concentrations ranging from 358 to 400 mg/L, which exceeds the secondary MCL of 250 mg/L.
- Iron concentrations ranging from 21.2 to 24 mg/L, which exceeds the secondary MCL of 0.3 mg/L.
- Manganese concentrations of 1.33 and 1.4 mg/L, which exceed the secondary MCL of 0.05 mg/L.

Exceedances of the inorganics are most likely related to natural conditions in groundwater.

No groundwater samples collected from EOD BH have been analyzed for HE compounds. However, nitrate, which may sometimes be associated with HE materials as a degradation product, has been detected in small concentrations in groundwater samples from EOD BH (<0.1 to 0.02 mg/L) (Copland, 2005).

Table 2-3: EOD-BH January 2010 & June 2011 Groundwater Monitoring Data, Kirtland AFB

	EPA Drinking Water Standards[1]	EOD Hill 01-10-01 Well Sample	EOD Hill 06-01-11 Well Sample
SM6640 Herbicides by GC/ECD (mg/L)			
2,4,5-T	NA	<20.0	<0.28
2,4,5-TP (Silvex)	50 µg/L	<10.0	<0.28
2,4-D	70 µg/L	<10.0	<0.92
SW846 3510C/8081A Pesticides by GC/ECD (mg/L)			
α-BHC	NA	<0.1	<0.10
α-Chlordane	NA	<0.1	<0.10
Aldrin	NA	<0.1	<0.10
β-BHC	NA	<0.1	<0.10
Chlordane, total	2.0 µg/L	<0.1	<0.10
d-BHC	NA	<0.1	<0.10
Dieldrin	NA	<0.1	<0.10
Endosulfan I	NA	<0.1	<0.10
Endosulfan II	NA	<0.1	<0.10
Endosulfan Sulfate	NA	<0.1	<0.10
Endrin	2.0 µg/L	<0.1	<0.10
Endrin Aldehyde	NA	<0.1	<0.10
Endrin Ketone	NA	<0.05	<0.10
g-BHC (Lindane)	0.2 µg/L	<0.1	<0.10
g-Chlordane	NA	<0.1	<0.10
Heptachlor	0.4 µg/L	<0.1	<0.10
Heptachlor Epoxide	0.2 µg/L	<0.1	<0.10
Methoxychlor	40 µg/L	<0.5	<0.10
p,p-DDD	NA	<0.1	<0.10
SM6640 Herbicides by GC/ECD (mg/L)			
2,4,5-T	NA	<20.0	<0.28
2,4,5-TP (Silvex)	50 µg/L	<10.0	<0.28
2,4-D	70 µg/L	<10.0	<0.92
SW846 3510C/8081A Pesticides by GC/ECD (mg/L)			
α-BHC	NA	<0.1	<0.10
α-Chlordane	NA	<0.1	<0.10
Aldrin	NA	<0.1	<0.10
β-BHC	NA	<0.1	<0.10
Chlordane, total	2.0 µg/L	<0.1	<0.10

	EPA Drinking Water Standards[1]	EOD Hill 01-10-01 Well Sample	EOD Hill 06-01-11 Well Sample
d-BHC	NA	<0.1	<0.10
Dieldrin	NA	<0.1	<0.10
Endosulfan I	NA	<0.1	<0.10
Endosulfan II	NA	<0.1	<0.10
Endosulfan Sulfate	NA	<0.1	<0.10
Endrin	2.0 µg/L	<0.1	<0.10
Endrin Aldehyde	NA	<0.1	<0.10
Endrin Ketone	NA	<0.05	<0.10
g-BHC (Lindane)	0.2 µg/L	<0.1	<0.10
g-Chlordane	NA	<0.1	<0.10
Heptachlor	0.4 µg/L	<0.1	<0.10
Heptachlor Epoxide	0.2 µg/L	<0.1	<0.10
Methoxychlor	40 µg/L	<0.5	<0.10
p,p-DDD	NA	<0.1	<0.10
p,p-DDE	NA	<0.1	<0.10
p,p-DDT	NA	<0.1	<0.10
Toxaphene, total	3.0 µg/L	<1.0	<0.80
EPA 300.0 Anions by IC (mg/L)			
Chloride	250 mg/L*	400	400
Fluoride	4.0 mg/L	1.5	1.7
Nitrate, as N	10 mg/L	<1.0	<0.20
Nitrite, as N	1.0 mg/L	<2.0	<0.20
Sulfate	250 mg/L*	120	120
EPA 420.1 Section 8.3 Phenolics (mg/L)			
Phenolics, Total	NA	0.013 (Estimated)**	0.02
SW846 3005A/6010B ICP or SW846 3005A/6020 ICP-MS (mg/L)			
Arsenic	0.01 mg/L	0.01	0.062
Barium	2.0 mg/L	0.130	0.24
Cadmium	0.005 mg/L	0.0001	0.00019
Chromium	0.1 mg/L	0.0033	0.017
Iron	0.3 mg/L*	24.0	27
Lead	0.015 mg/L	0.00055	0.0047
Manganese	0.05 mg/L*	1.4	2.9
Selenium	0.05 mg/L	<2.0	0.004
Silver	0.1 mg/L*	0.000057	0.00015
Sodium	NA	470.0	460
SW846 7470A CVAA (mg/L)			
Mercury	0.002 mg/L	<0.0002	<0.00008

	EPA Drinking Water Standards[1]	EOD Hill 01-10-01 Well Sample	EOD Hill 06-01-11 Well Sample
9040C pH, Electrometric			
pH	6.5 - 8.5*	6.50	6.85
SW-846 9020A (µg/L)			
TOX, Total Organic Halogens	NA	25	35
SM5310B (mg/L)			
Carbon, Total Organic, TOC	NA	<1.0	0.47
SWA846 6850 (µg/L)			
Perchlorates	15 µg/L[2]	2.70	27

[1] If USEPA National Primary Drinking Water Standards were not available, then USEPA National Secondary Drinking Water Standards were listed.

[2] USEPA Interim Drinking Water Health Advisory.

* USEPA Secondary Drinking Water Standards.

** Result was estimated. Compound was detected but was less than the reportable limit.

NA Not Applicable (if USEPA standards were not available, then "NA" was entered).

A duplicate sample was collected during the June 2011 sampling event. The reported value was the higher of the two samples. The well sample was collected on 6-1-11 and the duplicate sample was collected on 6-2-11.

The laboratory analytical data indicate that no herbicides or pesticides above the laboratory detection limits were detected in the samples. Chloride, iron, and manganese were detected above the Drinking Water Standards at concentrations similar to those historically detected (Copland, 2005). Other major ions were similar to previous concentrations based on Stiff diagrams included in the CE2 report (Copland, 2005).

Perchlorate was detected at a concentration of 2.7 µg/L in January 2010, which is below the Interim Drinking Water Health Advisory of 15 µg/L and over two orders of magnitude less than perchlorate concentrations detected in 2004 and 2006. However, the concentration of perchlorate was reported as 22 ug/L and 27 ug/L (duplicate) in June of 2011 which is approximately 1.6 times the Interim Drinking Water Health Advisory for exposure to perchlorate. The reason for the differences between recent perchlorate concentration and previous concentrations is unknown; however, previously used methods of analyses (Methods 314.0 and 8321A) are not currently recommended for perchlorate analysis (DoD, 2007). The water level measurement in January 2010 was reported by URS as 145 feet below the reference point, consistent with those previously measured between 1990 and 2005 (141 to 144 feet below the reference point).

2.5.3 Distribution of Groundwater Contamination

Perchlorate has been detected in groundwater samples collected from monitoring well KAFB-17 located at McCormick Ranch, approximately 5 miles southeast of EOD-BH. Perchlorate has been detected in KAFB 17 water samples at concentrations up to 15 µg/L. KAFB-17 is completed in limestone bedrock at a depth of approximately 200 feet bgs.

Additionally, groundwater samples collected by Kirtland AFB from another monitoring location in the area, the School House Mesa well (which is used for EOD Range groundwater monitoring), have also contained perchlorate ranging from 0.40 µg/L to 0.519 µg/L. However, these and larger concentrations may be within the range of naturally occurring perchlorate. Background concentrations have not been established for Kirtland AFB, but natural perchlorate from atmospheric deposition is known to occur in New Mexico (Plummer, 2006; Rajagopalan et al., 2006).

The direction of groundwater flow beneath the EOD Hill is assumed to be from east to west (CH2M Hill, 2009). However, no other monitoring wells or piezometers are within an appropriate proximity of EOD-BH to more precisely determine groundwater flow direction and the distribution of perchlorate in groundwater closer to the vicinity beneath the EOD Hill and the surrounding area.

2.5.4 Site Specific Fate and Transport

Most perchlorate salts are highly soluble in water and under neutral or near neutral pH conditions such as appear to occur in EOD BH water, because the perchlorate anion sorbs poorly to most mineral surfaces. As a result, perchlorate typically is mobile in surface and subsurface aqueous systems and its movement is largely controlled by the advection and diffusion of the groundwater system. Further investigations described in Section 3 will determine groundwater flow as well as perchlorate distribution in the area of EOD-BH.

Perchlorate is the most oxidized state of chloride, so the compound should be degradable by reduction. Although reduction is thermodynamically favorable, it does not occur spontaneously at ambient temperatures and the compound is quite stable. Slow reduction has been shown to occur in the presence of ruthenium and titanium; the concentrations of these metals at the site are unknown but unlikely to be abundant. Slow reduction also has been shown to occur as a result of oxidation of finely divided iron in the presence of hydrogen (Brown and Gu, 2006) and as a result of reactions within a zero-valent iron permeable reactive barrier (Peacock et al., 2010). The reaction is inhibited at ambient temperatures, neutral pH, and when chloride is present. Possible iron oxide staining along fractures was reported during the video logging of EOD-BH (Copland, 2005); however, chloride concentrations of 400 mg/L and near neutral pH (about pH 6 to 6.5) at EOD-BH would be inhibitory factors.

The influence of geochemistry and natural attenuation is discussed in Section 2.4.2. Geochemical conditions of groundwater at EOD-BH have not been investigated in detail. However, based on the January 2010 and June 2011 analytical results (elevated iron and manganese, no detected nitrate or nitrite), groundwater may be iron reducing. Also, a bubbling appearance in the water collected from EOD-BH during the 1991 hydrogeologic investigation was attributed to naturally occurring carbon dioxide, hydrogen sulfide, and methane (Copland, 2005). If these compounds are present in the aquifer, then perchlorate may degrade. However, low concentrations of organic carbon (TOC was not detected during January 2010 and was 0.47 mg/L in 2011) may inhibit degradation.

If perchlorate fate and transport is mainly controlled by advection, then the compound is expected to be detected in wells along a flow path that includes EOD-BH. Insufficient data is currently available to make this determination; Section 3 discusses planned data collection activities.

2.6 Potential Receptors

The main route of exposure to perchlorate for the general population and those exposed to contaminated media is through ingestion of food and/or water (ATSDR, 2008). Drinking water at Kirtland AFB is supplied by water supply wells such as Kirtland AFB groundwater production wells KAFB-15 and KAFB-16. The nearest potable water well is located more than 4.5 miles northwest of the EOD Hill. There is also a water supply well at the Tijeras Arroyo Golf Course; however, the golf course is located 3.5 miles from EOD Hill, and the two areas are separated by faults (Copland, 2005). Additionally, groundwater at EOD-BH has iron, manganese, and chloride in excess of secondary drinking water standards, and total dissolved solids is estimated to be over 2,000 mg/L [more than four times the secondary drinking water standard (Copland, 2005)] so is not suitable as drinking water. Therefore, it is unlikely to be a potential source for drinking water.

Surface water does not appear to exist in the vicinity of the EOD Hill. Vegetation may take up perchlorate; however, vegetation is limited at the site.

Construction workers who may be exposed to surficial and subsurface soils are considered potential receptors at this time because of the lack of information available regarding potential soil contamination. Soil samples have not been collected at the EOD Hill; this sampling plan includes collection of surficial soil samples (analyzed for perchlorate and HE) from the 12 EOD craters. A determination about the validity of this receptor will be made at a later date when a more representative set of soil analytical results is available.

The current exposure routes of concern associated with soil is direct contact. However, the existing Kirtland AFB digging permit clearance process provides notification and protection against inappropriate exposures to construction workers. Additionally, the Agency for Toxic Substances and Disease Registry (ATSDR) found no reports of adverse dermal effects of perchlorate in healthy humans (2008). There is no USEPA screening level for air (USEPA, 2005). Exposure to perchlorate through inhalation and vapor intrusion is not applicable at the EOD Hill because the contaminant is not volatile. Also, no minimal risk level has been derived by ATSDR for inhalation exposure to perchlorate because adequate experimental data were not available by this route of exposure; ATSDR found no inhalation studies in animals (ATSDR, 2008).

2.7 Conceptual Site Model Summary

Existing site-specific and regional data, presented in the preceding sections, were used to develop a preliminary CSM. The phased sampling approach, discussed in Section 3, is designed specifically to further refine the CSM. In particular, site-specific information obtained during the first phase (Phase 1) will greatly enhance understanding of local geology and hydrogeology.

EOD Hill is located in an area of complex geology, with several faults located near the hill (Van Hart, 2003). EOD Hill appears to be Madera Formation limestone, rising above the surrounding alluvial material. The existing borehole/well (EOD-BH), which is 248 ft deep, may terminate in limestone. Groundwater occurs at a depth of about 140 to 145 feet bgs, which is within the cased part of the borehole. The geology and calcium-bicarbonate water type (Copland, 2005) indicate that the water is in contact with limestone and likely occurs within fractures and cavities. The groundwater flow direction has not been defined, but regionally is to the west. The limestone beds are generally interpreted as dipping to the west, so local groundwater flow may also be to the west, following fractures and bedding planes within the limestone. A schematic block diagram of the Travertine Hills/EOD Hills area is included in Figure 2 7. The general area referred to as EOD Hills includes EOD Hill.

During March and April 2011, AECOM personnel conducted geophysical surveys using multiple techniques as lines of evidence to evaluate the presence of faulted bedrock in the vicinity of the EOD Hill area. Geophysical survey results are summarized below and illustrated on Figure 2-8. Geophysical survey results are also discussed in the Technical Memorandum presented in Appendix G.

Aerial photographic data identified a linear feature, roughly corresponding to the location of the prospective EOD fault. EM-31 and EM-34 terrain conductivity signatures appear to correlate to mapped geological units. Anomalies identified in the VLF Wadi investigation generally show sharp contrasts, which likely indicate a geological contact or altered/displaced rock. Seismic data indicated sharp contrasts in velocity, which is consistent with the interpretation that a fault may be present. Review of the satellite and magnetometer data appears to be inconclusive.

The identified contaminant of concern at the EOD Hill site is perchlorate in groundwater. Several potential sources of perchlorate have been identified, such as possible use of explosives to blast small craters existing on EOD Hill and detonation of large amounts of HE material in the last 40 years at the EOD Range to the east (upwind) of the hill. Although perchlorate sample results have been as elevated as 4,500 µg/L in the past, the most recent analytical result (June 2011) was 22 and 27 µg/L. It is possible that variable infiltration rates provide an intermittent source of perchlorate to the groundwater in the EOD Hill area, if perchlorate still exists in the soil.

Based on favorable site conditions for perchlorate degradation, such as a reducing environment, natural attenuation may be occurring and contributing to the observed decrease and variability in perchlorate concentrations. Major ion concentrations in groundwater sampled during June 2011 are consistent with previous sample values. This indicates that recent groundwater samples are of the same origin to those sampled previously.

The extent of perchlorate occurrence is unknown and constitutes a data gap. Additional sampling is designed to define the extent of the perchlorate plume, sample perchorate in soil, further evaluate geochemical conditions to determine if conditions are suitable for degradation, and analyze for the presence of HE in groundwater.

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3 DATA COLLECTION DESIGN AND PROCEDURES

3.1 Field Activities

Field activities associated with the SI Work Plan for EOD Hill include geophysical investigations, soil borings/drilling activities, soil sampling, groundwater monitoring well installation, and well development. Specific activities are defined below.

3.1.1 Groundwater Monitoring Well Locations

Five groundwater monitoring wells are included as part of this work plan. The number and location of the proposed wells were primarily selected to identify potential contaminant source area(s) and to define the nature and extent of contaminated groundwater in and around the EOD Hill area. The wells will be designated KAFB EOD1 through KAFB-EOD5. If additional wells are required to define the nature and extent of contamination at the site, these will be installed as part of the Phase 2 activities. Proposed well locations are shown on Figure 3-1.

The proposed well locations have been agreed upon by NMED and the Air Force and have been selected to not only provide monitoring points to assess potential groundwater quality impacts and source area(s) but also to provide key hydrogeologic data. The proposed monitoring wells will provide a monitoring network for evaluating local groundwater gradients, flow directions, and possible groundwater flow boundaries or divides that may exist in this area. These data will be critical for evaluating perchlorate impacts present in the groundwater and possible source area(s). NMED shall be notified of any deviations in well placement/constructions per Section 4.0.

Based on the limited groundwater data available, the inferred groundwater flow direction in the vicinity of EOD Hill is from east to west (DOE, 2005), although geologic faults immediately east and south of EOD Hill are likely to influence groundwater flow throughout this area.

KAFB-EOD1 shall be located adjacent to existing well EOD-BH, on top of EOD Hill. For the purpose of this work plan, wells KAFB EOD2, KAFB-EOD3, KAFB EOD4 and KAFB-EOD5 shall be oriented around the approximate base of EOD Hill to assess potential groundwater impacts in the apparent down gradient and side (cross) gradient directions from the EOD-BH. All monitoring wells shall be located west of the apparent fault zone, delineated during the geophysical investigation, located to the east of EOD Hill.

3.1.1.1 Borings/Drilling

The boreholes will be advanced for the purpose of collecting geologic data and installing groundwater monitoring wells in and around the EOD Hill area. The boring/well locations are shown on Figure 3-1. Each monitoring well borehole (KAFB-EOD1 through KAFB-EOD5) shall be advanced using an air rotary casing hammer (ARCH) or just air rotary drilling techniques.

In 2005 the depth to groundwater in EOD-BH was measured by the DOE as being roughly 140 feet bgs. The reported depth of EOD-BH is 248 ft-bgs and appears to have penetrated a confined aquifer in the limestone bedrock that is likely controlled by fracture patterns within the unit. Because the EOD BH borehole is located on a topographic high, it is likely that the proposed groundwater monitoring wells that will be installed in the lower lying areas around EOD Hill may encounter groundwater at shallower depths. However, the nature of fracture-controlled confined aquifers makes it difficult to predict the occurrence of water-bearing zones within the bedrock. Additionally, the potential that hydrogeologic conditions are influenced by fault zones in the area also makes it difficult to predict the depth to groundwater until additional local data points are available. Because of the unconfirmed nature of the aquifer type (i.e., confined or water table), the local geologic conditions, and the lack of other

groundwater elevation control points in this area, it is assumed that the proposed wells may need to be installed to depths of up to 250 feet bgs.

During drilling, each borehole shall be advanced roughly 20 to 30 ft below the first water-bearing zone encountered, and the water level will be allowed to stabilize. An assessment will be made at that time regarding whether the encountered water bearing zone seems to be substantially different from the depth and hydrogeologic conditions generally expected, based on the limited existing data and information obtained from each proposed boring/well installation. If conditions appear substantially different from what is generally anticipated, continued drilling and well installation options may be reassessed and modified or additional recommendations may be made for subsequent monitoring well drilling/installation. NMED shall be notified and approve any modifications and/or deviations in drilling and well construction per Section 4.0.

3.1.1.2 Soil/Rock Sampling

During advancement of each of the five boreholes (KAFB-EOD1 through KAFB-EOD5), soil samples shall be collected using a 2-ft-long split spoon sampler on 5 foot centers to the depth of bedrock. Once bedrock is encountered, rock (drill) cuttings shall be collected from the ARCH drill rig "cyclone" on representative 5 ft centers, and at changes in lithology/color, to the depth at which groundwater is encountered. If the presence of groundwater is encountered in unconsolidated material, continuous rock core samples will be collected from the top of rock to the borehole completion depth. If the presence of groundwater is encountered in rock, continuous rock core will be collected from the depth at which water is encountered to the borehole completion depth. It is anticipated that completion depths of the five boreholes will be completed in rock.

For the purpose of vertical delineation of contaminant impacts to soil, two soil samples collected from each borehole shall be selected for chemical analysis. The sample from the 0-2 ft depth interval and the soil sample from directly at/above the water table or bedrock, whichever occurs first, shall be analyzed by an accredited analytical laboratory for perchlorate and HE (HMX and RDX). Perchlorate and HE shall be analyzed by SW-846 Method 6850 (per the DoD 2007 guidance) EPA Method 8330, respectively.

An onsite geologist or hydrogeologist shall lithologically log the soil samples, drill cutting samples, and rock core as each borehole is advanced. All soil samples, drill cutting samples, and rock core shall be logged for geologic characteristics and retained until such time that NMED authorizes their disposal. The samples/core will be available for NMED inspection upon request. If noted, bedding and fault contacts and any other significant geologic features observed in each borehole shall be noted on logs. A lithologic log shall be prepared for each borehole.

Activities associated with soil/rock sampling and rock coring, equipment decontamination, lithologic logging, field screening, and IDW handling shall be performed in accordance with the Base-Wide Plans for Investigations Under the Environmental Restoration Program, 2004 Update, Kirtland Air Force Base, Albuquerque, New Mexico (Tetra Tech, 2004) and other pertinent site documents.

3.1.1.3 Downhole Geophysics

All newly installed monitoring well boreholes shall be video logged from ground surface to the bottom of the borehole. The video logger shall have an orientation feature that will allow the field geologist to orientate the rock core from the well to allow for the mapping of fractures. In addition a caliper log shall be run down the open hole to determine if void spaces or solution cavities are present that may represent zones of higher conductivity.

Equipment shall be decontaminated at each well location prior to conducting logging activities. The logs shall be evaluated/interpreted along with soil boring logs, well construction reports, and proposed seismic

survey results. Interpretive information obtained from the logging operation will be used in the placement of proposed soil boring locations and monitoring wells.

All new wells installed as part of the Phase 2 work being proposed at the site will also be logged using the same method.

3.1.1.4 Monitoring Well Installation

Each monitoring well riser shall be constructed of nominal 4-inch diameter Schedule-80 polyvinyl chloride (PVC). If unconfined aquifer conditions exist, each monitoring well will have a 20-foot PVC screen (0.010 inch slot) with no more than 5 feet of screen constructed above the water table. If confined aquifer conditions exist, well screens shall be placed to monitor across the thickness of the confined aquifer, with the screen top set at the top of the aquifer. The well screens shall not exceed 15 feet in length if the confined aquifer is greater than 15 feet in thickness. The top of the confined aquifer is considered the depth at which the first water bearing zone was intersected based on field observations. A 5-ft sediment sump shall be installed below each screen. Typical monitoring well installation/construction is shown on Figure 3-2

An appropriately sized filter pack for the screen slot size shall be installed in the annular space surrounding the well screen to at least 2 ft above the top of the screen, overlain by 2 ft of finer grained transition sand (fine sand seal). A bentonite seal of at least 10 ft shall be placed in the annular space immediately above the fine sand seal followed by a high solids bentonite grout tremmied into place overlying the bentonite seal and extending to about 30 bgs. Portland cement shall be installed in the uppermost 30 ft of annular space around the well casing. Surface completions shall be within a steel "stick-up" protective casing with lockable access cap.

A tremie pipe will be used for installation of the filter pack, fine sand seal, bentonite seal, and grout for each well. The bentonite chip seal shall be hydrated in lifts using a "clean" water source. The grout shall be installed in lifts, with the first lift not to exceed 100 ft in length, and each subsequent lift not to exceed 200 ft in length. A minimum of 24 hours of drying time is required to elapse between the placement of bentonite grout lifts.

Surface completions will consist of the installation of protective casings with locking covers to prevent damage or unauthorized entry. The protective casings 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 or piezometer, and a lock shall be installed on the cover of the protective casing to provide security against tampering. If a well or piezometer is located in an area that receives vehicular traffic, a minimum of four 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 yellow color to make them readily visible.

Monitoring well construction details shall be provided to NMED and shall be included in the SI report. Monitoring well construction details shall include the following information.

1. Well, boring or piezometer 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.

Activities associated with groundwater monitoring well installation, IDW handling, and decontamination shall be performed in accordance with the Base-Wide Plans for Investigations under the Environmental Restoration Program, 2004 Update, Kirtland Air Force Base, Albuquerque, New Mexico (Tetra Tech, 2004) and the 2010 Hazardous Waste Treatment Facility Operating Permit EPA ID No. NM9570024423 issued to United States Air Force for the Open Detonation Unit.

3.1.2 Surveying

A New Mexico-licensed professional surveyor shall survey the horizontal location of each well to the nearest one-tenth of 1 ft relative to New Mexico State Plane Coordinates and the vertical elevation to the nearest one-hundredth of 1 ft relative to mean sea level (MSL). Following well completion and surveying, well construction details and survey coordinates shall be provided for loading into Kirtland AFB's master well database. Survey coordinates for each monitoring well shall be provided to NMED and shall be included in the SI report.

3.1.3 Well Development

All proposed groundwater monitoring wells (KAFB-EOD1 through KAFB-EOD5) shall be fully developed following installation. The existing EOD Hill well will also be redeveloped. The monitoring wells shall be developed by mechanical bailing and surging and over-pumping following installation. Field measurements of pH, specific conductance, turbidity, and temperature will be collected during well development. Well development will be considered complete when parameters have stabilized to within 10 percent for four consecutive measurements. In addition to parameter stabilization proposed for well development, well development shall continue until turbidity has stabilized or reached 5 NTUs or less. Measurements shall be taken at a minimum of 10 minute intervals during the development process.

Activities associated with groundwater monitoring well, IDW handling, and equipment decontamination shall be performed in accordance with the Base-Wide Plans for Investigations under the Environmental Restoration Program, 2004 Update, Kirtland Air Force Base, Albuquerque, New Mexico (Tetra Tech, 2004), and other pertinent site documents.

3.1.4 Groundwater Sampling

During Phase 1 activities, a round of water samples shall be collected from the newly installed monitoring wells after the monitoring wells are installed and developed. Monitoring wells shall be sampled quarterly for seven quarters after the initial samples are collected. The first four quarters of monitoring shall consist of all proposed parameters. Depending on the results of the sampling the sampling parameter list may be shortened to include compounds detected above their relative standard and perchlorate.

If additional monitoring wells are needed and installed during Phase 2, groundwater samples shall be collected after the monitoring wells are installed and developed and subsequently for seven quarters afterward. An attempt will be made to synchronize the sampling of the Phase 1 and Phase 2 wells.

Groundwater monitoring will be performed using conventional sampling methods. Wells will be purged and sampled using a portable Bennett™ submersible pump system or similar device. Pumps for the newly installed monitoring wells will be dedicated, installed prior to the first quarterly sampling event. The pump intake shall be set at or near the bottom of the screened interval. The maximum purge rate will not exceed 12 liters per minute. Monitoring wells shall be purged a minimum of one borehole volume (volume of static water in the well plus the filter pack). Prior to the collection of groundwater samples, development shall continue beyond one well borehole volume until at least four stable field screening measurements (< 10 percent variability) are obtained for turbidity, pH, temperature, and specific conductivity. In addition to these parameters, purge water shall be field screened for dissolved oxygen and redox potential. Stabilization parameters shall be measured at minimum of 5 minute intervals. If a monitoring well is purged dry prior to meeting the above development and stability requirements, then sampling shall be conducted once the well has recovered such that the volume of water available in the well is the minimum necessary to collect the required water samples.

Following purging, groundwater samples shall be collected and analyzed by an US EPA accredited analytical laboratory for the parameters indicated in Table 3-1. These parameters include perchlorate, HE, major ions, minor groundwater constituents for fingerprinting groundwater source(s), and parameters needed to assess redox conditions, which may affect attenuation of perchlorate. Groundwater samples shall be analyzed for total constituents and will not be filtered.

Previous groundwater sampling has eliminated the need for analysis of other potential contaminants (refer to Section 2.5).

For quality control purposes, QA/QC samples shall be collected, as specified in the site's UFP QAPP. Field duplicates, field blanks, equipment rinsate blanks, reagent blanks, and trip blanks (the latter required for VOC analyses only) shall be collected or prepared and analyzed for quality control purposes. The samples shall be managed as described in the HAZARDOUS WASTE TREATMENT, FACILITY

OPERATING PERMIT, EPA ID No. NM9570024423 (2010) Section 6.5.5. 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. In the case of VOC analyses, 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.

The anticipated analytical methods are listed in Table 3-1, although the specific analytical methodology necessary to meet the SI's DQOs will be further evaluated during development of a site-specific QAPP and will be specified in that document. Field parameters, including pH, specific conductivity, and temperature shall be measured until stable prior to monitoring. These parameters, as well as redox and dissolved oxygen, shall be recorded to aid in the interpretation of groundwater conditions.

Table 3-1: EOD Hill Site Investigation Groundwater Analytical Parameters, Kirtland AFB

Analyte	Analytical Method
VOCs	SW8260B
SVOCs	SW8270C
Herbicides	SM6640
Pesticides	SW846 3510C/8081A
Perchlorate	SW6850
High Explosives (HE)	EPA Method 8330
Uranium	EPA Method 908
Gross Alpha spectroscopy	**EPA Method 900.0**
Gross Beta spectroscopy	**EPA Method 900.0**
Gamma spectroscopy	**EPA Method 901.1**
Sulfate	**EPA M300.0 Ion Chromatography**
Sulfide	EPA M376.2 Colorimetric
Chloride	**EPA M300.0 Ion Chromatography**
Calcium	**M200.7/6010B**
Magnesium	**M200.7/6010B**
Potassium	**M200.7/6010B**
Sodium	**M200.7/6010B**

Analyte	Analytical Method
Bromide	**EPA M300.0 Ion Chromatography**
Boron	**M200.7/6010B**
Fluoride	**EPA M300.0 Ion Chromatography**
Lithium	**SW6020**
Strontium	**M200.7/6010B**
Alkalinity	Standard Methods 2320 B Titrimetric
Dissolved Manganese	**M200.7/6010B**
Dissolved and Total Iron	**M200.7/6010B**
Nitrate/Nitrite	EPA M353.2 Automated Colorimetric
Ammonia	EPA Method 350.1
Total Organic Carbon	SM 5310B

Activities associated with groundwater sampling and field screening, IDW handling, and equipment decontamination shall be performed in accordance with the Base-Wide Plans for Investigations under the Environmental Restoration Program, 2004 Update, Kirtland Air Force Base, Albuquerque, New Mexico (Tetra Tech, 2004) and other pertinent site documents. Methods presented in Table 3-2 will be used subject to NMED's approval. A site specific UFP-QAPP shall be submitted for this site prior to the SI being completed. Note the methods proposed in Table 3-2 for the assessment of perchlorate nature, extent, fate and transport are limited to the assessment of perchlorate, HE, cations/anions, and geochemical indicators. Other analyses may be required for IDW characterization prior to disposal, and are listed for completeness purposes, but are not proposed for groundwater.

The potential influence of geologic faults on groundwater flow in the vicinity of the EOD Hill area may result in wells being located on opposite sides of fault features. Such wells would be subject to groundwater flow from potentially different hydrogeologic areas that may have discernible naturally occurring cation and anion signatures.

The groundwater data shall be evaluated, in conjunction with findings from soil borings and well installations to determine how complete the SI activities have identified the nature, extent, and magnitude of perchlorate impacts to groundwater in the EOD Hill area and possible source(s) of those impacts. SI activities presented in this work plan constitute an initial investigation phase. Subsequent phases, as needed, shall be conducted iteratively as data are gathered and evaluated and data gaps are reassessed.

Sample collection methods shall be documented in field monitoring logs. The samples shall be transferred to appropriate clean containers. Sample handling and chain-of-custody procedures that shall be implemented are described in Permit Sections 6.5.5.

3.1.5 Groundwater Measurements

After the installation and development of each proposed groundwater monitoring well, water level measurements shall be collected. Groundwater levels shall be measured in monitoring wells to determine horizontal gradients and to generate potentiometric surface maps indicating flow direction within the aquifer. All water levels shall be collected within 24 hours from the start of monitoring the water level in the first well, In addition groundwater levels also will 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 or other surveyed datum, as appropriate.

Activities associated with groundwater measurements and equipment decontamination shall be performed in accordance with the Base-Wide Plans for Investigations under the Environmental Restoration Program,

2004 Update, Kirtland Air Force Base, Albuquerque, New Mexico (Tetra Tech, 2004) and other pertinent site documents.

3.1.6 Surficial Soil Samples

Twelve shallow craters in the limestone outcrops are located on top of EOD Hill (Copland, 2005). It was reported that the presence of the craters resulted from research centered on explosive cratering (explosives excavating technology) using conventional explosives. To determine if any of these craters are a potential contaminant source, one surficial soil sample shall be collected from each crater during Phase 1 field activities. The samples shall be collected from the lowest points of the crater where it is expected contaminants, if present, would accumulate. Soil samples shall be collected using stainless steel spatulas which will be used to fill the jars. Soil samples shall be analyzed by an accredited analytical laboratory and for perchlorate and HE (HMX and RDX). Perchlorate and HE shall be analyzed by SW-846 Method 6850 (per the DOD 2007 guidance) and EPA Method 8330, respectively. All explosives detected by EPA Method 8330 shall be reported. Contingencies have been included in the Phase 2 for additional soil sampling within the craters based on the results of the Phase 1 sampling. A site specific UFP QAPP shall be prepared prior to conducting the SI which will provide information on the types of sample containers to be used, preservatives, holding times, shipping and handling procedures, and chain-of-custody and other security procedures related to this sampling. Please see figure 3-3 in appendix I for a map of the crater locations.

Activities associated with surficial soil sampling, IDW handling and equipment decontamination shall be performed in accordance with the requirements as presented in the Environmental Restoration Program Investigation Derived Waste Management Plan, 2009, and other pertinent site documents.

3.2 Quality Assurance/Quality Control

All investigation work shall be conducted under the direction of an appropriate Kirtland AFB Environmental Restoration Program Project Manager. Site work shall be conducted by an appropriately qualified Air Force contractor and their subcontractors. Upon contracting of the SI, the selected contractor's personnel and training and qualifications shall be appended to this SI work plan and a UFP QAPP shall be developed for the investigation.

Investigative activities being conducted as part of the EOD Hill Site Investigation Work Plan are similar to activities conducted as part of the Environmental Response Programs at the base in the past. Kirtland AFB currently has a Base-Wide Plan for Investigations under the Environmental Restoration Plan (ERP, 2004), which documents standard operating procedures for all investigative work conducted on the base. Included in the appendices to the Base-Wide Plan for Investigations are the Field Sampling Plan (FSP), the Construction Quality Assurance/Quality Control (QA/QC) Plan,, the Base-Wide Data Management Plan (DMP), the Base-Wide Waste Management Plan (WMP), the Base-Wide Safety Plan, and the Permitting Plan. These plans were written to cover all environmental restoration activities conducted at Kirtland AFB and include

- Resource Conservation and Recovery Act (RCRA) facility investigations (RFIs).
- Solid waste management unit assessments.
- Risk assessments.
- Corrective measures studies.
- Corrective actions.
- Monitoring of natural systems and treatment operations.
- Other site investigations and associated work efforts.

The Base-Wide Work Plan was prepared in accordance with the requirements and guidelines for data collection activities established by the USEPA, the U.S. Army Corps of Engineers (USACE), the Air Force Center for Engineering and Environment (AFCEC), and the USAF. The purpose of the Base-Wide Plan is to provide a comprehensive set of strategies for conducting field sampling operations that are integral to the performance of a variety of environmental restoration activities. The Base-Wide Plan appendices include Standard Operating Procedures (SOPs). The SOPs have detailed QA/QC procedures that shall be adhered to when conducting any ERP related work on the base.

A site-specific UFP QAPP shall be prepared to supplement this SI work plan and shall include specific data quality objectives for this investigation. Applicable QA/QC procedures outlined in the site's UFP QAPP shall direct monitoring well installation and groundwater sampling activities and validation of all laboratory data.

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4 PROJECT MANAGEMENT

4.1 Project Scheduling

The proposed schedule for the implementation of the Site Investigation Work Plan is shown in Appendix A. The schedule for installation of the five proposed groundwater monitoring wells shall be conducted upon award of the 2013 fence to fence Performance Based Remediation Contract for Kirtland AFB. The selected contractor shall work with NMED and the Air Force to develop an appropriate schedule. It is anticipated that Phase 1 field activities would commence approximately three to four months after the Air Force contracts the work to an appropriate contractor.

It is anticipated that the Phase 1 field work will take approximately one month, with a two month reporting period. The Phase 1 report will be submitted to NMED for review and concurrence of well placement. If the Air Force and NMED deem additional monitoring wells are required to define nature and extent of the plume Phase 2 activities will move forward. It is anticipated that Phase 2 activities, if required, will commence approximately three months after the report has been submitted for review. The SI's quarterly sampling of the new wells and the EOD-BH will begin no later than three months following completion of the last new groundwater monitoring well and shall proceed on a quarterly basis from that point, for a total of eight quarters.

4.2 Project Reporting

Following the completion of Phase 1 activities outlined in the work plan an SI report shall be generated. Results from Phase 1 activities shall also be incorporated into this report. If Phase 2 activities are required they will be reported as an addendum to the Phase 1 SI report. The report shall include the following information:

- Title page and signature block.
- Executive summary.
- Table of contents.
- Introduction.
- Background information.
- Scope of activities.
- Field investigation results, including, but not limited to surface conditions, subsurface conditions, monitoring well construction, boring or excavation abandonment, groundwater conditions.
- Geologic logs, geophysical logs, and surface geophysical data and analysis thereof are to be included in the Quarterly Reports and the Investigation Report. Additionally, geophysical logs must also be included in the reports in digital format.
- Regulatory criteria.
- Site contamination including, as applicable, but not limited to laboratory analytical results for soil, rock, and sediment samples; field analytical results for soil, rock, and sediment samples; groundwater sampling results; and conclusions.
- Conclusions and recommendations.
- Tables, with an explanation provided on each table for all abbreviations, symbols, acronyms, and qualifiers.

The work plan also includes allowances for quarterly sampling activities for up to two years (eight quarter), if required. Following each of the quarterly sampling event, a brief quarterly report shall be prepared. The quarterly reports shall include the following information:

- Field activity summary, including an estimate of the percentage of the total planned work that has been completed.
- Summaries of all findings, including summaries of laboratory data for groundwater samples and any other media.
- Summaries of all problems or potential problems encountered during the reporting period and actions taken to rectify problems.
- Planned work for the next reporting period.
- Summaries of contacts pertaining to connective action with representatives of the local community, public interest groups, or state government during the reporting period.
- Changes in key project personnel during the reporting period.
- Summaries of any variances from the approved work plan.

4.3 Project Coordination

Prior to the commencement of work, a kickoff meeting shall be held at Kirtland AFB or at NMED, as appropriate. Invitees will include Kirtland AFB, AFCEC, NMED, and the contractors conducting the work. The meeting will outline the roles and responsibilities of all participants; review scope, schedule, and procedures; and discuss base rules and security requirements. During the field implementation kickoff meeting, a list of critical contacts within the field team, AFCEC, Kirtland AFB, and NMED will be compiled for use should immediate input be needed to any decision process critically impacting field work. This list will be reviewed and revised as needed on a weekly basis (see below) during the weekly conference call to account for future personnel absences.

Field Change Request (FCR) Forms shall be completed if any changes from the approved scope of work occur. If the FCR represents a major change, AFCEC, NMED, and Kirtland AFB shall be notified and the change shall be approved prior to commencement. If the FCR is minor and the resolution is clearly outlined in the DQOs, the FCR will be filed, the change will be made in the field, and AFCEC, the project manager, and NMED will be notified of the change.

All proper notifications shall be conducted prior to the commencement of work in accordance with the Kirtland AFB's Community Relations Plan.

4.4 Health and Safety Plan

The implementation contractor is solely responsible for the safe performances of all agreed services performed by its employees and/or subcontracted service providers and for the implementation of any appropriate/required written health and safety documentation. All work shall be performed in accordance with applicable federal, state, and local regulations governing health and safety, including but not limited to Title 50, Chapter 9: New Mexico Occupational Safety and Health Act. The contractor must take all reasonable steps and precautions to prevent accidents and/or injuries to site personnel and visitors or damage to the surrounding environment and community.

In addition to conventional health and safety, appropriate munitions/UXO health and safety planning and precautions must be taken for work performed in an active or inactive DOD range. At a minimum, site specific health and safety plans for munitions/UXO avoidance and clearance, required training, and implementation procedures shall be prepared by the implementation contractor.

Well installation and sampling activities shall be conducted in compliance with the Kirtland AFB Environmental Restoration Program Base-wide Health and Safety Plan and a site specific health and safety plan shall be prepared to direct onsite work. The site-specific health and safety plan shall be prepared immediately prior to field work to capture the most recent data and specific contractor information.

The site-specific health and safety plan will be included with this Site Investigation Work Plan and the site-specific QAPP as part of the project's planning documents.

4.5 Investigation-Derived Waste Plan

All wastes generated during implementation of this work plan shall be handled and disposed of according to the requirements as presented in the Environmental Restoration Program Investigation Derived Waste Management Plan, 2009. Management of investigation derived waste complies with all applicable state regulations, including the New Mexico Hazardous Waste Management Regulations, 20.4.1 NMAC.

4.6 Community Relations Plan

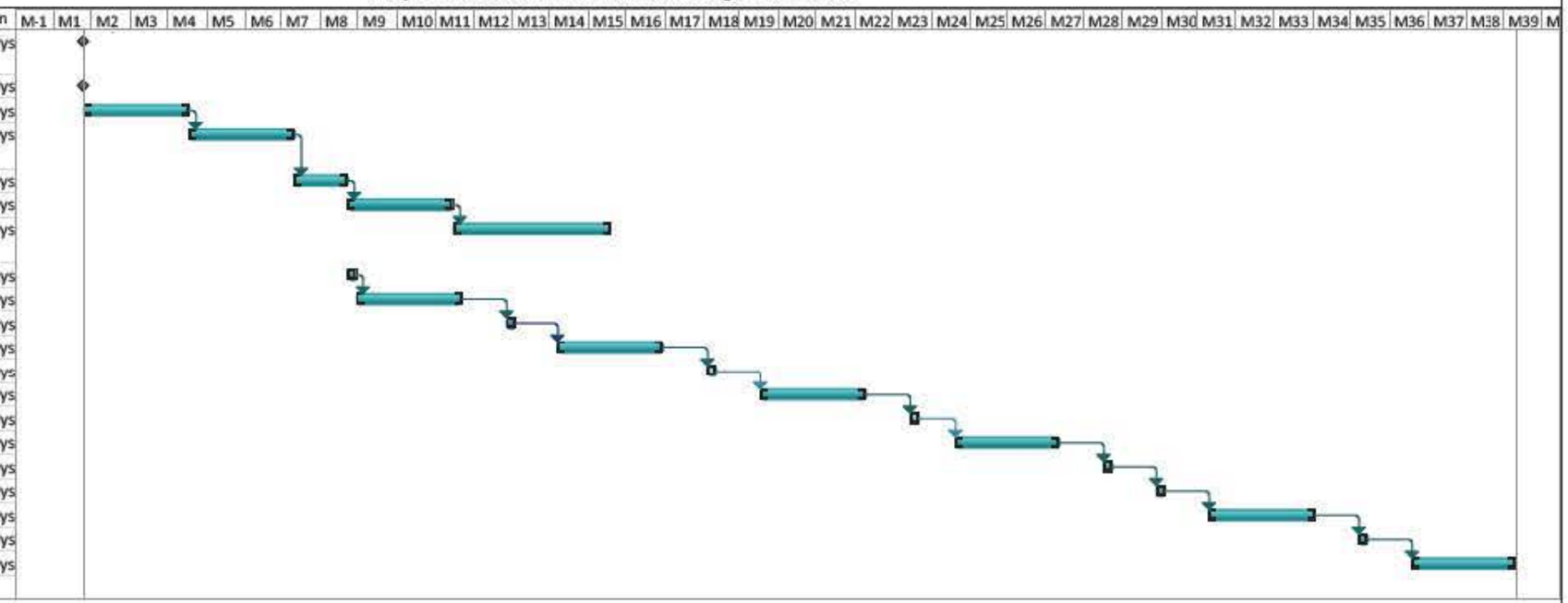
A Community Relations Plan has already been developed and implemented for Kirtland AFB. Community information meetings including community outreach and presentations at neighborhood association meetings are ongoing. The Community Relations Plan is included in the Base-Wide Plans for the Environmental Restoration Program, 2004 Update. The Community Relations Plan is included in the appendix.

APPENDIX A: Site Investigation Schedule

Appendix A. Site Investigation Schedule

Proposed Kirtland AFB EOD Hill Site Investigation Schedule

ID	Task Name	Duration
1	NMED Workplan Acceptance	0 days
2	Fence to Fence PBR Award	0 days
3	UFP QAPP	60 days
4	UFP QAPP Review by KAFB and NDMED	60 days
5	Phase 1 Field Work	30 days
6	Phase 1 Reporting	60 days
7	Phase 1 Report Review by KAFB and NMED	90 days
8	2nd quarter sampling	5 days
9	Second quarter reporting	60 days
10	3rd quarter sampling	5 days
11	Third quarter reporting	60 days
12	4th quarter sampling	5 days
13	Fourth quarter reporting	60 days
14	5th quarter sampling	5 days
15	Fifth quarter reporting	60 days
16	6th quarter sampling	5 days
17	7th quarter sampling	5 days
18	Seventh quarter reporting	60 days
19	8th quarter sampling	5 days
20	Eighth quarter reporting	60 days
21		



Project: EODHill_Kirtland
Date: Tue 9/25/12

Task		Project Summary		Inactive Milestone		Manual Summary Rollup		Deadline	
Split		External Tasks		Inactive Summary		Manual Summary		Progress	
Milestone		External Milestone		Manual Task		Start-only			
Summary		Inactive Task		Duration-only		Finish-only			

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APPENDIX B: References

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APPENDIX C: Comment Response

Comment Responses

NEW MEXICO ENVIRONMENT DEPARTMENT

Hazardous Waste Bureau Comments on July 2010, EOD HILL SI Work Plan, KAFB

PART 1 DIRECTION TO BEGIN IMMEDIATE INVESTIGATION

1.) Section 1.1 states that the Work Plan addresses the NOD issued May 11, 2010, concerning the need to conduct detailed geologic mapping of the EOD Hill area. However, the Work Plan does not contain any provisions for conducting geologic mapping. Additionally, detailed geologic mapping was not done in advance of revising the Work Plan as directed by the NMED in the May 11, 2010, NOD.

Although the Work Plan contains modifications of existing geologic maps prepared by the New Mexico Bureau of Geology and Mineral Resources and Sandia National Laboratories, the NMED informed the Permittee in the meeting held on February 4,2010, at the Hazardous Waste Bureau office in Santa Fe that these maps have errors and, in some cases, do not agree in many details. Additionally, based on field visits conducted on February 22, 2010, and March 4, 2010, NMED found that no field evidence supporting the presence of the EOD Hill and M-M' Faults shown in Figures 2-1 and 3-2 of the Work Plan and determined that the existence of the EOD Fault shown in Figures 2-1, 2-4, 2-5, 2-7, and 3-2 of the Work Plan is questionable. Even if the EOD Fault exists, there are no surface exposures to measure the fault plane's direction or angle of dip, which may be of considerable importance to the conceptual site model for the EOD Hill investigation. The Permittee must take advantage of nearby rock exposures that permit more accurate mapping than currently shown on existing maps.

As stated in the May 11, 2010, NOD, a detailed understanding of the surface geology is crucial to development of the site conceptual model for EOD Hill, which in turn, is critical to determining the best locations for monitoring wells, borings, and geophysical surveys. In the February 4, 2010, meeting, NMED understood that representatives of the Permittee agreed that detailed geologic mapping was a necessary task for the EOD Hill project. However, the required mapping was not completed, even though it is crucial to completing adequate site characterization.

This NOD also includes general and specific comments that apply to the Work Plan and to the document titled: AECOM Response to NMED Comments on Deficiencies, Notice of Disapproval, EOD Hill Site Investigation Work Plan, January 12, 2010, Kirtland AFB, that was submitted in electronic version on a CD along with the Work Plan. These comments comprise Part 2 of this letter. The Permittee must revise the Work Plan to correct each of the deficiencies identified in the comments by the indicated deadlines and in accordance with the compliance schedule, Table 1, included at the end of this letter in Part 3.

NMED therefore is again directing the Permittee to complete a detailed geologic map of the EOD Hill area. The detailed geologic map must show the locations and orientations of faults, the orientations of major fracture sets, the distributions and attitudes (strikes and dips) of lithologic units, and any other geologic features that may be relevant to the EOD Hill investigation. In addition, cross sections showing subsurface hydrologic and geologic conditions must be prepared based on the detailed geologic map. The cross-sections must be constructed along transects oriented roughly parallel to and perpendicular to major structures and bedding attitudes.

The Permittee must also investigate the EOD Fault and, if it exists, its orientation by trenching the area shown on Figure 1 enclosed with this letter. The trenching shall target the area occupied by the "Chaotic blocks of Madera Ls" shown on Figure 1 (and Figure 2-5 of the Work Plan), with the goal of exposing the EOD Fault such that the strike and dip of the fault can be measured. In accordance with Part 6, Section 6.1.2 of the hazardous waste facility permit for Kirtland Air Force Base (Permit), the Permittee shall provide notice to and allow access for the NMED to inspect the trench as it is being excavated, and after excavation is completed. If evidence of the fault is discovered in the trench, the Permittee shall observe and record the dip angle and strike of the fault plane. The Permittee shall complete the trenching by no later than December 1, 2010. The detailed geologic map must incorporate the results of the trenching effort.

If the EOD Fault is located by trenching, the Permittee shall further investigate the EOD Fault by conducting geophysical surveys along the 4 transects (A-A' through D-D") shown on Figure 1 enclosed with this letter, or by trenching at these 4 locations. If geophysical surveys are conducted, the Permittee shall use, one or more of the following types of geophysical survey methods, as necessary, to locate the fault: VLF-EM, magnetometer, EM-31/34, or shallow reflection survey, or another method capable of locating the fault. In accordance with Part 6, Section 6.1.2 of the Permit, the Permittee shall provide notice to and allow access for the NMED to inspect the surveys or trenching operations as they are conducted. The geophysical surveys or trenching operations must be completed by no later than December 8, 2010. The aforementioned detailed geologic map must incorporate the results of the surveys.

Although NMED staff did not find any field evidence that the EOD Hill and M-M' Faults exist, the Permittee shall show to NMED staff in the field all evidence supporting the existence, locations, and orientations of these faults to the extent that they are known by the Permittee. The Permittee shall make this demonstration to the NMED by no later than December 1,2010.

The Permittee shall provide to the NMED by no later than December 30, 2010, the detailed geologic map and at least 3 cross-sections constructed using the information shown on the detailed geologic map. The Permittee must revise the site conceptual model presented in the Work Plan using the detailed geologic map.

Response:

Agree. Prior to completion of this Work Plan additional work was completed to further define geology in the area of EOD Hill. The work consisted of the following activities.

- Constructing a detailed surface map of EOD Hill area outcrops and fracture orientations.
- Excavation of a trench was excavated in the vicinity of the former "chaotic blocks" area to expose a potential fault structure in this area.
- Examination view of high-resolution aerial photographic data to determine if vegetative patterns provided supporting evidence of the presence of a fault
- Conducting a detailed geophysical study which included an EM-31 investigation with multiple survey lines across four separate target transects, an EM-34 investigation with multiple survey lines across four separate target transects, with coil spacing at 10 meters in vertical and horizontal dipole mode, a VLF Wadi investigation with multiple survey lines across four separate target transects, a Proton magnetometer survey with multiple survey lines across four separate target transects, and four seismic refraction survey lines at each of the four targeted transects.

All data from the investigation was provided to NMED ensure that the site characterization data that was being collected was satisfactory. The data collected will be included in the Work Plan. A report detailing the geophysical field effort will be submitted under a separate cover.

PART 2 OTHER COMMENTS ON WORK PLAN

2.) The Work Plan and associated transmittal letter 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. § 270.11(d)(1), and Permit Part 6.2.4.11, 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 Work Plan or associated transmittal letter must include this certification, signed by a chief or senior executive officer of the Facility.

Response:

Cover letter will be revised to reflect comment..

3.) Section 1.2, ISI paragraph -This paragraph states that the extent of contamination will be largely driven by geologic features, such as faults. Even if faults exist at EOD Hill, it is not known what control, if any, they have on contaminant migration. Revise the Work Plan accordingly.

If the EOD Fault is confirmed to exist east of EOD Hill (see Comment #1 of Part 1), the Work Plan must also be revised to indicate that the fault will be further investigated by the drilling of least one angled borehole designed to intersect and cross-cut the fault. The borehole shall be located near transect C-C' shown on Figure 1 enclosed with this letter, and shall be completed from surface to total depth by diamond drilling. Continuous core shall be recovered from the surface to the total depth of the borehole and logged for lithologic, structural, and any other characteristics that may be important to the EOD Hill investigation. The core shall be oriented, or another technology employed in lieu of obtaining oriented core, such that the three-dimensional orientation of geologic and lithologic structures encountered in the boreholes can be accurately determined. Such geologic and lithologic structures are to include at a minimum bedding planes and contacts, fractures, faults, and solution cavities.

Response:

The geophysical investigation did not identify any specific EOD Fault but rather a fault zone. At a meeting at KAFB on October 25th 2011 Will Moats, Bill MacDonald and Sid Brandwein (NMED), Cole Crosgrove (KAFB), Greg Brooks AECOM and Bob Delgado (OTIE) NMED indicated that angle boring through the fault is not warranted to further define geology at the site.

4.) Section 1.2, 2nd through 4th paragraph -The text states that groundwater samples will be collected from existing wells, geophysical surveys will be conducted on existing wells, and an IPIDCRES survey will be completed as tasks under Phase 1 of the project. Additionally, the text states that work will be stopped prior to initiation of Phase 2, and the results of Phase 1 used to modify the Work Plan.

The above strategy is flawed because the amount of work proposed under Phase 1 is insufficient to significantly improve the understanding of the geology, hydrology, and groundwater contamination at EOD Hill. Additionally, the proposed IPIDCRES survey (see Comment # 44) is of questionable value, the wells (except for EOD-BH) where water samples are to be collected and the geophysical surveys are to be conducted are located too far away from EOD Hill, and the delay between Phase 1 and Phase 2 is unwarranted considering how little useful information will be generated under Phase 1.

Furthermore, the Work Plan in Section 1.2 and many places elsewhere in the Work Plan state that the number and locations of wells are not fixed. While this may be appropriate for the advanced stages of an investigation, NMED will not approve such a strategy in the beginning stages of a groundwater investigation. The Permittee, therefore, is directed to revise the Work

Plan to conduct all of the proposed work in Phases 1 and 2 as a single phase of work. The Work Plan shall also be revised to commit to the completion of wells KAFB-EOD 1, KAFB-EOD2, KAFB-EOD3, KAFB-EOD4, KAFB-EOD5, and KAFB-EOD6 (see also Comment #17). Furthermore, the Work Plan shall be revised to indicate that at the location of each well, the Permittee shall employ diamond drilling to retrieve continuous core from the surface to the total depth of each well. The core shall be oriented, or another technology employed in lieu of obtaining oriented core, so that the three-dimensional orientation of geologic and lithologic structures encountered in the boreholes can be accurately determined. Such geologic and lithologic structures are to include at a minimum bedding planes and contacts, fractures, faults, and solution cavities. The core shall be logged by a registered professional geologist. After each borehole is completed by diamond drilling, the borehole shall be reamed to a sufficient diameter, or a larger diameter borehole drilled to install the groundwater monitoring well for the particular location.

Response:

Per discussions with NMED on October 25th , 2011 the work plan will be revised to reflect that five monitoring wells (KAFB-EOD 1, KAFB-EOD2, KAFB-EOD3, KAFB-EOD4, KAFB-EOD5) will be installed, at the agreed upon locations, as part of Phase 1. If additional monitoring wells are need to further define the plume, the Air Force and NMED will mutually agree upon the number and placement of these wells to be installed Phase 2 of the investigation. The Air Force agrees that conducting work beyond the boundaries of the EOD Hill site is not warranted and will be stricken from the work plan.

During installation of the monitoring wells, the boreholes will be continuously cored using diamond drilling techniques. Cores will be collected in such a manner that they can be oriented using downhole geophysical techniques. The cores will be logged by a registered professional geologist, which will include geologic and lithologic structures such as but not limited to bedding planes and contacts, fractures, faults, and solution cavities. After diamond drilling each borehole, the borehole shall be either reamed to a sufficient diameter or a larger diameter borehole drilled, to install the groundwater monitoring well at the borehole locations.

5.) Section 1.2, last paragraph states that groundwater samples will be collected and analyzed on a quarterly basis, if required. The Permittee is hereby notified that groundwater samples shall be collected and analyzed on at least a quarterly frequency. Revise the Work Plan accordingly.

Response

Agree. Groundwater samples will be collected quarterly for eight quarters. NMED will be notified prior to groundwater sample collection.

6.) Section 1.3.1.1 - This Section states that the investigation will determine what contamination, if any, may have occurred, and that findings from the investigation will be used to determine the authority under which any remediation will take place. There should be no dispute that groundwater at EOD Hill is at least contaminated with perchlorate, so the phrase "if any" is inaccurate. Additionally, the NMED's authority to regulate perchlorate contamination is based on the New Mexico Hazardous Waste Act and the New Mexico Hazardous Waste Management Regulations. There is no question as to what authority will be used and no determination will be necessary. Revise the Work Plan accordingly, or remove the section in its entirety.

Response

The purpose of the SI is to investigate whether a release has occurred at the EOD Hill site.

7.) Section 2.1 and Figure 2-2 -Section 2.1 states and Figure 2-2 shows that perchlorate results for a water sample collected from EOD Hill Well (EOD-BH) in January 7, 2010, was 2.7 ug/L, orders of magnitude below the concentrations detected in samples collected by the NMED Department of Energy Oversight Bureau several years earlier. Although the sample is presumably from EOD Hill Well, the laboratory analysis data form in Appendix C of the Work Plan states that the sample comes from the "Kirtland AFB -School House Well". Clarify where the sample was collected.

Given such a significant change in concentration between the earlier NMED data and the 2010 data, the Permittee inexplicably did not verify (to the NMED's knowledge) the January 2010 result. Nevertheless, even if it is true that perchlorate levels have dropped significantly over the last several years, the contamination still needs to be characterized.

NMED also notes that the Permittee did not provide notification in advance to the NMED of the January 2010 sampling event, as required by the Permittee's hazardous waste facility permit that was in effect at the time (see Section 1.2 of Module IV of the 1994 Permit). The renewed Permit (issued on July 15,2010) contains similar notification requirements concerning field activities, including sampling (see Permit Section 6.1.2), with which the Permittee must comply.

Response:

Noted. The January 7, 2010 samples were collected as part of the annual _____ sampling conducted at Kirtland AFB. Supporting documentation will be appended to the Work Plan.

8.) Figure 2-4 -The dip angle and direction of the EOD Fault shown in the cross-section of this figure are not supported by field evidence. Additionally, some of the contacts of some of the rock units shown on the map near EOD Hill are known to be inaccurate based on NMED's site visits

conducted on February 22,2010, and March 4,2010. See Comment #1 concerning the direction to conduct geologic mapping of the EOD Hill area.

Response:
See response to comment 1.

9.) Figure 2-6, Regional Water Table Map -This map demonstrates that little is known about the water levels in the EOD Hill area. Revise the Work Plan to state that a water-level map will be prepared for EOD Hill using water-level measurements taken from new wells to be completed under the Work Plan and EOD Hill Well (EOD-BH). Also revise the Work Plan to indicate that the water-level map will be submitted with the Investigation Report for EOD Hill.

Response:
Agree. The Work Plan will state a water level map will be prepared and submitted with the investigative report.

10.) Section 2.4.1 -This Section mentions the EOD Hill and M-M' Faults. As mentioned in Comment #1, there is no field evidence that these faults exist. This Section also states that the EOD Fault strikes north and dips to the west. As mentioned in Comments #1 and 8, surface exposures are insufficient to determine the fault's existence and dip direction.
This Section also states that the EOD Hill Well (EOD-BH) appears to penetrate a confined aquifer. As indicated in the May 11, 2010, NOD, there is no evidence that the aquifer is under confining conditions. Revise the Work Plan accordingly.

Response:
Discussion of the geology will be amended to reflect the findings of the geologic field investigation as discussed in Response 1.

11.) Section 2.5.2 -NMED notes that laboratory results show detections of acetone at 5.74¬23 ug/L and arsenic at 0.0299 mg/L, in addition to perchlorate, in groundwater samples from the EOD Hill Well (EOD-BH). The Permittee argues that no other contaminants are present in the groundwater, that the detection of arsenic at 0.0299 mg/L is representative of natural background conditions, and that the detections of acetone are likely due to analytical laboratory contamination. A determination that a given constituent is not a groundwater contaminant can not be based on one or a few sampling events because laboratory analytical results are not always accurate, and concentrations of contaminants can vary with the seasons. See also Comment #32.

Response:
Noted.

12.) Section 3.1.3 -Water-level measurements taken from wells during Phase 1 will be insufficient to plan work for Phase 2. See also Comment #4.

Response
Agree. See response to Comment # 4.

13.) Section 3.1.4 -A map needs to be included in the Work Plan that shows the location of the craters and the locations where the samples will be collected in each of the craters. The procedure for collecting soil samples from the lowest point in each crater needs to be better described in the Work Plan. For example, soil in the craters may be virtually non-existent or several feet deep, and is expected to include large fragments of bedrock. Revise the Work Plan to explain how the soil samples will be collected and at what depth(s).

Response:
Agree. Additional detail will be added to the Work Plan.

14.) Section 3.2 -This Section concerns quality assurance/quality control. NMED specifically directed in the May 11, 2010 NOD that the Work Plan must specify in detail the quality assurance (QA) and quality control (QC) procedures that are to be implemented. The QA/QC procedures must include the types and frequencies of field and laboratory quality control samples to be prepared or collected, as appropriate (see Permit Sections 6.S.14, 6.S.17.6, 6.S.1S.1.1, 6.S.1S.1.3, and 6.S.1S.3). Revise the Work Plan to specify the QA/QC details.

Response:
Additional detail will be added to the Work Plan. The contractor selected to perform the work will submit a site specific UFP QAPP prior to commencing Phase 1.

15.) Section 3.3.2 -This Section states that Phase 2 wells are to be installed, as necessary. The installation of one well in Phase 1 will be inadequate to characterize the nature, extent, and rate of migration of groundwater contamination and the hydrogeologic conditions of the EOD Hill area. See also Comment # 4.

Response:
See response to Comment # 4.

16.) Section 3.3.2 -NMED concurs with the proposed locations as shown in Figures 2-4 and 3-2 for wells KAFB-EOD, KAFB-EOD2, KAFB-EOD3, and KAFB-EOD4. However, NMED reserves the right to require additional groundwater monitoring wells if they are needed to characterize the

nature, extent and rate of migration of groundwater contamination and the hydrogeologic conditions at EOD Hill. See also Comment #4.

Response:
The Air Force and NMED have mutually agreed on the location of the five monitoring wells to be installed as part of Phase 1.

17.) Section 3.3.2 -Proposed wells KAFB-EODS and KAFB-EOD6 are needed for the investigation. However, NMED reserves the right to require additional groundwater monitoring wells if they are needed to characterize the nature, extent, and rate of migration of groundwater contamination and the hydrogeologic conditions at EOD Hill. See also Comment #4.

Figure 3.2 shows the proposed wells to be located east of the as yet defined EOD Fault. Existing maps are not in agreement as to the location of this fault and the Permittee did not specify the rationale for locating the wells in relation to the fault. Wells KAFB-EODS and KAFB-EOD6 must be completed on the west side of the EOD Fault, if it exists, in the event that it influences the hydrologic conditions at EOD Hill. Revise the Work Plan accordingly.

Response:
See response to Comment # 4.

18.) Section 3.3.2 -The Work Plan does not provide for a background well should any of the proposed wells mentioned in Comment # 16 and 17 not be suitable for that purpose. Revise the Work Plan to address such a contingency.

Response:
The background well will be one of the five Phase 1 monitoring wells. The background well will be upgradient of the EOD-BH well. If none of the Phase 1 monitoring wells is deemed suitable as a background well, an additional well will be installed at a mutually agreed upon location.

19.) Section 3.3.2 -Proposed wells KAFB-EOD7 and KAFB-EOD8 are located too far (over 1000 feet) from EOD Hill to be useful for the EOD Hill investigation. As indicated in the May 11, 2010, NOD, the initial investigation of the groundwater contamination at EOD Hill must focus on the immediate EOD Hill area.

Response:
Depending upon the results of Phase 1 monitoring well sampling, monitoring wells KAFB-EOD7 through KAFB-EOD8 would be installed as part of the Phase 2 investigation. KAFB-EOD7 through KAFB-EOD8 well locations will be mutually agreed upon by NMED and the Air Force.

20.)Section 3.3.2.1 -This Section states that boreholes will be advanced 20-30 feet below the first encounter of water, and that if conditions are generally different than anticipated, other options may be assessed. The Permittee shall install wells at all locations where groundwater is first encountered no matter what conditions are present. If necessary, and as determined by the NMED, the Permittee may be required to install additional wells at deeper depths and different locations depending on site conditions. Revise the Work Plan accordingly.

Response:
Work Plan will be revised accordingly.

21.)Section 3.3.2.1 -This Section does not state what information is to be recorded in the geologic logs. Revise the Work Plan to indicate the information to be recorded.

Response:
Work Plan will be revised accordingly.

22.)Section 3.3.2.1 -This Section, in the first paragraph, states that boring/well locations are shown on Figure 3-1. Figure 3-1 does not show this information. Revise the Work Plan to indicate the locations on Figure 3-1.

Response:
Work Plan will be revised accordingly and reflect the new well locations.

23.)Figures 2-1, 2-4, 3-1, and 3-2 -The EOD Hill investigation must focus on the immediate EOD Hill area. The figures depict a large area surrounding EOD Hill, which does not allow for clear presentation of details of the EOD Hill area. Proposed wells KAFB-EOD7 and KAFB¬EOD8 are located too far from EOD Hill to be useful for the EOD Hill investigation (see Comment #19). These wells should be deleted from the figures so that the figures can be drawn to a scale appropriate to clearly show details of the EOD Hill area. Revise the Work Plan accordingly.

Response:
Per discussions with NMED at the October 25th meeting NMED indicated that they wished to have the investigation focus on the EOD Hill area as they believed some of the existing wells proposed for sampling would not be reflective of localized geology and groundwater flow patterns. The work plan will focus in the immediate area of the EOD Hill. All figures will be revised accordingly.

24.)Section 3.3.2.3 -The second sentence of the first paragraph of this Section states "The need for surface casings at the well locations is not anticipated". Explain what this statement means, and revise the Work Plan to clarify the meaning of the statement (see Permit Sections 6.5.17.10,6.5.17.10.2 and 6.5.17.10.7).

Response:
The Work Plan will be revised to include well construction information required by the permit.

25.)Section 3.3.2.3 -This Section does not state what information is to be recorded on the well construction logs. Revise the Work Plan to indicate the information that is to be recorded (see Permit Section 6.5.17.10.10).

Response:
The Work Plan will be revised to include the well construction information required by the permit.

26.)Section 3.3.4 -This Section states that well development will be conducted by over pumping, bailing, and surging. The fourth sentence of the first paragraph states that well purging will be considered complete when pH or other parameters have stabilized. Clarify if the phrase "Well purging" is an error and should have been written as "Well development", and revise the Work Plan accordingly (see Permit Section 6.5.17.10.6).

Also, revise the Work Plan to indicate that well development will be considered complete when pH, specific conductance (SC), turbidity, and temperature stabilize, and turbidity does not exceed 5 NTUs. Also revise the Work Plan to indicate the frequency at which measurements of pH, SC, turbidity, and temperature will be taken to check for such stability (see Permit Section 6.5.17.10.6).

Response: Work Plan will be revised to reflect comment.

27.)Section 3.3.5 -The first sentence of the second paragraph of this section states that Phase 2 groundwater samples will be collected after an initial sampling event is conducted following well installations, if required. The Permittee is hereby notified that at least eight quarterly sampling events are required for the analysis of perchlorate (see Permit Section 6.4.1.4) and at least four quarters for all other parameters to be analyzed in the laboratory (see Comment #32). Revise the Work Plan accordingly.

Response:
Work Plan will be revised to reflect comment.

28.)Section 3.3.5 -The second paragraph, in part, states, "If the groundwater samples are below the standard for four consecutive quarters, the sampling will be discontinued". A fixed standard for perchlorate does not exist (see Permit Section 6.2.3.2). Additionally, groundwater monitoring must be conducted for at least eight quarters for perchlorate and at least four quarters for other parameters (see also Comments #27 and 32). Revise the Work Plan accordingly.

Response:
Work Plan will be revised to reflect comment.

29.)Section 3.3.5 -The second paragraph indicates that purging will be continued beyond the evacuation of one well bore volume until field parameters (pH, turbidity, temperature, and specific conductance) are stabilized. Revise the Work Plan to indicate what constitutes stabilization of the field parameters. Also revise the Work Plan to indicate the frequency at which measurements of pH, SC, turbidity, and temperature will be taken to check for such stability (see Permit Section 6.5.17.4).

Response:
Work Plan will be revised to reflect comment.

30.)Section 3.3.5 -The fourth paragraph indicates that samples will be analyzed in a DOD-accredited analytical laboratory. The Permittee shall in any event use a laboratory accredited by the U.S. Environmental Protection Agency (EPA). Revise the Work Plan accordingly.

Response:
Work Plan will be revised to reflect comment.

31.)Section 3.3.5 -Revise the Work Plan to state that groundwater samples will be analyzed for total constituents, and that groundwater samples will not be filtered.

Response
Work Plan will be revised to reflect comment.

32.)Table 3-2 -Revise the Work Plan to include lithium and ammonia in the table. Lithium, a minor groundwater constituent, is an important parameter for fingerprinting the source of the groundwater at EOD Hill. Ammonia is a standard parameter for evaluating reduction/oxidation conditions.

The May 11, 2010, NOD directed the Permittee to collect water samples quarterly for at least four quarters and analyze them for volatile organic compounds, semi-volatile organic compounds, herbicides, pesticides, metals, uranium, gross alpha, gross beta, and gamma spectroscopy. This direction is based on the fact that the well was left unsecure for an unknown duration. However, the Work Plan states that volatile organic compounds, semi-volatile organic compounds, herbicides, pesticides, metals, uranium, and radioactive constituents have been ruled out as groundwater contaminants.

NMED will not approve curtailed sampling and analysis of potential groundwater contaminants based on the results of limited data (see Comment #11). Revise the Work Plan to include the

collection of groundwater samples quarterly for at least four quarters and analyzed them for volatile organic compounds, semi-volatile organic compounds, herbicides, pesticides, metals, uranium, gross alpha, gross beta, and gamma spectroscopy.

The sampling and analysis of groundwater to determine the concentrations of perchlorate must continue beyond four quarterly sampling events (see also Comment #27).

Response
Work Plan will be revised to reflect comment.

33.)Table 3-1, DQO Summary Table. Revise Table 3-1 in accordance with the directives in this NOD, or delete the table. Although the Permittee may use the EPA's DQO process to plan work, Table 3-1 should be deleted from the Work Plan, as it adds little additional 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 NOD.

Response
Agree. DQO tables will be removed from the Work Plan.

34.)Section 3.3.5 -The sixth paragraph indicates that QC samples will be collected and that the samples may include duplicates, equipment rinsate blanks, reagent blanks, and spikes. The text does not commit the Permittee to collect and analyze any QC samples. Revise the Work Plan to specify exactly what types of QC samples will be collected, for what constituents and their associated analytical methods, and at what frequencies. The revised Work Plan must commit the Permittee to obtain and analyze these QC samples (see Permit Section 6.5.17.6). See also Comment #14.

Response
Work Plan will be revised to specify types of number and types of QC samples and their corresponding analytical method.

35.)Section 3.3.5 -The sixth paragraph indicates that the analytical methods listed in Table 3-2 may be changed. Thus, the text does not commit the Permittee to use these analytical methods. An analytical methods are subject to NMED review and approval. Revise the Work Plan to commit to using specific analytical methods.

Response
Analytical methods presented in Table 3.2 will be used pending NMED approval.

36.)Section 3.3.5 -The sixth paragraph indicates that the field parameters pH, specific conductance, and temperature will be measured and records kept. Revise the Work Plan to include turbidity (see Permit Section 6.5.17.4).

Also, revise the Work Plan to discuss the sampling equipment to be used, the types of sample containers to be used, preservatives, holding times, shipping and handling procedures, and chain-¬of-custody and other security procedures related to the sampling of groundwater (see Permit Sections 6.5.17.5 and 6.5.5).

Response
Work Plan will be revised to add turbidity. A site specific UFP QAPP will be submitted by the contractor conducting Phase 1 work at the site. The UFP QAPP will detail all procedures relative to sample handling and collection.

37.)Section 3.3.7 -This Section implies that soil samples are to be analyzed for HMX and RDX as the only explosives included in the analysis. The Permittee must revise the Work Plan to include analysis and reporting of all of the explosive compounds that can be detected by EPA Method 8330.

Response
Work Plan will be revised to reflect comment.

38.)Section 3.3.7 -This Section discusses soil sampling of the craters. Revise the Work Plan to discuss the sampling equipment to be used, the types of sample containers to be used, preservatives, holding times, shipping and handling procedures, and chain-of-custody and other security procedures related to this sampling (see Permit Sections 6.5.5 and 6.5.12).

Response:
A site specific UFP QAPP will be submitted by the selected contractor conducting Phase 1 work at the site. The UFP QAPP will detail all procedures relative to sample handling and collection.

39.)Section 4.1, Project Scheduling -This Section indicates that implementation of the investigation will depend on the receipt of funds. The investigation is required as explained in NMED's letters of June 23, 2009 and November 12, 2009. Such references to funding issues should be deleted from the Work Plan.

Response:
Any funding related references will be removed from the Work Plan.

40.)Section 4.1, Project Scheduling and Appendix A, Site Investigation Schedule -Section 4.1 states that Phase 2 work will not begin until after NMED review of Phase 1 work. This is shown as line item #8 on the schedule in Appendix A. Given the small amount of work proposed under Phase 1 under the Work Plan as it is currently written, and given how little new information will be generated from the implementation of Phase I, there would be no need to delay the project to wait on a NMED review at the conclusion of Phase 1. See also Comment #4.

The schedule in Appendix A must be revised to include more detail on the field work to be completed, including submittal of quarterly reports to NMED.

Response
The schedule will be modified to reflect the new scope of Phase 1 and add more detail with regards to submittal of reports and the quarterly monitoring events.

41.)Section 4.2, Project Reporting -This Section implies that quarterly reports are not necessarily required, contrary to NMED's May 11,2010, NOD, which specifically states that quarterly reports are in fact required. The Work Plan and schedule contained therein must be revised to explicitly include submittal of quarterly reports on the EOD Hill project.

Response
Work Plan will be changed to clarify quarterly report submission.

42.)Section 4.3 -See Comment #50 about making changes to the Work Plan during the course of conducting the investigation. Revise the Work Plan accordingly.

Response
Work Plan will be revised accordingly.

43.)Section 4.5 Investigation-Derived Waste Plan -This section does not provide a discussion on the procedures for management of investigation-derived wastes and anticipated waste streams, nor does it meet the requirement of the May II, 2010, NOD, directing that the Permittee revise the Work Plan to note that the management of investigation-derived waste must comply with all applicable State regulations, including the New Mexico Hazardous Waste Management Regulations, 20.4.1 NMAC. Revise the Work Plan accordingly.

Response:
Work Plan will be revised accordingly.

44.)Section 3.3.1.1 -The Permittee proposes an IPIDCRES geophysical survey. Exposed bedrock covers much of the proposed survey area which will make electrode emplacement difficult. The topography is such that adjacent electrodes (15-20 feet apart as stated in the Work Plan) may have differences in relief between them on the order of 10 feet; NMED is unaware of any computer models or analytical techniques that can take this amount of relief into account. The rule of thumb used for electrode spacing (electrode spacing -3 times the depth of penetration) does not apply to highly resistive environments like those that are expected for this site (dry limestone). Such a survey will therefore likely not provide useful information on fracture patterns and frequency, fault locations and orientations, and lithologic contacts.

Describe in the Work Plan any sensitivity modeling that was done to anticipate AB and MN spacing versus available current, voltage sensitivity, and resistivity with respect to determining data quality objectives. For example, will the potential difference value measured by the equipment be sensitive enough to differentiate a potential difference expected at the planned AB and MN spacings in this environment?

The text describes the proposed transects to be approximately 1000 feet in length, while Figure 3-1 shows them as 750 feet. The figure also shows that the surveyed area may not cover the inferred trace of the EOD Fault, which, if it exists, may be an important factor of the site conceptual model. The Work Plan must be revised to indicate the correct length of the transects and to explain why the survey is not targeting the inferred location of the EOD Fault.
Given that the survey is centered on and largely covers EOD Hill, surface mapping of major fracture distributions and orientations, lithologic contacts, and faults (if any) is expected to be more useful than a IP/DCRES geophysical survey because rock exposures are generally excellent on EOD Hill. Surface geophysical surveys would be much more useful where valley fill covers bedrock, particularly at locations east of EOD Hill where the EOD Fault may exist.

Response

Geophyics has been removed from this Work Plan. All geophysical investigation was completed prior to development of this Work Plan to assist in the development of the CSM.

45.)Table 3-1, under Uncertainty Topic 4, the DQO step between 4 and 5 discusses "56 phones." It should probably read "56 electrodes." The next sentence reads "data will be analyzed to determine fractures and potential flow pathways." Describe how the data will be analyzed and what computer programs, if any, will be used. Explain how it was determined that the method will meet the "fracture sets/contaminant flow pathways within 20 feet" Limits on Decision Errors (DQO Step 6, Uncertainty Topic 4). See Comment also #33, and revise the Work Plan accordingly.

Response
DQO table has been removed from Work Plan.

46.)Section 3.3.1.2, Downhole Geophysics, states"... logging of these wells using acoustic televiewer, acoustic velocity/full wave form acoustic, gamma, and neutron methods. The logs will be run from the groundwater table (approximately 140 ft bgs) to ground surface through the well casing." Acoustic televiewer and acoustic velocity/full wave form acoustic logs are not effective in the absence of water or some other liquid. The logs must be run from the bottom of the hole to the top, as appropriate, and certainly below any casing if open-hole conditions such as those in the EOD Hill Well exist. Induction logging must also be conducted in each well from bottom to surface. A caliper log must be conducted in the open-hole portion of the EOD Hill well.

Different logging suites are more useful in open boreholes than in cased boreholes. Since the Permittee does not specify with any certainty how the boreholes will be drilled (e.g., casing hammer or ordinary rotary methods) or the timing of geophysical logging relative to well construction, it is unclear what logging should be useful and what type of logging will be conducted. Specify in the Work Plan what geophysical logging will be conducted, under what circumstances, and whether or not logging will be conducted before or after well construction. Spinner flow logging should be given serious consideration in the EOD Hill Well (EOD-BH). It appears that the School House Well may be constructed with steel casing (see SNL's Compilation of Monitoring Well Construction Diagrams Contained in SNUER Project Well Database, 2004). Revise the Work Plan to clarify the geophysical logging suite proposed for this well.

Response:
Work Plan will clarify what suite of downhole geophysics will be run on the monitoring wells installed during Phase 1. Downhole geophysics will be limited to wells located on the EOD Hill site.

46.)Table 3-1, DQO Summary Table, Uncertainty Topic 2, Optimized Design, states "If Phase I concentration of COPCs are < PRGs or screening parameters are < decision levels then no further sampling is required." The table also mentions PRGs and "< decision levels" in other places. PRGs and decision levels are subject to NMED review and approval; none have been approved to date. The Permittee shall revise the Work Plan to indicate that site characterization will continue until the concentrations of contaminants that are detected do not exceed the background levels approved by the NMED for KAFB. See also Comment # 33.
Response
DQO tables are going to be eliminated from report.

47.)Section 3.3.1.2, Downhole Geophysics, mentions a proposed seismic survey. However, a discussion of such a survey is not included in the Work Plan. Revise the Work Plan to include a discussion of the proposed seismic survey if such a survey is to be conducted.

Response
Seismic survey was conducted prior to this revision of the Work Plan. Reference will be removed from this section.

48.)Section 3.3.2.3, Monitoring Well Installation. As directed in the May 11, 2010, NOD, the Permittee must revise the Work Plan to clarify that all monitoring wells will have a locking mechanism for security purposes, whether completed with stickup or flushmount well casing.

Response
Work Plan will be revised to reflect comment.

49.)Section 3.3.2, Groundwater Monitoring Well Locations, third paragraph, states: "NMED will be notified of any deviations in well placement/constructions ..." NMED must approve deviations from the Work Plan, including, but not limited to, the relocation of and construction specification of wells, in advance of implementing changes.

Response
Work Plan will be revised to reflect comment.

50.)Section 4.6, Community Relations Plan, states: "The Community Relations Plan is included in the Base-Wide Plans for the Environmental Restoration Program, 2004 Update." The Permittee shall append a copy of the community relations plan to the Work Plan.

Response
A Community Relations Plan will be appended to the Work Plan.

51.)Section 4.3, Project Coordination, third paragraph, discusses weekly conference calls. NMED does not need to be involved in weekly updates and planning sessions. However, NMED is available for discussions on an "as needed" basis. Revise the Work Plan accordingly.

NMED must approve deviations from the Work Plan in advance of the Permittee implementing the changes. See also Comment #50.

Response
Work Plan will be revised to reflect comment.
52.)Section 4.2, Project Reporting, needs to specify that geologic logs, geophysical logs, and surface geophysical data and analysis thereof are to be included in the Quarterly Reports and the Investigation Report. Additionally, geophysical logs must also be included in the reports in digital format. Revise the Work Plan accordingly.

Response
Work Plan will be revised accordingly.

54.)Sections 2.4.1 and 2.7 -Section 2.4.1, Page 2-3, last paragraph, states "Video logging... indicated that the bottom of the borehole is completed in limestone bedrock." In contrast, Section 2.7, Page 2-11, first paragraph states "The existing borehole ... may terminate in Precambrian granite." Revise the Work Plan to include the correct information, or otherwise resolve the discrepancy.

Response
Work Plan will clarify discrepancy.

55.)Section 2.4.1. The discussion on page 2-3 second paragraph and Figure 2-4 implies that the EOD fault is a reverse fault while the next paragraph and Figures 2-5 and 2-7 imply it is a wrench fault with a normal component. Revise the Work Plan to be consistent, should the EOD Fault be shown to exist (see also Comment #1).

Response
Figures will be revised to reflect our current understanding of the site based on the geological investigation work conducted at the site.

56.)Section 3.3.5, Groundwater Sampling, first paragraph, states "DQOs have been developed to address potential changes in well locations based on preliminary contaminant concentrations." The DQOs state "After each well is installed data will be gathered and incorporated into the CSM and adjustments to well location made as needed." This implies that the Permittee will construct a well, collect water samples, and wait for laboratory analysis before drilling the next well. This approach would cause considerable delay in completing site characterization. The Permittee must modify the approach in the revised Work Plan to reduce delays of this sort. See Comment # 4.

Response
All Phase 1 wells will be installed at the agreed upon locations prior to sampling and surveying. Phase 1 data will be analyzed and submitted prior to commencing Phase 2 if required.

57.)Section 3.3.5, Groundwater Sampling. The well discussed in the text and shown on Figures 1-1,2-1,2-4,3-1 and 3-2 that is named "EXISTING UST-58 WELL" does not correspond to any of the locations supplied by the Permittee in its Response to the New Mexico Environment Department, Hazardous Waste Bureau, Request for Information Regarding Monitoring Well and Groundwater Quality Data, February 2009, although it is nearby other wells listed as Site 58 RW-I, and Site 58 MW-I through Site 58 MW-5. The well is shown south of the fence surrounding Manzano Base, whereas the other Site 58 monitoring wells are located north of the fence. Clarify whether the "EXISTING UST-58 WELL" is shown at the correct location on the maps in these figures and submit the well log, geologic log, and information on the water level in the well. If necessary, revise the Work Plan to indicate the correct position of the well, or otherwise resolve the discrepancy.

See also Comment # 23 concerning constructing figures showing wells that are located too far from EOD Hill to be useful to the investigation.

Response
Groundwater sampling will be limited to wells in the EOD Hill area.

58.)Section 3.3.5 -The last paragraph on page 3-8 discusses a site-specific QAPP to be developed. See Comment #14 concerning the inclusion of QA/QC information in the Work Plan.

Response:
See comment response to Comment #14.

59.)Figure 3-1. The word "Geophysical" is misspelled in the title block of Figure 3-1. Revise the Work Plan to correct the spelling.

Response:
Figure will be corrected.

60.)Appendix A, Site Investigation Schedule, shows what should be in a Phase II activity report as "Final SI Reporting", but does not show a final report which would incorporate sampling results and provide conclusions and recommendations at the end of at least eight quarters of sampling. Revise the Work Plan accordingly.

Response
Report titles will be changed to reflect the comment.

61.) The Work Plan is labeled "Draft". Revise the Work Plan to remove all such "Draft" labels.

Response
The Label will be changed to removing the word “Draft”

<u>Comments on AECOM Response to May 11.2010 NOD</u>

NMED has reviewed a file on the CD submitted with the Work Plan which contains a table entitled AECOM Response to NMED Comments on Deficiencies, Notice of Disapproval, EOD Hill Site Investigation Work Plan, January 12, 2010, Kirtland AFB. NMED considers these to be additional comments by the Permittee. NMED will address some of the responses included in the AECOM table in Comments #62 through 67 of this NOD. However, the Permittee is responsible for making revisions to the Work Plan as directed in Comments #62 through 67.

1.)AECOM Response to Comment #1 of May 11,2010, NOD -AECOM indicates that the well is now secured. The Permittee must revise the Work Plan to indicate when and how the well was secured.

Response
Additional detail will be added to the Work Plan.

62.)AECOM Response to Comment #2 of May 11,2010, NOD of May 11,2010, NOD, states:

Comment noted. As agreed during prior discussions with NMED, investigation into source of perchlorate in EOD-BH is being carried out by the Air Force under CERCLA authority in accordance with DoD Perchlorate Release Management Policy of 22 April 2009. Upon determination of the source, legal authorities governing cleanup of any perchlorate contamination in excess of DoD preliminary remediation goal of 15 ppb will be jointly determined by Air Force and NMED.

The above response does not accurately represent any agreements made, or NMED's position. Specifically, NMED did not agree and does not now agree that the perchlorate investigation to be conducted at EOD Hill will be conducted under CERCLA authority in accordance with the DoD Perchlorate Release Management Policy of April 22, 2009. NMED did not agree and does not now agree that establishment of the legal authority will wait until a source is found. NMED did not agree and does not now agree that 15 ppb will be the remediation goal. The investigation, remediation (if necessary), and establishment of cleanup goals (if necessary) shall be conducted under the New Mexico Hazardous Waste Act and the Permit.

Response
Please see cover letter.

63.) AECOM Response to Comment #3 of May 11, 2010, NOD -the AECOM response states:
Site conceptual model was revised based on available geologic mapping. Geologic cross sections were generated/taken from available data and present information on lithology units and structure such as faults. No physical geologic mapping off site will be completed.
See Comment #1 in Part 1 of this letter.

Response
See response to comment #1.

64.)AECOM Response to Comment #5 of May 11, 2010, NOD -The AECOM response states that continuous core will be collected in rock at depths below the water table. Although restricting the collection of core to depths below the water table would likely minimize costs to the Permittee, it will not provide the best information concerning the geologic and hydrologic conditions in the vadose zone at EOD Hill. Observations of fracture patterns and their frequencies and other lithologic characteristics should not be restricted to areas located below the water table. For example, fractures, faults, and lithologic units encountered in a borehole above the water table may extend to depths below the water table elsewhere, and may serve as preferential flow paths for contaminant migration in the vadose zone, saturated zone, or both.

Response

Work Plan will be amended to include rock coring from the point where rock is first encountered.

65.)AECOM Response to Comment #6 of May 11, 20 I 0, NOD -The AECOM response states that steep topography prevents the installation of wells closer to EOD Hill Well (EOD¬BH). NMED is aware of the topography of the site. However, if necessary, roads and drill pads can be constructed to provide safe access for drilling and installing wells anywhere on EOD Hill.

Response
The Air Force and NMED have mutually agreed upon the locations for the five Phase 1 monitoring wells. The above comment is no longer relevant.

66.)AECOM Response to Comment #21 of May 11, 2010, NOD -The AECOM response states:

Air Force sampled EOD-BH in January 2010 and there was no indication of any of these contaminants being present above regulatory limits in sample collected from EOD-BH. Given these results, it is highly unlikely that any of these compounds were introduced through the well. Therefore, no further sampling for these parameters is being proposed for EOD-BH in Work Plan. Air Force was requested by NMED to determine source of perchlorate in EOD-BH and these parameters are not necessary, and do not assist in that effort. See Comment #11.

Response:
Noted.

PART 3 COMPLIANCE SCHEDULE
The Permittee shall meet the due dates shown in Table 1 of this letter. The Permittee shall submit to NMED a revised Work Plan that corrects the deficiencies discussed in this letter by no later than January 31,2011. The revisions shall meet the technical requirements of Part 6 of the Permit issued on July 15, 2010, unless otherwise directed under this letter.

APPENDIX D: EOD-BH Analytical Results (June 2011)

MEMORANDUM

DATE: July 28, 2011

TO: Jennifer Dann, Kirtland AFB

FROM: E.J. Anderson, URS

CC: Cheryl Frischkorn, Kirtland AFB
Michael Litman, USACE
Paula Schuh, URS
Project File

RE: **EOD Range (EOD Hill Well) Monitoring Report for (June 23, 2011) the Second Quarter 2011.**

The EOD Hill Well at Kirtland Air Force Base (KAFB) was sampled on June 23, 2011, as part of the Explosive Ordnance Disposal (EOD) Range monitoring required by the Resource Conservation and Recovery Act (RCRA) permit. The EOD Hill Well was sampled in place of the Schoolhouse Well at the request of KAFB with approval by AFCEE. This letter report briefly describes the sampling effort, the analytical data, and provides a summary of the data quality review.

Well Sampling

Samples were collected at the EOD Hill Well in accordance with the Project Work Plan (June 2008). All samples were prepared, and analyzed within the required hold time. As well, all quality control measures were met for each analysis.

Before purging, the depth to water was measured and the purge volume was calculated. Depth to groundwater surface occurred at 142.45 feet below the reference point, corresponding to a wetted casing volume of approximately 66.55 feet. The well was purged and sampled using a Grundfos Ready-flo pump with dedicated polyethylene tubing. One well sample and one duplicated sample were obtained and labeled EOD Hill-06-11-01 and EOD Hill-06-11-02 respectively.

Approximately 150 gallons of water were removed during purging. The pH was stable at 6.85 pH units throughout. Field measurements of conductivity and temperature were stabilized to approximately 61 mV and 21.3°C.

The lab acidified the bottles and the pH was verified per the preservation procedure referenced in Section 2.3, Sample Collection, in the Work Plan. The analytical results and the Groundwater Quality Sampling Log, including the purging information, are included as attachments.

Analytical Results

The results of the groundwater analyses are shown in Table 1, along with the Environmental Protection Agency (EPA) Primary and Secondary Drinking Water Standards, where applicable.

All analyte concentrations, with the exception of arsenic, chloride, iron, manganese, and perchlorates (laboratory values), were within the EPA National Primary and Secondary Drinking Water Standards as of June 2011 for both the well sample and the duplicate samples collected. This well has not been used as a supply well. This well has been used for past research purposes, and currently only used for monitoring purposes.

Data Quality

All of the groundwater data from the EOD Hill Well was reviewed. The review focused on initial and continuing calibration data, laboratory blanks, matrix spikes, surrogate recoveries, and laboratory control samples as required by the Quality Assurance Project Plan (QAPP) for this project. Overall, quality control data for this quarter indicate that analytical results are acceptable.

Table 1. Kirtland AFB EOD Hill Well Monitoring Groundwater Data
June 2011

	EPA Drinking Water Standards[1]	EOD Hill 06-11-01 Well Sample	EOD Hill 06-11-02 Duplicate Sample
SM6640 Herbicides by GC/ECD (µg/L)			
2,4,5-T	NA	<0.28	<0.28
2,4,5-TP (Silvex)	50 ug/L	<0.28	<0.28
2,4-D	70 ug/L	<0.92	<0.92
SW846 3510C/8081A Pesticides by GC/ECD (µg/L)			
α-BHC	NA	<0.10	<0.10
α-Chlordane	NA	<0.10	<0.10
Aldrin	NA	<0.10	<0.10
β-BHC	NA	<0.10	<0.10
Chlordane, total	2.0 µg/L	<0.10	<0.10
d-BHC	NA	<0.10	<0.10
Dieldrin	NA	<0.10	<0.10
Endosulfan I	NA	<0.10	<0.10
Endosulfan II	NA	<0.10	<0.10
Endosulfan Sulfate	NA	<0.10	<0.10
Endrin	2.0 µg/L	<0.10	<0.10
Endrin Aldehyde	NA	<0.10	<0.10
Endrin Ketone	NA	<0.10	<0.10
g-BHC (Lindane)	0.2 µg/L	<0.10	<0.10
g-Chlordane	NA	<0.10	<0.10
Heptachlor	0.4 µg/L	<0.10	<0.10
Heptachlor Epoxide	0.2 µg/L	<0.10	<0.10
Methoxychlor	40 µg/L	<0.10	<0.10
p,p-DDD	NA	<0.10	<0.10
p,p-DDE	NA	<0.10	<0.10
p,p-DDT	NA	<0.10	<0.10
Toxaphene, total	3.0 µg/L	<0.80	<0.80
EPA 300.0 Anions by IC (mg/L)			
Chloride	250 mg/L*	390	400
Fluoride	4.0 mg/L	1.6	1.7
Nitrate, as N	10 mg/L	<0.20	<0.20
Nitrite, as N	1.0 mg/L	<0.20	<0.20
Sulfate	250 mg/L*	120	120

Table 1. Kirtland AFB EOD Hill Well Monitoring Groundwater Data
June 2011

	EPA Drinking Water Standards[1]	EOD Hill 06-11-01 Well Sample	EOD Hill 06-11-02 Duplicate Sample
EPA 420.1 Section 8.3 Phenolics (mg/L)			
Phenolics, Total	NA	0.013	0.02
SW846 3005A/6010B ICP or SW846 3005A/6020 ICP-MS (mg/L)			
Arsenic	0.01 mg/L	0.029	0.062
Barium	2.0 mg/L	0.11	0.24
Cadmium	0.005 mg/L	0.00016	0.00019
Chromium	0.1 mg/L	0.0059	0.017
Iron	0.3 mg/L*	25	27
Lead	0.015 mg/L	0.0017	0.0047
Manganese	0.05 mg/L*	1.4	2.9
Selenium	0.05 mg/L	0.004	0.0029
Silver	0.1 mg/L*	0.000095	0.00015
Sodium	NA	460	460
SW846 7470A CVAA (mg/L)			
Mercury	0.002 mg/L	<0.00008	<0.00008
9040C pH, Electrometric			
pH	6.5 - 8.5*	NA	NA
Turbidity	<5.0 NTU	NA	NA
SW-846 9020A (µg/L)			
TOX, Total Organic Halogens	NA	23	35
SM5310B (mg/L)			
Carbon, Total Organic, TOC	NA	0.39	0.47
SWA846 6850 (µg/L)			
Perchlorates	15 µg/L**	22	27

Note: [1]If EPA National Primary Drinking Water Standards were not available, then EPA National Secondary Drinking Water Standards were listed.
If EPA standards were not available, then "NA" was entered.
NA = Not Applicable
EPA = Environmental Protection Agency
mg/L = milligrams per liter
µg/L = micrograms per liter
*= EPA Secondary Drinking Water Standard
**= EPA Interim Drinking Water Health Advisory Level

GROUNDWATER QUALITY SAMPLING LOG

Project: **Kirtland Air Force Base EOD OB Range Quarterly Monitoring**

Well ID: ~~School House~~ EOD Hill Well

Location: Upgradient of KAFB EOD OB Facility

Date: 6/23/11

Weather: Sunny, hot, & breezy

Time: Onsite: ~~[illegible]~~ 1030

Sample Taken: 13:00

Offsite: 13:30

Samplers: Luis Marquez & EJ Anderson

Comments:

Field Measurements:

Water Depth (ft BTOC): 142.45ft.

Well Depth (ft BTOC): 246ft. (casing = 209ft)

Borehole Vol. (gal.): unk

Sat. Thickness (ft.): 66.55ft.

Purge/Sample Method: Grundfos Redi-flo Pump

3 Borehole Vol. (gal.): unk

Time	Cum. Vol. (gal)	Temp. (Deg. C)	pH	Conductivity (µS/cm)	Turbidity	Comments:
11:23	0	27.1	6.02	113mV		
11:30	15	22.4	5.83	122mV		
11:39	30	21.8	5.70	118mV		
11:48	45	22.5	6.11	106mV		
11:56	60	21.9	6.29	95mV		
12:04	75	21.7	6.46	85mV		
12:13	90	21.7	6.60	77mV		
12:22	105	21.2	6.70	69mV		
12:31	120	21.0	6.79	60mV		
12:39	~~[illegible]~~ 135	20.9	6.87	62mV		
12:48	150	21.3	6.85	61mV		

Final Field Measurements:

Temp: 21.3°C **pH:** 6.85 **Cond:** 61mV

Sample ID: EOD-06-11-01 & Duplicate = EOD-06-11-02

Additional Comments:

Approximately 150 gallons were removed from the EOD Hill well during purging

330 Hz = Pump Speed

APPENDIX E: Geology of EOD Hills Area

June 8, 2011

Wayne Bitner
Kirtland AFB

Albuquerque, NM

Subject: **Geology of the EOD Hills Area**
Kirtland AFB, NM
AECOM Project No. 60164311

Dear Mr. Bitner:

This letter report documents the results of geologic mapping and the analysis of a fault zone in the EOD Hills area.

PURPOSE AND SCOPE

AECOM entered into a Contract with the Air Force Center for Engineering and Environment (AFCEE) to conduct a site investigation (SI) of potential groundwater impacts of perchlorate at the Explosive Ordinance Disposal (EOD) Hill site at Kirtland Air force Base (AFB), Albuquerque, New Mexico. The portion of the Work under this contract and documented in this letter report includes geologic mapping of the EOD Hill area and trenching across an area located immediately northeast of EOD Hill, thought to contain the EOD Hill fault. Following is a discussion of the work performed.

GEOLOGIC MAPPING

Geologic mapping was performed on EOD Hill and in the area surrounding EOD Hill as illustrated in Figure 1. The mapped area extends approximately 2,700 feet east to west and 2,600 feet north to south. Mapping was performed during January, February and April 2011. Field notes are included in Appendix A. Site locations are designated by numbers and sample locations are designated by letters and numbers.

The strata encountered in the area include Precambrian age igneous and metamorphic rocks, Middle Pennsylvanian Sandia Formation and Middle to Late Pennsylvanian Madera Group rocks.

Precambrian age rocks crop out at locations 500 feet north of EOD Hill and in the prominent hill directly north of EOD Hill. Granite, granite-gneiss, gneiss, schist and phyllite were observed in outcrops.

The Sandia Formation crops out in the north end of EOD Hill and in areas immediately northeast and northwest of EOD Hill. The Sandia Formation consists of pale-brown to whitish quartzose, medium to coarse-grained sandstone (quartz arenite) grading downward to coarse pebble conglomerate. The conglomerate consists predominantly of fine to medium, sub-round to sub-

angular gravel and coarse quartz sand with siliceous cement. Some carbonate cement was observed in the upper siliceous (non-carbonate) sandstone beds. The formation underlying the north end of EOD Hill consists of light brown-gray, fine to coarse quartzose grains with calcareous cement, and is transitional with the Madera Group.

The Madera Group crops out on EOD Hill, and on small hills and ridges located west, northwest, east and northeast of EOD Hill. The lower part of the Madera Group is exposed on EOD Hill and consists principally of gray to light gray-brown micritic limestone. Small (1-inch long) to large (12-inch long) dark brown, gray-brown to black chert nodules are common along bedding planes and on the limestone surface on top of the hill. The limestone occurs as massive and thin-bedded units. There are also slope forming units (shale/mudstone) between ledges. Crinoids and bryozoans fossils were observed on EOD Hill, particularly on the northern end and the eastern side of the hill. Fossiliferous limestone (crinoids and brachiopods) was also encountered in Madera Group beds located northeast and northwest of EOD Hill.

Sandstone and siltstone overlies the lower Madera Group limestone at locations in the northwestern part of the mapped area. The sandstone is predominantly pale yellow to light yellow-brown, medium to coarse-grained quartzose and feldspathic sandstone. Occasional thin (6-inch to one foot thick) coarse pebble conglomerate layers are interbedded with the sandstone. Pebbles are fine to medium grain, sub-round to round quartzite. The matrix is quartzose and feldspathic medium to coarse grained sand with calcareous cement. The basal portion of the arenaceous unit consists of a layer of micaceous, thin-bedded, quartzose, fine grained sandstone and siltstone with some calcareous cement.

The sandstone/siltstone is overlain by Madera Group limestone. The uppermost Madera Group limestone unit crops out in the western and southwestern part of the mapped area. The uppermost limestone is gray, micritic and contains numerous dark gray-brown to black chert nodules along bedding planes and on surfaces.

Alluvium and slopewash colluvium overlies the bedrock surface in much of the area.

GEOLOGIC STRUCTURES

Folds

Strikes and dips of bedding planes were measured at several locations in the mapped area and are illustrated in Figure 1. The major geologic structure delineated by the measured strikes and dips is a south plunging anticline. The estimated trace of the axial plane of the anticline is located immediately east of EOD Hill as illustrated in Figure 1. EOD Hill is a western limb of the anticline.

Several small folds occur in Madera Group strata located northwest of EOD Hill as illustrated in Figure 1. Highly variable strikes and dips in the northwestern area may also indicate the presence of faults.

Faults

Van Hart (2003) observed an area of chaotic blocks northeast of EOD Hill with highly variable strikes and dips. Van Hart (2003) interpreted the chaotic blocks zone as a Laramide wrench fault and called it the EOD fault. Figures 3-8 and 3-9 in Appendix B (Van Hart (2003)) illustrate the location of the chaotic blocks and the location of the inferred north-south trending EOD fault. The location of chaotic blocks are also illustrated on Figure 1.

During February 2011 a trench was excavated across the location of the inferred EOD fault by Universal Constructors, Albuquerque, New Mexico. The location of the trench is illustrated on Figure 1. The trench is approximately 210 feet long, and is 6 to 7 feet deep at most locations. On April 5, 2011 a 10 foot wide portion of the trench, the center of which was located 39 feet west of the western most chaotic block, was deepened to approximately 10 feet to better observe a fault.

Rock types encountered in the trench include limestone, shale, mudstone, siltstone, and sandstone. A thin (one-inch) vein of gypsum was observed near the eastern end of the trench. The bedrock units in the trench are dipping 13 to 18 degrees toward the southeast. It is our opinion that the strata encountered from the chaotic blocks and eastward are part of the Madera Group, and strata encountered west of the chaotic blocks are part of the Sandia Formation.

Photos in Appendix C show the trench area.

EOD Fault Area

A normal fault (down to the east) was observed in the western part of the trench, at a location approximately 39 feet west of the large limestone block in the chaotic blocks area. The fault trends N18^{o}W and dips approximately 33 degrees east-northeast (azimuth 72 degrees).

Photos in Appendix D show the normal fault. The apparent displacement on the upper part of the fault is only approximately 2.3 feet. Slickensides were observed on quartzose sandstone surfaces on the fault. It is our opinion that the formations shown in the photo are all part of the Sandia Formation.

An annotated photo in Appendix D shows the rock units encountered. A description of the rock units encountered is also provided in Appendix D. Rock units consist of hard quartzose sandstone, shale, and siltstone. The shaly layers are brecciated and the uppermost sandstone unit is highly fractured. The units are non-calcareous. Some fractured siliceous rock surfaces are calcrete lined, and effervesce with application of hydrochloric acid.

It is concluded that this normal fault is part of the EOD Fault Zone, which also includes the chaotic blocks area.

Chaotic Blocks Area

A photomosaic of the excavated chaotic blocks portion of the trench is presented in Appendix E. An annotated photomosaic and descriptions of rock units encountered in the chaotic blocks area are also provided in Appendix E. Number 35 in the photomosaic is a large limestone block that was one of the chaotic blocks observed by Van Hart (2003). The bedrock on either side of the block is highly fractured and is bleached. Units 3, 4, 5 and 6 may correlate with Units 17, 21 and 22. Units 4, 6 and 17 and 21 are thick bedded limestone layers, whereas units 3, 5 and 22 are thin bedded siltstone and/or shale layers. A distinct fault line was not observed, however, it appears that Units 17, 21 and 22 could be offset down to the west relative to Units 3, 4, 5 and 6, with about 3 feet of displacement. A normal fault could be located between Unit Numbers 10 and 13. At the west end of beds 3, 4, 5 and 6, the overlying fractured siltstone/shaly units bend downward draping over the end of the broken thick bedded limestone as if they had moved downward.

A significant line of limonite mineralization extends from the location designated as Number 14 in the photomosaic, then upward along bedding planes. Other lines of limonite mineralization are observed at three locations east of the chaotic block.

The siliceous unit designated Number 32 (Sandia sandstone) seems to be out of place relative to the shaly units on either side of it, and joints are only apparent in the sandstone and not in the overlying brecciated shaly units. The very pale brown to whitish siltstone/shaly unit above the sandstone block and labeled Numbers 24, 26 and 31 has a small flexure fold.

In the eastern part of the photomosaic a fractured limestone block measuring approximately 1.5 feet by 1.5 feet and located 24 feet east of the large chaotic block is surrounded by brecciated limestone and shale. A line of mineralization occurs adjacent to the block.

In our opinion, the argillaceous and siliciclastic units located west of the primary limonite line are Sandia Formation or transitional units. The carbonate units east of the limonite line are Madera Group and the bleached siliciclastic (siltstone and shaly) Units Number 1 and 2 are also Madera Group units.

Other Faults

Krumhansl and McConnell (1994) proposed a fault on the east side of EOD Hill along a mineralized zone and a sub parallel fault to the north which they named M-M'. The location of Krumhansl and McConnell's (1994) fault on EOD Hill and the M-M' fault are illustrated in the inset map in Figure 3-9 in Appendix B. Van Hart (2003) interpreted the fault on EOD Hill and M-M' fault as a composite splay of the EOD fault. Historical test pits from mining exploration were observed on both the east and west sides of EOD Hill. Each of the test pits encountered mineralized (limonite) zones.

Near the northern end of EOD Hill some limestone beds and cliffs on the northeast side of EOD Hill appear to be offset and truncated as described by Van Hart (2003), but the formation is not

brecciated or more intensely fractured than the limestone formation at other locations on EOD Hill. It is concluded that strong evidence for a fault on EOD Hill is not apparent.

Northwest of EOD Hill (600 to 1,000 feet) in a zone with several small north-south trending folds (see Figure 1), the limestone formation at sites Q, Q1, 42, PPZ and 44 is highly to intensely fractured. The intense fracturing as well as highly variable strikes and dips throughout the northwest area may provide evidence of faulting.

Fractures in The EOD Hill Area

The Sandia Formation and the Madera Group are exposed in the EOD Hill area as illustrated in Figure 2. Formation exposures are weathered and fractured. Fracture types observed in the Sandia Formation are sharp, and typically open with vertical and sub-vertical dips. Fracture types observed in the Madera limestone include open hairline through open large aperture fractures, calcite-filled fractures, preferentially weathered/eroded open and closed fractures and grooves. Trends of 228 fractures in the EOD Hills area were measured during mapping events performed during January through April 2011. Fracture types and locations where fractures were measured are presented in Figure 2. Photos of fracture types and patterns observed in the EOD Hills area are presented in Appendix F.

The orientations of fractures encountered in the EOD Hill area, and on EOD Hill are presented as rose diagrams in Appendices G and H, respectively. The fracture orientations are presented in 10 degree intervals with north, east, south and west compass directions represented as 0/360, 90, 180 and 270 degrees, respectively. The primary orientation of all measured fractures in the EOD Hills area is 1° - 10° (45 out of 228 fractures (20 percent) average orientation 7.5^o). Secondary orientations are 341° – 350°, and 311° – 320°. The primary orientation of measured fractures in the EOD Hills area that are not located on EOD Hill is 341° - 350° (12 out of 93 fractures (13 percent) average orientation 345°). The primary orientation of measured fractures located west of EOD Hill is 341° – 350° (11 out of 64 fractures (17 percent) average orientation 345°). The primary orientation of measured fractures located east of EOD Hill is 21° – 30° (5 out of 29 fractures (17 percent) average orientation 26.5^o).

The primary orientation of measured open fractures on EOD Hill is 1° - 10° (19 out of 85 fractures (22 percent) average orientation 7°). The primary orientation of measured calcite-filled fractures on EOD Hill is 1° - 10° (6 out of 26 fractures (23 percent) average orientation 7.5^o). The primary orientation of preferentially weathered closed fractures and grooves on EOD Hill is 1° - 10° (10 out of 24 fractures (42 percent) average orientation 8°).

Open fractures have widths ranging from hairline to several inches. The widths of the majority of open fractures range from $1/8^{th}$ to ¼-inch. Many fractures occur as parallel joints with varying spacing between joints. Open fractures have vertical to sub-vertical dips.

The maximum observed width of calcite-filled fractures was approximately ½-inch. Fractures wider than ½-inch were open.

Preferentially weathered (solution enlarged) fractures range from closed (with no apparent fracture) to enlarged 1/2 to 1–inch wide open fractures. Solution enlarged fractures and grooves on cliff faces often do not cut across all beds.

Many of the horizontal bedding planes in the Madera Group limestone have been solution enlarged and are intersected by vertical and sub-vertical fractures. No stylolites were observed, but solution enlarged crenulated surfaces were observed.

GROUNDWATER FLOW

Figure 2-6 in Appendix I illustrates the regional water table map (Van Hart (2003)). The map was constructed based on ground water levels measured in 2002 in several monitoring wells in the region including the EOD Hill well. The EOD Hill is located in the southeastern part of the area illustrated in the map. At the time of measurement, the water elevation in EOD Hill well was 5,684 feet above mean sea level and the estimated direction of groundwater flow was toward the west. There are very few wells in the vicinity of EOD Hill. The available wells are widely spaced wells and provide very little control for determining the groundwater flow direction.

The estimated groundwater flow direction in the immediate vicinity of EOD Hill is illustrated in Figure 3. The direction of groundwater flow is estimated to be toward the west-southwest under a steep horizontal hydraulic gradient of approximately 0.11 feet/feet.

A brushy area with deciduous trees occurs in the southeastern part of the mapped area along a drainageway. The ground surface elevation in the brushy area is approximately 5,680 feet above mean sea level and is the lowest elevation in the mapped area. The depth to groundwater is likely relatively near-surface in the brushy area given that the elevation of groundwater at EOD Hill was 5,684 feet above mean sea level. Near-surface groundwater would account for the increased vegetation and growth of deciduous trees, which are not are common in the EOD Hill area.

The trend of the observed normal fault in the chaotic blocks area is toward the brushy area. A spring was not observed in the brushy area. It is uncertain whether portions of the EOD Fault Zone might act as a low-permeability barrier that causes the upward flow of groundwater along the fault zone barrier. There is relatively little displacement on the observed fault and a continuous fault gouge permeability barrier may not have formed along the entire fault. Slickensides were observed on sandstone surfaces at discrete locations along the fault plane and are low permeability surfaces, but where shale and siltstone layers border the fault the formations are merely pulverized and fractured. It is likely that groundwater readily flows across the fault zone through the pulverized and fractured zones; however, the impact of the fault zone on groundwater elevations and flow direction cannot be determined based on the available data.

At locations one to two miles west of EOD Hill, fault zones have affected groundwater occurrence and flow. Figure 2-6 in Appendix I illustrates how the Sandia Fault has impeded groundwater flow across the fault zone as evidenced by the dramatically different groundwater elevations from one side of the Sandia Fault Zone to the other.

The Sandia Formation is tightly cemented and groundwater moves through the unit principally through fractures. Groundwater flow through the Madera Group strata is along bedding planes and through fractures. Some fractures observed at the ground surface in the Madera Group limestones are solution enlarged. It is likely that some fractures and bedding planes occurring at depth have also been solution enlarged. Groundwater flow direction is affected by the strike and dip of the bedding planes and the strike of the intersecting fractures. Bedding planes in the Madera Group limestone on EOD Hill strike toward the northwest and dip toward the southwest, and the primary strike direction of fractures is north with a secondary percentage of fractures striking toward the northwest. Although the fractured rock aquifer occurring in the Sandia Formation and the Madera Group strata is anisotropic and heterogeneous, it is also apparent that bedding planes and open fractures are numerous in the formations. Therefore, until additional data is available it is assumed that the fractured rock aquifer occurring in the Sandia Formation and the Madera Group strata behaves similarly to a porous medium at the scale of the mapped area with groundwater flow principally toward the west-southwest.

It is proposed that four monitoring wells be installed to help determine the groundwater flow direction in the immediate vicinity of EOD Hill. The locations of the proposed monitoring wells are illustrated on Figure 4. Two wells will be constructed east of EOD Hill on both sides of the EOD Fault Zone, one well will be installed at a location estimated to be directly downgradient from the EOD well, and another well will be constructed at a location northwest of the EOD well in the direction of northwest trending fractures observed on the bedrock surface near the EOD well.

We appreciate the opportunity to serve Kirtland AFB. We welcome the opportunity to respond to any questions you may have concerning this report.

Sincerely,

AECOM

Greg J. Brooks, P.G.
Project Manager / Hydrogeologist

Joel R. Giraud, P.G.
Hydrogeologist

Enclosures:

Figure 1	Geology of EOD Hills Area
Figure 2	Fracture Trends

Figure 3	Potentiometric Surface Map
Figure 4	Proposed Monitoring Well Locations
Appendix A	Mapping Field Notes
Appendix B	Location Map – EOD Fault Zone
Appendix C	Trench Area Photos
Appendix D	Normal Fault Photos and Descriptions of Rock Units
Appendix E	Photomosaic – Chaotic Blocks Area and Descriptions of Rock Units
Appendix F	Fracture Photos
Appendix G	Orientations of Fractures in the EOD Hill Area
Appendix H	Orientations of Fractures on EOD Hill
Appendix I	Regional Water Table Map
Appendix J	References

FIGURES

AREA NOT MAPPED
AREA NOT MAPPED
EOD HILL WELL
DRILL HOLE
DRILL HOLE
DRILL HOLE
DRILL HOLE
LEGEND
NORMAL FAULT
(BALL ON DOWNTHROWN SIDE)
PLUNGING ANTICLINE
APPROXIMATE
AXIS LOCATION
ANTICLINAL FOLD
APPROXIMATE
SYNCLINAL FOLD
APPROXIMATE
TEST LOCATIONS
SITE NUMBER
STRIKE AND DIP SYMBOL
DIP ANGLE (DEGREES)
EOD HILL WELL
SAMPLE LOCATION
(SEE FIELD NOTES FOR DESCRIPTIONS)
SITE LOCATION
(SEE FIELD NOTES FOR DESCRIPTIONS)
TEST PIT (MINING EXPLORATION)
SIGNIFICANT LIMONITE IN FRACTURES,
BEDDING PLANES, OR ON GROUND SURFACE
BLAST CRATER
CENOZOIC DEPOSITS
COLLUVIUM AND ALLUVIUM (UNDEFINED),
AND/OR UNMAPPED AREAS.
MADERA GROUP, GRAY TO LIGHT GRAY-BROWN MICRITIC
TO MEDIUM CRYSTALLINE LIMESTONE, LEDGE FORMING AND THIN
BEDDED. CHERT NODULES ON SURFACE AND IN BEDDING PLANES
COMMON.
MADERA GROUP, PALE YELLOW TO LIGHT YELLOW BROWN QUARTZOSE AND
FELDSPATHIC SANDSTONE, MEDIUM TO COARSE GRAINED, WITH
SOME SUBROUND, FINE TO MEDIUM QUARTZITE GRAVEL,
CALCAREOUS CEMENT.
MADERA GROUP, MICACEOUS, THIN BEDDED QUARTZOSE
SANDSTONE/SILTSTONE SOME CALCAREOUS CEMENT.
MADERA GROUP, GRAY TO LIGHT GRAY-BROWN MICRITIC
TO MEDIUM CRYSTALLINE LIMESTONE, LEDGE FORMING AND THIN
BEDDED. CHERT NODULES ON SURFACE AND IN BEDDING PLANES
COMMON. SOME BEDS FOSSILIFEROUS INCLUDING BRYOZOANS,
CRINOIDS, OSTRACODS, AND BRACHIOPODS.
SANDIA FORMATION, PALE BROWN TO WHITISH QUARTZOSE MEDIUM
TO COARSE GRAINED SANDSTONE GRADING DOWNWARD TO COARSE
PEBBLE CONGLOMERATE (FINE TO MEDIUM, SUBROUND TO SUBANGULAR
GRAVEL), CARBONATE CEMENT'S OCCASIONALY IN UPPER SILICEOUS
(NON-CARBONATE) SANDSTONE BEDS.
PROTEROZOIC ROCKS
GRANITE, PORPHYRITIC, PINKISH RED WITH DARK MINERALS,
COARSE POTASSIUM FELDSPAR PHENOCRYSTS, MUCH QUARTZ,
SODIUM PLAGIOCLASE FELDSPAR, BIOTITE AND AMPHIBOLE
(HORNBLENDE).
GNEISS-GRANITE GNEISS, FOLIATED, QUARTZ, MUCH
ORTHOCLASE FELDSPAR, SODIUM PLAGIOCLASE FELDSPAR,
BIOTITE, MUSCOVITE, DARK (AMPHIBOLE?) STREAKS. SOME
RELICT LAYERING (BEDDING).
SCHIST-PHYLLITE, SATIN-LIKE LUSTER, MUSCOVITE,
GRAY TO PINK-RED QUARTZ.
0 100 200
Feet
N
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FIGURE 1
GEOLOGY OF EOD HILLS AREA
BERNALILLO, NEW MEXICO
FEB. 2011
60134617

AECOM

FIGURE 2
FRACTURE TRENDS
GEOLOGY OF EOD HILLS AREA
BERNALILLO, NEW MEXICO

APR. 2011 60134617

Thursday, May 12, 2011, 1:33:34 PM

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AREA NOT MAPPED
AREA NOT MAPPED
EOD HILL WELL
DRILL HOLE
DRILL HOLE
DRILL HOLE
DRILL HOLE
5600
5500
5400
5300
LEGEND
5600 GROUNDWATER CONTOUR (APPROXIMATE) FEET ABOVE MSL
GROUNDWATER FLOW DIRECTION (ESTIMATED)
NORMAL FAULT (BALL ON DOWNTHROWN SIDE)
PLUNGING ANTICLINE APPROXIMATE AXIS LOCATION
ANTICLINAL FOLD APPROXIMATE
SYNCLINAL FOLD APPROXIMATE
OPEN FRACTURE
CALCITE FILLED FRACTURE
PREFERENTIALLY WEATHERED FRACTURES (CLOSED), AND GROOVES
TEST LOCATIONS
SITE NUMBER
STRIKE AND DIP SYMBOL
DIP ANGLE (DEGREES)
EOD HILL WELL
SAMPLE LOCATION (SEE FIELD NOTES FOR DESCRIPTIONS)
SITE LOCATION (SEE FIELD NOTES FOR DESCRIPTIONS)
TEST PIT (MINING EXPLORATION)
SIGNIFICANT LIMONITE IN FRACTURES, BEDDING PLANES, OR ON GROUND SURFACE
BLAST CRATER
MADERA GROUP, GRAY TO LIGHT GRAY-BROWN MICRITIC TO MEDIUM CRYSTALLINE LIMESTONE, LEDGE FORMING AND THIN BEDDED. CHERT NODULES ON SURFACE AND IN BEDDING PLANES COMMON.
CENOZOIC DEPOSITS
COLLUVIUM AND ALLUVIUM (UNDEFINED), AND/OR UNMAPPED AREAS.
MADERA GROUP, PALE YELLOW TO LIGHT YELLOW BROWN QUARTZOSE AND FELDSPATHIC SANDSTONE, MEDIUM TO COARSE GRAINED, WITH SOME SUBROUND, FINE TO MEDIUM QUARTZITE GRAVEL, CALCAREOUS CEMENT.
MADERA GROUP, MICACEOUS, THIN BEDDED QUARTZOSE SANDSTONE/SILTSTONE SOME CALCAREOUS CEMENT.
MADERA GROUP, GRAY TO LIGHT GRAY-BROWN MICRITIC TO MEDIUM CRYSTALLINE LIMESTONE, LEDGE FORMING AND THIN BEDDED. CHERT NODULES ON SURFACE AND IN BEDDING PLANES COMMON. SOME BEDS FOSSILIFEROUS INCLUDING BRYOZOANS, CRINOIDS, OSTRACODS, AND BRACHOPODS.
SANDIA FORMATION, PALE BROWN TO WHITISH QUARTZOSE MEDIUM TO COARSE GRAINED SANDSTONE GRADING DOWNWARD TO COARSE PEBBLE CONGLOMERATE (FINE TO MEDIUM, SUBROUND TO SUBANGULAR GRAVEL). CARBONATE CEMENTS OCCASIONALY IN UPPER SILICEOUS (NON-CARBONATE) SANDSTONE BEDS.
PROTEROZOIC ROCKS
GRANITE, PORPHYRITIC, PINKISH RED WITH DARK MINERALS, COARSE POTASSIUM FELDSPAR PHENOCRYSTS, MUCH QUARTZ, SODIUM PLAGIOCLASE FELDSPAR, BIOTITE AND AMPHIBOLE (HORNBLENDE).
GNEISS-GRANITE GNEISS, FOLIATED, QUARTZ, MUCH ORTHOCLASE FELDSPAR, SODIUM PLAGIOCLASE FELDSPAR, BIOTITE, MUSCOVITE, DARK (AMPHIBOLE?) STREAKS. SOME RELICT LAYERING (BEDDING).
SCHIST-PHYLLITE, SATIN-LIKE LUSTER, MUSCOVITE, GRAY TO PINK-RED QUARTZ.
0 100 200
Feet
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FIGURE 3
POTENTIOMETRIC SURFACE MAP
EOD HILLS AREA
BERNALILLO, NEW MEXICO
JUN. 2011
60134617

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FIGURE 4
PROPOSED MONITORING WELL LOCATIONS
EOD HILLS AREA
BERNALILLO, NEW MEXICO

JUN. 2011 60134617

APPENDIX A

MAPPING – FIELD NOTES

Thursday January 13, 2011, Sunny ≈ 45°F
EOD Hill Area, Kirtland AFB
≈ 500' W-SW of EOD Hill

(1) Gray 2.5Y 6/1 micritic Limestone, with brown chert nodules on rock surface and in bedding planes,

(2) Gray micritic Limestone
Strike N29°W, Dip 8° SW

(3) Gray micritic Limestone
Strike N21°W Dip 30° SW

(4) Gray micritic Limestone, much chert nodules
Strike N43°W Dip 21° SW

(5) Gray micritic Limestone
Strike N29°W Dip 12° SW

(6) Gray micritic Limestone
Strike N47°W Dip 12° SW

(7) North end of hill, micritic limestone
calcite filled fractures 3/8 - 1/2" fractures
Trend N 9° W

(8) calcite filled fractures in gray limestone
Trend N 29° E

(9) Gray micritic Limestone
Strike N 51° W Dip 18° SW

(10) Gray micritic Limestone
Strike N 47° W Dip 9° SW

(11) Gray micritic Limestone
Strike N 41° W Dip 15° SW

(12) Calcite filled fractures in Limestone
Trend N 1° W

(13) Brown chert nodules on Limestone
surface and in bedding plane.

(14) Gray micritic Limestone
Strike N41°W Dip 36° SW

(15) Gray micritic Limestone
strike N 33° W Dip 12° SW

Monday Jan. 31, 2011
overcast/ partly sunny, breezy 10° from NW

(20) Drainage channel, alluvium surface
Trend N 42° E, silt, vfn-cs Sand, fn-cs gravel, brushy.

(21) Micritic Limestone with brown chert nodules in bedding planes
Strike N 20° W Dip 12° SW
Weathered, prominent fractures N 37° E; Fewer calcite filled fractures trend N 51° W
Photo #21, rough surface, diff. weathered

(22) Fracture trends N 33° E,
Solution enlarged fractures N 27° E
Photo # 23

(23) Gray Limestone w/ brn chert along bedding plane
Strike N 59° W Dip 18° SW

(24) Gray Limestone
Strike N 59° W Dip 12° SW
fracture trend N 13° W
photo #24 compass w/ fractures
Photo #25 Junipers view east

(25) Gray Limestone
Strike N 23° W Dip 20° SW
surface & vert. calcite filled fractures
vert manifest @ surface N 21° W

SAMPLE (A) highly weathered Sandstone
md - vcs Sand - quartzose w/ some
feldspar, sbrnd - sbang grains,
Light gray 2.5Y 7/2 ("grus" like)
Calcareous cement
Photos # 27, 28, 29, 30 w/ hammer

SAMPLE (A') arkosic, siliceous, ang - sbrnd
m - vc sand to granule, weathered mound-
like surface. Lt olive gray 5Y 6/2, qtzose
and feldspar grains fn Sand - fn gravel,
fractures Trend N 39° E and N 29° W

(next)

SAMPLE (A') (continue)
weathered fractures
iron (Limonite) staining along N39°E fractures
Photos # 31, 32, 33, & 34
Limestone ledge above Sandstone
near the tree.

SAMPLE (B), Limestone ledge above sandstone
Gray 2.5Y 5/1 Limestone.
Rip-up clasts & fossils, weathered @
surface brachiopods and bivalve type shell
Fractures - calcite filled
Trend N19°W and N41°E

Photos # 31, 32, 33 & 34

(26) Gray Limestone outcrop / ledge
Strike N43°W Dip 10°SW
chert nodules on bed surface,
intensely fractured Limestone
prominent sets N59°E / N31°W

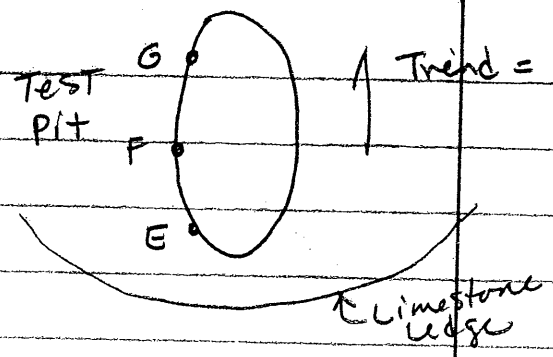
Sample (D) Located just below the Limestone contact.
Very pale brn/tan 10YR 8/2, Vfn-md grose sand w/ feldspar grains.
Sandstone, calcareous cement
Siliceous grains
Photo #36 / 37 ledge above test pit.
photo #38 Test pit area
photo #39 Test Pit
Test pit has limonite pieces / stains

Sample (E) very pale brn 10YR 7/4 matrix
siliceous grains w/ trace calcareous cement
fn-cs grains, red brn 5YR 4/4 stains

Sample (F) Lt yl brn 10YR 6/4 Sandstone
hard, siliceous grains, trc carbonate
cement, weathers out fn-cs sand grains

Sample (G) Lt oliv brn 2.5Y 5/3 to
gray Sandstone, md-cs grained
Sbrnd-rnd grains, siliceous
no carbonate

Survey Marker RE 94 p9 8



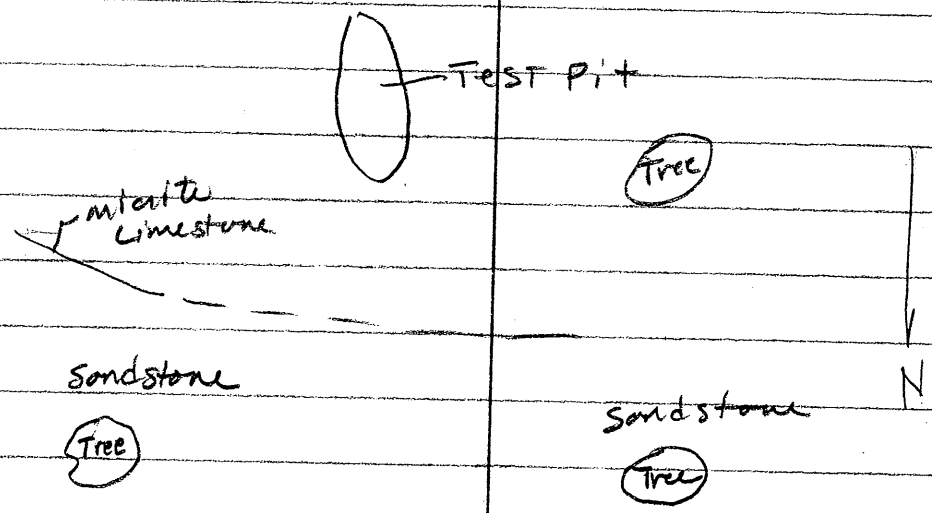


Photo #44 - view toward Test Pit on ridge and trees shown in sketch

Photo #46

(27) Gray Limestone:
Small 1-2" dia. chert nodules on surface
Surface & vert. and bedding plane fractures
Strike N 42° W Dip 10° SW

(28) Gray Limestone
Strike N 39° W Dip 14° SW
Prominent calcite filled fractures
Trending N 9° E
Photo # 40 calcite filled fractures

(29) Micritic Limestone
Strike N61° W Dip 24° SW
Calcite-filled fractures N47° W
N 9° E
SAMPLE (H) Gray 10YR 5/1
Micritic Limestone, dense,
Calcite-filled, thin (hairline) fractures

(30) Gray Limestone
weathered surface
Calcite-filled fractures
N 41° W - larger fractures
N 9° E - smaller (thinner), less prominent
Crinoid - columnal pieces

(31) Micrite Limestone
Rough weathered surface, pocked
Strike N 33° W Dip 8° SW
Small (thin) calcite-filled fractures
Trend N 39° E

(32) Limestone
Calcite-filled fractures
Largest/prominent N 41° W
other calcite-filled N 17° W ; N 9° E

Photos # 41 / 42 w/ hammer & compass

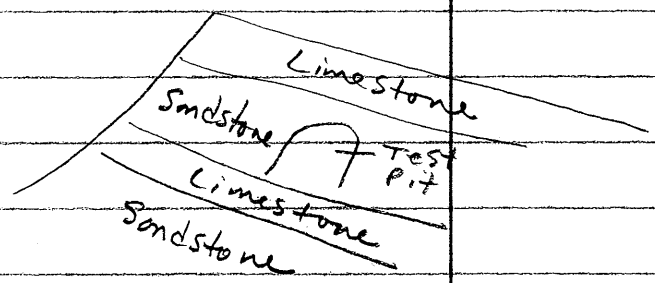
(33) Outcrop of Sandstone w/ coarse gravel
Sample (I)
Lt yl brn 2.5Y 6/3 fn-cs sand w/
fn-md sbrnd gravel, qtzose, qtzite
very weathered
Prominent fractures N 16° W
Photo w/ hammer #43
Coarse pebble conglomerate

(34) Micritic Limestone
Much dk gry/blk chert along bedding plane
pitted surface
Strike N 39°W Dip 16° SW

(35) Micritic Limestone
Strike N41°W Dip 16° SW
Vertical and bedding plane fractures

(36) SAMPLE (J)

pale yellow 2.5Y 7/4, qtzose and feldspar "grus"-like, Sandstone, weathered, some calcareous cement
weakly cemented, sbrnd - sb ang grains
md - vc grains w/ trace granule size



SAMPLE (K)

Collected from near small pine - for NW area
Lt yl brn 2.5Y 6/3 quartz & feldspar grains, fn grain, hard
quartzite pebbles fn-md, sbrnd weather out from fine gr matrix.
Calcareous cement
Lt olive brn, 2.5Y 5/4, some iron staining
well cemented, fn-vcs grains, qtzite grains,
Slight calcareous, mostly siliceous

(37) Micritic Limestone
Rough surface - pock marked
Calcite-filled fractures
Trend N 21° W
Also weathered "channel" incised fractures

(38) Micritic Limestone
Strike N29°E Dip 9° SE
calcite-filled fractures
photo #47 w/ hammer
Limestone - basal
Sandstone Above
nearby shaly interbeds in Limestone

(39) Sandstone Outcrop
Strike N53°E Dip 24° SE
Photo #48 hammer w/ coarse pebble congl.

SAMPLE (L)
Lt yl brn 2.5Y 6/4 fn gr. Sandstone
Siliceous, non-calcareous cement
1/8" thick weathering rind.

Sample (M)
Lt yel brn 2.5Y 6/4, fn-cs grained
Sandstone, sbang-sbrnd grains (coarse)
part hard, well cemented
part poorly cemented (crumbly)
crumbly is calcareous cement
hard well cemented is siliceous cement

Sample (N)
pale yl brn 2.5Y 7/4 Sandstone
qtzose and feldspar grains, cs-vcs
grains. weathered out grains are
quartz, sbang-sbrnd
hard, well cemented, calcareous cement

Sample (O)
Lt yl brn 2.5Y 6/4
micaceous (muscovite) siltstone/sandstone
thin bedded 1/4-1/2" thick, fn-md grained,
qtzose grains, slightly calcareous cement

3:30 PM - Snowstorm moving in - End
field work.

Monday 2/7/2011 3pm ≈ 40°F, breezy

SAMPLE (P)

Gray 2.5Y 5/1 6/1 Micrite Limestone

Strike N 43° W Dip 9° SW

Rough surface, eroded,

calcite-filled fractures, thin 1/32-1/16" width

fossiliferous, crinoid columnal

Photo #1 - crinoid

Photos #2 & 3 - view near fence line

SAMPLE (Q) Along fence line (north)

Gray 2.5Y 6/1 Limestone with dk brn

chert nodules in bedding plane,

highly weathered, rough, fractured

surface.

Intensely fractured - primary N 23° W

surface and vertical fractures

other fractures inclined and dip W.

Fractures are differential weathered

and filled.

fossiliferous, brachiopod, circ. form,

likely crinoid columnal

Photos #5, 6 & 7, views south, north & east

from sample Q site.

SAMPLE (Q1) 75' above sample Q
Gray 2.5Y 6/1 5/1 fossiliferous Limestone
crinoids, brachiopod pieces
photo #6 Limestone ledge
photo 30' east, vert fractures w/hammer/yel grass
fracture trend N 17° W
photo #8 fractured Limestone

Photo #9 small test pit 75-100' N-NE
of sample Q1 location

(40) Sandstone outcrop (SANDIA) above
a large test pit. Sample (S)
pale yel brn 2.5Y 7/4, Coarse-
pebble conglomerate
Coarse sbrnd - sbang qtzite gravel w
coarse qtz sand, siliceous cement
Some Limonite stains on rock.
Fractures - Open largest trend N 10° W
Vert. fractures trend N 17° W
Small fractures trend N 29° E
Outcrop Strike N 23° W Dip 34° SW
Photos 10-19 - Views of Sandia Fm
Above Large test pit and area

Sample (R) 30' SW of site 40
Gray 2.5Y 6/1 fossiliferous Limestone
brachiopod shell

(41) Limestone with chert nodules
on the surface
much differential weathering
Strike N 21°W Dip 8° SW
Fracture Trends N 61° E, N 33° W
N 31° W, N 11° W and N 56° W

Test Pit Z (TPZ)
Lt gray 2.5Y 7/2 Micrite Limestone
some 1/16" calcite (golden color) filled
fractures. Limonite pieces on ground
fractures above Test Pit N 56° W N 32° W, N 11° W
Photo # 20 - fractured rock ledge
above test pit.

(42) Micritic Limestone
Strike N 13° W Dip 9° SW
Large fracture w/ Limonite
Surface holes and ground slump
into enlarged fracture N 83° E
Calcite-filled smaller fractures N 13° W

(43) Micritic Limestone
Strike N 15° E Dip 24° SE
Gray brn 2.5y 5/2 Sample (T)
fractures - vertical open N 83° W
diff. weathered & filled N 15° W
Also bedding plane fractures

(44) Micritic Limestone
Strike N83° E Dip 12° SE
Very fractured, open surface & vertical
Trend N 64° E, N 86° W, N 21° W

(45) Micritic Limestone
≈ 25 ft west of fenceline
Strike N49°E Dip 9°SE
Open surface and vertical fractures N59°E
Differential weathered fractures, some are open N 19° W

(46) Gray 10YR 6/1 med crystalline to micritic Limestone, some sandy with surface weathered fossils (fossiliferous) Sample (U)
Strike N49°W Dip 12° SW

Tuesday 2/8/2011

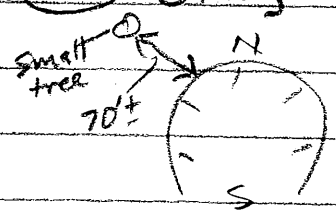
Sample (V) ≈ 200' west of dirt road north of EDD Hill
Pale brn 10YR 6/3 Sandstone - coarse pebble conglomerate (Sandia) qtzose and feldspar grains, some carbonate cement, very weathered
md-vcs sbrnd-angular sand grains
fn-md gravel, sbrnd-sbang, qtzite

Sample (V1)

very pale brn 10YR 8/2 sandstone/
Coarse pebble conglomerate
Strike N 25° W Dip 23° SW
hard, qtzose, well cemented
non-carbonate
very fractured

(V2) Qtzose Sandstone,
very fractured, broken
Prominent/ numerous N 11° E
Cross-cut and less frequent N 51° W

(W) Gray 2.5Y 6/1 Micritic Limestone



dish-like structure
(synclinal)

calcite - filled & diff. weathered N 41° E
calcite - filled & diff. weathered N 54° E
open broken fractures N 61° W

(47) Gray 10 YR 6/1 Micritic Limestone
Sample (X)
Strike N 19°E Dip 12° SE
Filled & diff. weathered fractures
N 21°W
hairline 1/32" to 1/8" wide fractures

(48) Micritic Limestone
strike N 1°W Dip 12° W
fractures N 79°E broken & open
diff. weathered fractures N 4°E
small fold (anticlinal) structure
between sites 47 & 48.

(49) Micritic Limestone w/ dk brn
gray chert nodules on surface
strike N 53°E Dip 10° SE

(50) Micritic Limestone with
Chert nodules on surface
Limonite stains along fracture
photo #29 - Limonite/fractures/hammer

(52) Light gray 10YR 7/1 Micritic Limestone
Strike N86°W Dip 12° SSW
Sample (Y)

(53) Micritic Limestone
Strike N37°W Dip 16° SW
fractured - filled, diff weathering
enhanced N 9°E , N 33° W

(54) Sample (Z)
pale yellow 2.5Y 7/4, coarse Sandstone
and coarse pebble conglomerate, angl-sbang
qtzose & feldspar, non-calcareous cement
Strike N71°W Dip 14° SSW
Prominent surface fractures N 31° W
Less numerous fractures N 89° E

Sample Z1

Lt brn gray 2.5Y 6/2,
fossiliferous limestone
coarse crystalline

Sample Z2

Lt brn gray 2.5Y 6/2,
Micritic limestone, very rough
weathered surface, Pitted & pockmarked
hairline - 1/16" calcite filled fractures

Sandia Base Grid Marker near Z

249	35.54 S	Just north of
155	30.08 E	Limestone outcrop on the hill

USAEC

Sample Z3

Gray 2.5Y 5/1 to 6/1 fossiliferous limestone
Contact between gray micritic L.S. & fossiliferous,
gry grn pale yel sandy limestone.
brachiopod shells & large 1.5" shell fossil
very rough, diff. weathered surface

(55) Gray Limestone
Strike N57°E, Dip 18°SE
uppermost rock
underlying rock is qtzose sandstone

(56) Micritic Limestone
Strike N41°E Dip 9°SE

(57) Sample (AA)
Gray 2.5Y 6/1, micritic Limestone
Strike N71°W Dip 9° SSW
some fossils - crinoids and other
pieces - calcite replaced.
broken, irregular surface.

(58) Micritic Limestone
Strike N49°W Dip 8° NE

(59) Sample (BB)

Gray 2.5y 5/1 Micritic limestone
much bedding plane chert nodules
wavy laminations, faint weathered fossils
strike N29°W Dip 11° NE
diff weathered fractures trend N26°W

(60) Coarse pebble conglomerate
strike N51°W Dip 21° SW
primary fractures N9°E
other fractures N39°W

Photos NW-SE views, Saddle Area

Sample (CC1) pale yellow 2.5y 7/3, coarse gr
Sandstone, qtzose + feldspar, sbang-sbrnd
surface weathers speckled, trc carbonate cement
and carbonate coating.

Sample (CC2) pale yellow to lt gry brn, 2.5y 7/4.
Limestone, some fossil pieces, very
weathered, rough surface, transition

Sample (CC3)

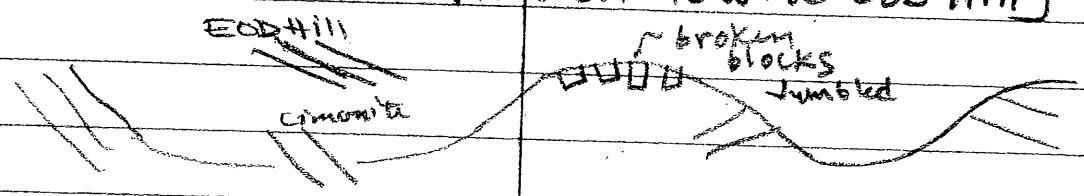
Lt gray 2.5y 7/2, Limestone, sandy

(61) Micritic Limestone
Strike N9°W Dip 16° ENE
East Limb of small anticlinal structure

(62) Sandia Sandstone
Strike N41°W Dip 21° SW
Fractured

Photo Transition CC2 + hammer
highly fractured, zone between Sandia and Limestone which dip opposite directions
Limonite on ground surface
photo

Sketch (Photos view So. toward EDD Hill)



(63) Micritic Limestone
Strike N49°W Dip 12° SW
prominent surface and vertical fractures N69°E

Sample (DD) Sandia Sandstone
yl brn 10YR 5/6 to dk yl brn 10YR 3/4
very dark surface, Limonite
Sandstone, md-cs grains, qtzose,
non-carbonate - siliceous grains,
Lt colored carbonate mass on some fracture surfaces

(64) Sandia Coarse Pebble Conglomerate
Strike N53°W Dip 18° SW
rough surface - approx attitude

(65) Sample (EE)

Lt ol. brn 2.5 Y 5/3, vfn gr Sandstone
some Muscovite mica,
non-calcareous matrix
fm dips SW beneath Sandia Sandstone
some calcareous coating along fractures
strike N 19° W Dip 24° SW

(66) Sample (FF)

Granite-gneiss, qtz, much orthoclase
feldspar, Na-plag fldsp, biotite,
muscovite, dark streaks (amphibole?)
other ferro magnes. minerals
foliation developing

Sample (GG)

Granite, porphyritic
pinkish red to red, coarse crystals,
K-feldspar phenocrysts, much quartz,
Na-plag. feldspar, biotite, amphibole
(hornblende).

Sample (HH)
Schist, phyllite, satin-like luster muscovite, with gray to pinkish red qtz masses.

Sample (II) Gneissic,
loose rock, scattered, angular pieces, fine grained, relict layering, dark and pinkish foliation.

(67) Sample (JJ)
Gray 2.5y 5/1 Limestone, trace of crinoid columnal pieces,
narrow 1/32" to 1/8" calcite filled fractures
Strike N 27° E Dip 24° SE
fractured surface, differential erosion incised fractures, very rough
N24°E, N9°E

(68) Trench - 3 ridge blocks of limestone
Strike N 47° E Dip 13° SE
large L.S. blocks overlying less competent fractured rock.

(69) Sample (KK) 50' east of east end of trench
Grey brn 2.5Y 5/2 Micritic Limestone
Lt yel brn 2.5Y 6/4 coarsely crystalline L.S.
Strike N 75° E Dip 12° SSE
Chert nodules on surface
calcite filled and open fractures N 53° W
Surface fractures N 12° NE

(70) Sample (LL)
Whitish 2.5Y 8/1 to Pale Yellow 2.5Y 7/3
SANDSTONE, md-cs sbrnd grains
highly weathered, crumbles
Some calcareous cement and coating, but non-calcareous grains
filled fractures

(71) Gray Limestone
Strike N 13°E Dip 10°E
fractured, diff. weathering enhanced
Calcite-filled

(72) Sample (MM1) West side of hill Limestone ridge
Light gray 10YR 7/2, fossiliferous Limestone
crinoid columnal pieces, brachiopod shells
Strike N 23°E Dip 9°SE
open fractures N 71°W surface and vertical
diff weathered filled fractures N 13°E

Sample (MM2) "Top Area"
Gray 2.5Y 5/1 Micritic Limestone
White 1/8" calcite-filled fractures
whitish calcite coating
Dug-out places

Sample (MM3) "Top East Area"
Gray brown 2.5Y 5/2 siltstone, thin-bedded
and brittle. Gray 2.5Y 6/1, Limey siltstone
/ Limestone, thin-bedded, whitish calcite surface,

(73) Gray fossiliferous Limestone
Strike N83°E Dip 14° SSE
crinoid columnal pieces, chert
nodules on surface.
Rough, differential weathered surface
Surface and vertical filled fractures
Trend N51°W, N73°W
Surface diff. weathered fractures N13°E

(74) Sample (N1)
Very pale brn/gry 10YR 7/3 micritic Limestone
Chert nodules (dk gry brn) on surface
Very fractured, calcite filled,
much diff. weathering, rough surface
Primary fractures N31°W, filled.

Sample (N2) Test Pit
Pale yellow 2.5Y 7/3 to lt yel brn 2.5Y 6/3
Sandstone, cs grained, ang-sb ang,
quartz, Na plag. fldsp., well cemented
non calcareous (siliceous) grains, with
trace calcareous cement and coating.

Sample (N2) Limestone Ledge
ledge dipping ESE, adjacent to
Small Test Pit.
Light gray 10YR 7/2 Micritic Limestone

(75) Sample (N3) ≈75' So. of Test Pit
Gray 2.5Y 5/1 Limestone, thin-bedded
wavy laminated, chert (dk gr brn)
nodules on surface
Strike N9°E Dip 33°E

(76) Sample (N4) adjacent to "fox hole"
Limestone ridge
Lt brn gray 2.5Y 6/2 Micritic Limestone
some md size calcite crystals
on Limestone surface.
Thin-bedded, fractured, broken
Strike N33°E Dip 24° SE

(77) Gray Micritic LIMESTONE
thick bedded ledge
Strike N27°E Dip 24°SE

Sample (N5) (opposite Site 77 ≈ 40' west)
Lt yel brn 2.5Y 6/3 to Lt olir. br 2.5Y 5/3
Limestone, thin bedded, trc burrows
pock-marked surface. Surface weathers
Lt yel brn 10YR 6/4 to vy dk gray 10YR 3/1
Fractures Trend N49°E, N5°E

(78) LEDGE - low relief Limestone
Strike N17°E Dip 30°E
Calcite filled fractures N49°W, N11°W, N64°E
diff. weathered/eroded enhanced fractures

Sample (00)
Gray 2.5Y 5/1 Micritic Limestone

Sample (00Z) ≈ 5' SSW of "00"
Gray 2.5Y 6/1 Micritic Limestone
Surface weathers pale yellow 2.5Y 7/4 and "Stair Step"

(79) Gray Micritic Limestone
Strike N 5° E Dip 29° E
Fractured, diff. weathered,
very irregular, rough surface
Fractures Trend N 61° W (diff.)
calcite filled N 27° E

(80) Gray fossiliferous Limestone
Strike N 21° E Dip 9° ESE
crinoid columnal pieces, brachiopods

Sample (003)
lt yel brn 2.5Y 6/3 to lt ol. brn 2.5Y 5/3
md crystal Limestone, some fossil
pieces, crinoid, rip-up pieces, shells

Sample (004) ≈ 50' SE of site 80
pale yellow 2.5Y 7/4 to lt yel brn
2.5 6/4, Limestone with fossil
pieces, crinoids, some non-carbonate
(quartzose) grains, Sandy Limestone
md-cs grains

Sample (005) ≈ 150' SW of Site 80
Lt gray 2.5Y 7/2 Limestone,
md calcite crystals,
weathers dark gray,
vy Rough surface, diff. weathering

(81) Gray fossiliferous Limestone
(same as Site 80)
Strike N9°W Dip 15° NE
fossil pieces weather out on surface
rough surface

(82) Anastomosing pattern on
Gray Limestone Surface
General trend of pattern N25°E

(83) Sample (PP) Gray 2.5Y 5/1, Fossilif.
micritic Limestone, thin ledge
Strike N27°E Dip 12° SE
Fossils weather-out on surface
Crinoid, brachiopod

(84) Sample (PP1)

Gray 2.5Y 5/1 Micritic LIMESTONE
Strike N27°E Dip 11° SE
much chert (nodules) (dk blk brn) on
surface and in bedding planes
Calcite-filled fractures, diff weathering
created vy rough surface
Fracture Trends (Surface & vert) N79°W, N29°E

(85) Sample (QQ)

Lt brn gry 10YR 6/2 to lt brn 7.5YR 6/4
SANDSTONE, md-vcs and granule size
grains, qtzose, Na plag. fldsp,
Coarse pebble conglomerate,
non-calcareous Siliceous cement & grains
Prominent fractures N13°E
Open fractures N27°E, N49°E
minor (less fqt) N59°W

(86) Sample (QQ2)

Very pale brn to whitish 10YR 7/3
Coarse Pebble conglomerate,
very cs Sand to fn-md gravel
sbang - sbrnd quartz
* Strike N49°E Dip 18°SE
non-calcareous Siliceous cement & grains
weathers gry to dk speckled

* Estimated attitude on rough granule surface

Sample (QQ3)

dark gray brn 10YR 4/2 Sandstone
pinkish mineralization at this site,
fn-md grained, non-calcareous,
hard, well cemented, siliceous.

Sample (QQ4)

Lt brn gray 10YR 6/2 to brn 10YR 5/3
Sandy LIMESTONE, md-cs grains,
much siliciclastic fn-cs grains,
diff. weathering, some calcite filled fractures
are inverted/raised relief N39°E, N51°E

Sample QQ6
Pale brn 10YR 6/3 fn grained Sandstone, siliciclastic grains, some calcareous cement, surface weathers gray with some speckling.

Sample QQ7 Valley Edge
very Pale brn 10YR 7/3, Sandstone fn-md qtzose grains with carbonate cement, also silica cement, hard relatively smooth sloping surface filled fractures Trend N9°E, N61°W

Sample QQ8 ≈50' E of QQ7 Ridge - valley edge
Lt yel brn 2.5Y 6/3 Micritic Limestone

Sample QQ9
white to pale yellow 2.5Y 7/3, Sandstone fn-md grained, thin-bedded, qtzose, located near large Sandstone blocks well cemented, calcareous cement.

Sample QQ 10 SANDSTONE, fn grained
dark gray blk weathering
mineralization between fractures
Limonite - yellow/reddish
non-carbonate, Silica cement

Sample QQ 11
very pale brn 10YR 7/3, Sandstone
qtzose grains, fn-md grained
non-carbonate, silica cement
weathers in chunks
highly fractured - prominent N13°E
Prominent N68°E
less prominent N25°W

Sample QQ 12
very pale brn 10YR 8/2 Sandstone
fn grained, qtzose grains,
some calcareous cement and coating
silica cement, hard.
"hammer sparks"

Sample (QQ13) Block in trench
Lt brn gray 2.5Y 6/2 Limestone,
md crystal, hard

Thursday Feb 10, 2011

(87) Sample (RR) (No. End of EOD Hill)
Lt brn gray 10YR 6/2 Sandstone
fn-cs qtzose grains, cs are sbang-
sbrnd, calcareous cement, hard
weathers speckled gray/blk

Sample (RR1) NE side EOD Hill
Lt brn gray 10YR 6/2 Sandstone
fn-cs qtzose grains, sbang-sbrnd,
calcareous cement, hard

(88) Sample (SS1) No. Side EOD Hill, Ledge
dk gray 2.5Y 4/1, Micritic Limestone
Strike N 37°W Dip 16°SW
chert nodules on surface, very irreg, rough
Surface weathers yel brn 10YR 5/4
Calcite filled fractures N61°E, N45°E, N41°W
open break fractures N57°W
Cross-hatching on surface/extend vertical N 21°W, N71°E

Sample (SS2)

gray brn 2.5Y 5/2 Micrite Limestone,
very rough pock-marked surface

(89) Gray Limestone ledge
Strike N35°W Dip 21°SW
highly fractured, diff. weathering
cross-hatch, weathers in blocky pieces
Open & Filled Fractures N29°E
calcite filled fractures N41°W

Sample (SS3)

Gray 2.5Y 5/1 Micritic Limestone
ledge 1.5' thick
photo w/ hammer / yellowish weathering

(90) North End of EOD Hill - 15' from top
Limestone Ledge
Strike N27°W Dip 9°SW
Calcite filled fractures N5°E, N87°E, N51°E
diff weathering enhanced fractures

LIMESTONE Ledges

Sample TT1 (lower)
Gray 10YR 6/1 to very pale brn
thin bedded, Fossiliferous Limestone,
Shaly, brachiopods, bryozoans

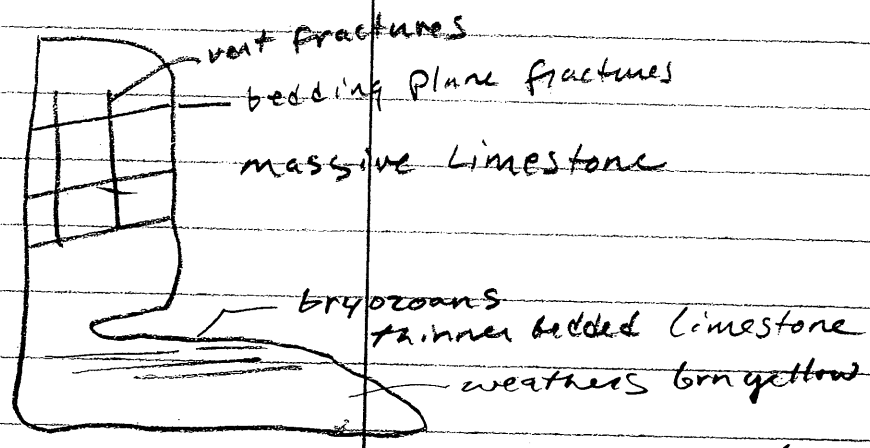
Sample TT2
Lt brn gray 10YR 6/1 Limestone
thin bedded, fossiliferous,

Sample TT3
Gray 2.5Y 5/1 fossiliferous Limestone
massive thick bed with dk gry brn
Chert on weathered surface,
bryozoans and brachiopods

Sample TT4 (upper)
Lt gray 10YR 7/1 Limestone,
massive thick bed
Chert on weathered surface

(91) Limestone ledge 12-15' high
Strike N 39°W Dip 12° SW
fossiliferous (bryozoans),
thin-bedded layers, very irregular surface,
bedding planes and vertical fractures
vert. open and diff. weathered calcite filled.
N 13°E, N 35°E, N 87°E

(92) Limestone, massive ledge
strike N65°W Dip 18° SW
fossiliferous (bryozoans) in lower part and thinner-bedded.
irregular surface and wavy bedding planes
vertical fractures trend N 31°E



(93) Sample (UU1) (Lower)

Gray 2.5Y 5/1 micritic Limestone
strike N 12° W Dip 12° SW
(poor surface for attitude measurement)
massive and thin-bedded,
bryozoans in thin beds
surface weathers pale yellow 2.5Y 8/3

Sample (UU2)
Lt brn gray 2.5Y 6/2 Limestone
md crystals, weathers craggy
very rough

Sample (UU3)
Lt gray 2.5Y 7/1 Micritic Limestone
massive with hairline - 1/16" fractures
weathers crusty pale yellow 2.5Y 7/4

Sample (UU4) (Upper)
Lt gray 2.5Y 7/1 Micritic to
med crystal LIMESTONE,
craggy "broken vessicular-like" texture
very rough, irregular surface

(94) Limestone, Massive ledge
Strike N36°W Dip 16°SW
horizontal bedding
cemented and open diff. weathered fractures
vertical fractures

(95) Limestone, Massive ledge
Strike N31°W Dip 24°SW
very rough surface,
cross-hatched enhanced from diff. weathering
prominent calcite-filled fractures N67°E, N27°E
less prominent & frequent fracts N49°W
fossiliferous in micritic limestone
ostracod (?), shells,
occas. chert (dk gry brn) nodules on surface

(96) Gray Limestone SE side of EOD Hill
Very rough surface - questionable attitude
fractures surface & vert N84°E
diff weathered fracts. N11°W

(97) Limestone ledge 6' below "trail"
Strike N30°W Dip 12° SW
very rough surface on ledge face
relatively smooth surface top of ledge

Sample (VV) Top of EOD Hill near well
Gray 2.5Y 6/1 Micritic Limestone
trace of fossil pieces (shells),
white calcite filled fractures
Trend N9°E and N39°W
chert nodules dk gry blk on surface

(98) Gray Micritic Limestone
Strike N13°W Dip 19° SW
Diff. weathered fractures - filled N5°E
vert. & surface filled fractures N35°W
shell fossil pieces

(99) Limestone, Gray (Micrite)
Strike N 37°W Dip 15° SW
Chert nodules dk gry blk on surface
rough weathered surface
diff. eroded fractures N 13°E
diff. eroded and calcite filled N81°W

(100) Limestone, Gray (Micrite)
Strike N43°W Dip 10° SSW
Chert nodules dk gry blk on surface

(101) Limestone, Gray (Micrite)
Strike N 25°W Dip 14° SW
Open surface & vert fractures
Trends N81°E, N71°W, N11°W

(102) Limestone, Gray (Micrite)
Strike N23°W Dip 17° SW

(103) Gray Limestone (Micrite)
rough, pock-marked, vesicular-like surface
cross-hatch, diff. weathered fractures
calcite filled Trends N23°W, N13°E, N67°E

(104) Gray Limestone (micrite) ledge
Strike N41°W Dip 14° SW
Chert nodules dk gry black on surface
prominent open fractures N13°E
chert nodules in bedding planes

Photos of Limonite zones along
northwest side of EOD Hill
near test pits

Test Pit X, Far NNW side of EOD Hill
Gray 2.5 Y 5/1 Micritic Limestone
hairline fractures - white calcite filled
Limonite and other mineral staining
on surface.

Test Pit X Far NNW side of EOD Hill
(In Pit)

Lt yel. brn 2.5Y 6/4, Sandy Limestone, fn grains, with 1/8" white calcite filled fractures, limonite stains common.

APPENDIX B

LOCATION MAP - EOD FAULT ZONE

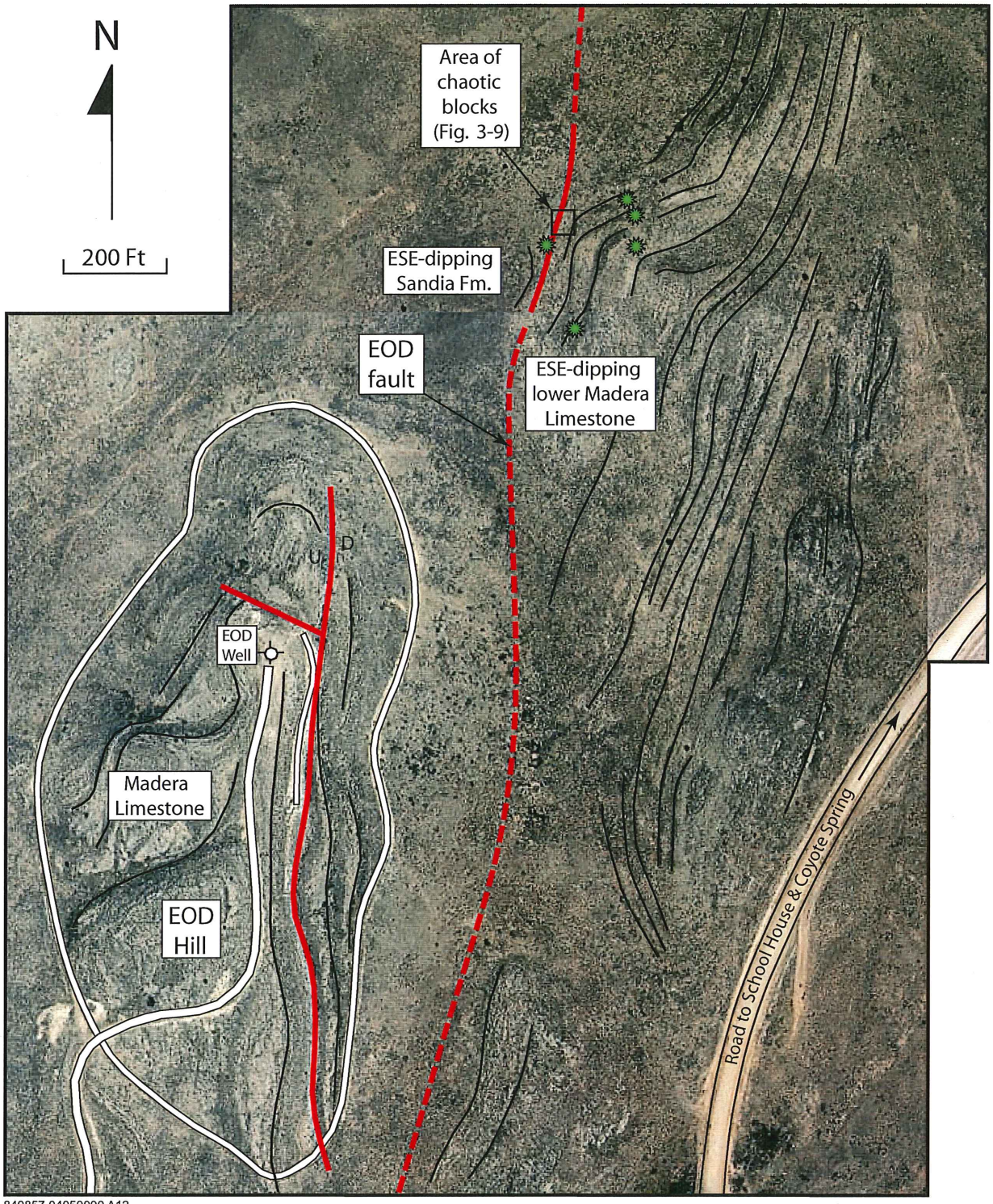


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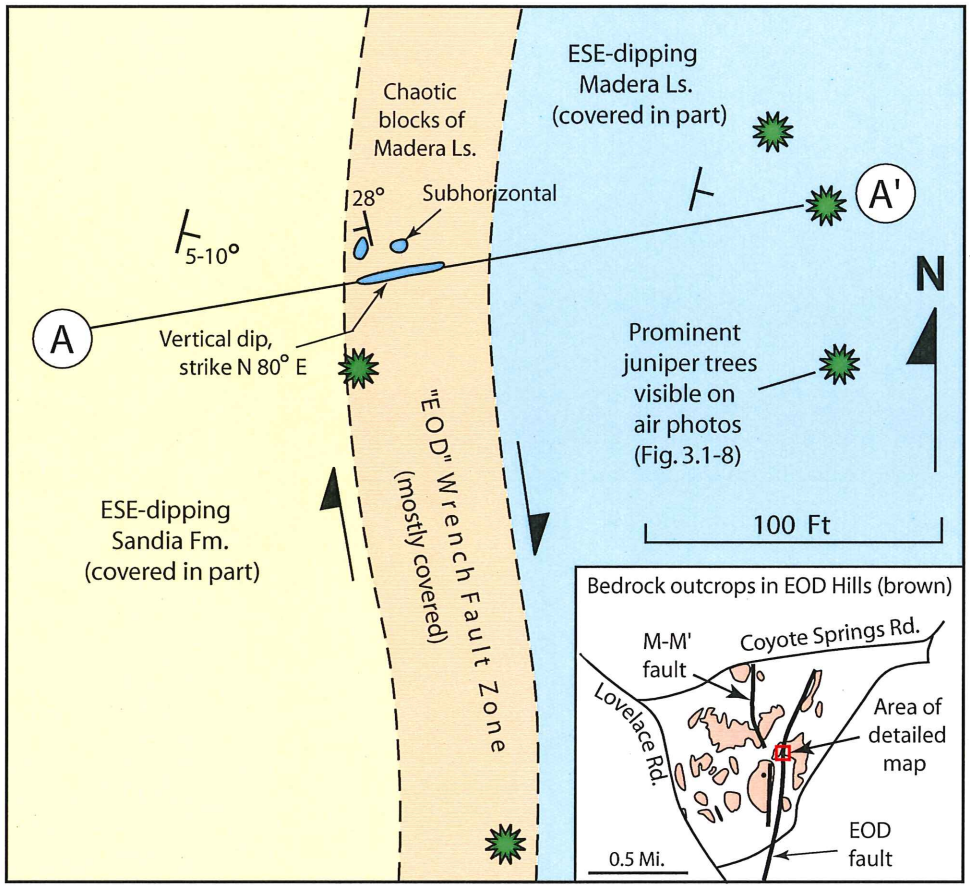
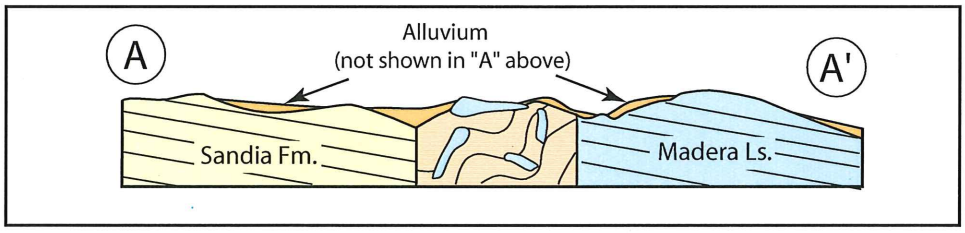
Figure 3-8 Eastern Portion of EOD Hills and EOD Fault
(Shown are reference juniper trees in green and select formlines; air photo by USAF, 1989, scale 1:4800)



A. Sketch Map



B. Schematic Cross Section

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Figure 3-9 EOD Fault Zone on East Side of EOD Hills

APPENDIX C

TRENCH AREA PHOTOS

View eastward along area to be trenched. The actual trench extends from the green flag to the east (far) end of the cleared area. A chaotic block is shown along the left side at the west (bottom) end of the cleared area. Sandia sandstone outcrop is lower right. Ledge at top of hill is Madera Group limestone.

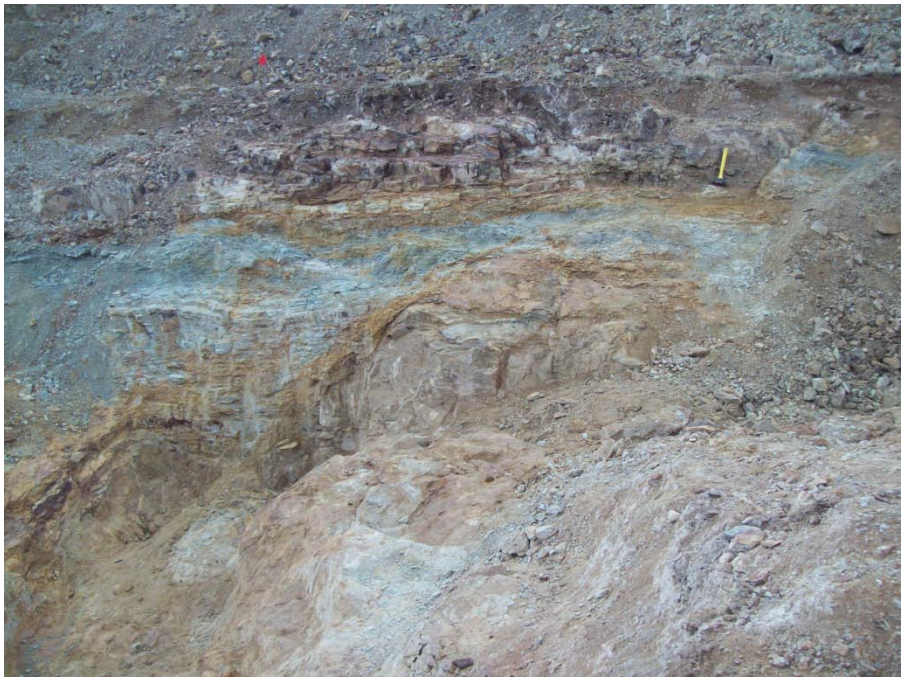
View westward in area to be trenched. A chaotic block is shown right side of photo at the transition from tan to yellowish-tan in the scraped area.

View westward. Chaotic blocks in area to be trenched. Mineralization on either side is apparent at ground surface.

View westward. Chaotic blocks in foreground. Excavator near the west end of the trench.

View eastward along south wall of trench. Normal fault in foreground. Chaotic blocks area near red flags in center of photo.

View south wall of trench. Chaotic blocks area.

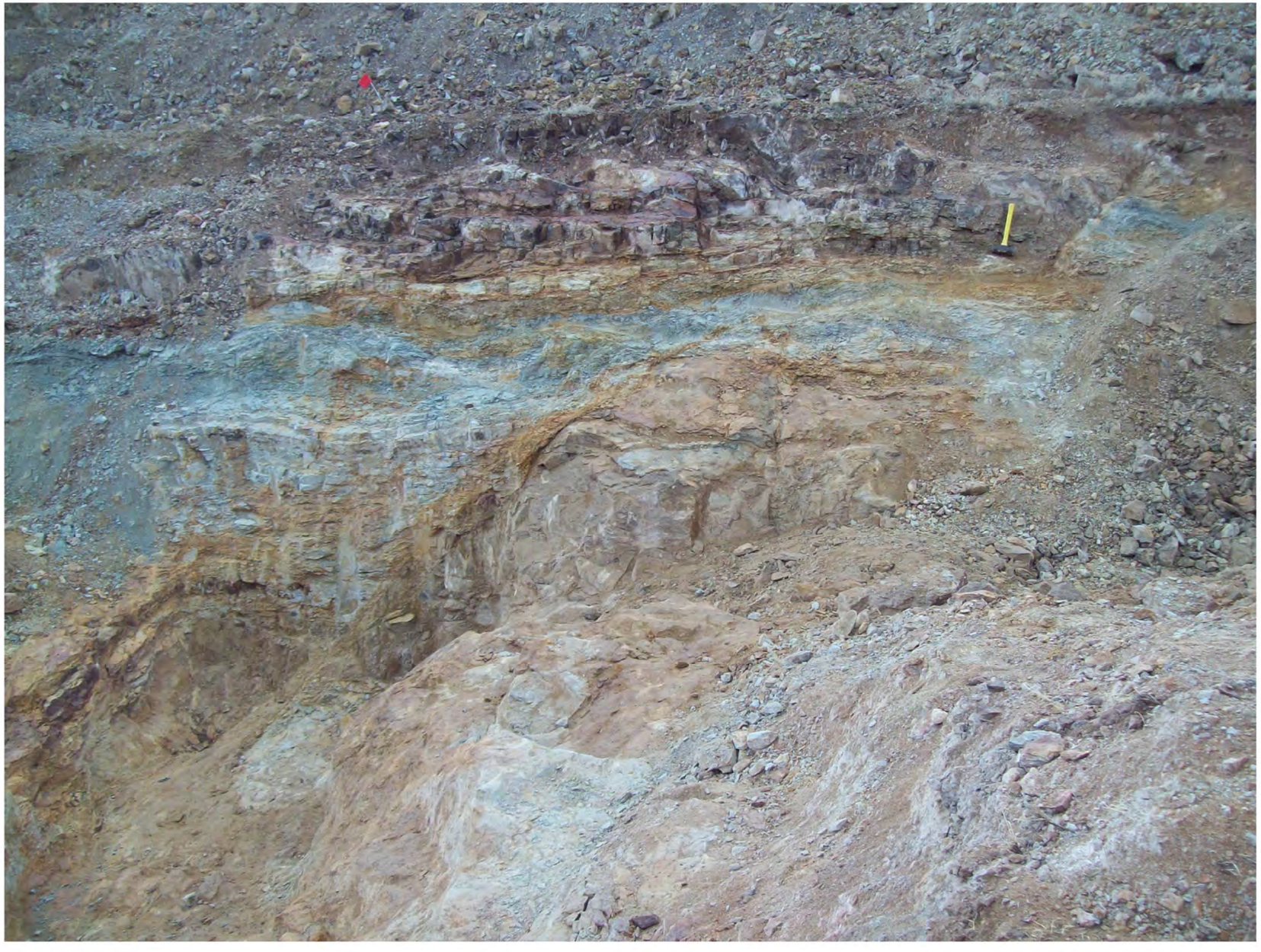


View south wall of trench. Exposed normal fault (down to the east (left side)). (Hammer is 15-inches long). Red flag extends above ground surface.

View south wall of trench. Exposed normal fault (down to the east (left side)). (Hammer is 15-inches long).

APPENDIX D

NORMAL FAULT PHOTOS AND DESCRIPTIONS OF ROCK UNITS



0 3 6
FEET

AECOM

NORMAL FAULT
STRIKE N18 W, DOWN TO THE ENE
EOD FAULT ZONE
BERNALILLO, NEW MEXICO

APR. 2011 **60134617**

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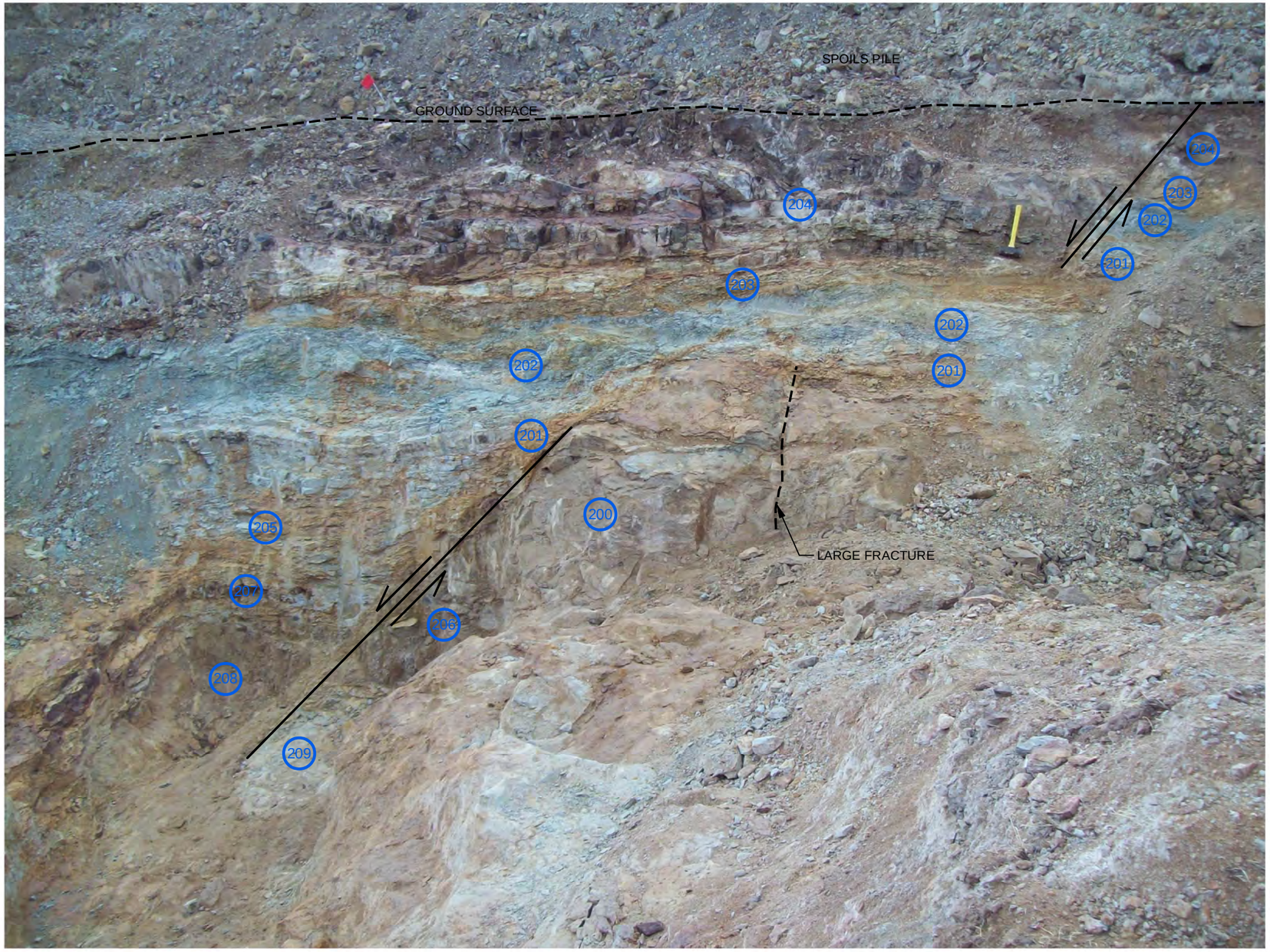

LEGEND

200 NON-CARBONATE UNIT
(SEE SAMPLE DESCRIPTIONS FOR NUMBERS)

0 3 6
FEET

AECOM

NORMAL FAULT
STRIKE N18 W, DOWN TO THE ENE
EOD FAULT ZONE
BERNALILLO, NEW MEXICO

APR. 2011 **60134617**

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AECOM

JOB TITLE
JOB NO. CALCULATION NO.
ORIGINATOR J. Girard DATE 4/6/2011
REVIEWER DATE
SCALE SHEET NO. 1 OF 2

Trench - South WALL

Normal Fault -

Sample Descriptions:

Sample No.	Description
200	white 2.5Y 8/1, massive qtzose Sandstone, non-calcareous, hard, well cemented, md-vcs sbrnd qtz grains
201	lt yellow-brn, 10YR 6/6, thin-bedded Sandstone, non-calcareous, med hard, med. cemented, fn-md qtzose grains some mineralization staining
202	Lt gray, 2.5Y 7/1, Shale, sandy-Shale and Siltstone, thin-bedded, highly fractured to pulverized, med hard, sand is vfn-fn grain, non-calcareous
203	brownish-yellow 10YR 6/6, Siltstone and vfn grain Sandstone, thin-bedded, crumbles to med hard, quartzose w/ mostly siliceous cement, trc calcareous cement
204	white 10YR 8/1, Sandstone, mostly fn-md w/ some cs-vcs grains, quartzose, hard, siliceous, non-calcareous cement
also	Light yellowish brown, 10YR 6/4, Sandstone, arkose-like fn-vcs Sand-granule, hard, well-cemented, siliceous, some mineralization staining

Grid: 5x5 = 1 in

AECOM

JOB TITLE

JOB NO. CALCULATION NO.

ORIGINATOR J. Girard DATE 4/6/2011

REVIEWER DATE

SCALE SHEET NO. 2 OF 2

(continued)

Trench - South Wall

Normal Fault -

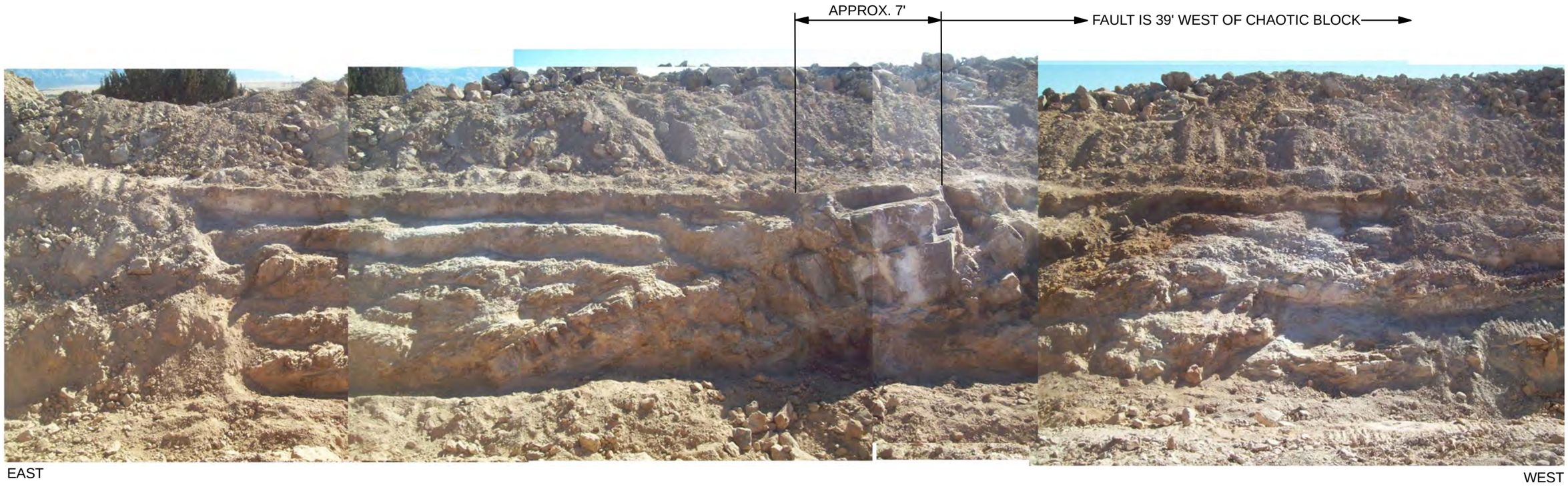
Sample Descriptions:

Sample No.	Description
204 continued	Pale brown 10YR 6/3 Sandstone, md- vcs grain, quartzose, hard well-cemented, non-calcareous
205	Light-olive gray 5Y 6/2 Siltstone and Shale interbeds, Shale intervals have talc-like feel, quartzose w/ some mica in siltstone, med hard.
206	Light-yellowish brown 2.5Y 6/3 Sandstone, md-vcs grain, quartzose, hard, well-cemented non-calcareous
207	brown 10YR 4/3 mineral coating on white 10YR 8/1 to very pale brown 10YR 8/2 Sandstone, quartzose, hard, siliceous cement, fn-md grain.
208	pale-yellow 2.5Y 7/3 SANDSTONE md grain, trc fn sb-rnd gravel (quartz) in upper part, siliceous cement, hard, well-cemented.
	Bottom of trench east of fault-line pale-yellow 2.5Y 7/3 Sandstone vfn-fn with silt, weakly-cemented siliceous cement
209	light-gray 2.5Y 7/1, Shale, talc-like greasy feel, non-calcareous

Grid: 5x5 = 1 in

APPENDIX E

PHOTOMOSAIC – CHAOTIC BLOCKS AREA AND DESCRIPTIONS OF ROCK UNITS



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CHAOTIC BLOCKS AREA IN TRENCH
EOD FAULT ZONE
BERNALILLO, NEW MEXICO

FEB. 2011 **60134617**

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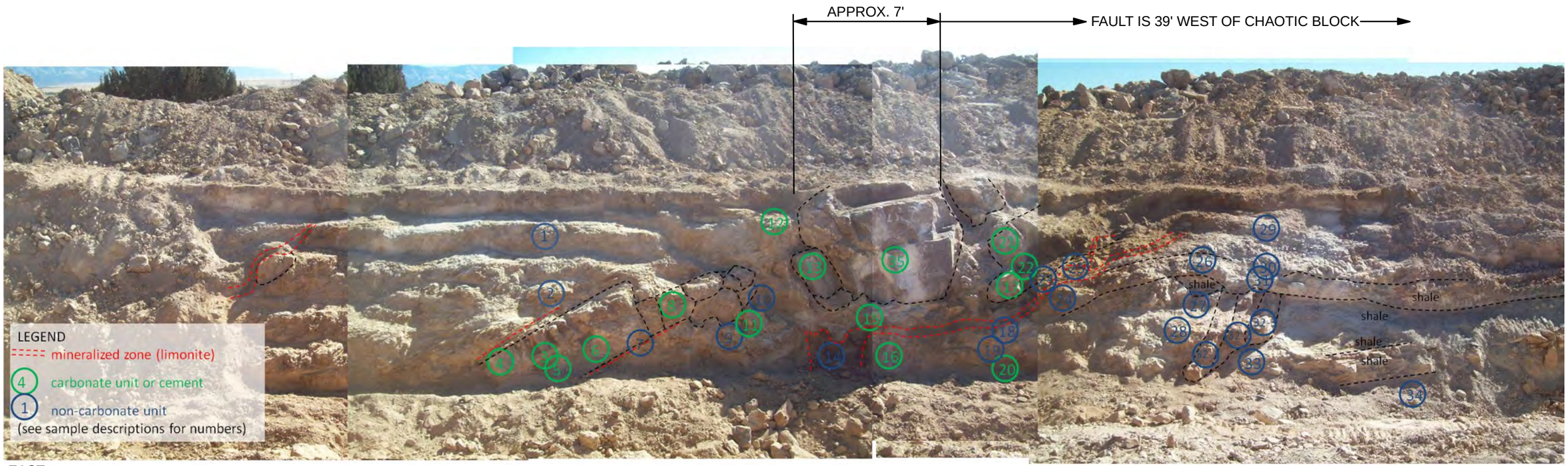

EAST

Note: No. 35 is a large limestone block (chaotic block)

WEST

AECOM

CHAOTIC BLOCKS AREA IN TRENCH
EOD FAULT ZONE
BERNALILLO, NEW MEXICO

FEB. 2011 **60134617**

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AECOM

JOB TITLE

JOB NO. CALCULATION NO.

ORIGINATOR J.R. Girard DATE 2/11/2011

REVIEWER DATE

SCALE SHEET NO. 1 OF 5

Trench - South Wall - Chaotic Blocks Area

Sample descriptions:

Sample No	Description
1	Lt olive brn 2.5Y 5/4, broken (breccia) siltstone w brn 7.5YR 4/3 mineralized siltstone some limonite, Siltstone (Lt ol. brn) is micaceous. (muscovite) Rock pieces are aligned angled relative to horiz (see sketch) non-calcareous (no efferv), contains some coarse grained gravel, Top of bed has roots extending
2	Pale yellow 2.5Y 7/3, broken (breccia) mudstone (siltstone and shaly), micaceous (muscovite). non-calc. Rock pieces are aligned angled relative to horiz (sketch)
3	Lt olive brn 2.5Y 5/4, thin bedded, laminated shaly, grading siltstone below effervesces w/ HCL, calcareous (some) mostly non-calcareous, clastic, some micaceous
4 upper U.S bed	Lt olive brn 2.5Y 5/3, massive limestone, (calcareous) fossiliferous (brachiopod), calcite filled fractures 1/16"-1/8 inch,
5	Lt yel brn 2.5Y 6/4, siltstone, shaly, soft, easily crumble, ≈ 3" thick layer, calcareous some, but mostly non-calcareous clastic
6	Lt olive brn 2.5Y 5/3, massive limestone, fossiliferous (broken pieces, rip-up), (calcareous)
7	Lt yel brn 2.5Y 6/4, Shaly bed, ≈ 4" thick, "waxy" micaceous, fractured non-calcareous, clastic.
8	Ol. yellow 2.5Y 6/6 to yel brn 10YR 5/6, Limestone w/ limonite mineralization, fractured, med coarse calcite crystals

Grid: 5x5 = 1 in

AECOM

JOB TITLE

JOB NO. CALCULATION NO.

ORIGINATOR JR. Girard DATE 2/11/2011

REVIEWER DATE

SCALE SHEET NO. 2 OF 5

Trench - South Wall (continued) Chaotic Blocks Area

Sample No.	Description
9	Lt brn gry 2.5Y 6/2, Shale non-calcareous, thin bedded, 2" thick layer
10	Pale yellow, 2.5Y 7/4, talc-like shaly, micaceous, non calcareous, argillaceous
11 (similar to Sample 8)	Dk yellow 2.5Y 6/6 to yel brn 10YR 5/6, Limestone w/ limonite mineralization, fractured, med-cs calcite crystals
12	pale yellow 2.5Y 7/4, Siltstone, some calcareous and non-calcareous clastic, gtzose (silt & vfn sand) broken, jumbled material
13	Lt olive brn, 2.5Y 5/3, Limestone, fn-md calcite crystals, calcite filled fractures 1/16" width, some limonite staining.
14	Lt yel brn 2.5Y 6/4 to dk yl brn 10YR 3/4, Limonite Siltstone, non-calcareous
15	pale yellow 2.5Y 7/4 siltstone and limestone pieces, siltstone has some carbonate (effervesce) cement, soft, weakly cemented.
16	Lt ol. brn 2.5Y 5/4 siltstone, some carbonate cement, limonite staining, silty and some vfn clastic
17	Lt ol. brn 2.5Y 5/4, Limestone, some limonite staining, calcite filled fractures 1/32-1/16"

Grid: 5x5 = 1 in

AECOM

JOB TITLE

JOB NO. CALCULATION NO.

ORIGINATOR J.R. Girard DATE 2/11/2011

REVIEWER DATE

SCALE SHEET NO. 3 OF 5

Trench South wall (Continued) Chaotic Blocks Area

Sample No.	Description
18	olive brn 2.5Y 4/4 to lt ol. brn 2.5 5/4 Siltstone and vfn grn Sandstone non-calcareous, micaceous
19	whitish 2.5Y 8/1 to pale yellow 2.5Y 8/4 qtzose Sandstone, vfn-mcd grained, limonite staining, broken (brecciated) non-calcareous
20	yellow brn 10YR 5/2 to dk yl brn 10YR 4/6 fn Sandstone, carbonate cement and coating, broken rock, limonite staining,
21	lt yl brn 2.5Y 6/3 Sandy Limestone, limonite staining, fractured L.S. carbonate w/ limonite, other dark non-carbonate minerals.
22	Pale yellow 2.5Y 8/3 Siltstone, w/ carbonate cement, weak, some vfn sand, qtzose, broken, thin bedded.
23	pale yellow 2.5Y 7/3 Siltstone, mod cemented, non-calcareous, limonite staining, broken rock
24	brn 7.5YR 5/3 to very pale brn 10YR 7/4 Silty vf Sandstone, non-calcareous, broken, limonite stains
25	yel brn 10YR 5/6, Silty vfn Sandstone, w/ much limonite, non-calcareous, broken

Grid: 5x5 = 1 in

AECOM

JOB TITLE

JOB NO. CALCULATION NO.

ORIGINATOR J. R. Girard DATE 2/11/2011

REVIEWER DATE

SCALE SHEET NO. 4 OF 5

Trench - South Wall (continued) Chaotic Blocks Area

Sample No.		Description
26		White, 10YR 8/1 Siltstone/shale chalk like non-calcareous, soft
	(below)	Lt gray, 10YR 7/2 Siltstone non-calcareous, med hard (harder than white layer above), broken
27		Whitish 10YR 8/1, to lt gray 10YR 7/1 Sandstone, gtcose silty to cs grained, subangular some limonite staining, broken, (jumbled) rock non-calcareous
28		Pale yellow 2.5Y 7/3 to yel brn 10YR 5/6 Siltstone, non-calcareous, micaceous flecks, broken
29		Lt gray 10YR 7/2, silty vfn Sandstone non-calcareous, broken rock
30	(similar to 26 but more yellow stain)	Vy pale brn 10YR 8/2 to lt yellow brn 10YR 6/4 Siltstone, non-calcareous, broken rock
31		Olive gray 5Y 5/2 Shale, soft non-calcareous, bedded and broken rock
32	(3 samples separated by fractures blocks)	32-1 brn 10YR 5/3, Sandstone, hard, well cemented, non-calcareous, limonite stains mottled type structure gray-yellow
		32-2 lt gry 10YR 7/2, Silty vfn Sandstone, mod hard (not as cemented as 32-1 or 32-3 Stained purplish & yellowish.

Grid: 5x5 = 1 in

AECOM

JOB TITLE

JOB NO. CALCULATION NO.

ORIGINATOR J.R. Girard DATE 2/11/2011

REVIEWER DATE

SCALE SHEET NO. 5 OF 5

Trench. South wall (continued) Chaotic Blocks Area

Sample No.	Description
32	32-3 lt gry 10YR 7/2 Sandstone, vfn-coarse grained, siliceous ftzose, feldspar well cemented, non-calcareous, hard, subang-subrnd grains,
33	yellow brn 10YR 5/8 Shale, mod. soft, waxy, non-calcareous
34	pale yl 5Y 8/2 to tint of greenish. Siltstone/vfn Sandstone, moderate cementing, non-calcareous fracture 1/32-1/16" filled w/ brn non-calcareous
35 (large block)	grayish brn 2.5Y 5/2, Limestone some limonite staining, calcite-filled fractures, md-cs calcite crystals groundmass

Grid: 5x5 = 1 in

APPENDIX F

FRACTURE PHOTOS

Preferentially enlarged grooves in Madera limestone (NW of EOD Hill).

Preferentially enlarged grooves and open fractures in Madera limestone (EOD Hill)

Preferentially enlarged slots, grooves and fractures in Madera limestone, with chert nodules (EOD Hill)

Preferentially enlarged slots and bedding plane in Madera limestone, with chert nodules (EOD Hill)

Bedding planes and vertical fractures in Madera limestone (West of EOD Hill)

Bedding planes, vertical fractures and solution enlarged vertical slots in Madera limestone (EOD Hill).

Horizontal bedding planes and solution enlarged vertical fracture in Madera limestone (NW of EOD Hill)

Vertical and horizontal fractures in Madera limestone (EOD Hill).

Calcite-filled fractures in Madera limestone (west of EOD Hill).

Calcite-filled fractures in Madera limestone (EOD Hill)

Open fractures, calcite-filled and preferentially enlarged grooves in Madera limestone (Top of EOD Hill).

Open fractures, calcite-filled and preferentially enlarged grooves in Madera limestone (Top of EOD Hill).

Fractured thin-bedded Madera limestone (NE of EOD Hill)

Anastomosing calcite-filled veins, fractures and preferentially enlarged veins – Madera Ls (SE of EOD Hill)

Highly fractured Sandia Formation 150 feet south of trench (NNE of EOD Hill)

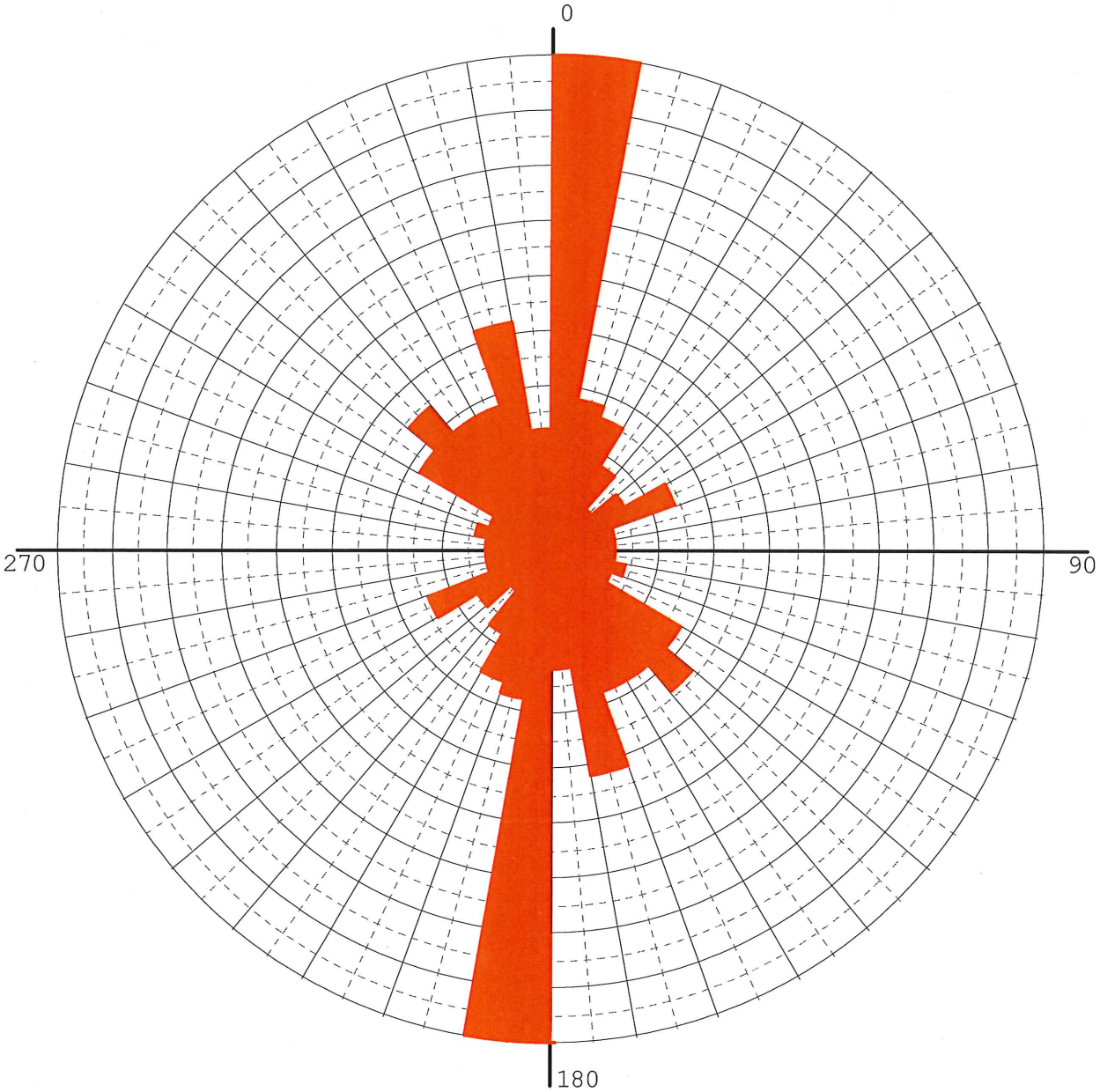
Fractures in Madera Group sandstone (Site 33 west of EOD Hill)

Vertical and horizontal fractures in Sandia sandstone formation (NW of EOD Hill)

Fractures in Sandia sandstone formation (NNE of EOD Hill)

APPENDIX G

ORIENTATIONS OF FRACTURES IN THE EOD HILL AREA



All Measured Fractures In EOD Hill Area

228 Measurements

All Measured Fractures in EOD Hill Area

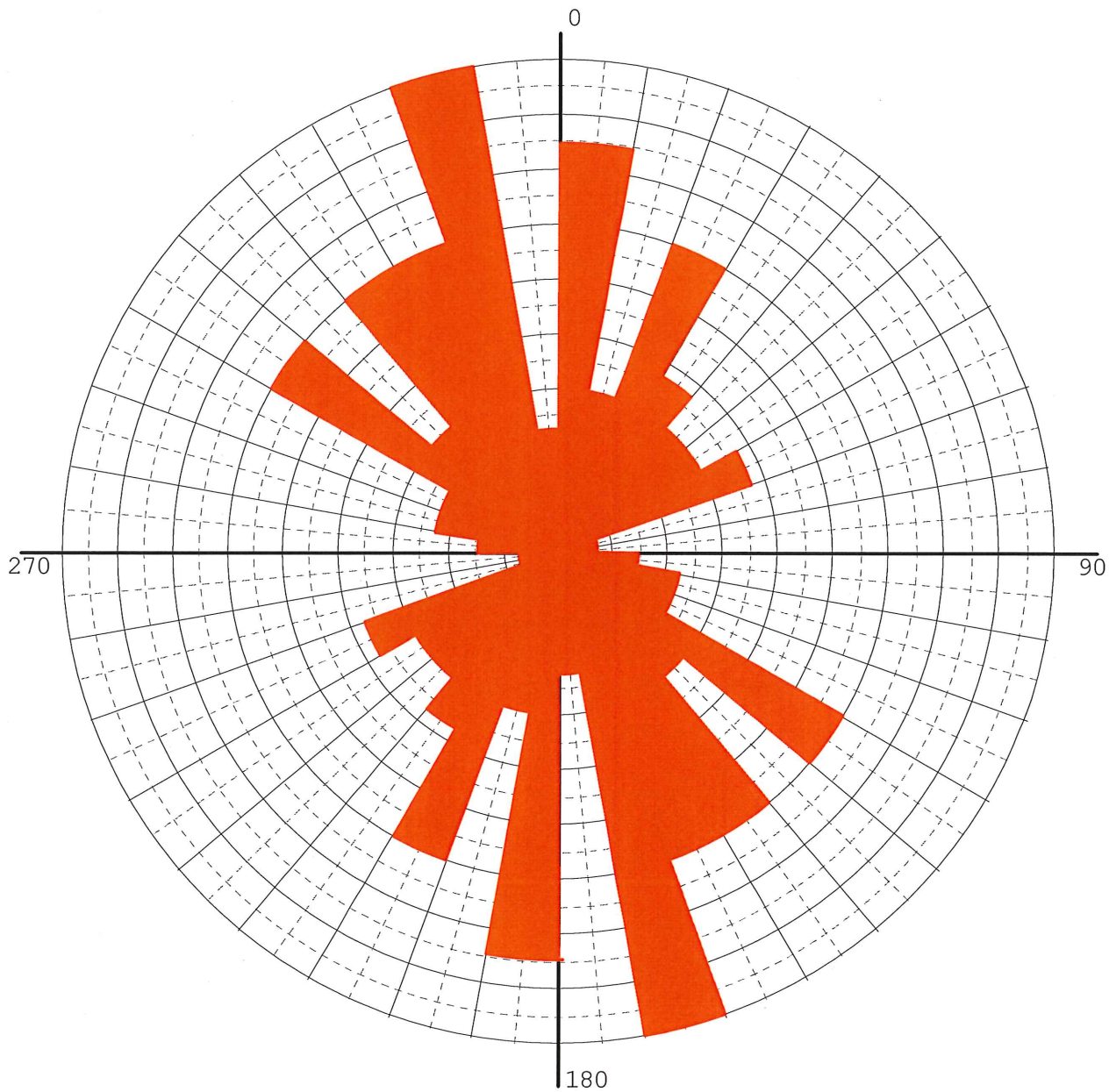
Compass Interval (degrees)	Number of Fractures Measured Per Compass Interval	Measured Fracture Azimuth (degrees)
0 - 10	45	5; 5; 9; 9; 3; 9; 9; 9; 9; 7; 9; 1; 1; 1; 9; 9; 9; 9; 9; 9; 9; 9; 9; 7; 7; 9; 9; 9; 1; 9; 9; 9; 5; 9; 5; 9; 9; 9; 9; 4; 9; 9; 9; 5; 9
11 - 20	14	19; 20; 19; 11; 11; 12; 13; 13; 13; 13; 11; 12; 13; 13
21 - 30	13	30; 29; 29; 29; 27; 29; 27; 29; 24; 27; 25; 29; 27
31 - 40	9	31; 39; 35; 31; 37; 33; 39; 39; 39
41 - 50	5	45; 41; 41; 49; 49
51 - 60	8	55; 53; 54; 51; 59; 59; 54; 51
61 - 70	12	63; 65; 65; 69; 61; 67; 67; 61; 64; 69; 64; 68
71 - 80	6	71; 79; 75; 71; 71; 79
81 - 90	6	87; 87; 87; 84; 81; 89
271 - 280	6	279; 279; 271; 279; 277; 274
281 - 290	7	289; 289; 285; 289; 289; 287; 281
291 - 300	6	299; 291; 291; 299; 299; 299

All Measured Fractures in EOD Hill Area

301 - 310	14	301; 310; 307; 307; 307; 303; 309; 304; 304; 304; 309; 307; 309; 301
311 - 320	17	319; 316; 315; 317; 319; 313; 319; 319; 311; 319; 319; 319; 311; 313; 319; 319; 311
321 - 330	14	327; 329; 329; 321; 321; 325; 329; 327; 328; 328; 327; 329; 321; 329
331 - 340	14	331; 335; 333; 333; 339; 337; 339; 331; 339; 337; 339; 339; 334; 335
341 - 350	21	341; 346; 346; 344; 347; 341; 347; 349; 349; 347; 341; 343; 344; 343; 343; 349; 349; 349; 345; 341; 349
351 - 360	11	357; 359; 359; 359; 359; 359; 359; 353; 351; 359; 359

Total measurements: 228

Azimuth Note: Range of Degrees - North = 0 degrees, East = 90 degrees,
South = 180 degrees, West = 270 degrees



Measured Fractures in Area Not on EOD Hill

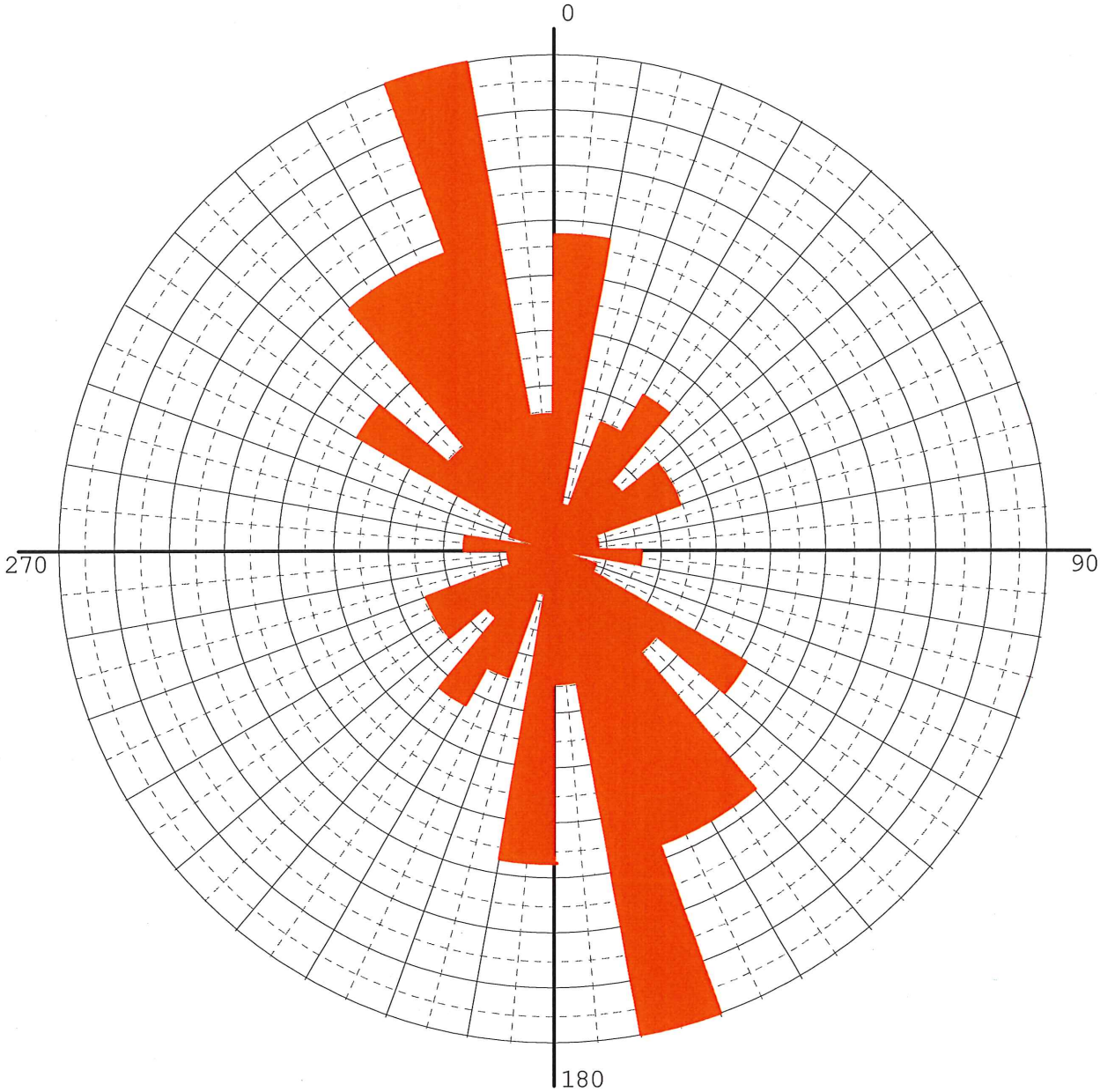
93 Measurements

Measured Fractures in Area Not on EOD Hill

Compass Interval (degrees)	Number of Fractures Measured Per Compass Interval	Measured Fracture Azimuth (degrees)
0 - 10	10	9; 9; 9; 9; 4; 9; 9; 9; 5; 9
11 - 20	4	11; 12; 13; 13
21 - 30	8	29; 27; 29; 24; 27; 25; 29; 27
31 - 40	5	37; 33; 39; 39; 39
41 - 50	4	41; 41; 49; 49
51 - 60	4	59; 59; 54; 51
61 - 70	5	61; 64; 69; 64; 68
71 - 80	1	79
81 - 90	1	89
271 - 280	2	277; 274
281 - 290	3	289; 287; 281
291 - 300	3	299; 299; 299
301 - 310	8	309; 304; 304; 304; 309; 307; 309; 301
311 - 320	4	313; 319; 319; 311
321 - 330	8	329; 327; 328; 328; 327; 329; 321; 329
331 - 340	8	339; 331; 339; 337; 339; 339; 334; 335
341 - 350	12	347; 341; 343; 344; 343; 343; 349; 349; 349; 345; 341; 349
351 - 360	3	351; 359; 359

Total measurements: 93

Azimuth Note: Range of Degrees - North = 0 degrees, East = 90 degrees,
South = 180 degrees, West = 270 degrees



Measured Fractures in Area West of EOD Hill

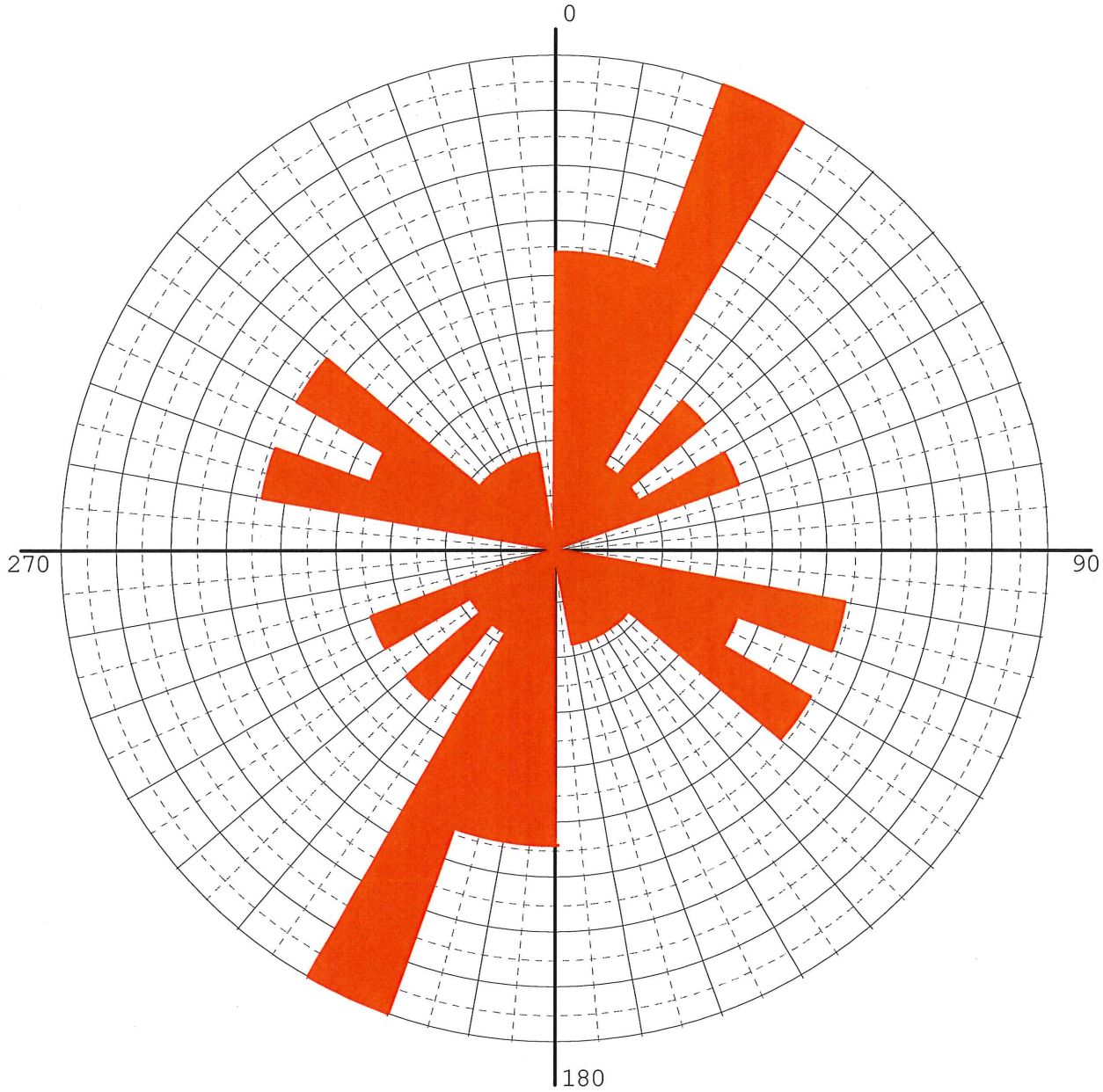
64 Measurements

Measured Fractures in Area West of EOD Hill

Compass Interval (degrees)	Number of Fractures Measured Per Compass Interval	Measured Fracture Azimuth (degrees)
0 - 10	7	9; 9; 9; 9; 4; 9; 9
11 - 20	1	11
21 - 30	3	29; 27; 29
31 - 40	4	37; 33; 39; 39
41 - 50	2	41; 41
51 - 60	3	59; 59; 54
61 - 70	3	61; 64; 69
71 - 80	1	79
81 - 90	1	89
271 - 280	2	277; 274
281 - 290	0	
291 - 300	1	299
301 - 310	5	309; 304; 304; 304; 309
311 - 320	3	313; 319; 319
321 - 330	7	329; 327; 328; 328; 327; 329; 321
331 - 340	7	339; 331; 339; 337; 339; 339; 334
341 - 350	11	347; 341; 343; 344; 343; 343; 349; 349; 349; 345; 341
351 - 360	3	351; 359; 359

Total measurements: 64

Azimuth Note: Range of Degrees - North = 0 degrees, East = 90 degrees,
South = 180 degrees, West = 270 degrees



Measured Fractures in Area East Of EOD Hill

29 Measurements

Measured Fractures in Area East of EOD Hill

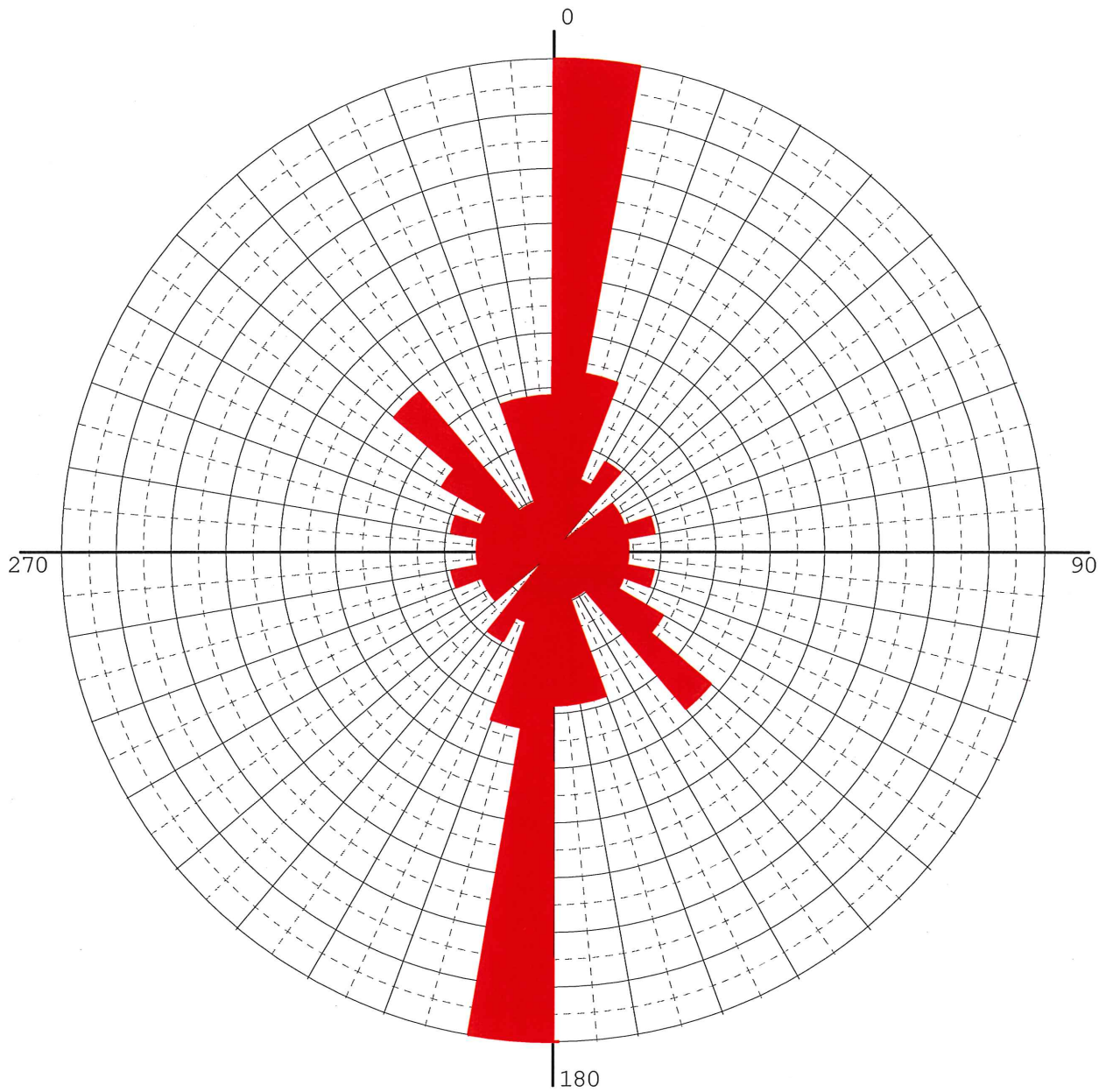
Compass Interval (degrees)	Number of Fractures Measured Per Compass Interval	Measured Fracture Azimuth (degrees)
0 - 10	3	9; 5; 9
11 - 20	3	12; 13; 13
21 - 30	5	24; 27; 25; 29; 27
31 - 40	1	39
41 - 50	2	49; 49
51 - 60	1	51
61 - 70	2	64; 68
71 - 80	0	
81 - 90	0	
271 - 280	0	
281 - 290	3	289; 287; 281
291 - 300	2	299; 299
301 - 310	3	307; 309; 301
311 - 320	1	311
321 - 330	1	329
331 - 340	1	335
341 - 350	1	349
351 - 360	0	

Total measurements: 29

Azimuth Note: Range of Degrees - North = 0 degrees, East = 90 degrees,
South = 180 degrees, West = 270 degrees

APPENDIX H

ORIENTATIONS OF FRACTURES ON EOD HILL



Open Fractures on EOD Hill

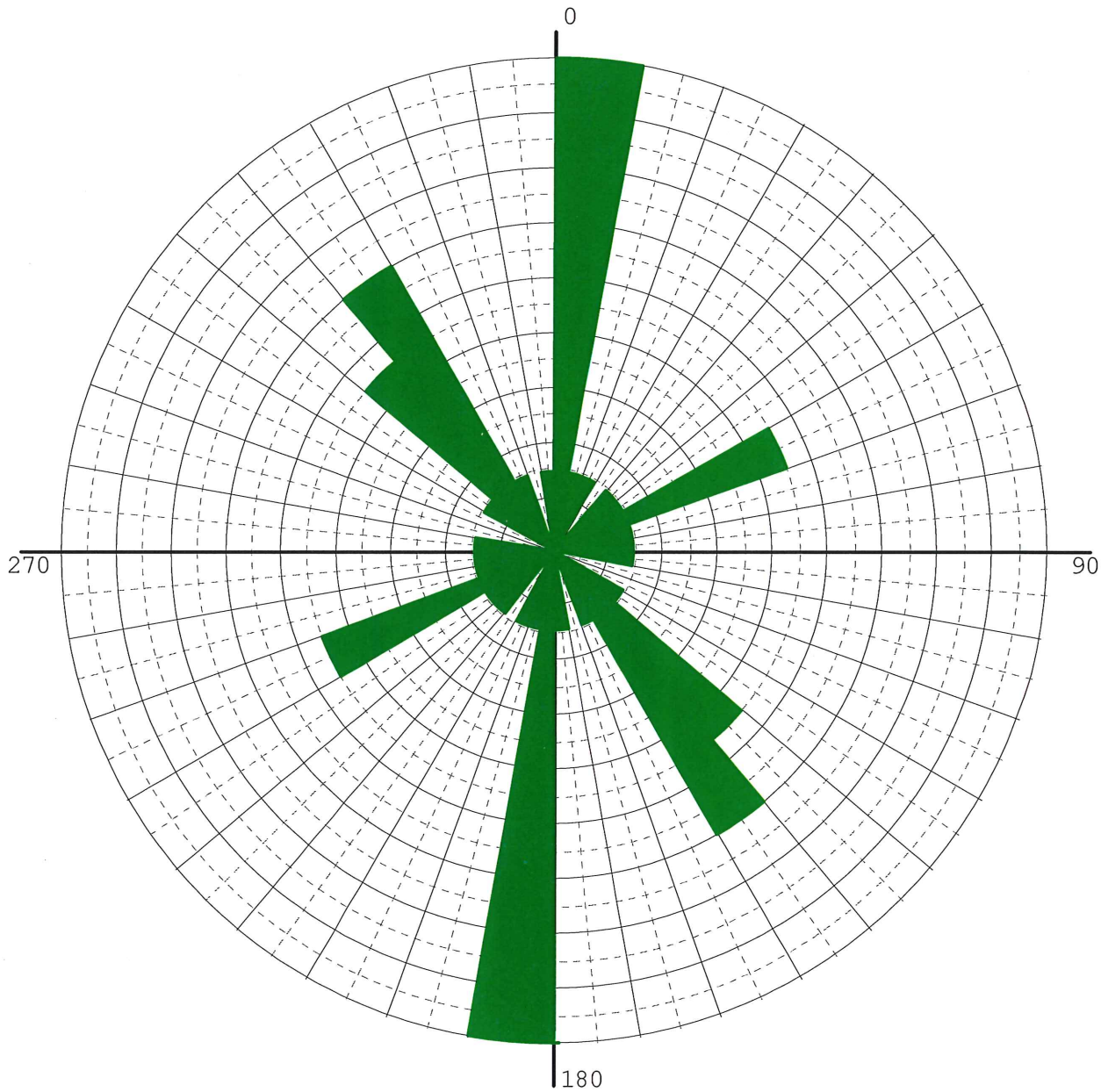
85 Measurements

Open Fractures on EOD Hill

Compass Interval (degrees)	Number of Fractures Measured Per Compass Interval	Measured Fracture Azimuth (degrees)
0 - 10	19	5; 9; 9; 3; 9; 9; 9; 1; 1; 1; 9; 9; 9; 9; 9; 1; 9; 9; 9
11 - 20	7	19; 20; 19; 11; 12; 13; 13
21 - 30	3	30; 29; 29
31 - 40	4	31; 39; 35; 31
41 - 50	0	
51 - 60	3	55; 53; 54
61 - 70	3	63; 65; 65
71 - 80	4	79; 75; 71; 71
81 - 90	3	87; 84; 81
271 - 280	3	279; 279; 271
281 - 290	4	289; 289; 285; 289
291 - 300	3	299; 291; 291
301 - 310	5	310; 307; 307; 307; 303
311 - 320	8	319; 316; 315; 317; 313; 319; 311; 319
321 - 330	2	329; 321
331 - 340	2	331; 339
341 - 350	6	346; 346; 344; 347; 347; 349
351 - 360	6	357; 359; 359; 359; 359; 353

Total measurements: 85

Azimuth Note: Range of Degrees - North = 0 degrees, East = 90 degrees,
South = 180 degrees, West = 270 degrees



Calcite-Filled Fractures on EOD Hill

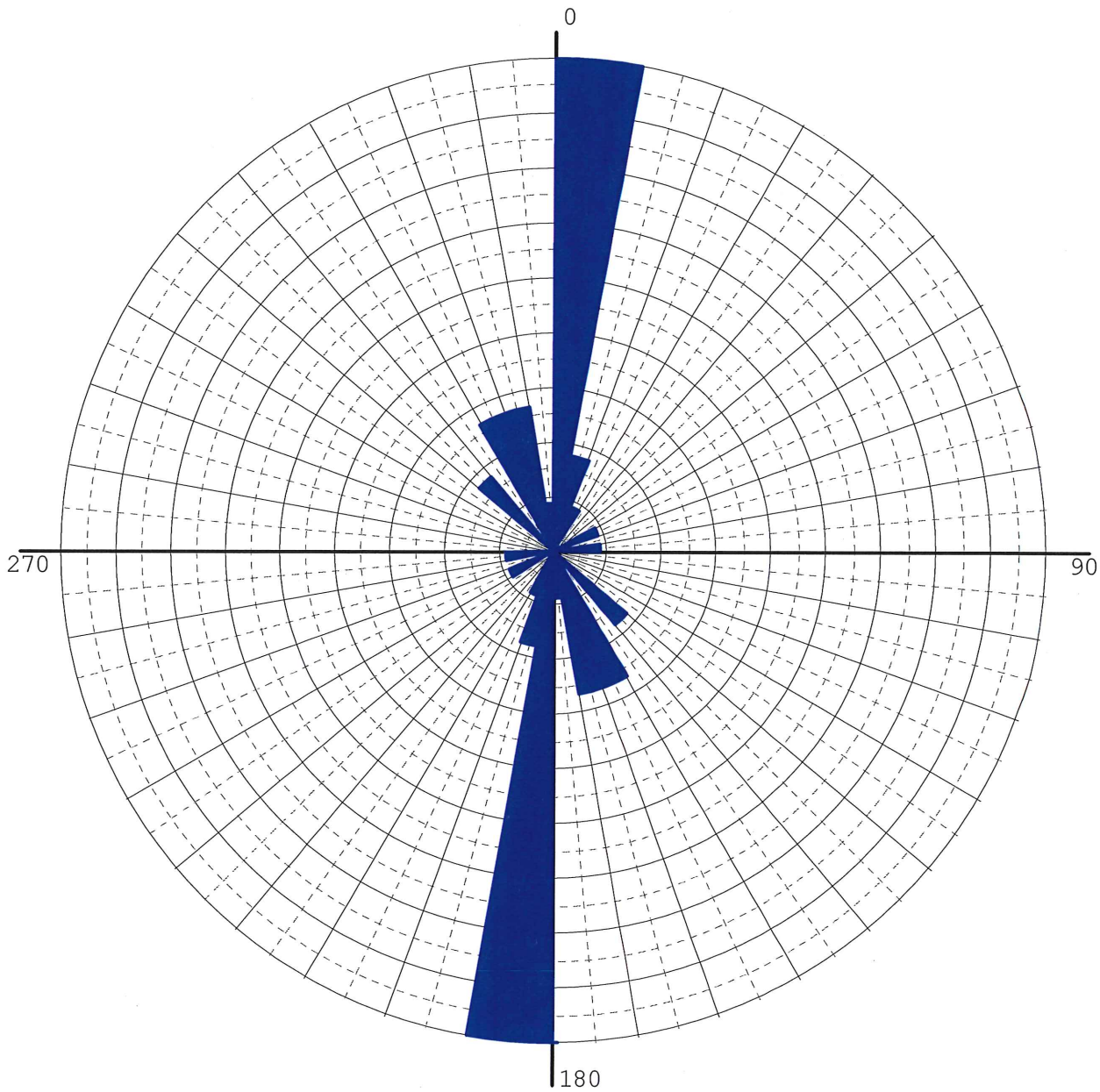
26 Measurements

Calcite-Filled Fractures on EOD Hill

Compass Interval (degrees)	Number of Fractures Measured Per Compass Interval	Measured Fracture Azimuth (degrees)
0 - 10	6	5; 9; 9; 7; 5; 9
11 - 20	1	13
21 - 30	1	27
31 - 40	0	
41 - 50	1	45
51 - 60	1	51
61 - 70	3	61; 67; 67
71 - 80	1	71
81 - 90	1	87
271 - 280	1	279
281 - 290	0	
291 - 300	0	
301 - 310	1	301
311 - 320	3	319; 319; 319
321 - 330	4	327; 329; 321; 325
331 - 340	1	337
341 - 350	0	
351 - 360	1	359

Total measurements: 26

Azimuth Note: Range of Degrees - North = 0 degrees, East = 90 degrees,
South = 180 degrees, West = 270 degrees



Preferentially Weathered, Closed Fractures, and Grooves on EOD Hill

24 Measurements

Preferentially Weathered, Closed Fractures and Grooves on EOD Hill

Compass Interval (degrees)	Number of Fractures Measured Per Compass Interval	Measured Fracture Azimuth (degrees)
0 - 10	10	9; 9; 9; 9; 9; 9; 7; 7; 9; 5
11 - 20	2	11; 13
21 - 30	1	29
31 - 40	0	
41 - 50	0	
51 - 60	0	
61 - 70	1	69
71 - 80	0	
81 - 90	1	87
271 - 280	0	
281 - 290	0	
291 - 300	0	
301 - 310	0	
311 - 320	2	319; 311
321 - 330	0	
331 - 340	3	335; 333; 333
341 - 350	3	341; 341; 349
351 - 360	1	359

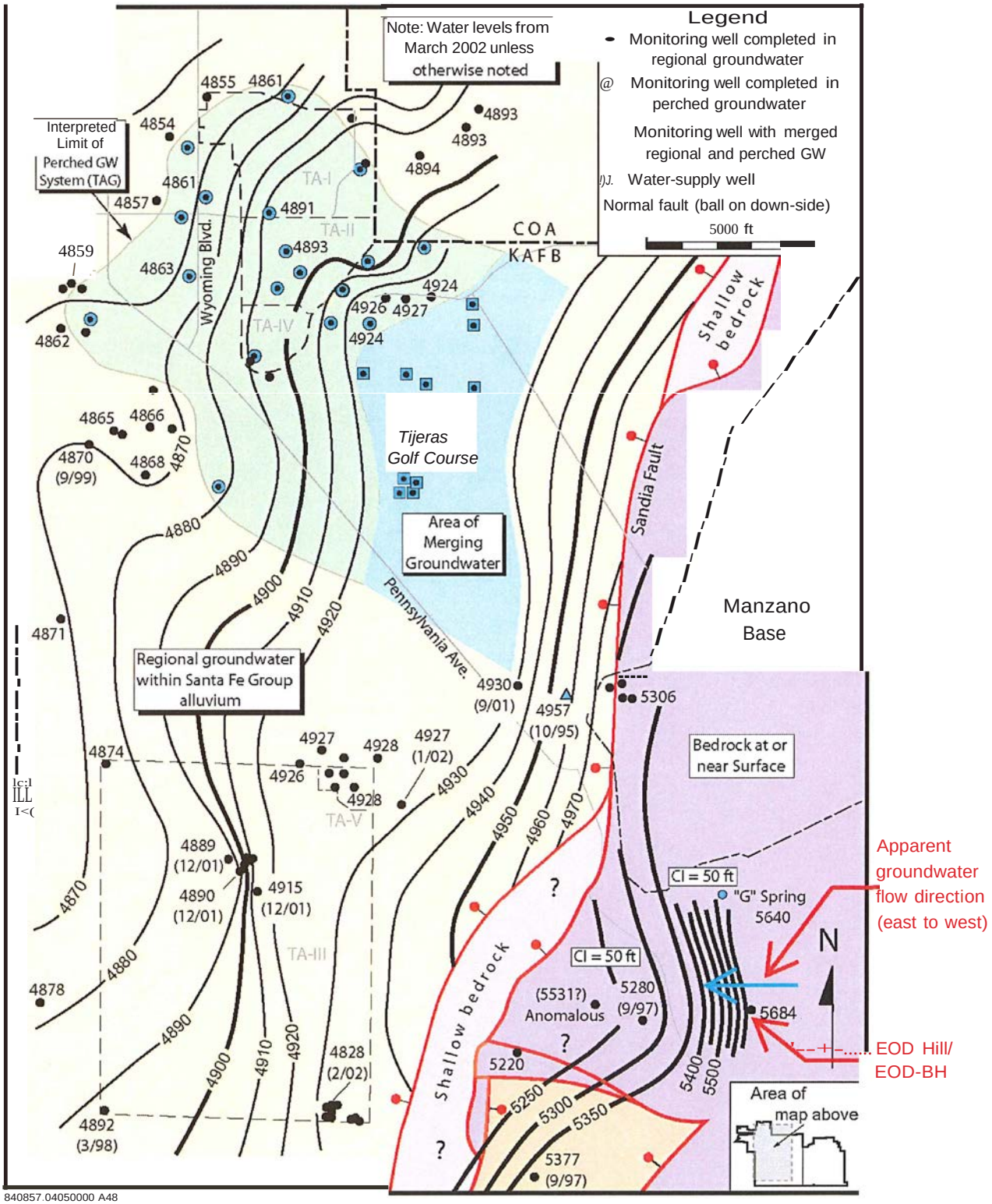
Total measurements: 24

Azimuth Note: Range of Degrees - North = 0 degrees, East = 90 degrees, South = 180 degrees, West = 270 degrees

APPENDIX I

REGIONAL WATER TABLE MAP

Figure 2-6. Regional Water Table Map (CI=10 ft, except where noted)



APPENDIX J

REFERENCES

REFERENCES

Krumhansl, J. L., and V.S. McConnell, 1994, Geology of the Travertine Hills Area, Kirtland Air Force Base, Sandia National Laboratories, Albuquerque, New Mexico, revised November 15, 1994.

Van Hart, D. 2003, Geologic Investigation: An Update of Subsurface Geology on Kirtland Air Force Base, New Mexico. SAND Report, SAND2003-1869, Prepared by Sandia National Laboratories, Albuquerque, New Mexico 87185 and Livermore, California 94550.

APPENDIX F: Description of Fractures in the EOD Hills Area

Description of Fractures in The EOD Hill Area

The Sandia Formation and the Madera Group are exposed in the EOD Hill area. Formation exposures are weathered and fractured. Fracture types observed in the Sandia Formation are sharp, and typically open with vertical and sub-vertical dips. Fracture types observed in the Madera limestone include open hairline through open large aperture fractures, calcite-filled fractures, preferentially weathered/eroded open and closed fractures and grooves. Trends of 228 fractures in the EOD Hills area were measured during mapping events performed during January through April 2011. Fracture types and locations where fractures were measured are presented on Figure 2. Photos of fracture types and patterns observed in the EOD Hills area are presented in Appendix A.

The orientations of fractures encountered in the EOD Hill area, and on EOD Hill are presented as rose diagrams in Appendices B and C, respectively. The fracture orientations are presented in 10 degree intervals with north, east, south and west compass directions represented as 0/360, 90, 180 and 270 degrees, respectively. The primary orientation of all measured fractures in the EOD Hills area is 1° - 10° (45 out of 228 fractures (20 percent) average orientation 7.5^o). Secondary orientations are 341° – 350°, and 311° – 320°. The primary orientation of measured fractures in the EOD Hills area that are not located on EOD Hill is 341° - 350° (12 out of 93 fractures (13 percent) average orientation 345°). The primary orientation of measured fractures located west of EOD Hill is 341° – 350° (11 out of 64 fractures (17 percent) average orientation 345°). The primary orientation of measured fractures located east of EOD Hill is 21° – 30° (5 out of 29 fractures (17 percent) average orientation 26.5^o).

The primary orientation of measured open fractures on EOD Hill is 1° - 10° (19 out of 85 fractures (22 percent) average orientation 7°). The primary orientation of measured calcite-filled fractures on EOD Hill is 1° - 10° (6 out of 26 fractures (23 percent) average orientation 7.5^o). The primary orientation of preferentially weathered closed fractures and grooves on EOD Hill is 1° - 10° (10 out of 24 fractures (42 percent) average orientation 8°).

Open fractures have widths ranging from hairline to several inches. The widths of the majority of open fractures range from $1/8^{th}$ – ¼-inch. Many fractures occur as parallel joints with varying spacing between joints. Open fractures have vertical to sub-vertical dips.

The maximum observed width of calcite-filled fractures was approximately ½-inch. Fractures wider than ½-inch were open.

Preferentially weathered (solution enlarged) fractures range from closed (with no apparent fracture) to enlarged 1/2 to 1–inch wide open fractures. Solution enlarged fractures and grooves on cliff faces often do not cut across all beds.

Many of the horizontal bedding planes in the Madera Group limestone have been solution enlarged and are intersected by vertical and sub-vertical fractures. No stylolites were observed, but solution enlarged crenulated surfaces were observed.

AECOM

FIGURE 2
FRACTURE TRENDS
GEOLOGY OF EOD HILLS AREA
BERNALILLO, NEW MEXICO

APR. 2011 60134617

Thursday, May 12, 2011, 1:33:34 PM

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APPENDIX G: Draft Technical Memorandum EOD Hill Fault Geophysics Investigation

DRAFT TECHNICAL MEMORANDUM

Date: May 24, 2011

To: Cole Crosgrove - AFCEE, Greg Brooks - AECOM

From: Barry J. Harding, CPG; Kris Nolan, PG; Brad Hoare, PG

Re: Draft TM – EOD Hill Fault Geophysics Investigation

AECOM has completed geophysical surveys using multiple techniques as lines of evidence to evaluate the presence of faulted bedrock in the vicinity of EOD Hill, Kirtland Air Force Base, in Albuquerque, New Mexico. Completed investigations and data review included:

- Review of high-resolution aerial photographic data,
- Review of 30 meter-resolution Landsat TM data,
- EM-31 investigation with multiple survey lines across 4 separate target transects,
- EM-34 investigation with multiple survey lines across 4 separate target transects, with coil spacing at 10 meters in vertical and horizontal dipole mode,
- VLF Wadi investigation with multiple survey lines across 4 separate target transects,
- Protem magnetometer survey with multiple survey lines across 4 separate target transects,
- Four seismic refraction survey lines at each of the four targeted transects.

Originally, an EM-34-3 survey in vertical and horizontal dipole orientation along each transect line was proposed at 8 meter, 20 meter and 40 meter coil spacing; however, the field geophysicists noted that responses of the EM-34 in 20 meter and 40 meter coil spacing were erratic (conductivity measurements did not stabilize). AECOM attributed the inconsistent responses of the instrument to faulty coils or board malfunction. The EM-34 survey was thus limited to survey at approximately 10m.

The transect lines are presented in **Figure 1**.

Aerial Photography / Landsat

Findings from the aerial photographic and satellite data review were previously summarized in a Technical memorandum dated March 11, 2011. In general, AECOM concluded:

- Analysis of 30-meter resolution Landsat 7 ETM+ data was not effective for mapping of EOD fault underlying alluvial overburden at the site.
- Several isolated patches of vegetation were identified using Landsat 7 ETM+ data.
- A linear feature, roughly corresponding to the location of the prospective EOD fault is visible in on-line high resolution composite aerial photographic images.

VLF Wadi Survey

The Wadi survey takes advantage of high-powered very low frequency military communication transmission in the 15-25 kHz band. VLF waves propagate efficiently over long distances in the waveguide formed by the ground surface and the ionosphere. VLF waves also induce secondary magnetic fields that are sensitive to underlying bedrock geometry and structure. Hence, VLF exploration methods have been used to map faults, fractures and other geological anomalies. An ABEM Wadi instrument was used at the EOD Hill site. The effective depth of exploration for the Wadi instrument was approximately 100 meters.

The Wadi data was Fraser-filtered, which is a numerical averaging technique used to remove noise from data sets. Presented data at each of the four transects is shown in **Figure 2** and **Appendix A**.

In general, positive in-phase responses are indicative of conductive bodies such as dipping beds, conductive materials, zones of mineralization or ore-bodies, water-bearing zones and fractured or faulted systems (Milsom, 1996). Anomalies imaged through the Wadi instrument are best represented in Transect B, Transect A and Transect D (**Figure 2**).

Wadi data at Transect C potentially shows dipping beds of the Madera limestone outcrop, near the western portion of Transect C and a two-track access road.

EM-31

The EM-31 survey identified high conductivity zones in each of the four transect locations. Contoured EM-31 quad-phase terrain conductivity data is presented as an overlay on the Wadi data in **Figure 3**. These data represent the 5-rows at each transect (blue to pink color values) presented on the figure. Conductivity values ranged from negative values to approximately 35 mS/m. Higher conductivity zones (pink) were identified in all of the transect locations. The EM-31 data correlated to Wadi signatures at Transect B (note strong VLF dip and EM conductivity near center of transect) and Transect A. In addition, higher conductivity anomalies in the 35 mS/m range were identified in the western portion of Transect C and the eastern edge of Transect D. The effective depth of exploration for the EM-31 was approximately 6 meters (about 20 feet).

The EM-31 is not typically used to map geological structure. However, at the EOD fault area, the EM-31 was proposed to potentially map conductivity signatures associated with shale weathering zones, chemical leaching or mineralization, limonitic zones, or water-bearing fractures potentially associated with the EOD fault system. Based upon a comparison of mapped surface geology and EM-31 signatures, it appears that the EM-31 effectively imaged geological contacts below the overlying alluvial overburden. The high conductivity zones identified in Transect B and C also correlate to a lineament identified during the aerial photographic review.

EM-34

Preliminary EM-34 data contours are presented in **Figure 4**. EM-34 horizontal dipole conductivity data shows a similar signature as the EM-31, with prominent conductivity anomalies identified in Transects A and Transect B.

In the vertical mode, the EM-34 is sensitive to vertical geological structure and is widely used for mapping of fractured and faulted bedrock systems, thus was particularly applicable for mapping the EOD fault. Particularly high level of conductivity contrast is shown in Transects B and C.

Protem Magnetometer

Magnetometer data appears to be inconclusive and is not presented in the TM. In general, the magnetic data shows a 25 nT decrease in magnetic intensity toward the eastern portion of each transect. Several single point magnetic anomalies were identified and generally correspond to pieces of ferro-magnetic debris (wire, nails, bottle caps and other metal fragments) found in overburden at the site.

Seismic Refraction

Four seismic refraction lines were performed and are attached in **Appendix B**.

Line 2 (Transect B) indicates a stark velocity inversion at approximately 30 feet from the western limit of the line. This shows progressively increasing velocity until it gets to that point, then the velocity drops substantially. The later arrivals then speed up again. This can be caused be a fault zone, filled with a jumble of loose material, or a much lower velocity rock lying next to a much higher velocity rock. In this case (Transect B), the inversion is much stronger from the high end of the profile to the low end. This is interpreted that the bedrock on the high end is higher velocity (more dense) than the rock on the low end. It could also be interpreted that the deeper rock is lower velocity that the rock above it, which is usually only caused by reverse faulting.

Lines 1 (Transect A) and Line 2 (Transect B) show a discontinuity, in which the higher velocity body is up next to the lower velocity body. This is consistent with a fault zone or stark change in geological contacts. Line 3 (Transect C) does not exhibit any substantial change in velocity and suggests fairly inform geological substrate. Line 4 (Transect D) shows nearly completely different geology (note comparatively faster underlying strata) with a velocity inversion at approximately 40 feet from the western limit of the line. This may also be interpreted to be a fault.

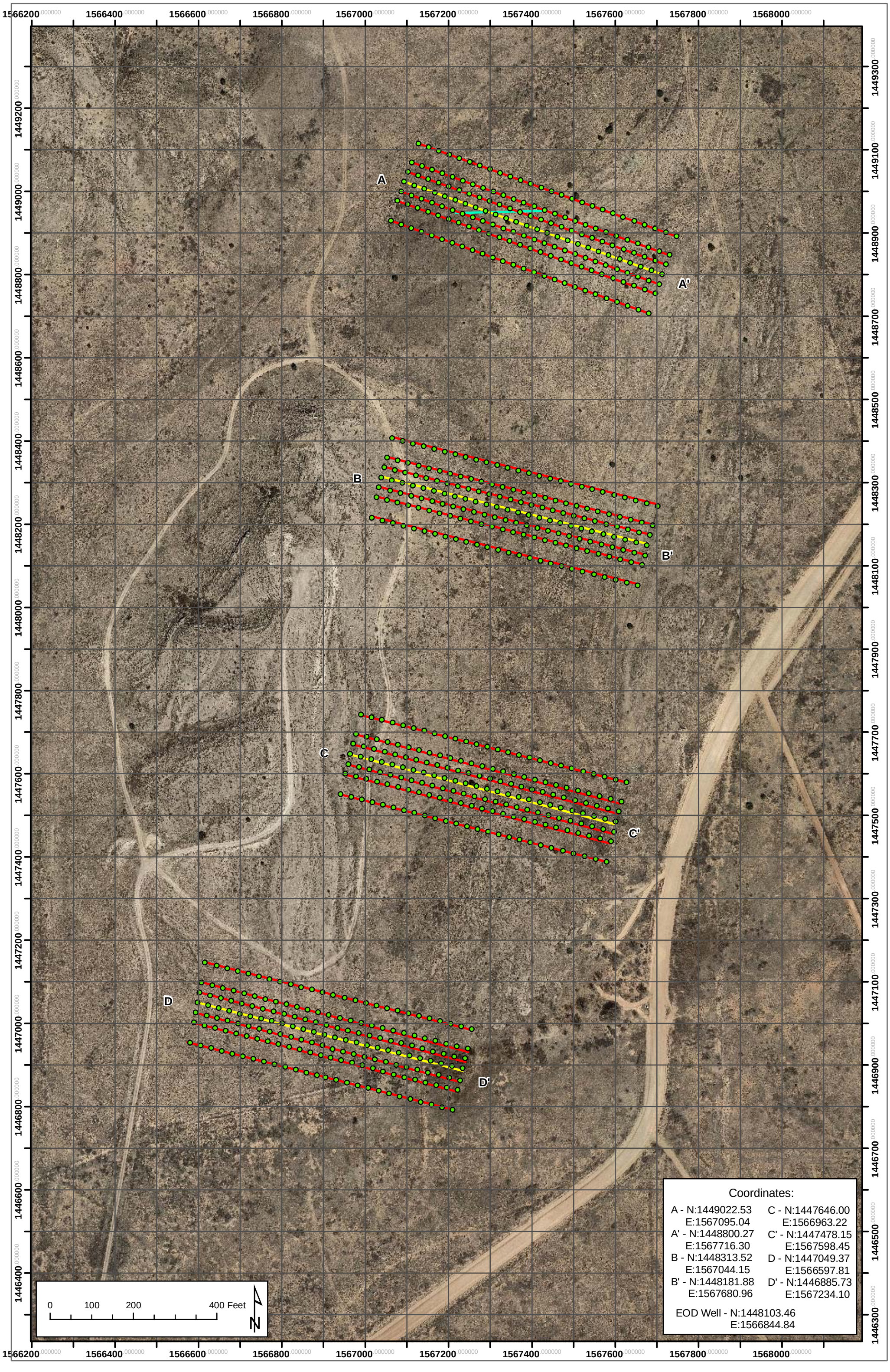
Summary

- Additional survey using EM-34 with 20 and 40 meter coil spacing, to attain deeper exploration of the target transect areas is not recommended due to near surface conductivity signatures identified both in the EM-31 and EM-34 (potentially masking underlying features).
- EM-31 and EM-34 terrain conductivity signatures appear to correlate to mapped geological units at the site. High conductivity zones imaged in areas mapped with alluvial overburden are interpreted to be responses from underlying bedrock and possibly deeper water-bearing zones or zones of mineralization (indirect indicators of fault systems).
- VLF Wadi data potentially suggest presence of sharply dipping beds or fractured or faulted rock. Given that anomalies identified in the Wadi survey generally show sharp contrast, it is likely that the Wadi identified changes is geological contacts or altered or displaced rock.
- Seismic data indicated sharp contrast in velocity at three of the four seismic lines. This is consistent with the interpretation that the EOD Fault is present in the transect locations.

References

J. Milsom, 1996. Field Geophysics, John Wiley & Sons. 187 pp.

FIGURES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1446700
1446600
1446500
1446400
1446300
A
A'
B
B'
C
C'
D
D'
0
100
200
400 Feet
N
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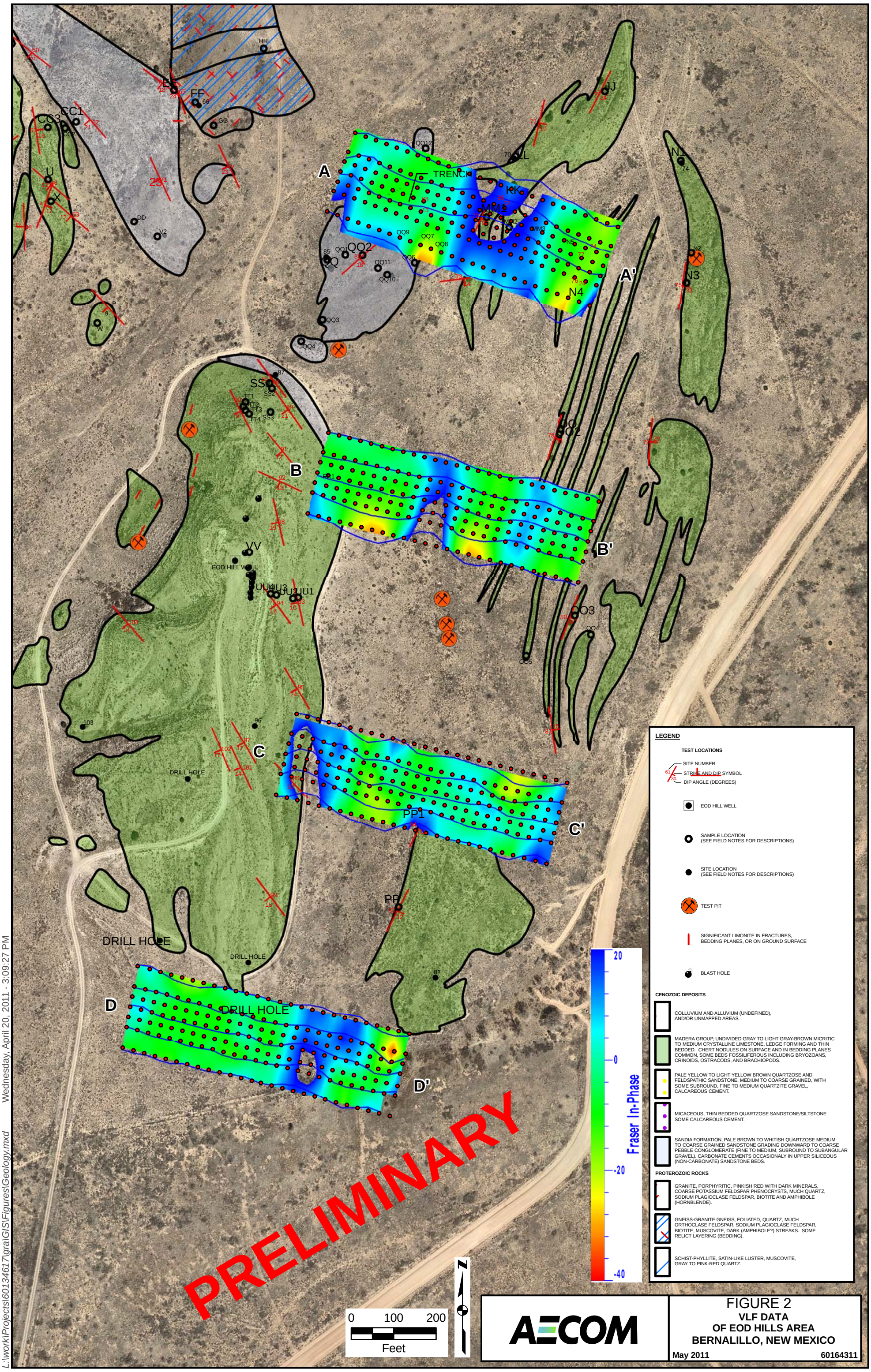

AECOM

FIGURE 2
VLF DATA OF EOD HILLS AREA BERNALILLO, NEW MEXICO

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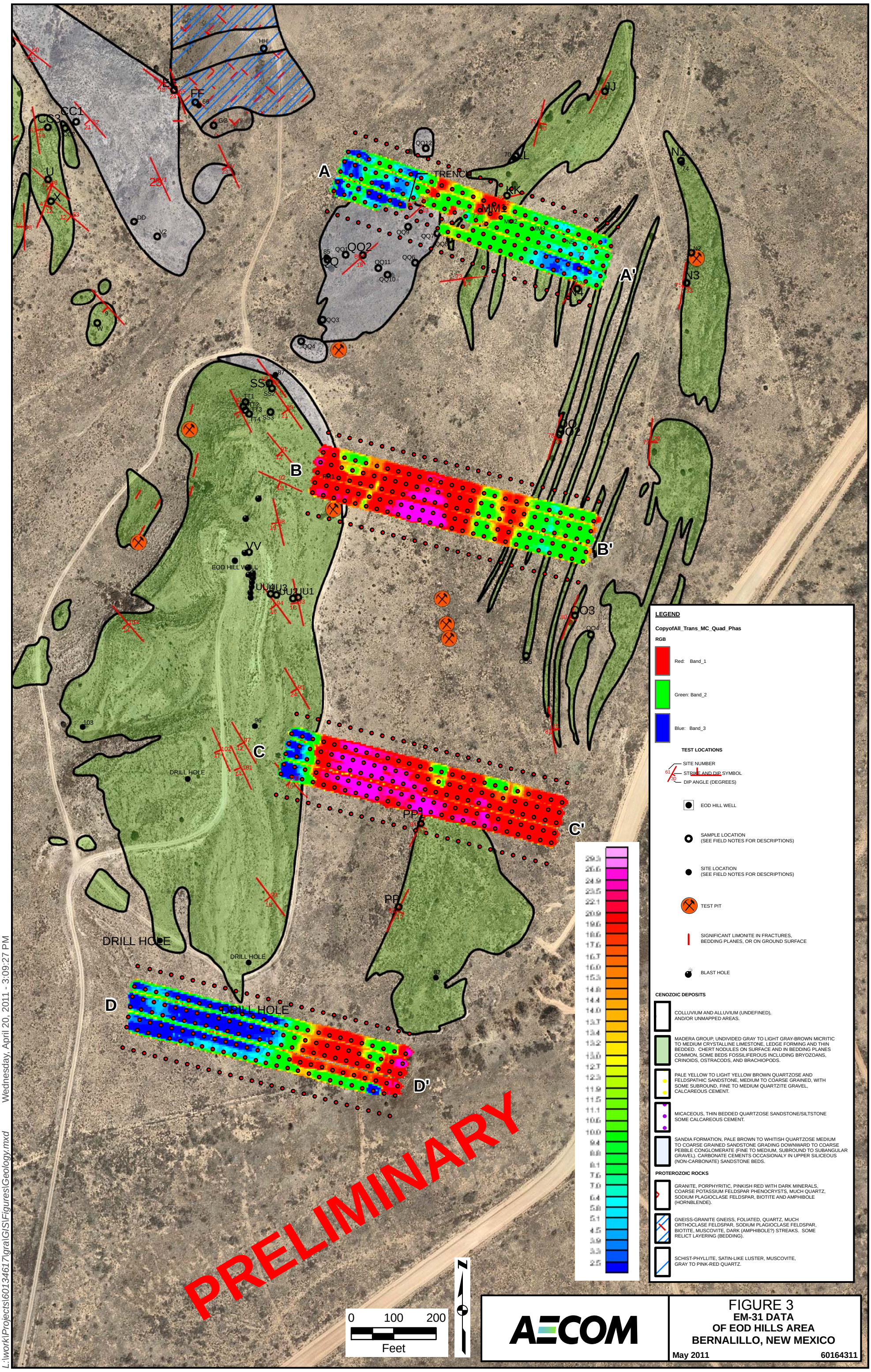

AECOM

FIGURE 3
EM-31 DATA
OF EOD HILLS AREA
BERNALILLO, NEW MEXICO

May 2011 **60164311**

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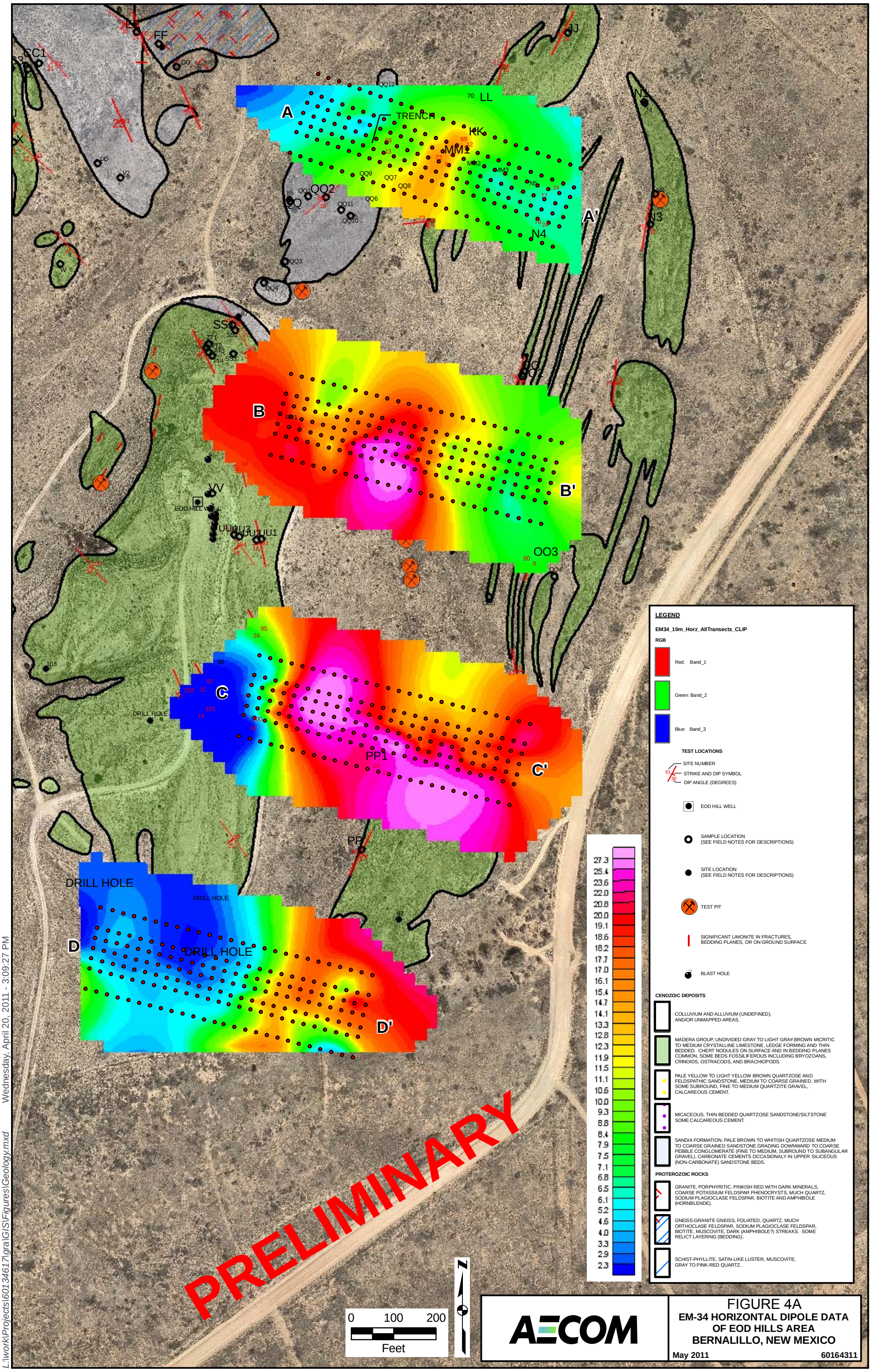

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FIGURE 4A

EM-34 HORIZONTAL DIPOLE DATA OF EOD HILLS AREA BERNALILLO, NEW MEXICO

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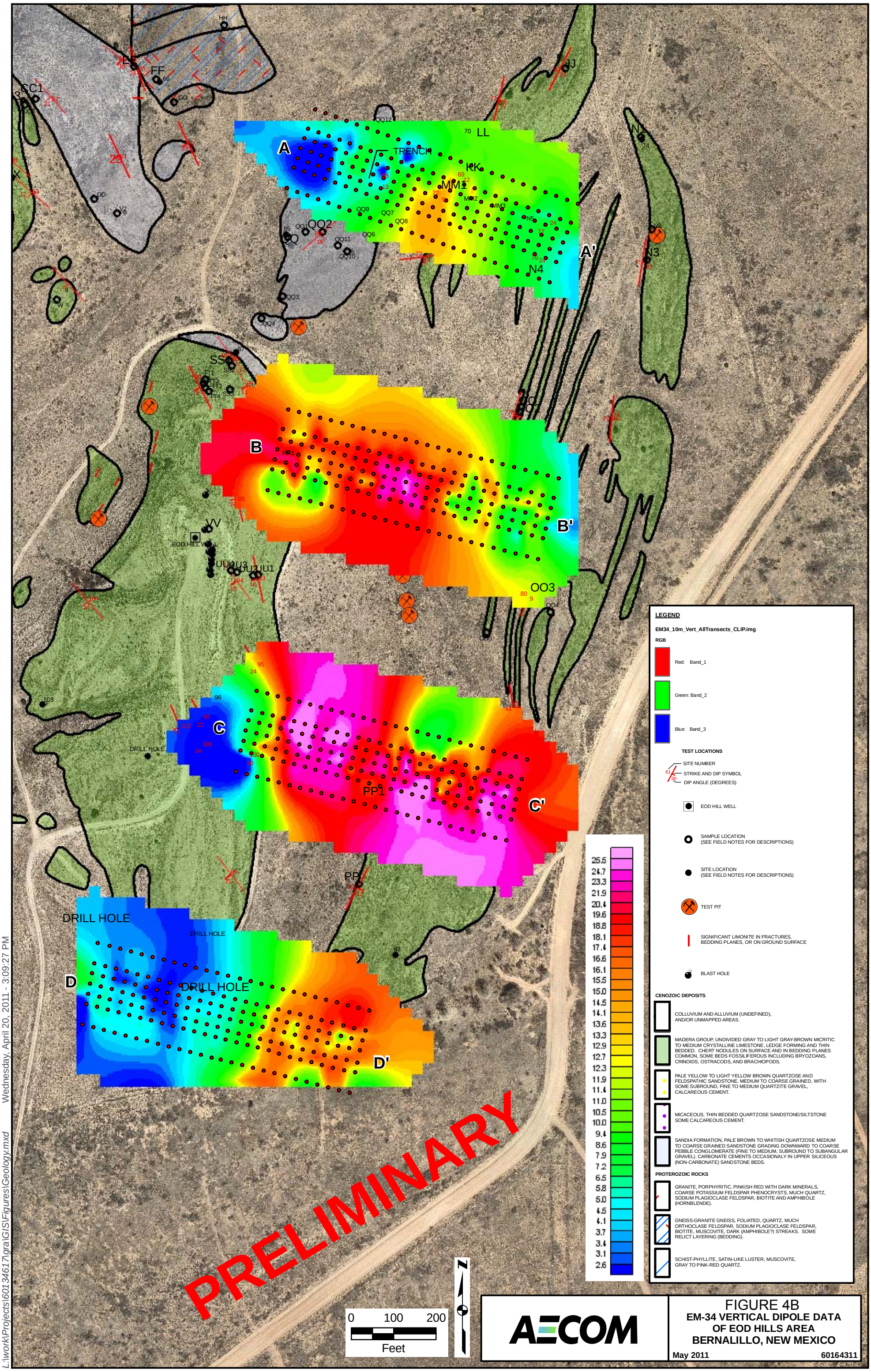

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FIGURE 4B
EM-34 VERTICAL DIPOLE DATA OF EOD HILLS AREA BERNALILLO, NEW MEXICO

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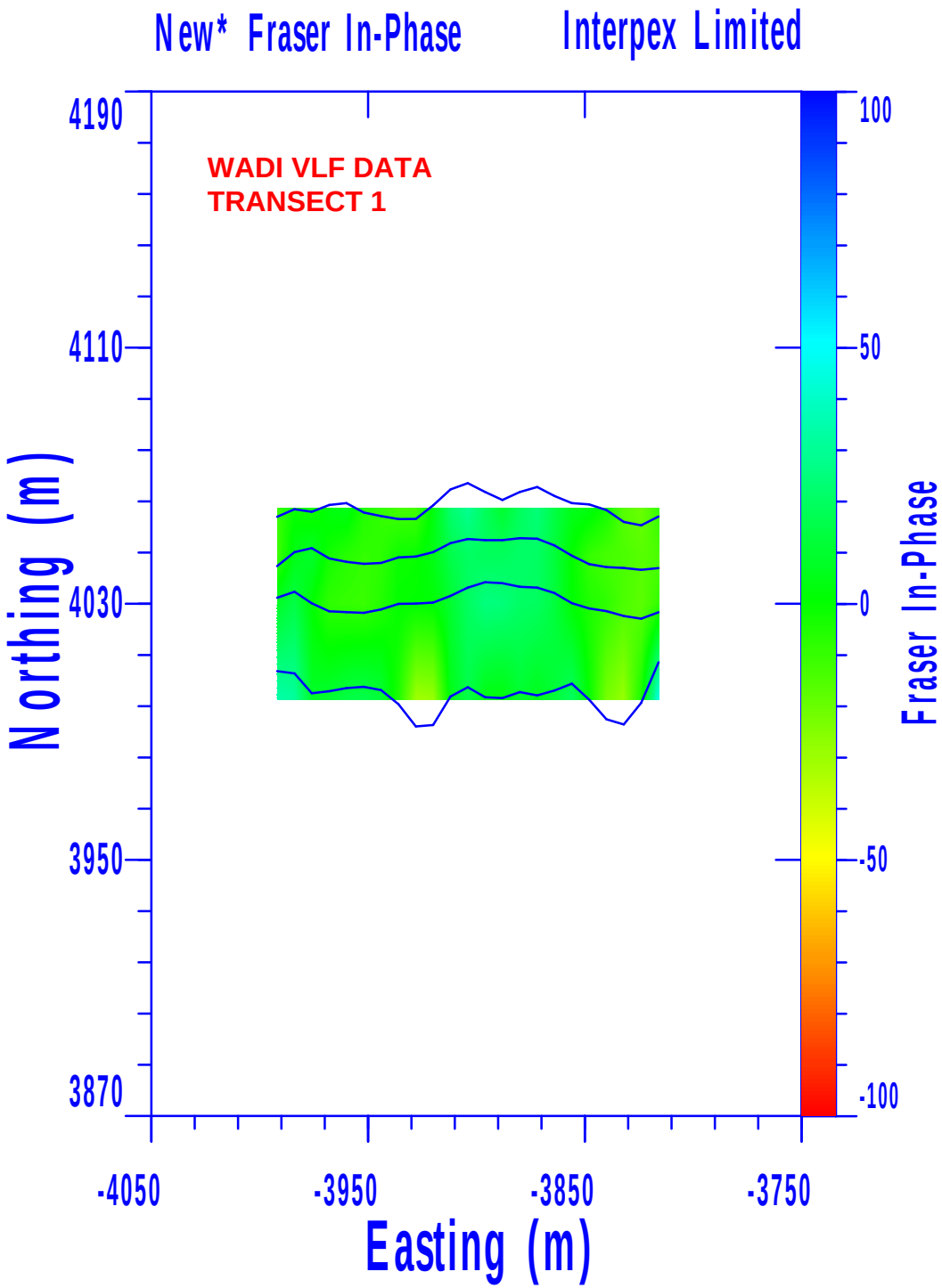
APPENDICES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Interpex Limited
WADI VLF DATA
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4030
3950
3870
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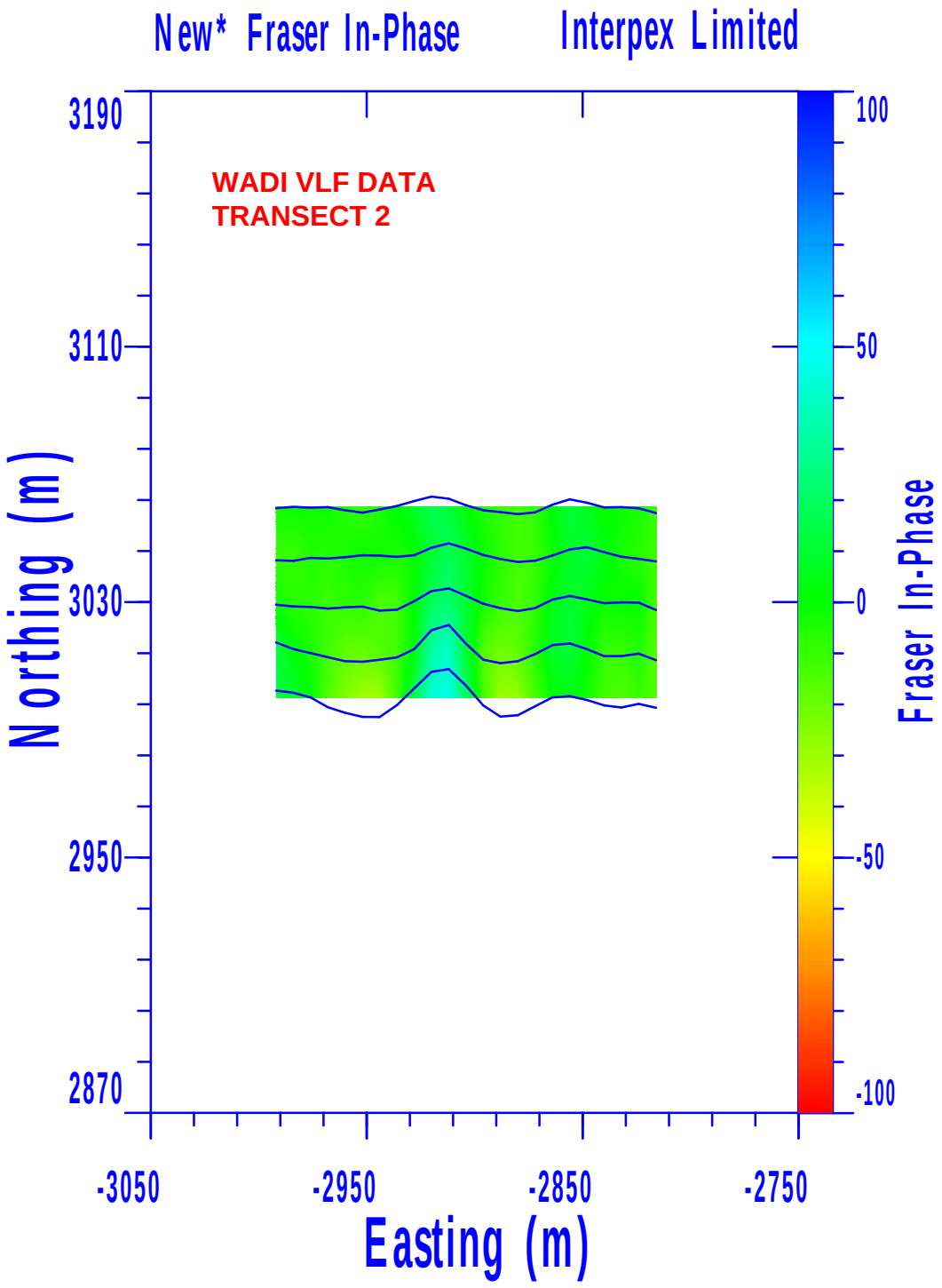
-3950
-3850
-3750
Easting (m)
100
50
0
-50
-100
Fraser In-Phase

DRAFT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Interpex Limited
WADI VLF DATA
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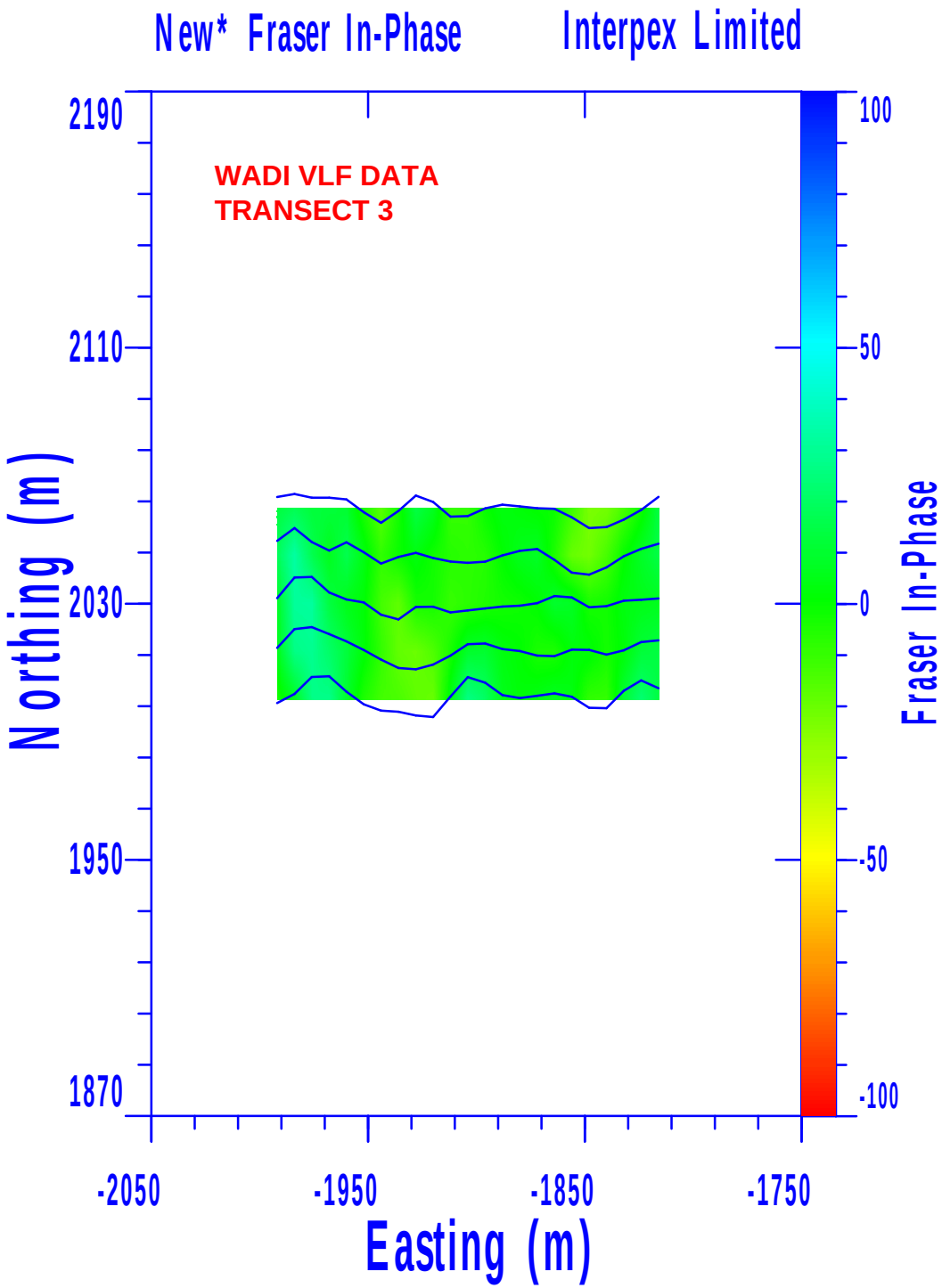
0
-50
-100
Fraser In-Phase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Interpex Limited
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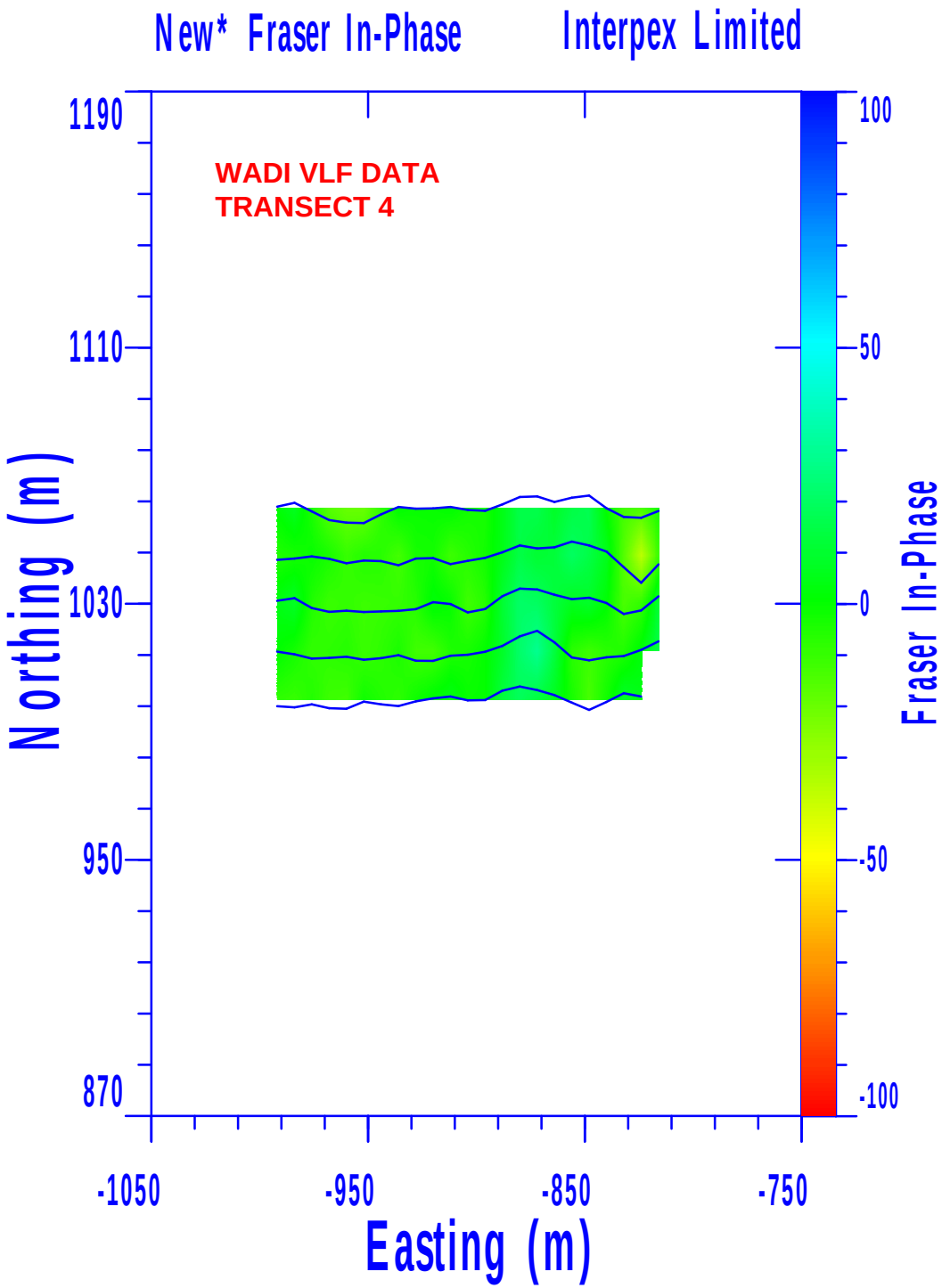
Fraser In-Phase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Interpex Limited
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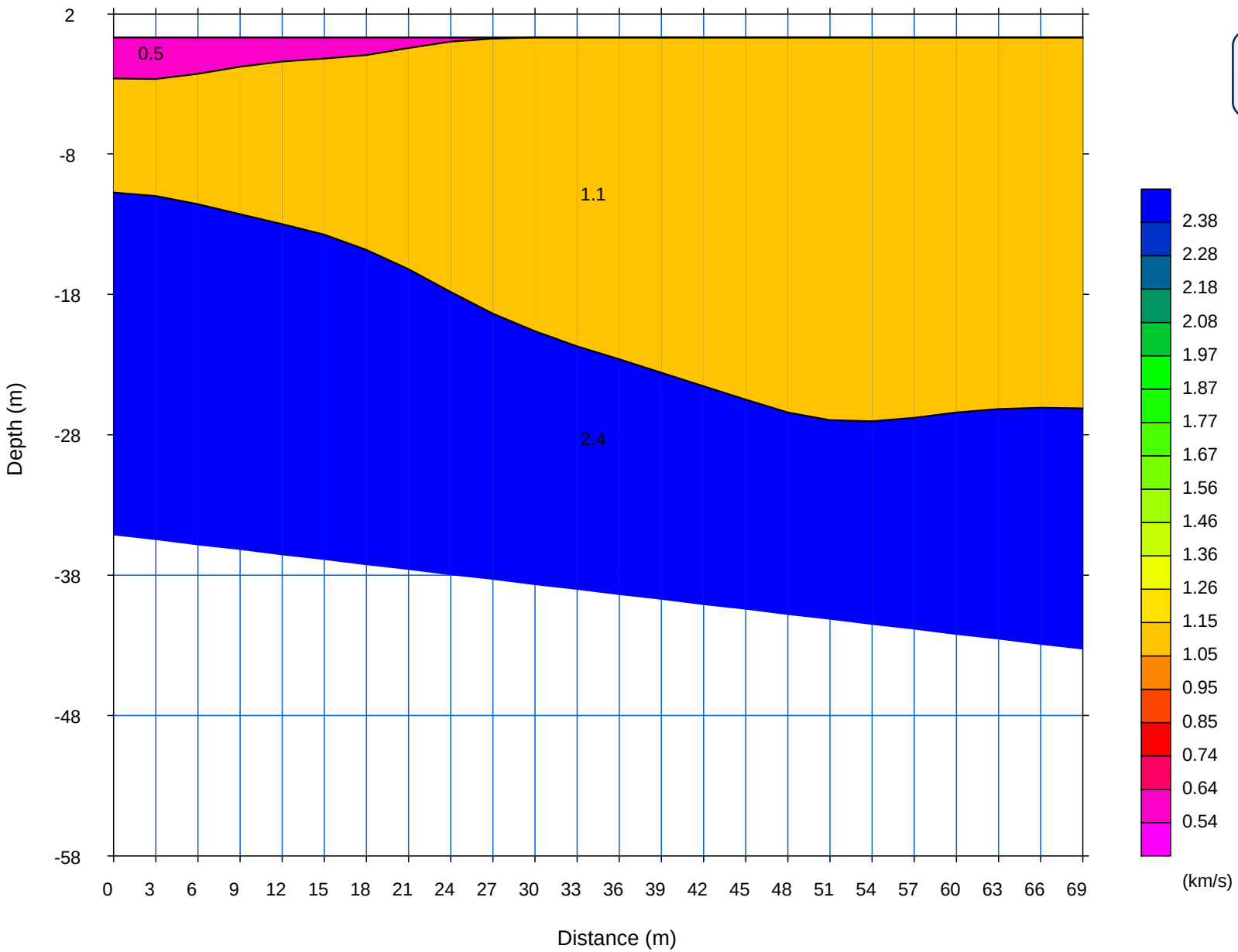
Fraser In-Phase



DRAFT

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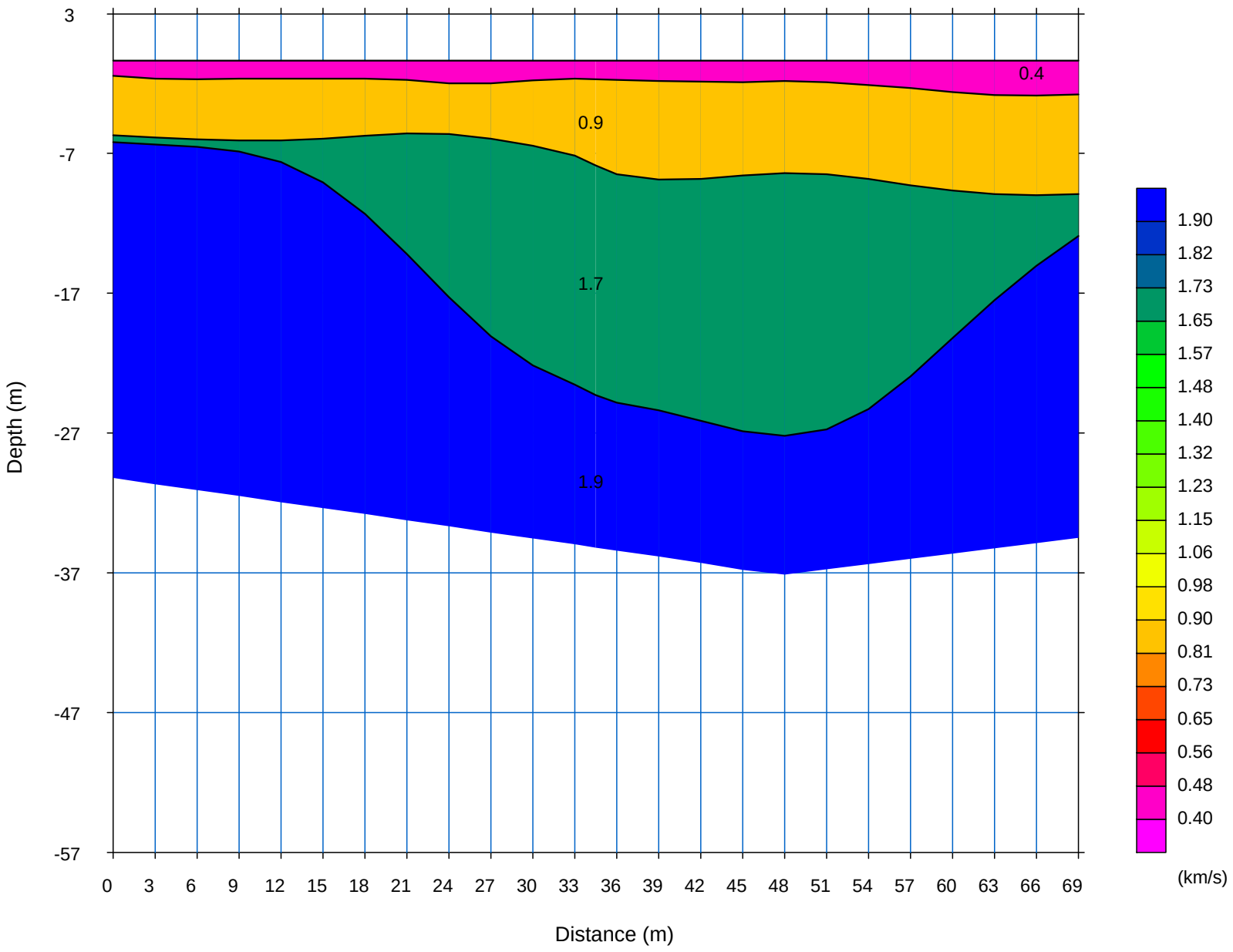
SEISMIC TRANSECT 1



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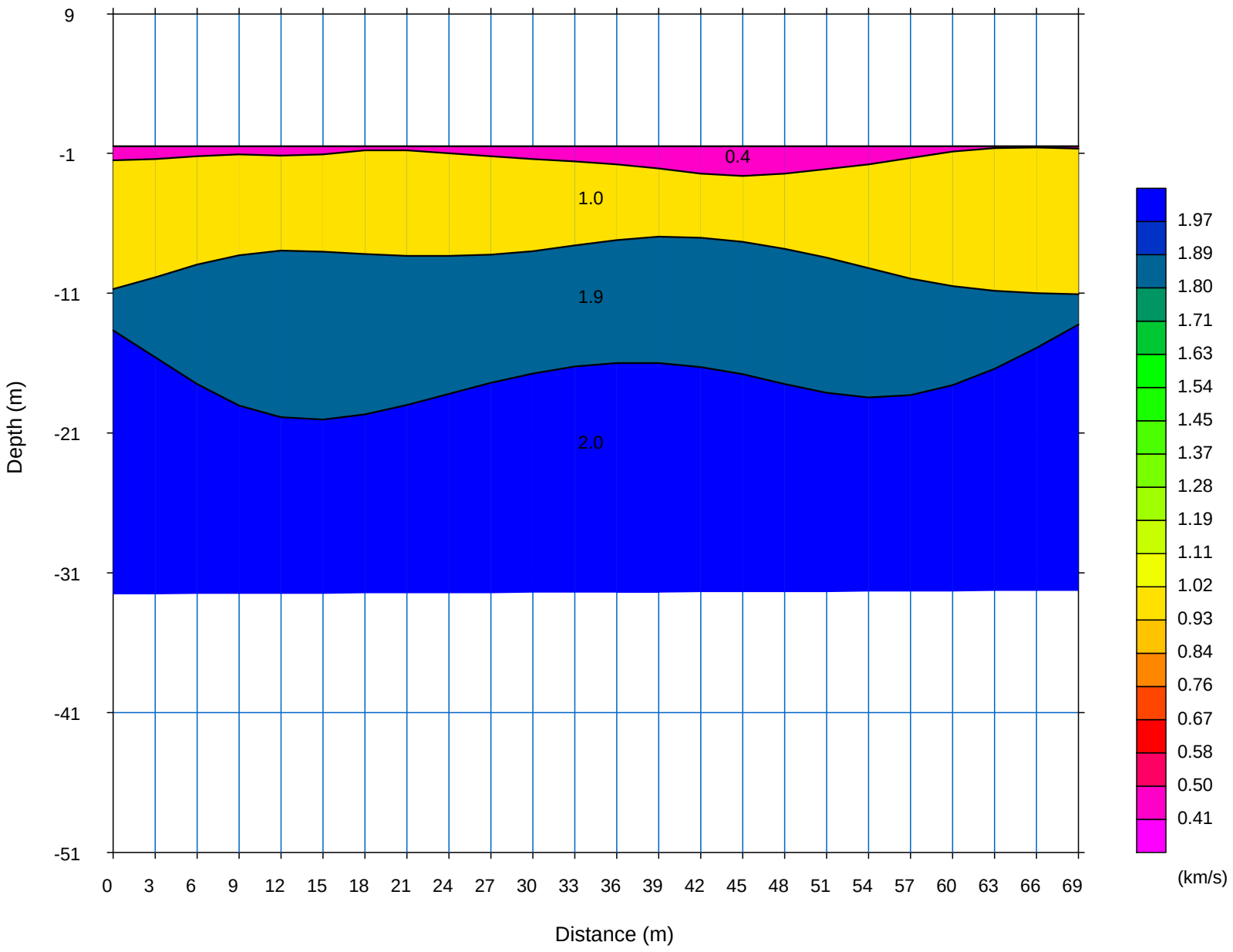
SEISMIC TRANSECT 2



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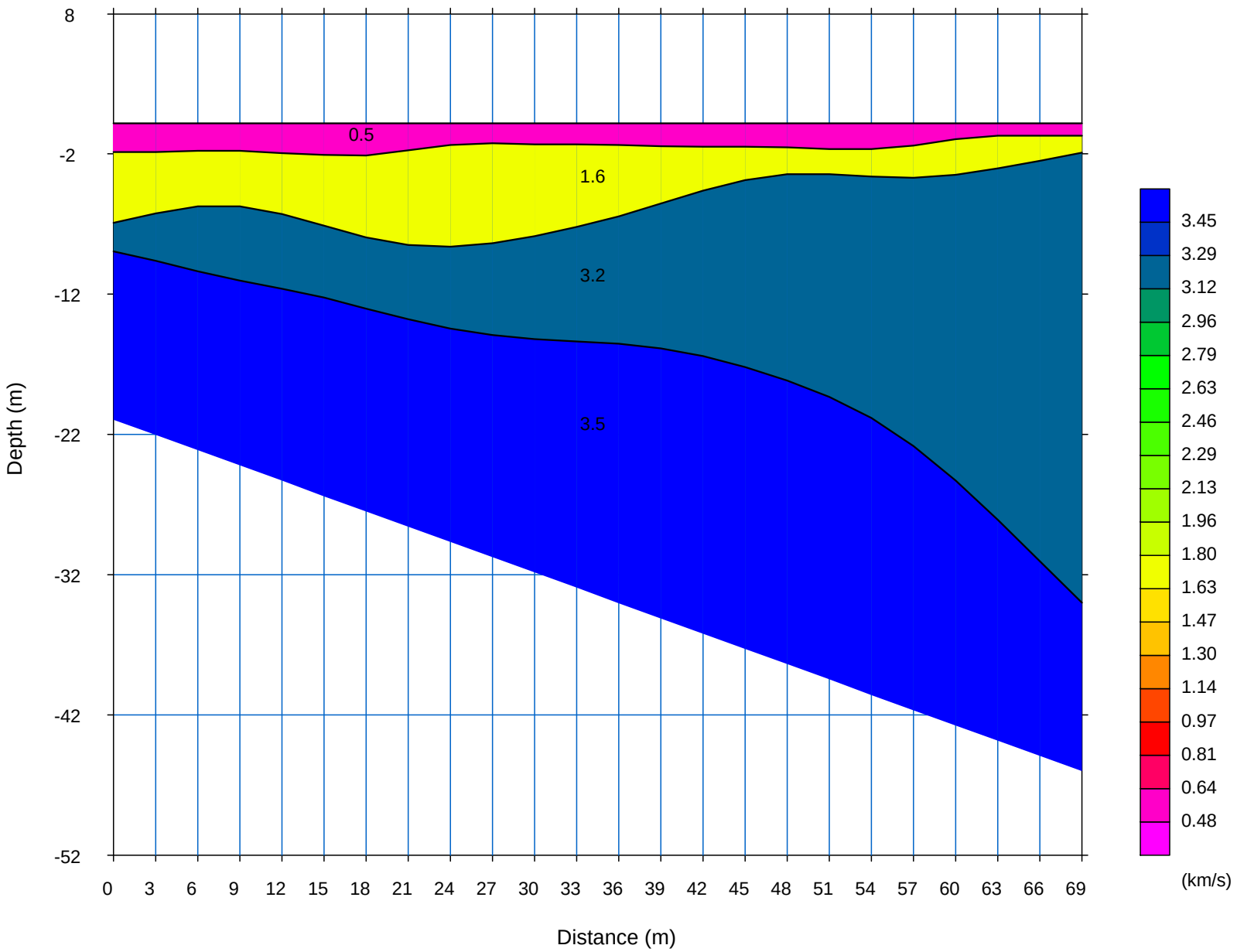

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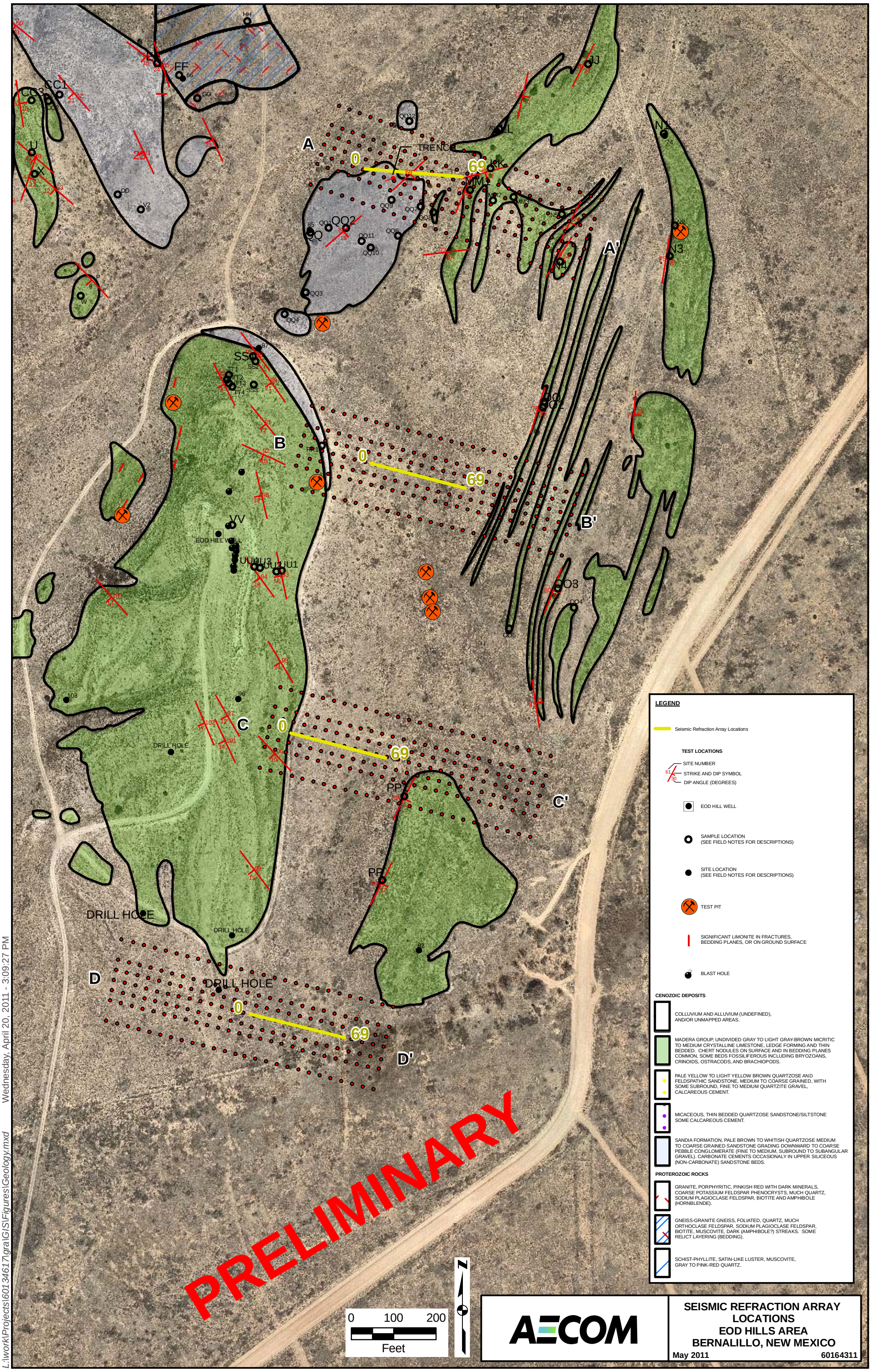

SEISMIC REFRACTION ARRAY LOCATIONS
EOD HILLS AREA
BERNALILLO, NEW MEXICO

May 2011 60164311

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USAF's RESPONSE TO NMED's July 18, 2011 and June 29, 2011 Questions
Regarding USAF's Geophysical Technical Memorandum of the EOD Hill Area

Previous response to NMED Comments attached in Appendix A.

July 18, 2011 Email Questions:

1. *Was there a reason the contractor didn't use the "interpret" button on the WADI? Also is there an easy way to show the data gaps along transect A where the lines crossed the trench (why weren't the lines run parallel to the trench instead of crossing it?).*

   Response:
   The ABEM Wadi instrument does have an "auto interpret" key and functionality, which provides a simple interpretation of dip angle and depth to anomaly. This concept is discussed in Section 3.11 and C10 of the ABEM Wadi user's manual here:

   http://www.abem.se/files/upload/WADI%20Instruction%20Manual%20200dpi.pdf

   A. AECOM's field geophysical team elected not to use a field-filtered instrument interpretation, but to focus on collecting the raw data and performing an interpretation during post-processing. In retrospect, AECOM and USAF recognize that the auto-interpret functionality may have served as an additional line of evidence for quick discrimination of buried structure or other anomalies at a field screening level.
   B. AECOM has prepared new figures that show only data stations where data was collected and contoured. Rather than showing an X we have simply removed the data point. The figures show the same contouring and data signatures as previously sent to NMED, but differ in not showing the "data gaps" along various transects. Rather than performing survey parallel to exposed trench (which was a construction work in progress, AECOM's field staff elected to stay clear of the area and stuck to a pre-constructed grid/survey array that was developed for geophysical data acquisition (i.e. we stuck to the original plan).The revised figures are shown in Appendix B.

June 29, 2011 Email Questions:

2. *I can't read the seismic files, but if your consulted produced a time distance graph that would suffice (or alternatively a first arrival pick at each phone for each shot, or maybe a quick phone call to see what we can do?)*

   Response:
   Time-Distance plots for the 4 seismic refraction lines are attached in Appendix C.

3. *I don't seem to find the figure ""Seismic Refraction Array Locations" provided to NMED". Could you forward me a copy?*

   Response:
   Seismic Refraction Locations Figure attached in Appendix C.

4. *For the WADI files labeled TransectX.wad what do the 3 columns represent?*

   Response:
   The three columns represent:

Column 1 = Station ID for each Transect
Column 2 = In-Phase Component
Column 3 = Quadrature Component

5. *For the magnetometer data labeled Transect_D.dat columns H, I and J seem to be missing as compared to Transect_A.dat*

   Response:
   These missing data columns are Station ID and State Plane Coordinate conversions. The coordinate data for Transect D were added in the contouring program.

APPENDIX A

USAF's RESPONSE TO NMED's June 7, 2011 Questions Regarding USAF's Geophysical Technical Memorandum of the EOD Hill Area

1. How was the data obtained across the trench? Which dots (or line segments if collecting continuous data - see question 3) have data in the trench area?

   RESPONSE: EM-31 data was not collected across the trench or spoils pile. In addition, data collection for the EM-31 was stopped when the southern-most interior line of the EM-31 data encountered the excavator and loader that were parked adjacent to the trench on the north side. EM-34 data was not collected across the trench due to access with the equipment. Magnetometer data was collected at each point within the five inner lines. WADI data was collected at each point along the northern, southern, and center lines of the inner five lines, of which the southern and center lines crossed the trench. The seismic line in the Transect A area, did not cross the trench.

2. If a contouring program was used for the colors, did it violate the data, and smooth through the data points?

   RESPONSE: Oasis Montaj was used to process the EM-31, EM-34 and Magnetometer data. The data was gridded using minimum curvature, which will smooth the dataset (will not affect the EM-31 data as it was collected continuously at a rate of 10 Hz). This algorithm creates the grid by continually applying an equation to the grid in an attempt to smooth the data. The minimum curvature algorithm is described by I.C. Briggs (*Machine Contouring using Minimum Curvature*, Geophysics, Vol. 39, No. 1, February 1974). The advantages of contouring data using minimum curvature is the method tends not to render weighting artifacts sometimes observed using other algorithms (inverse distance method, kriging and others).

3. For magnetometer and EM-31 – Is there continuous or point data? What is the station spacing for all the methods? Were any other lines run cross country to help the geologic mapping or get background data on the different geologic units?

   RESPONSE: Magnetometer data was collected on a point by point basis. EM-31 data was collected continuously except across the trench (see response to question #1). Station spacing for the EM-34 (with 10m coil separation), magnetometer, WADI was 7.5 meters. No other lines other than the four transect areas were completed in the EOD Hill area.

4. Did both the EM-34 and Wadi collect data along all 7 lines in a given transect and the EM-31 in the interior 5?

   RESPONSE: EM-31, EM-34 (with the exception of the two lines in transect A), and magnetometer data was collected along the interior five lines in each transect area (5 lines spaced at 7.5 meters). WADI data was collected along the two outlying transects, the two outermost lines of the interior group, and the centermost transect (for 5 lines spaced at 15 meters).

5. Magnetometer - provide the data.

   RESPONSE: Magnetometer data provided in the data packet.

6. EM-31 - provide the data, both in-phase and quadrature.

RESPONSE: EM-31 data provided in the data packet.

7. EM-34 - provide the data. How did you orient the transmitter and receiver, parallel to or perpendicular to the transect line? How was data obtained off both ends of the transects as shown on the figures? Wadi - provide the data - real and imaginary components,(vertical, horizontal) current density. What did the Wadi interpret when interpret button was pressed - did it interpret shallow, deep, or no features, and did it infer any dip direction to the features?

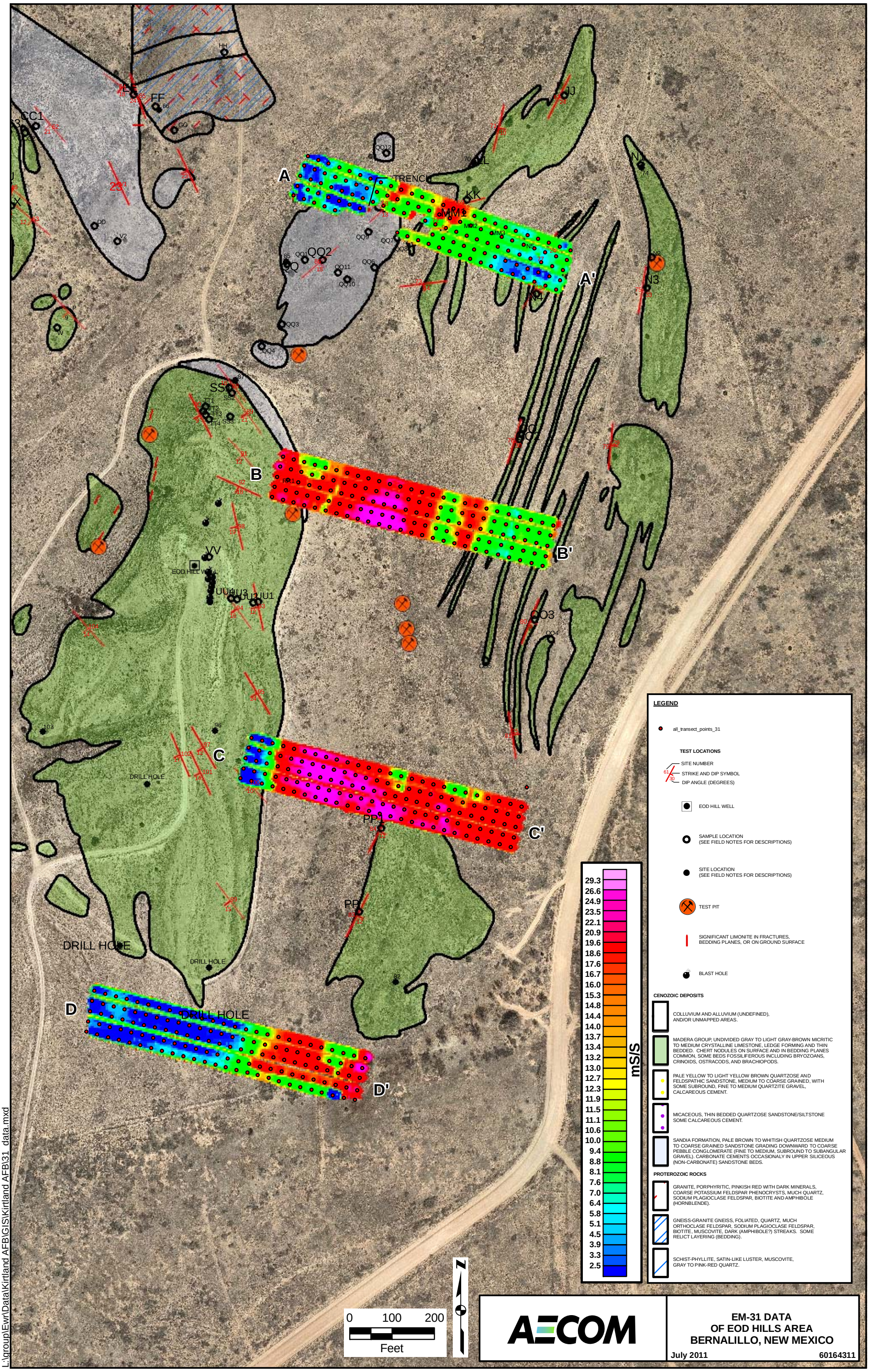
   RESPONSE: EM-34 data provided in the data packet. The EM-34 transmitter and receiver were oriented parallel to the transect lines. At the first station of a given transect the transmitter was placed at the station with the receiver behind the transmitter so that it was approximately 10 meters off the end of the transect. A reading was recorded, and the equipment was moved down the line until the transmitter was at the next station. This process was repeated until the transmitter was at the last station of a given transect. The orientation of the equipment setup was then rotated 180º and moved north (or south) to the next line with the transmitter at the first station. Data collection progressed in the opposite direction than that of the previous line.

   WADI data provided in the data packet. During the WADI data collection the interpret button was not utilized.

8. Seismic - time-distance plots (how many shot points per line, geophone spacing) - the color interpretations show the lines as about 230 feet long, but the transect lines are a lot longer. Where are the seismic lines located along the transects? How was the time distance-data interpreted, GRM?

   RESPONSE: Seismic lines were setup with 24 geophones at 10 foot spacing for a total length of 230 feet. Seismic line locations are presented in the figure *"Seismic Refraction Array Locations"* provided to NMED. Seismic data was interpreted using the Generalized Reciprocal Method.

APPENDIX B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PALE YELLOW TO LIGHT YELLOW BROWN QUARTZOSE AND FELDSPATHIC SANDSTONE, MEDIUM TO COARSE GRAINED, WITH SOME SUBROUND, FINE TO MEDIUM QUARTZITE GRAVEL, CALCAREOUS CEMENT.
MICACEOUS, THIN BEDDED QUARTZOSE SANDSTONE/SILTSTONE SOME CALCAREOUS CEMENT.
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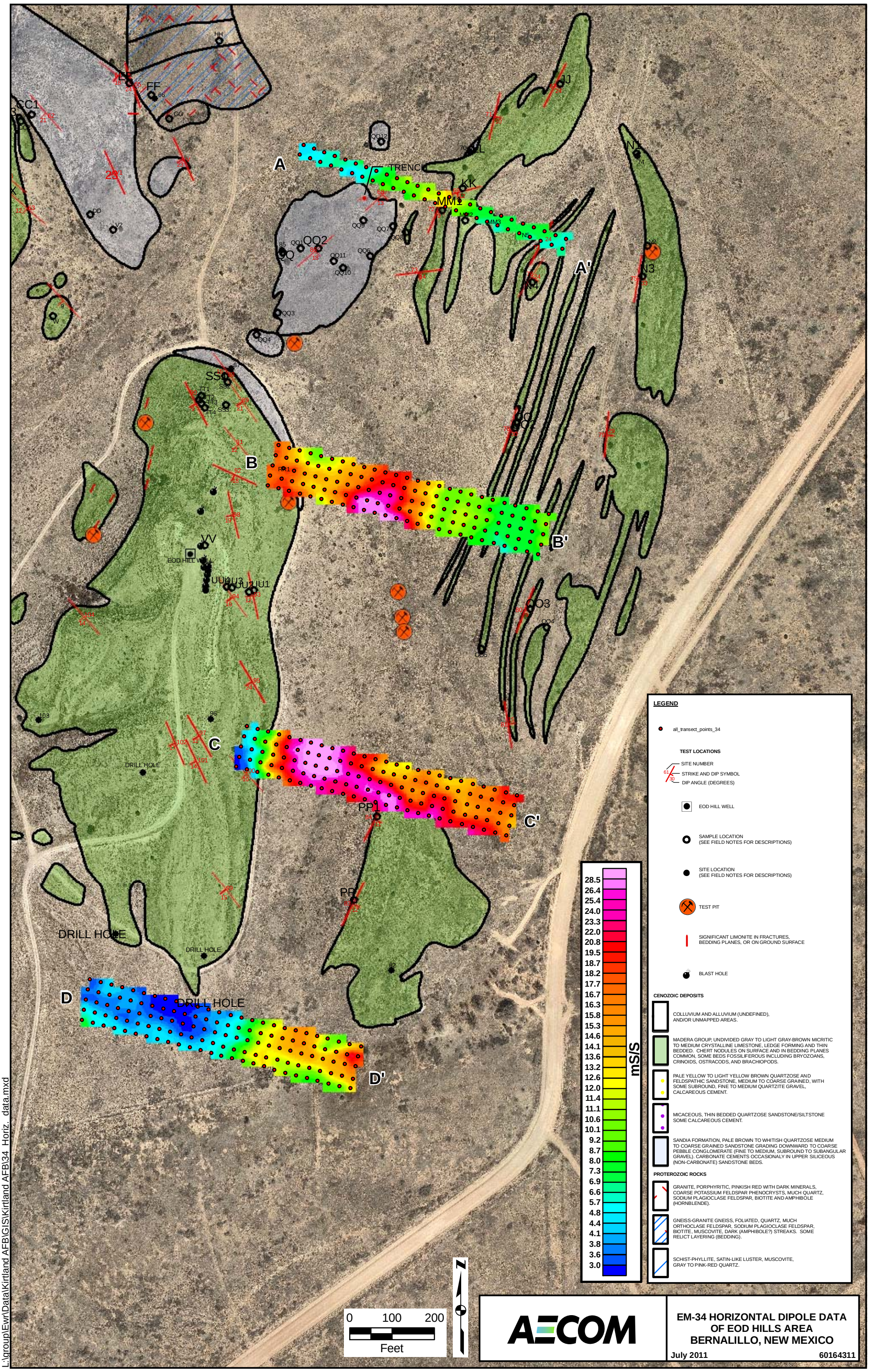

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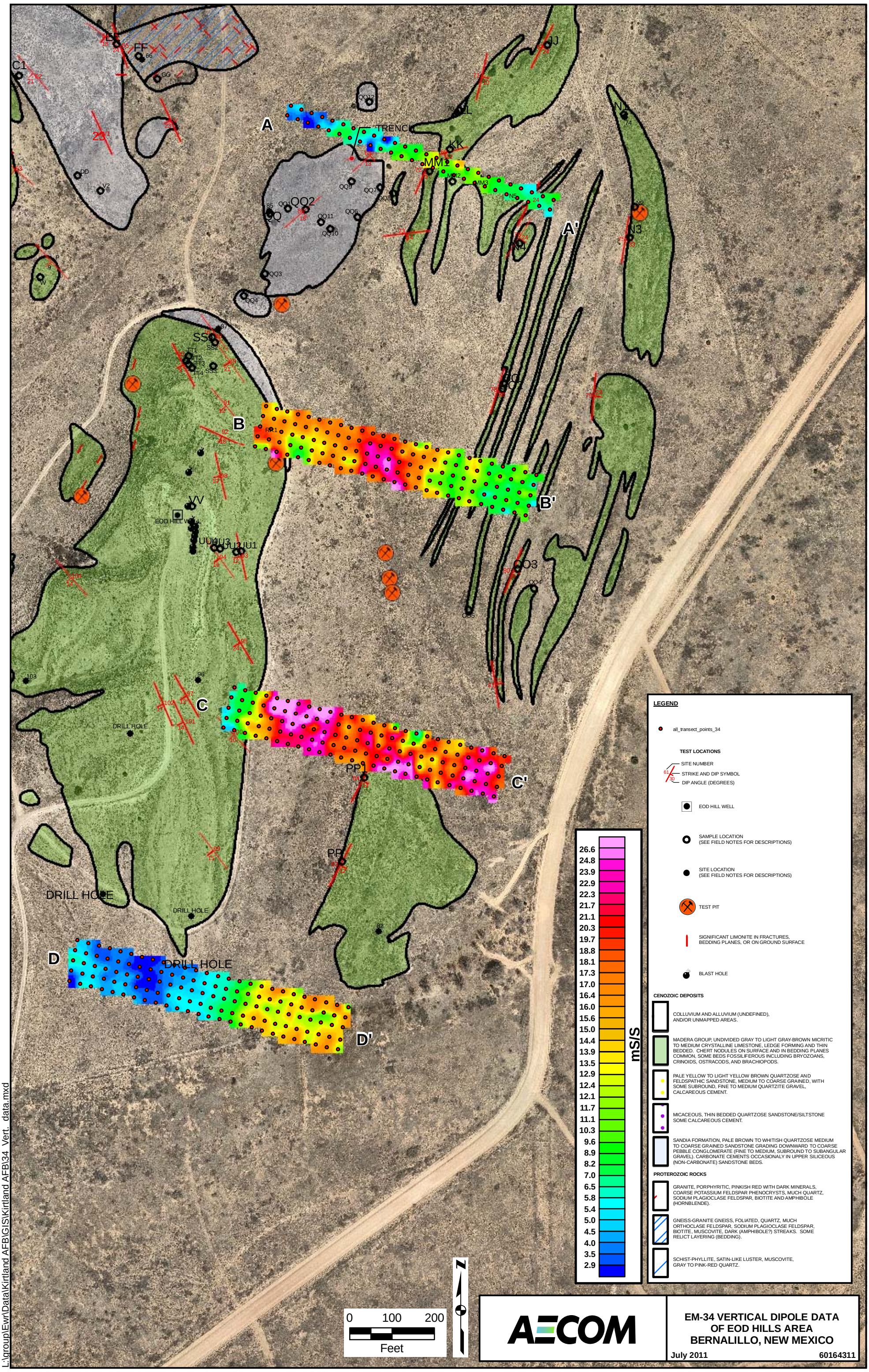

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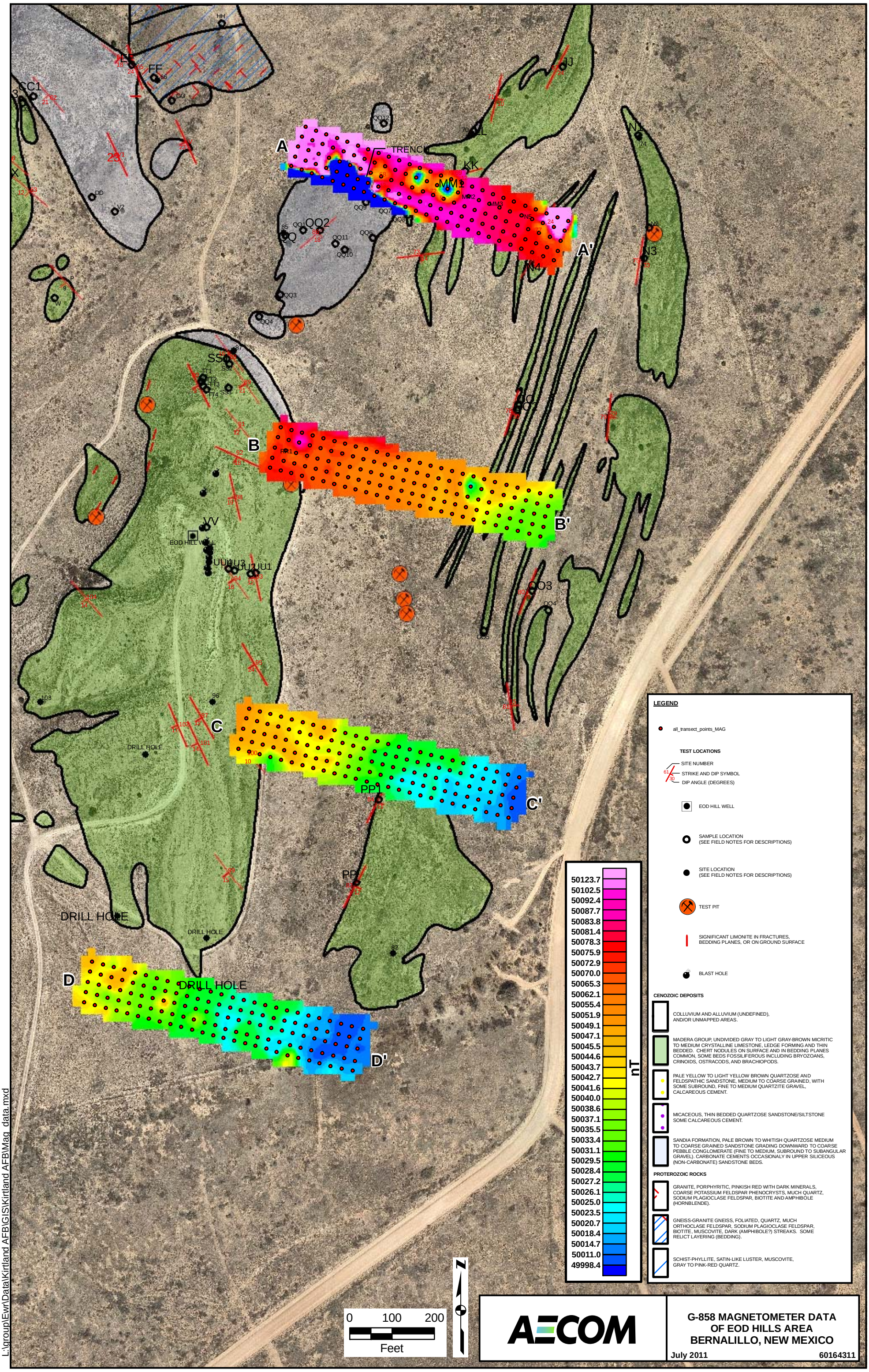
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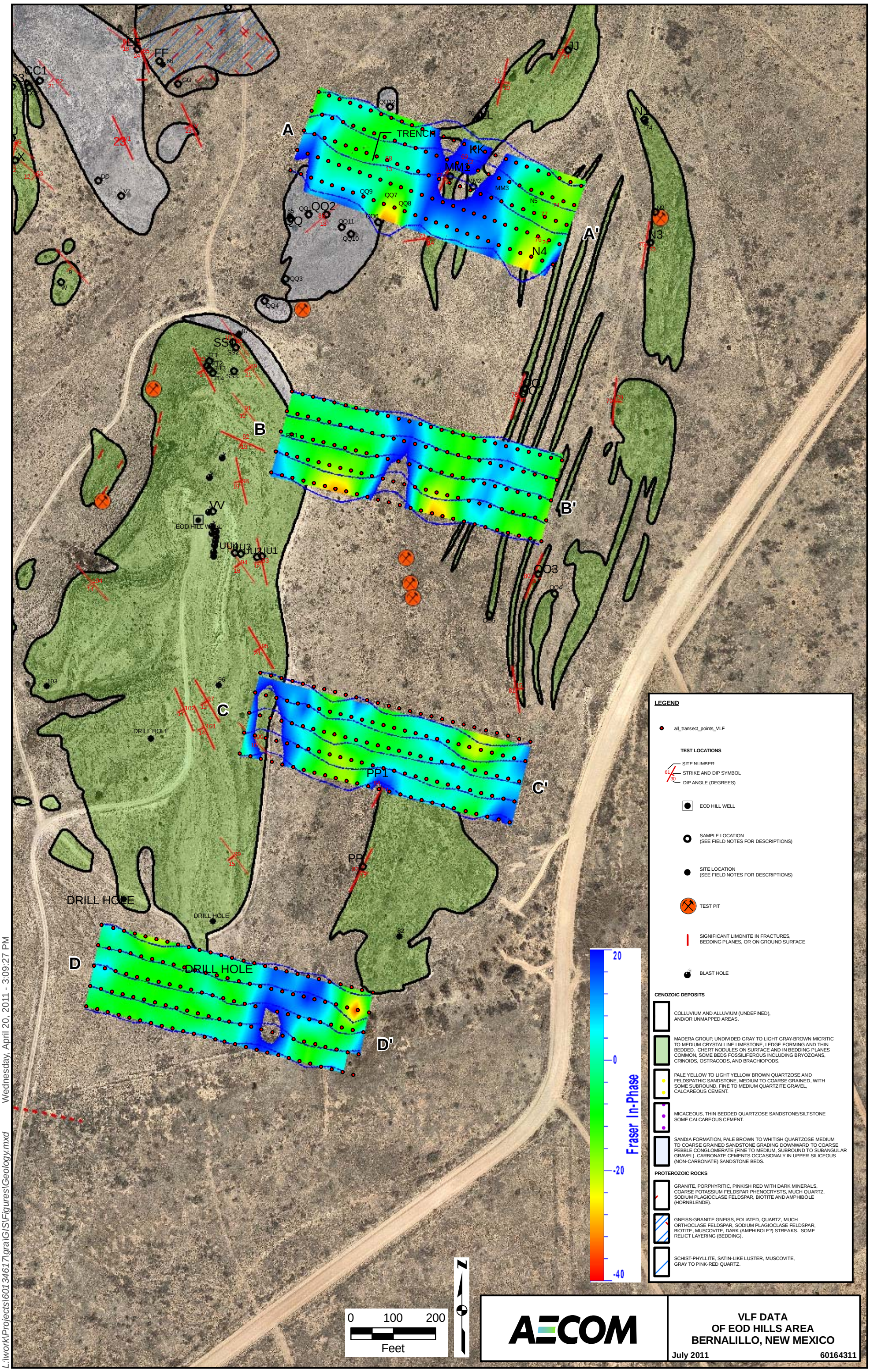

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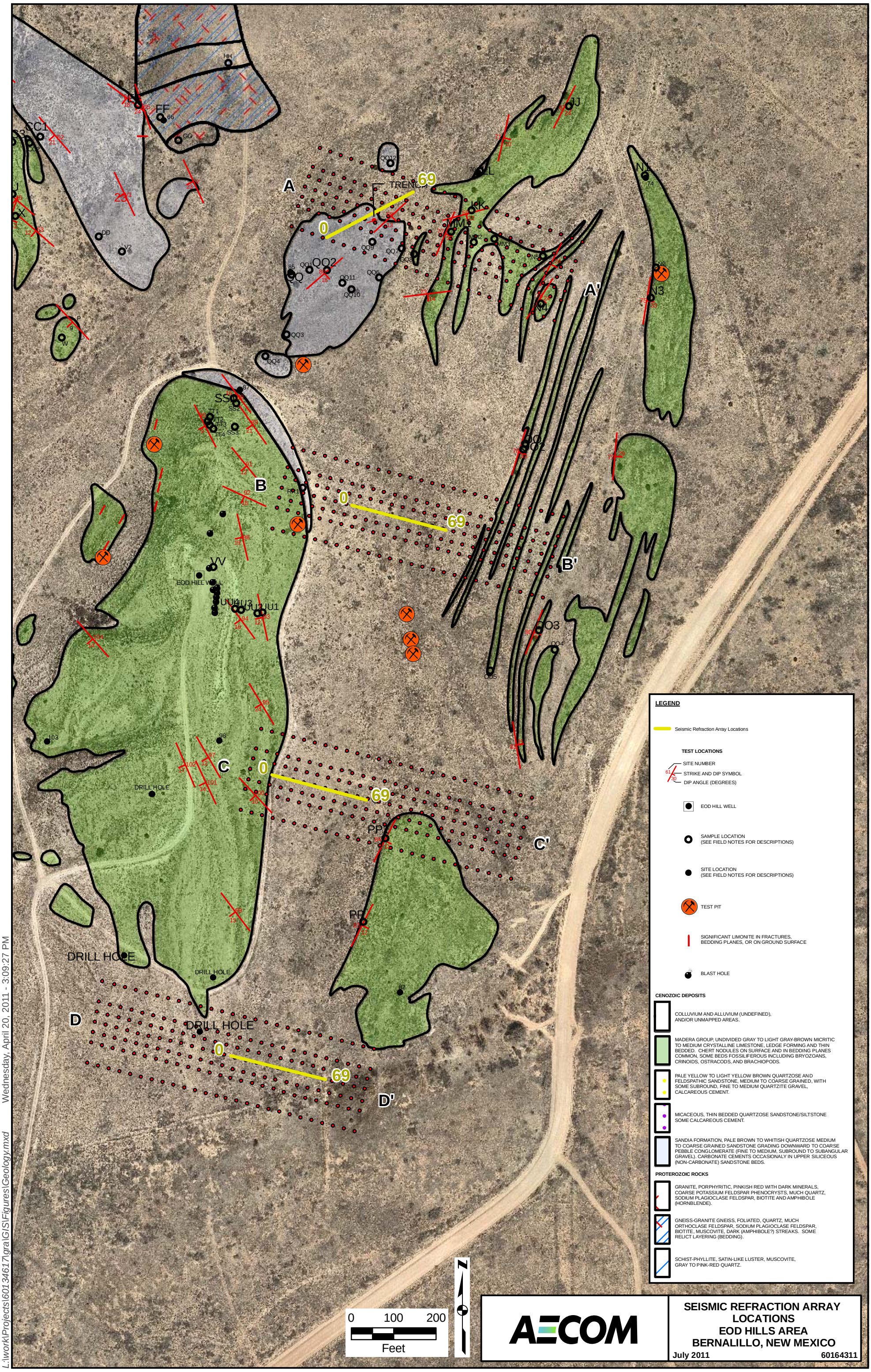
APPENDIX C



SEISMIC REFRACTION ARRAY LOCATIONS
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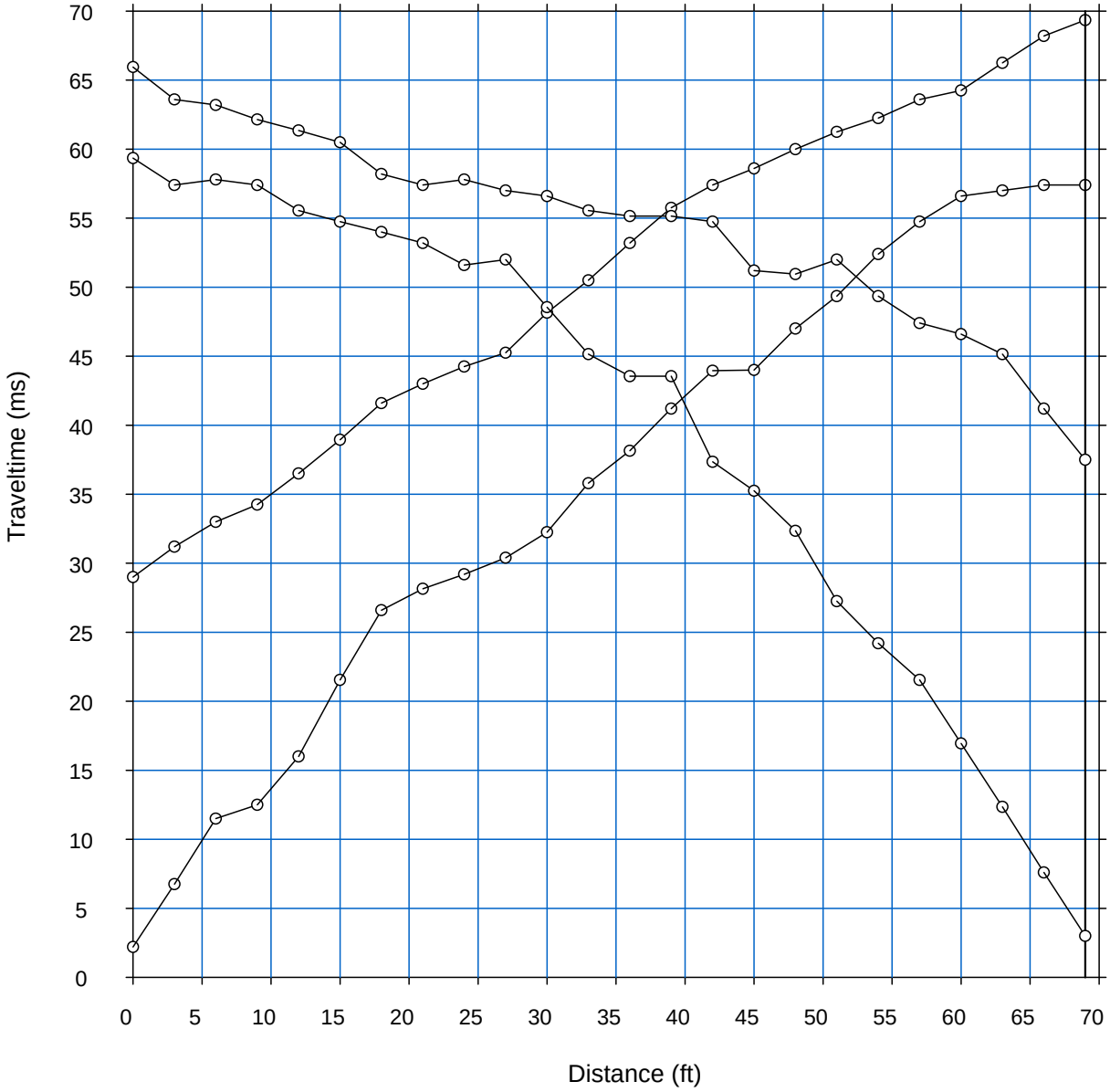

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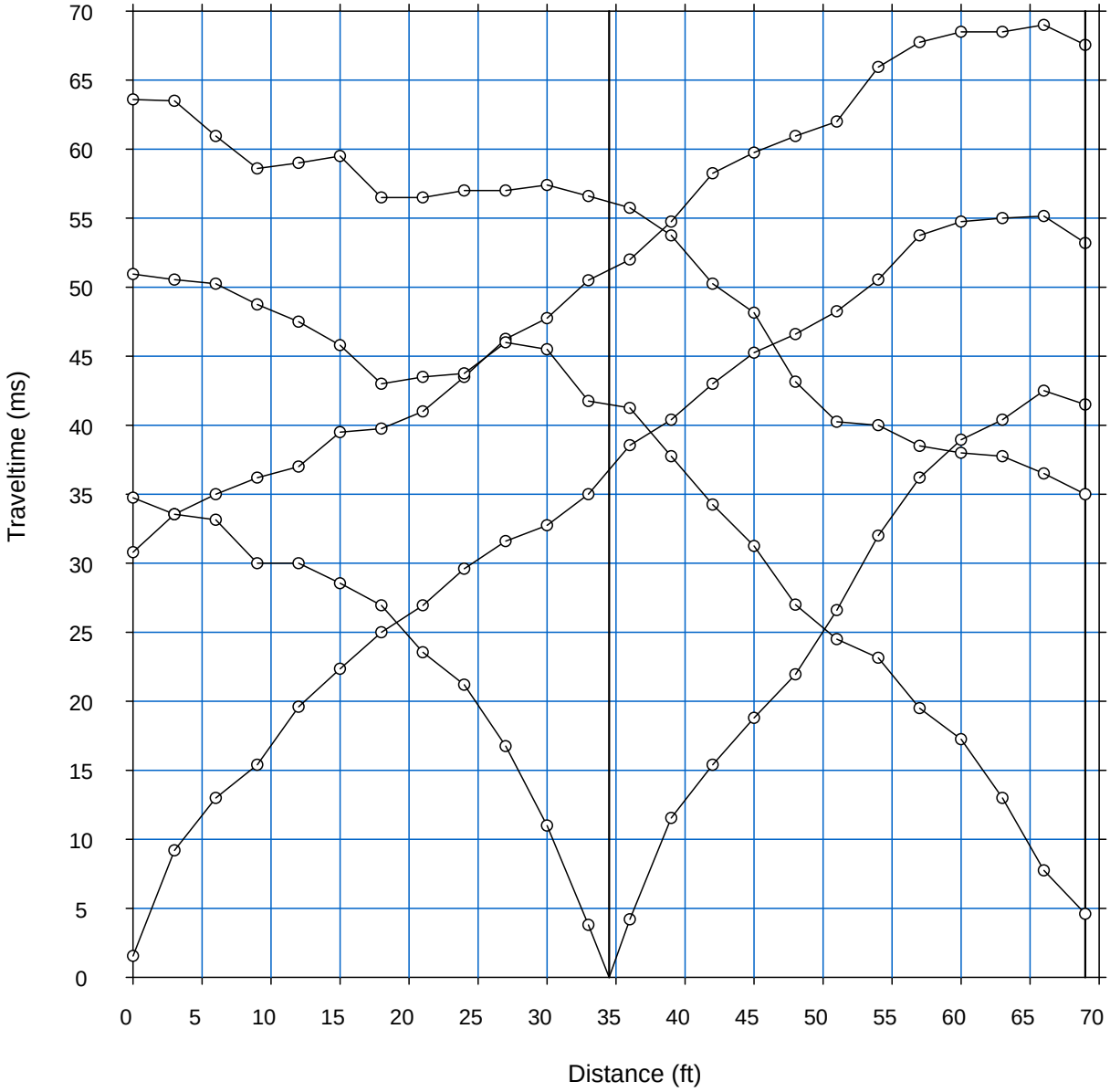

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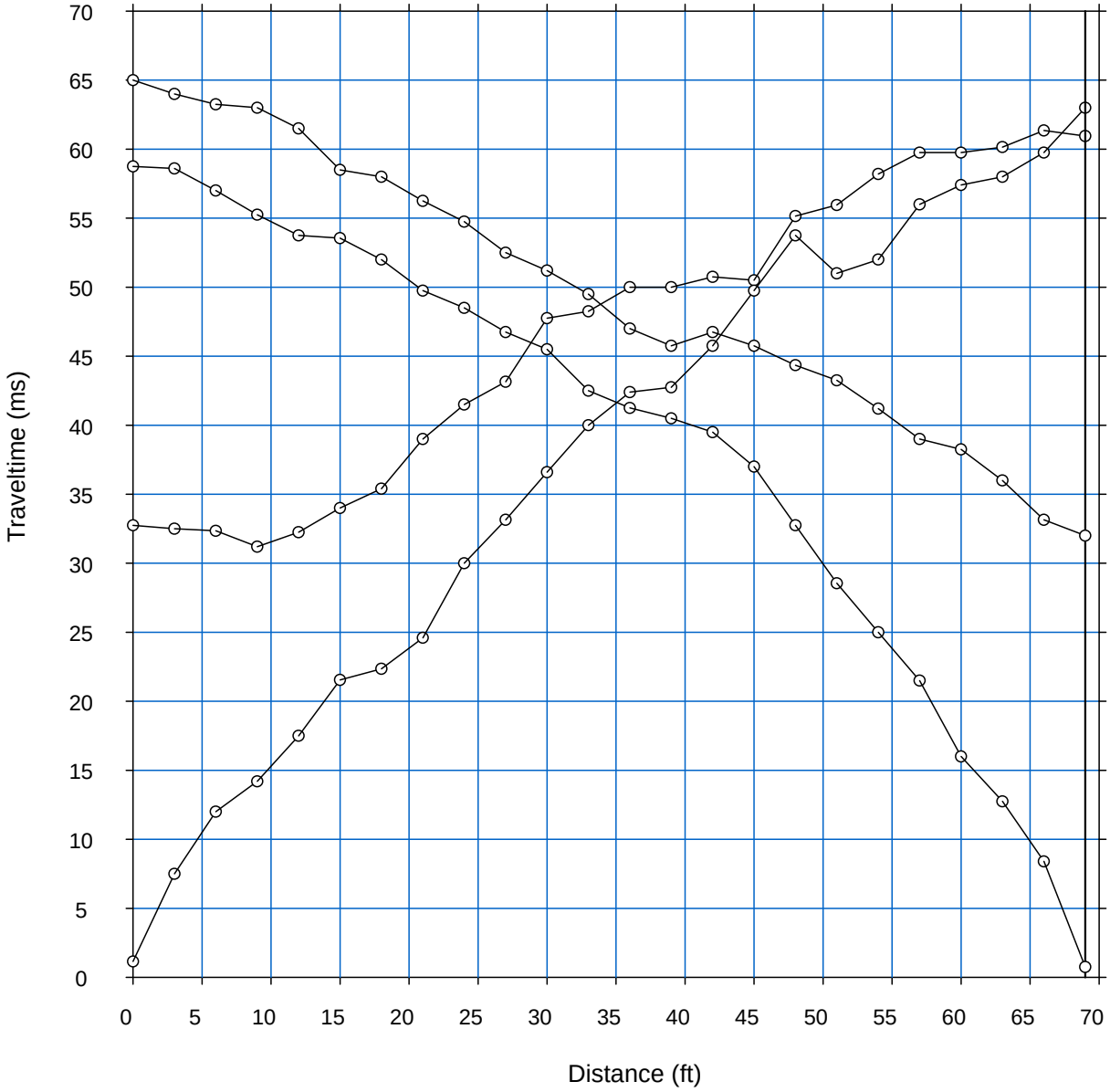

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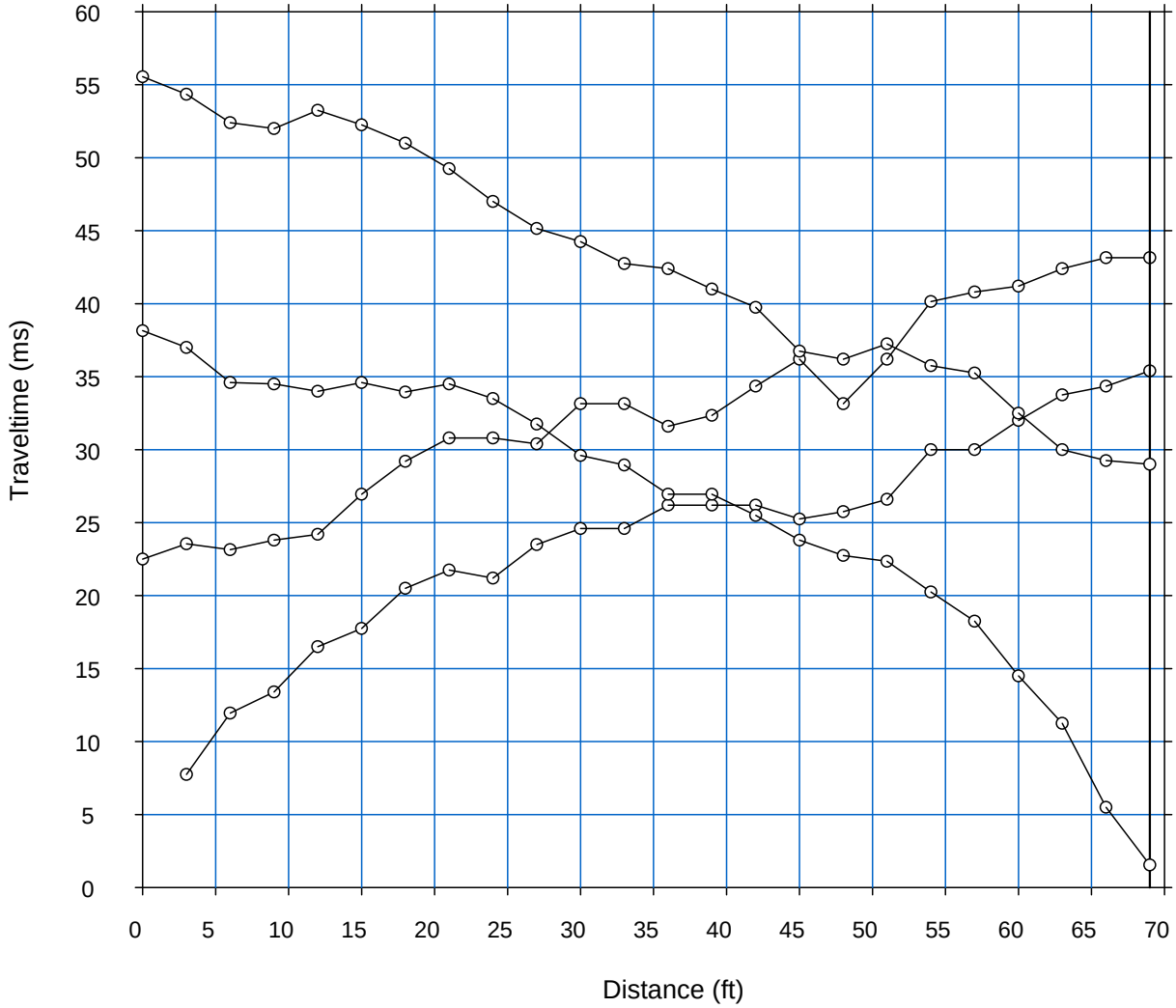

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APPENDIX H

KIRTLAND AIR FORCE BASE
ALBUQUERQUE, NEW MEXICO

Environmental Restoration Program
Community Relations Plan

October 2011

Prepared for Kirtland Air Force
Base Environmental Restoration
Section Albuquerque, New Mexico

Contract No. W912PP-10-P-0175

Submitted by
Bering Sea Environmental, LLC
4300 B Street, Suite 402
Anchorage, Alaska 99503

Prepared by
TLI Solutions, Inc.
560 Golden Ridge Road, Suite 130
Golden, Colorado 80401

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NOTICE

TLI Solutions, Inc. (TLI) prepared this document under subcontract to Bering Sea Environmental, LLC (BSEn). BSEn is the prime contractor to the U.S. Army Corps of Engineers under Contract No. W912PP-10-0175-ERP/MMRP RAB Support.

TLI prepared this Community Relations Plan (CRP) for Kirtland Air Force Base (AFB) Environmental Restoration Program (ERP) for the purpose of facilitating two-way communication with the community surrounding the Installation and to encourage community involvement in site activities.

The Kirtland AFB ERP CRP was first created in 1995 according to requirements stipulated in Module IV Special Conditions of the Hazardous and Solid Waste Amendments (HSWA) permit issued by the United States (US) Environmental Protection Agency (EPA)(USEPA) Region 6; the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA); the National Environmental Policy Act; the 1994 National Oil and Hazardous Substances Pollution Contingency Plan; and New Mexico state laws and regulations. Additionally, this CRP was prepared in accordance with EPA Superfund Community Involvement Handbook, dated April 2005, Section 324 National Defense Authorization Act of 1996 and 40 CFR §300.405, §300.415, §300.425, §300.430, and §300.435. Revisions may be made at any time and as site conditions change with the ERP.

The ERP CRP was last updated in 2005. The ERP CRP research contents supported with performance contract are current through May 2011; however some edits were made in October 2011, including the report date. The Air Force will continue to keep the community informed of ongoing activities as needed, as well as any new environmental activities should they emerge. To achieve these goals, some broadly applicable approaches will be employed as standard practices in all specific community involvement activities.

A copy of this document is available for review at the Joseph M. Montoya Campus Library [Central New Mexico (CNM) Community College, 4700 Morris St. NE, Albuquerque, New Mexico].

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40 CFR §270.11
DOCUMENT CERTIFICATION
OCTOBER 2011

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

DAVID J. HORNYAK, Colonel, USAF
Commander

This document has been approved for public release in accordance with Department of Defense Directives and Air Force Instructions.

KIRTLAND AIR FORCE BASE
377th ABW Public Affairs

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ACRONYMS AND ABBREVIATIONS

ABCWUA	Albuquerque Bernalillo County Water Utility Authority
ABW	Air Base Wing
AFB	Air Force Base
AFCEE	Air Force Center for Engineering and the Environment
AFMC	Air Force Materiel Command
AFNWC	Air Force Nuclear Weapons Center
AFSWC	Armed Forces Special Weapons Command
AMC	Air Materiel Command
AOC	Area of Concern
AFI	Air Force Instruction
AR	Administrative Record
ARES	Advanced Research Electromagnetic Simulator
BSEn	Bering Sea Environmental, LLC
CA	Corrective Action
CAA	Clean Air Act
CAB	Citizen Advisory Board
CAG	Citizen Action Group
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CEVR	Civil Engineering Environmental Compliance
CFR	Code of Federal Regulations
CM	Corrective Measures
CMD	Corrective Measures Design
CMI	Corrective Measures Implementation
CMS	Corrective Measures Study
CNM	Central New Mexico
CRP	Community Relations Plan
CSE	Comprehensive Site Evaluation
CWA	Clean Water Act
DERP	Defense Environmental Restoration Program
DoD	Department of Defense
DoDD	Department of Defense Directive
DOE	Department of Energy
DOT	Department of Transportation
DTRA	Defense Threat Reduction Agency
EA	Environmental Assessment
ECP	Environmental Compliance Program
EO	Executive Order
EOD	Explosive Ordnance Disposal
EPA	Environmental Protection Agency
ER	Environmental Restoration
ERA	Environmental Restoration Account
ERP	Environmental Restoration Program
ET	Evapotranspiration
FAA	Federal Aviation Administration

FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FOIA	Freedom of Information Act
FS	Feasibility Study
HQ	Headquarters
HSWA	Hazardous and Solid Waste Amendments
HW	Hazardous Waste
HWA	Hazardous Waste Act
HWB	Hazardous Waste Bureau
HWMA	Hazardous Waste Management Act
HWP	Hazardous Waste Permit
GWQB	Groundwater Quality Bureau
ICM	Interim Corrective Measures
IM	Interim Measures
IR	Information Repository
IRP	Installation Restoration Program
LNAPL	Light Non-Aqueous Phase Liquid
MAP	Management Action Plan
MMRP	Military Munitions Response Program
MOU	Memorandum of Understanding
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NDAA	National Defense Authorization Act
NFA	No Further Action
NMDHE	New Mexico Department of Health & Environment
NMED	New Mexico Environment Department
NMEID	New Mexico Environmental Improvement Department
NOD	Notice of Deficiency
NRC	Nuclear Regulatory Commission
OSHA	Occupational Safety and Health Act
PSHs	Phase-Separated Hydrocarbons
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
RAB	Restoration Advisory Board
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
RHMA	Radioactive and Hazardous Materials Act
RI	Remedial Investigation
RPA	Radiation Protection Act
RSI	Request for Supplemental Information
SAP	Sampling Analysis Plan
SAR	SWMU Assessment Report
SARA	Superfund Amendments and Reauthorization Act
SDWA	Safe Drinking Water Act
SNL	Sandia National Laboratories

SOW	Special Operations Wing
SVE	Soil Vapor Extraction
SWMA	Solid Waste Management Act
SWMU	Solid Waste Management Unit
TAPP	Technical Assistance for Public Participation Rule
TLI	TLI Solutions, Inc.
TSCA	Toxic Substances Control Act
TSD	Technical Support Document
TVI	Technical Vocational Institute
US	United States
USEPA	United States Environmental Protection Agency
UST	Underground Storage Tank
VA	Veterans Administration

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1. INTRODUCTION

1.1 Overview

The Environmental Restoration (ER) section at Kirtland AFB, New Mexico, prepared this CRP in order to assess the effectiveness of current community relations activities and to improve them as necessary. The specific objectives of this CRP are to: provide the community with ER related information; establish two-way communication between Kirtland AFB and its neighbors; respond to community concerns and needs that may arise during base clean-up efforts; provide effective management of the CRP; and fulfill the Department of Defense (DoD) and Air Force objective of "maximum disclosure with minimum delay."

This plan is organized to allow for ease of readability.

- Section 1, Introduction, provides an overview and purpose of the community relations plan, to include goals and objectives.
- Section 2, Installation Background, provides an installation description, history, and site chronology of Kirtland AFB.
- Section 3, Environmental Restoration Program (ERP), provides information on regulatory guidance that was applied by the Kirtland AFB ERP, the ERP process, and the Restoration Advisory Board (RAB)/Citizens Advisory Board (CAB).
- Section 4, Community Background presents the demographic data for the Bernalillo and Valencia counties to include a listing of the Neighborhood Associations and Community Centers adjacent to Kirtland AFB
- Section 5, Community Relations Program, provides community interviews and interview results.
- Section 6, Communication Activities and Techniques lists methods used for sharing all and any new developments at Kirtland AFB.
- Section 7, Freedom of Information Act (FOIA) provides information on submitting a FOIA request, fees and the FOIA handbook.

A Military Munitions Response Program (MMRP) CRP dated December 2008 has also been developed and is available for review on the Kirtland AFB website in the Environmental Issues section.

1.2 Purpose of the CRP

The purpose of this CRP is to establish an effective community-interactive program that informs the community about Kirtland AFB's ERP and provides for early and continuous community involvement in the cleanup process. This CRP is designed as a planned approach to establishing and maintaining two-way communication between Kirtland AFB and its surrounding community during lengthy and complex technical processes. An interactive communication system enables the community and those implementing the ERP at Kirtland AFB to convey information to each other, provide responses to questions and concerns, and formulate more responsive actions. Thus, community relations activities benefit both local citizens and Kirtland AFB by providing all parties with insight and first-hand information on continuous ERP efforts.

The CRP maps out a recommended course of action that the ERP team will implement to facilitate public involvement. Under the Resource Conservation and Recovery Act (RCRA), review of permit applications, issuance of permits and administrative orders, permit modifications, implementation of

corrective action (CA) programs, and approval of closure plans are all activities that require varying degrees of public involvement.

1.3 Goals and Objectives

Community participation is an important aspect of a site or installation cleanup. The Kirtland AFB ERP community relations program seeks to continue to facilitate communication that has existed between Kirtland AFB and local citizens for many years. The overall objective of the CRP is to increase direct communication with individual citizens who are interested in the Kirtland ERP.

Currently, Kirtland AFB meets the following five objectives of the community relations program:

Objective #1: Fulfill Federal Information Availability Requirements
Because the Kirtland AFB ERP follows CERCLA and RCRA protocols, information availability requirements apply. These information availability requirements include developing a CRP; establishing an IR; maintaining an ERP AR; providing public comment opportunities on major documents; conducting public meetings on proposed plans for site decisions; and responding to public comments.
Objective #2: Educate community members about all ERP activities.
Open availability of information of information to all members of the public. A positive working relationship with the community requires community members to have some understanding of the basis for environmental clean-up and site closure decisions. Effective risk communication is a hallmark of a successful CRP.
Objective #3: Encourage Involvement in the Kirtland AFB ERP
Experience has shown that a successful ERP requires the community's trust and support. The community interest on the Bulk Fuels Facility revealed that Kirtland AFB has earned a fairly solid foundation of public support and trust. This foundation can be expanded and strengthened by encouraging public participation in Kirtland AFB's environmental activities. A key goal of the CRP is to encourage a level of public involvement that will support a working relationship based upon open communication. Creating a climate of positive interest in Kirtland AFB can result in greater community involvement and trust in the ERP and consistency is critical.
Objective #4: Develop a Partnership between Kirtland AFB and the Community
Information, education, and a positive working relationship are key components to forming a successful partnership between Kirtland AFB and the community. This partnership will ensure that decisions are made that meet the requirements of the ERP, the community, and the regulators. This partnership is essential to accomplishing timely and cost-effective site closures.
Objective #5: Maintain communication at all times
Maintain communication with everyone. A positive working relationship with the community requires community members to have some understanding of the basis for environmental clean-up and site closure decisions. Effective risk communication is a hallmark of a successful CRP.

2. INSTALLATION BACKGROUND

2.1 Installation Description

Kirtland AFB is located in southeast Albuquerque, Bernalillo County, New Mexico. The installation is adjacent to the City of Albuquerque airport, the Albuquerque International Sunport. Kirtland AFB occupies approximately 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.

Kirtland AFB employs over 21,000 people, including more than 3,300 active duty personnel, 1,131 National Guard personnel, and 3,748 Federal civilian employees. The installation is home to the 377th Air Base Wing (ABW), Kirtland AFB's host organization.

Kirtland AFB is home to the Air Force Nuclear Weapons Center (AFNWC) and its subordinate wings, the 498th Nuclear Systems Wing and the 377th ABW. It is also home to the Defense Threat Reduction Agency (DTRA) Albuquerque office, the Air Force Safety Center, the Air Force Inspection Agency, the Air Force Operational Test and Evaluation Center, the 58th Special Operations Wing (SOW), Space Development and Test Directorate, the New Mexico Air National Guard 150th Wing, the Directed Energy and Space Vehicle Directorates of the Air Force Research Laboratory, the Department of Energy (DOE) Albuquerque Office, the National Nuclear Security Administration and Sandia National Laboratories (SNL). A general site map of Kirtland AFB can be found in Appendix A.

2.2 History

Kirtland AFB’s beginnings stem from three private airfields which operated in 1928-1939 and are similar to that of other installations choosing to adapt existing runways and hangars for military use. In 1928, Frank G. Speakman and William L. Franklin, two Santa Fe railroad employees, had inaugurated a private venture for an airport. Working with the town of Albuquerque, they graded two runways on the East Mesa, one approximately 5,300 feet long and the other just under 4,000 feet. Albuquerque Airport was wholly a private venture, irrespective of the town's involvement. Immediately following construction of the airport, other individuals and promoters became interested in Albuquerque as a crossroads location for southwestern air traffic. James G. Oxnard, a New York air transportation promoter, bought Franklin's interest in Albuquerque Airport, expanding the facility toward the end of 1928.

As the decade closed, two airlines initiated competitive passenger, mail, and cargo service between the Midwest and California, positioning Albuquerque as an important transcontinental airfield. Shortly after beginning activities, one of the companies, Western Air Express, decided to build its own airport on the West Mesa. This airport became known as Albuquerque Airport, while the former Albuquerque Airport on the East Mesa took on the name Oxnard Field, continuing as a private venture.

As of late 1939, Army and Navy pilots began using Oxnard Field for refueling and maintenance during a variety of military flights. Later that same year, the Army Air Corps leased 2,000 acres neighboring Albuquerque Airport, four miles west of Oxnard Field. The Army eventually bought the Oxnard Field property and its subsequent transfer to the federal government restricted the runways to military use only.

Construction of Albuquerque Army Air Base began in January 1941 and was completed in August 1941. The first Albuquerque Army Air Base commander, Colonel Frank D. Hackett, arrived in March 1941. The following month, base received its first military aircraft. On April 1, 1941, a lone B-18 bomber, piloted by Lieutenant Sid Young, landed on the north-south runway. With the assignment of five pilots to the aircraft, the day marked the official opening of Albuquerque Army Air Base.

The summer of 1941 saw the arrival of the first troop train, loaded with 500 base support personnel, as well as arrival of the 19th Bombardment Group (19th BG) under the command of Lt. Col. Eugene L. Eubank. Business on the new airfield really began to boom with the arrival of 2,195 pilots, bombardiers, and navigator trainees for the new B-17 "Flying Fortress." The 19th BG moved out shortly thereafter for duty in the Philippines and South Pacific, where many crewmembers were decorated for bravery. Even in the absence of the 19th BG, activity at Albuquerque Army Air Base increased. Just a week after the attack on Pearl Harbor, the first class of bombardiers began with the establishment of the Army's first wartime advanced flying school.

In February 1942, Albuquerque Army Air Base was renamed Kirtland Army Air Field in honor of Col. Roy C. Kirtland, one of the Army's oldest pioneers in aviation. Colonel Kirtland is one of the early Army pilots, receiving in 1911 Certificate No. 46 from the Federation Aeronautique Internationale. He also holds Expert Aviatior License No. 11 from the Aero Club of America. From April to June, 1911, he was in charge of the U.S. Aviation School at College Park, Maryland. Since the airfield originally opened, Kirtland's aircraft inventory had grown to 50 AT-11s and 28 B-18s.

The war years at Kirtland continued to be filled with distinguished records of training entire flight crews for the B-17 and B-24 bombers and Kirtland AFB’s three schools; advanced flying, bombardier training and the multi-engine school, operated at full capacity. In February 1945, Kirtland Field also engaged in training combat crews for the B-29. This was the "Superfortress" which eventually brought an end to the hostilities with Japan by dropping atomic bombs on Hiroshima and Nagasaki, nicknamed Fat Man and Little Boy.

In February 1946, Kirtland was placed under the Air Materiel Command (AMC) and its flying training activities ceased. Its new job entailed flight test activities for the Manhattan Engineering District, the wartime organization that produced the atomic bomb. The new role for Kirtland was to develop proper aircraft modifications for weapons delivery and to determine ballistic characteristics for weapons of the future.

Kirtland's role in testing and evaluating these special weapons increased in 1947, as the U.S. Army Air Forces became the U.S. Air Force. At that time, Kirtland Army Air Field, with a population of 972 military and civilian personnel, became Kirtland AFB. Most of the weapon proving was conducted on a 46,000-acre tract in the Manzano Mountains, on the southern part of Kirtland AFB, including Forest Service lands withdrawn for testing purposes. Artillery emplacements were set up; observation stations were built; fragmentation areas were prepared; and two 248-foot oak towers were erected near the present day Starfire Optical Range. The establishment of such activities at Kirtland was considered ideal because of its proximity to Los Alamos Laboratory and to Sandia Base, where the Department of Defense (DoD) had established the Armed Forces Special Weapons Command (AFSWC) to direct military employment of the new weapons to be built.

The story of Kirtland AFB is really the story of three bases, since the merger in 1971 of Kirtland, Manzano and Sandia Bases that brought the three installations together under one command. Sandia Base was originally created in 1942 as Albuquerque Air Depot Training Station for aircraft maintenance personnel. By late 1943, however, Sandia was in a caretaker status. A year and a half later, the Manhattan Engineering District created the Armed Forces Special Weapons Project at Sandia Base to coordinate military special weapons activity.

The AFSWC also constructed two operational sites. One was known as Site Able, located in the foothills of the Manzano Mountains, just east of Sandia Base. On February 22, 1952, Site Able was renamed Manzano Base and came under operational control of the Air Force.

In December 1949, Kirtland AFB became headquarters for the newly created Special Weapons Command. The nucleus of this organization was composed of pioneering Air Force agencies that had located here to determine future employment of special weapons. The command became the AFSWC on April 1, 1952, and was a unit of the Air Research and Development Command. The Special Weapons Center assumed management of the Air Force Systems Command's test and evaluation facilities at Holloman AFB, near Alamogordo, New Mexico, during the summer of 1970. Just one year later on July 1, 1971, Kirtland merged with Manzano and Sandia Bases, its neighbors to the east, creating a sprawling military complex known as Kirtland AFB.

The 377th ABW came under the Air Armament Center on October 1, 1998, reflecting the unique mission of the wing within AFMC as the Air Force's premier munitions storage and maintenance unit. The 377th ABW supports organizations at Kirtland AFB and continues to have significant wartime mobility requirements in various critical specialties. On May 3, 2004, the 377th ABW came under AFMC Headquarters (HQ) as a Direct Reporting Unit. Currently, more than 21,000 people, including more than 10,000 people who work in nonfederal and civilian contractor positions, work at Kirtland AFB in the areas of base support, munitions maintenance, research and development, readiness, homeland security, and military technology.

In order to support DoD missions at Kirtland AFB, large quantities of petroleum, oils, lubricants, solvents, and other materials have been used (including radioisotopes and other radioactive materials), resulting in the generation of various wastes. As a result of past waste and resource management practices at Kirtland AFB, various chemical constituents have appeared in soil and groundwater in some areas of Kirtland AFB. In response to federal and state environmental laws and regulations, the Air Force initiated an ERP at Kirtland AFB. In coordination with ERP activities, Kirtland AFB manages the Environmental Compliance Program (ECP) sites in a manner to meet environmental restoration goals. The MMRP has been established to manage cleanup of unexploded ordnance, discarded military munitions, and munitions constituents at closed ranges.

Table 2-1 History of Operations at Kirtland AFB

Period	Type of Operations	Aircraft	Chemical Use Activities
Prior to 1928	Rangeland	None	None
1928-1930	Oxnard Field Constructed	None	Construction
1930-1939	• Refueling/Maintenance Stop • Airfield Expansion	Miscellaneous Bombers	Fuel/Oil Storage
1939-1941	Aircraft Mechanic Training	B-17 Bombers	Fuel/Oil Storage
1941	Army Base Construction	B-17 Bombers	Construction/Demolition
1941-1944	• Training of Signal, Ordnance Medical, and Chemical Warfare Units • Flight Training School • Aircraft Mechanic Training	AT-11 Trainers; B-17, B-24, B-18A, and LB-7 Bombers	• Construction/Demolition • Fuel/Oil Storage • Weapons Storage • Bombing Runs • Landfills

Period	Type of Operations	Aircraft	Chemical Use Activities
1944-1948	• Training Activities • Support for B-29 Bombers • Aircraft Salvage and Scrapping • Sandia Base Construction • Armed Forces Special Weapons Project • 188th Fighter Bomber Group	AT-11 and T-6 Trainers; B-17, B-18A, B-26, B-29, and B-36 Bombers; F-51, P-39, P-40, P-51, and P-47 Fighters	• Construction/Demolition • Fuel/Oil Storage • Weapons Storage • Weapons Handling • Metal Smelting • Disposal of Chemical Wastes • Landfills • Sewage Treatment • Explosives Storage • Explosives Handling
1949-1959	• Sandia Base Operated by Western Electric for the Atomic Energy Commission • Site Able/Manzano Base Operated by Armed Forces Special Weapons Project • 188th Fighter Bomber Group	B-36, B-45, B-47, B-52, and B-57 Bombers; C-47 Cargo; F-86, F-80, F-100, and F-102 Fighters; T-6 Trainers	• Engineering and Weapons Development • Explosives Testing • Weapons Storage • Fire Training • Landfills
1960-1976	• Research and Development • 150th Tactical Fighter Group	A-7D Corsair II	• Storage, Development and Testing of Weapons Systems • Support to Tenant Units Including DOE • Pesticide Usage • Landfills • Low-Level Radioactive Waste Disposal • Radiation Training • Fire Training • Sewage Treatment • Explosive Ordnance Disposal (EOD) • Explosives Testing
1976-1984	• 150th Tactical Fighter Group • 1550th Aircrew Training and Testing Wing of the Military Airlift Command Aerospace Rescue and Recovery Service • Air Force Contract Management Division • Research and Development	Helicopters: CH53, H-3E, H-60, HC-13H, HH-53, MH-53, MH-60G, TH-1F, UH-1, UH-60A, and UH-60L; also A7-D Corsair II and HC-130P Cargo	• Fuel/Oil Storage • Equipment Maintenance • Fire Training • Landfills • Low-Level Radioactive Waste Disposal • Radiation Training • EOD • Pesticide Usage • Explosives Testing
1984-1994	• 150th Tactical Fighter Group	Helicopters: CH53, H-3E, H-60, HC-	• Fuel/Oil Storage

Period	Type of Operations	Aircraft	Chemical Use Activities
	• 377th ABW • 542nd Crew Training Wing • 1550th Combat Crew Training Wing • 1606th ABW	13H, HH-53, MH-53, MH-60G, TH-1F, UH-1, UH-60A, and UH-60L; also A7-D Corsair II and HC-130P Cargo	• Equipment Maintenance • Fire Training • Landfills • Radiation Training • EOD • Pesticide Usage • Explosives Testing
1994-Present	• 58th Special Operations Wing • 150th Wing • 377th ABW	Helicopters: HH-60G, MH53A, MH53J, UH-1H, UH-1N; C-12, HC-130, MC-130H; MC-130P Cargo; F-16 Fighters (departure date: September 2010) and CV-22 (arrival date: March 2006)	• Fuel/Oil Storage • Equipment Maintenance • Fire Training • Landfills • Radiation Training • EOD • Pesticide Usage • Explosives Testing

2.3 Site Chronology

A summary of the pertinent base-wide events related to the ERP, ECP and MMRP are presented in Table 2-2, Chronology of Key Base-Wide Events.

Table 2-2 Chronology of Key Base-Wide Events

Event	Date
Installation Restoration Program (IRP) Phase I Records Search Conducted.	1981
Kirtland AFB submits a RCRA Part B permit application for hazardous waste storage.	1984
New Mexico Environment Department (NMED) issues Notice of Deficiency to Kirtland AFB for RCRA Part B permit application. NMED determined that the permit application was incomplete.	January 1985
ERP Phase II Confirmation/Quantification Stage 1 Report submitted. Addressed five landfills, one fire training pit and one disposal area for irradiated organic materials.	March 1985
Preliminary Assessment Report prepared for Kirtland AFB on behalf of USEPA Region 6.	March 1986
USEPA Region 6 issues comments on the ERP Phase II Confirmation/Quantification Stage 1 Report.	June 1987
Air Force response to USEPA Region 6 comments on the ERP Phase II Confirmation/Quantification Stage 1 Report.	October 1987
New Mexico Department of Health & Environment (NMDHE) issues comments on proposed statement of work for Kirtland ERP Remedial Investigation/Feasibility Study (RI/FS) addressing 8 sites (LF-001, LF-002, LF-008, FT-013, SD-025, WP-026, OT-028, and OT-029).	July 1988

Table 2-2 Chronology of Key Base-Wide Events

Event	Date
USEPA Region 6 issues RCRA Facility Assessment (RFA) Report at the Kirtland AFB. A total of 108 sites identified in RFA Report.	August 1988
New Mexico Environmental Improvement Department (NMEID) issues a Compliance Order to Kirtland AFB requiring submittal of closure plan for solid waste management units.	September 1988
NMEID notifies Kirtland AFB that work proposed under the ERP RI/FS may be insufficient to meet the requirements for corrective action mandated by RCRA.	March 1989
Kirtland AFB submits to NMED a base-wide Closure Plan for Units requiring closure. Three specific units are included: WP-026 Sewage Lagoons, Golf Course and Golf Course Main Pond.	April 1990
NMDHE issues RCRA Operating Permit No. NM9570024423-1 to Kirtland AFB for the storage of hazardous wastes in three container storage areas.	July 1990
USEPA Region 6 issues a HSWA Permit to Kirtland AFB. HSWA Permit requires further investigation for 51 Sites and 4 Areas of Concern (AOCs).	October 1990
NMED issues Compliance Order No. 91701 which requires submittal of closure plans for three sites: WP-026 Sewage Lagoons, Golf Course and Golf Course Main Pond.	July 1991
NMED approves the closure plan for the WP-026 Sewage Lagoons. Closure requirements stipulated within the plan required Kirtland AFB to conduct a soil survey and quarterly groundwater sampling.	November 1991
Kirtland submits Stage 2B Resource Conservation and Recovery Act Facility Investigation (RFI) Work Plan to USEPA Region 6. This work plan addresses the following sites: RW-006, FT-014, WP-047, ST-070A(202/203), 070B (210), 070C (211), 070D (215/216), 070E, (219), 070F (247), 070G (248), 070H (258, 070I (260)), ST-071 (221), ST-072 (265), ST-073 (266), ST-201-267, ST-270-272, and ST-326.	January 1993
USEPA Region 6 issues comments on Stage 2B RFI Work Plan.	April 1993
Kirtland AFB submits response to comments on Stage 2B RFI Work Plan to USEPA Region 6.	May 1993
NMED approved a modification of closure plans for WP-026 Sewage Lagoons and Golf Course Pond to allow Kirtland AFB to perform a soil investigation by installing soil borings rather than conducting a soil gas survey.	May 1993
USEPA Region 6 approves Stage 2B RFI Work Plan.	June 1993
Kirtland AFB files for clean closure of the WP-026 Sewage Lagoons and Golf Course Pond.	August 1993
NMED denies clean closure of the WP-026 Sewage Lagoons due to chromium levels that exceeded regulatory limits in some groundwater samples collected from wells at the site. Kirtland AFB was required to address the issue in a post-closure plan.	September 1993
Kirtland submits Stage 2B RFI Report to USEPA Region 6.	December 1994
SNL and Kirtland AFB signed a Memorandum of Understanding (MOU) which indicated that Kirtland AFB would assume responsibility for the RW-006 site.	April 1995
USEPA Region 6 issues comments on Stage 2B RFI Report.	May 1995
Kirtland submits Final Stage 2B RFI Report and Notice of Deficiency (NOD) Response to USEPA Region 6.	July 1995
USEPA Region 6 issues comments on Final Stage 2B RFI Report and NOD Response dated July 1995.	September 1995

Table 2-2 Chronology of Key Base-Wide Events

Event	Date
USEPA Region 6 issues comments on Final Stage 2B RFI Report and NOD Response dated July 1995.	November 1995
Kirtland conducts Interim Corrective Measures (ICM) at seven solid waste management units (SWMUs) and one Nuclear Regulatory Commission (NRC) site. Sites addressed included: ST-060, WP-047, SS-065, RW-006, RW-010, RW-021, RW-068 and WP-016.	1996 - 1997
NMED approves the use of background concentrations from Background Concentrations of Constituents of Concern to the Sandia National Laboratories/New Mexico Environmental Restoration Project and the Kirtland AFB Installation Restoration Program, March 1996.	November 1998
NMED issues Hazardous Waste Permit (HWP) to Kirtland AFB. HWP identifies 146 active ECP Sites, which include 41 permitted units, 2 non-RCRA units, and 9 inactive sites.	1999
Kirtland AFB submits Corrective Measures Study Work Plan for Solid Waste Management Unit ST-070, Kirtland AFB Oil/Water Separators (ST-070) (Former ST-202, ST-210, ST-211, ST-215, ST-219, ST-247, ST-248, ST-255 and ST-260).	January 1999
Kirtland AFB submits Draft Stage I Abatement Plan for ST-106, Kirtland AFB Bulk Fuels Facility to NMED.	January 2000
Kirtland AFB submits Corrective Measures Work Plan for ST-073 Building 57001, Area Drain Line (ST-266) to NMED.	March 2000
NMED Groundwater Quality Bureau provides conditional approval of Final Stage I Abatement Plan for ST-106, Kirtland AFB Bulk Fuels Facility dated April 2000.	July 2000
Kirtland AFB submits Addendum to Stage I Abatement Work Plan for ST-106, Kirtland AFB Bulk Fuels Facility to NMED.	September 2000
Kirtland AFB submits initial SWMU assessment report (SAR) on SS-102, ST-347, ST-348, ST-349, ST-350, ST-351, ST-352, ST-353, ST-354, ST-355, and ST-356 to NMED.	December 2000
Kirtland AFB submits Addendum 2 to Stage I Abatement Work Plan for ST-106, Kirtland AFB Bulk Fuels Facility to NMED.	January 2001
Kirtland AFB submits Stage I Abatement Report for ST-106, Kirtland AFB Bulk Fuels Facility to NMED.	May 2001
Kirtland AFB submits Corrective Measures Study Sampling and Analysis Plan (SAP) SAP Addendum Corrective Action Unit ST-70 (Former ST-219) to NMED.	May 2001
NMED approves Corrective Measures Design (CMD) and Implementation Work Plan for LF-008.	June 2001
NMED Groundwater Quality Bureau provides conditional approval of Stage I Abatement Report for ST-106, Kirtland AFB Bulk Fuels Facility.	September 2001
Kirtland submits RFI Work Plan to NMED for SS-102 Advanced Research Electromagnetic Simulator (ARES) Test Facility.	September 2001
Kirtland AFB submits Draft Stage 2 Abatement Work Plan for ST-106, Kirtland AFB Bulk Fuels Facility to NMED.	February 2002
NMED issues conditional approval of Stage 2 Abatement Plan for ST-106, Kirtland AFB Bulk Fuels Facility.	February 2002
Kirtland AFB submits ST-106, Kirtland AFB Bulk Fuels Facility Stage 2 Abatement Plan Work Plan for the Soil Abatement Plan for Extraction Pilot Test to NMED.	December 2002
Kirtland submits RFI Report to NMED for SS-102 ARES Test Facility.	December 2002

Table 2-2 Chronology of Key Base-Wide Events

Event	Date
Kirtland AFB notifies NMED that benzene was detected in the groundwater at concentrations exceeding the New Mexico Water Quality Control Commission Regulations standards. This occurrence was at ST-106, Kirtland AFB Bulk Fuels Facility.	March 2003
Kirtland submitted a Focused Corrective Measure Study (CMS) Work Plan for LF-001, LF-002, and LF-008to NMED.	May 2003
Kirtland AFB submits Draft CMS Final Report for *S*WMU 6-1, Landfill 1 (LF-001); SWMU 6-2, Landfill 2 (LF-002); and SWMU 6-4, Landfills 4, 5, and 6 (LF-008) to NMED.	September 2003
Kirtland AFB submits RFI SAP SWMU ST-70 (Former ST-219).	September 2003
NMED requests supplemental information from Kirtland AFB regarding their review of the Draft CMS Final Report for *S*WMU 6-1, Landfill 1 (LF-001); SWMU 6-2, Landfill 2 (LF-002); and SWMU 6-4, Landfills 4, 5, and 6 (LF-008).	October 2003
Kirtland AFB submits ST-106, Kirtland AFB Bulk Fuels Facility Soil Vapor Extraction (SVE) Pilot Test Report to NMED.	November 2003
Kirtland AFB submits CMS Final Report for SWMU 6-1, Landfill 1 (LF-001); SWMU 6-2, Landfill 2 (LF-002); and SWMU 6-4, Landfills 4, 5, and 6 (LF-008) and Response to Request for Supplemental Information to NMED.	November 2003
NMED approves CMS Final Report for SWMU 6-1, Landfill 1 (LF-001); SWMU 6-2, Landfill 2 (LF-002); and SWMU 6-4, Landfills 4, 5, and 6 (LF-008) and Response to Request for Supplemental Information.	December 2003
Kirtland AFB submits Engineering Evaluation of 21-Inch Vitrified Clay Tijeras Sewer Interceptor at Kirtland AFB to NMED.	March 2004
Air Force Center for Engineering and the Environment (AFCEE) prepares Report for Corrective Measures Design for Solid Waste Management Unit 6-2, Landfill 2 (LF-002).	May 2004
Kirtland AFB started full-scale operation of the SVE system at ST-106.	June 2004
NMED modifies Kirtland AFB's HWP to require corrective measures for LF-001, LF-002 and LF-008.	June 2004
Kirtland AFB submits Corrective Measures Implementation (CMI) work plan to construct the Evapotranspiration (ET) cover, associated drainage structures, and erosion control measures, and to perform grading at LF-001.	July 2004
NMED disapproves the document titled Engineering Evaluation of 21-Inch Vitrified Clay Tijeras Sewer Interceptor at Kirtland AFB.	July 2004
Kirtland AFB provides response to NMED Request for Supplemental Information (RSI) on CMD and Implementation Work Plan for LF-002.	August 2004
NMED issues a request for supplemental Information to Kirtland AFB regarding CMI Work Plan for LF-001.	September 2004
Kirtland submits a CMD and Implementation Work Plan Addendum for LF-002 to NMED.	September 2004
NMED issues Class III Permit Modification to grant No Further Action (NFA) status to 11 Sites: SS-082, SS-103, RW-021, OT-086, LF-056, SS-061, SS-065, ST-059, ST-060, DP-067 and RW-085.	September 2004
NMED approves CMD and Implementation Work Plan for LF-002 with modifications. The modifications include: (1) the Tijeras Interceptor Sewer must be rerouted so that no portion of the active pipeline is within 100 feet of LF-002; and (2) the abandoned portion of the sewer pipeline must be drained and disposed	September 2004

Table 2-2 Chronology of Key Base-Wide Events

Event	Date
of in accordance with all applicable laws and regulations.	
NMED approves Corrective Measures Design and Implementation Work Plan for LF-001.	October 2004
Air Force Materiel Command (AFMC) Headquarters (HQ) Civil Engineering Environmental Compliance (CEVR) validates 31 closed munitions sites and adds them to the Kirtland ERP.	2004
Kirtland AFB submitted a request to NMED for removal of 67 of the active ECP sites from the Hazardous Waste Permit. These sites consist of sanitary sewers, storm sewers, and septic systems.	2004
Kirtland AFB submits RFI Sampling and Analysis Plan for SS-102 ARES Test Facility to NMED.	June 2005
Kirtland AFB submits RCRA Facility Investigation Report SWMU ST-070 (Former ST-219) to NMED.	November 2005
Kirtland AFB submits CMI Report for LF-008 to NMED.	January 2006
Kirtland AFB submits RFI Report for SS-102 ARES Test Facility to NMED.	March 2006
NMED approves CMI Report for LF-008 provided that abandoned septic system is properly closed.	May 2006
Kirtland submits closure notification information for abandoned septic system associated with LF-008.	May 2006
NMED approves RFI Report for SS-102 ARES Test Facility.	August 2006
Kirtland AFB submits CMI Report for LF-001 to NMED.	August 2006
Kirtland AFB submits to NMED Response to April 12, 2006 NOD on RCRA Facility Investigation Report for SWMU ST-070 (Formerly ST-219). Kirtland AFB proposes to install a SVE system as an IM. The IM would be in lieu of a CMS.	September 2006
Kirtland AFB submits to NMED Voluntary Corrective Measures Report Solid Waste Management Unit ST-070, Kirtland AFB Oil/Water Separators (ST-070) (Former ST-202, ST-203, ST-210, ST-211, ST-215, ST-216, ST-247, ST-248, and ST-258). Report addressed 9 Sites and serves as justification for recommending NFA at these subunits. The 9 units will remain on Kirtland AFB's Part B Permit.	September 2006
MMRP Comprehensive Site Evaluation (CSE) Phase I Conducted.	2006-2007
Draft PRP Search Report prepared for DP-067 Three Mine Shaft Sites prepared.	January 2007
Kirtland AFB submits CMI Report for LF-002 to NMED.	February 2007
Kirtland AFB notifies NMED of Discharge of Bulk Fuels Facility Phase-Separated Hydrocarbons (PSH) Near the Bulk Fuels Facility (SS-111/ST-106).	February 2007
Accelerated Corrective Measures Work Plan for Solid Waste Management Unit DP-088, Trestle Site Disposal Area submitted to NMED.	April 2007
NMED approves Accelerated Corrective Measures Work Plan for Solid Waste Management Unit DP-088, Trestle Site Disposal Area.	June 2007
Kirtland AFB submits Final Work Plan for CSE Phase II to NMED.	September 2007
Kirtland AFB submits RFI Report for Solid Waste Management Unit 6-30 Radioactive Burial 11 (RW-006) to NMED.	October 2007
Kirtland AFB notified NMED that two new mine shaft areas approximately one hundred yards northwest of the DP-067-1 mineshaft site had been discovered.	October 2007
Kirtland AFB submits Accelerated Corrective Measures Report For Solid Waste Management Unit ST-073 to NMED.	October 2007

Table 2-2 Chronology of Key Base-Wide Events

Event	Date
Solid Waste Management Unit Assessment Report for Site DP-067 Three Mine Shafts prepared.	January 2008
Kirtland AFB submits ICM Work Plan for SWMU ST-070 (Former ST-219) to NMED.	January 2008
NMED accepts the RFI Report for Solid Waste Management Unit 6-30 Radioactive Burial 11 (RW-006). NMED determined that the report was acceptable but determined that this site was not suitable for a NFA petition. In addition, NMED notifies Kirtland AFB that a CMS is required for this site.	March 2008
NMED determined that all of the listed sites (i.e., Oil/Water Separators (ST-070) (Former ST-202, ST-203, ST-210, ST-211, ST-215, ST-216, ST-247, ST-248, and ST-258)) are suitable for petition for NFA – corrective action complete without controls status.	March 2008
Accelerated Corrective Measures Report for Solid Waste Management Unit DP-088, Trestle Site Disposal Area submitted to NMED.	April 2008
NMED approves CMI Report for LF-001.	April 2008
Kirtland AFB submits Stage 2 Abatement Plan Modification Addendum to NMED. This addendum summarizes ongoing activities at Bulk Fuels Facility in continued efforts to delineate phase-separated hydrocarbon discovered on the water table, both on Kirtland AFB and off-base properties.	July 2008
NMED approves Accelerated Corrective Measures Report for Solid Waste Management Unit DP-088, Trestle Site Disposal Area. NMED agrees that this site is suitable for proposal for NFA based on NMED Criterion No. 5.	October 2008
NMED approves ICM Work Plan for SWMU ST-070 (Former ST-219).	October 2008
NMED approves the Solid Waste Management Unit Assessment Report for Site DP-067 Three Mine Shafts and concurs with proposal to remove discarded military munitions and to conduct sampling to confirm site cleanup.	October 2008
Kirtland AFB submits RFI Sampling and Analysis Plan for SS-102 ARES Test Facility to NMED.	January 2009
Kirtland AFB submits request to NMED for modification of ICM Work Plan, Solid Waste Management Unit (SWMU) ST-070 (Former (ST-219). Request is for 3-month extension to submit the ICM Construction Summary Report. The original submittal date had been January 9, 2009. The request is due to the fact that the SVE was removed from operation due to an apparent failure of the carbon canister offgas treatment system to adequately reduce organic effluent concentrations. The offgas treatment system was evaluated and determined to have inadequate capacity for the volume of organic contaminants extracted. The system was subsequently modified and is back in operation.	February 2009
Final Accelerated Corrective Measures Work Plan for Solid Waste Management Unit DP-067 Three Mine Shafts submitted to NMED.	March 2009
Kirtland AFB submits Interim Corrective Measures, Construction Summary Report for the Soil Vapor Extraction System for Solid Waste Management Unit ST-070 (Former ST-219).	April 2009
NMED approves Phase II Investigation Report for Kirtland AFB Site UST-058.	June 2009
Kirtland AFB submits Environmental Compliance Program Underground Storage Tank Site 058 Sampling and Optimization Work Plan to NMED.	August 2009
Kirtland submits Environmental Compliance Program Underground Storage Tank Site 058 Remediation and Monitoring Report. Report covers period of April 1	September 2009

Table 2-2 Chronology of Key Base-Wide Events

Event	Date
through June 30, 2009. Report recommends that one additional groundwater monitoring well to replace MW-2 and one additional SVE well be installed in 2010. The additional SVE well is to expedite remedial efforts.	
NMED approves RFI Sampling and Analysis Plan for SS-102 ARES Test Facility.	October 2009
Kirtland AFB submits Addendum to Phase II Investigation Sampling and Analysis Plan, Underground Storage Tank Site 058 to NMED.	November 2009
Kirtland AFB submits a Stage 3 Abatement Plan Modification Addendum to NMED. The Addendum proposes the installation of three additional off base groundwater monitoring wells to further investigate the fuel plume released from the SS-111/ST-106 Kirtland AFB Bulk Fuels Facility.	March 2010
NMED notifies Kirtland AFB that it must: (1) immediately implement Interim Measures (IM) to remediate the Light Non-Aqueous Phase Liquid (LNAPL) plume; (2) excavate and remove structures and contaminated soil in the vadose zone at and in the vicinity of the Former Fuel Offloading Rack (ST-106); (3) install 96 additional wells; and (4) continue operation of the existing soil-vapor extraction units.	April 2010
NMED HWB Notice to KAFB of NMED requirements to conduct an investigation of contaminated groundwater at the Bulk Fuels Facility Former Fuel Offloading Rack 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").	April 2010
Notice by the NMED Groundwater Quality Bureau (GWQB) to KAFB that it has transferred oversight of corrective action at SS-111 and ST-106 to the HWB, which will enforce corrective action under the Hazardous Waste Act (HWA) and the New Mexico Hazardous Waste Management Regulations, 20.4.1 NMAC. From this point forward, KAFB shall respond directly to the HWB and copy the GWQB on all correspondence and required plans and reports related to SS-111 and ST-106.	April 2010
NMED response to Kirtland AFB request for Extension of Time for Vadose Zone Investigation, Interim Measures, and Groundwater Investigation Plans, Solid Waste Management Units ST-106 and SS-111, Bulks Fuels Facility Spill, EPA ID# NM9570024423, HWB·KAFB·I0-004. NMED grants extension of 15 days for submittal of Vadoe Zone Investigation and IM Plan only.	May 2010
NMED response to Kirtland AFB May 3, 2010 letter requesting approval to deviate from modifications made by NMED to plan. NMED approves request for 25-foot long well screens; NMED will not require replacement well for KAFB-10626 at this time; and 2 additional wells to be installed by July 7, 2010.	May 2010
Kirtland AFB request to Water Compliance Division for Pumping Information Related to City of Albuquerque Well Fields. Request was for actual pumping rates from individual Albuquerque Bernalillo County Water Utility Authority (ABCWUA) wells.	May 2010
KAFB transmittal to NMED of the Vadose Zone Work Plan, Bulk Fuels Facility, Kirtland AFB, New Mexico, June 2010.	June 2010
KAFB transmittal to NMED of the Interim Measure Work Plan, Bulk Fuels Facility, SS-111, June 2010. Includes undated transmittal letter.	June 2010
Remediation and Site Investigation Report October 2009 through March 2010, Bulk Fuels Facility, SS-111, June 2010.	June 2010

Table 2-2 Chronology of Key Base-Wide Events

Event	Date
Stage 2 Abatement Program for Nitrate-Contaminated Groundwater (Site ST-105) Third Annual Groundwater Monitoring Report, June 2010.	June 2010
Vertical Profiling of Groundwater Contamination and Monitoring Well Installation Workplan Addendum to the Stage 2 Abatement Plan for Nitrate-Contaminated Groundwater, June 2010. Attached to transmittal letter dated 15 July 2010.	June 2010
NMED Revised Due Date for Well Installation Report, Solid Waste Management Units ST-106 and SS-111, Bulk Fuels Facility Spill, Kirtland AFB. Report on well installations conducted under March 16 Plan no later than October 5, 2010.	June 2010
NMED Hazardous Waste Bureau letter reporting, sampling, and analysis requirements related to the characterization and remediation of contaminated groundwater at Kirtland AFB ("Permittee") Solid Waste Management Units ST-I06 and SS-111, collectively known as the Bulk Fuels Facility Spill.	June 2010
Albuquerque Bernalillo County Water Utility Authority response to KAFB Request for Pumping Information Related Albuquerque Bernalillo County Water Utility Authority (Water Authority) Well Fields. Letter grants CH2M Hill to provide KAFB with monthly run-time information for the Water Authority production wells for calendar years 2000 through 2009.	June 2010
KAFB transmittal letter and submittal to NMED of the July 2010 Annual Monitoring and Maintenance Activities Report for Solid Waste Management Units (SWMUs), 6-1, Landfill 1 (LF-001); SWMU 6-2, Landfill 2 (LF-002); and SWMU 6-4, Landfill 8 (LF-008), July 2010.	July 2010
Kirtland AFB submission of the Resource Conservation and Recovery Act (RCRA) Corrective Action (CA) Quarterly Report, Kirtland AFB, New Mexico, 01 January - 31 March 2010. EPA ID No. NM 9570024423.	July 2010
NMED Ground Water Quality Bureau response to KAFB Notice of Intent to discharge approximately 765 gallons of monitoring well purge water associated with the sampling of 15 ground water monitoring wells at closed Landfills LF-001, LF-002, and LF-008. NMED determined that a Discharge Permit is not required as long as the discharge is as described.	July 2010
NMED Ground Water Quality Bureau response to Notice of Intent to Discharge; Discharge Permit Not Required for Kirtland AFB, AI: 2404: discharge 900 gallons of monitoring well purge water and 450 gallons of monitoring well development water associated with the Bulk Fuels Facility restoration project.	July 2010
Kirtland AFB submittal of analytical results for water samples collected from private irrigation well for the last three quarters of monitoring (October 2009, and January and May 2010).	July 2010
KAFB submittal to NMED Hazardous Waste Bureau of analytical results for water samples collected from private individual's well on October 2009, and January and May 2010.	July 2010
NMED Ground Water Quality Bureau Response to Notice of Intent to Discharge, (July 20, 2010); Discharge Permit Not Required for Kirtland AFB, AI: 2404: approximately 2,100 gallons of monitoring well drilling and purge water associated with the Nitrate Abatement Program. NMED has determined that a Discharge Permit is not required as long as the discharge is as described.	July 2010

Table 2-2 Chronology of Key Base-Wide Events

Event	Date
NMED approval with exceptions of RCRA Corrective Action Quarterly Reports Kirtland AFB, New Mexico, 01 July 09 to 30 September 09; 01 October to 31 December 09; and 01 January to 31 March 2010. KAFB-09-018, KAFB-10-006, and KAFB-10-021.	July 2010
Kirtland AFB Corrective Measures Study Report for Solid Waste Management Unit WP-26, Sewage Lagoons and Golf Course Main Pond, August 2010	August 2010
Kirtland AFB Quarterly Remediation and Site Investigation Report for the Bulk Fuels Facility Spill, April 2010 through June 2010, August 2010	August 2010
CMS Report for Solid Waste Management Unit WP-26, Sewage Lagoons and Golf Course Main Pond, August 2010	August 2010
NMED Directive for Conducting IM and Notice of Disapproval for IM Work Plan, June 2010; Vadose Zone Work Plan; June 2010; Groundwater Investigation Work Plan June 2010, SWMUs ST-106 and SS-111, EPA ID# NM9570024423 HWB KAFB-10-015, HWB KAFB-10-016, HWB KAFB-101019.	August 2010
Kirtland AFB Long-Term Groundwater Monitoring Summary Report, Fiscal Year 2009, September 2010.	September 2010
Kirtland AFB submittal of the Five Year Review Report, September 2010 for US EPA review and concurrence. Includes transmittal letter dated Oct 25, 2010.	September 2010
KAFB submission of January 2010 to June 2010 Interim Corrective Measures Report For Solid Waste Management Unit ST-70 (Former ST-219), September 2010.	September 2010
Kirtland AFB Environmental Restoration Program Underground Storage Tank Site 58 Annual Remediation and Monitoring Report, 01 July 2009 - 31 July 2010 , October 2010	October 2010
NMED Second Notice of Disapproval, Draft Investigation Work Plan, EOD Hill, June 2010, Kirtland AFB, NM. Contains Compliance Schedule.	October 2010
New Mexico Environment Department, Hazardous Waste Bureau transmittal letter and figure for Second Notice of Disapproval for Draft Site Investigation Work Plan, EOD Hill dated June 2010.	October 2010
Vadose Zone Investigation Work Plan Part 1: Field Investigation Activities Bulk Fuels Facility Spill Solid Waste Management Units ST-106 and SS-111. With Shaw transmittal letter dated Nov 4, 2010.	November 2010
Groundwater Investigation Work Plan Part I: Field Investigation Activities Bulk Fuels Facility Spill Solid Waste Management Units ST-106 and SS-111. With Shaw transmittal letter dated Nov 4, 2010.	November 2010
Interim Measures Work Plan Part I: Field Investigation Activities Bulk Fuels Facility Spill, Solid Waste Management Units ST-106 and SS-111, November 2010.	November 2010
Kirtland AFB Environmental Restoration Program, Quarterly Remediation and Site Investigation Report for the Bulk Fuels Facility Spill, July 2010 through September 2010, November 2010.	November 2010
Light Non-Aqueous Phase Liquid (LNAPL) Containment IM Work Plan Bulk Fuels Facility Spill Solid Waste Management Units ST-106 and SS-111 November 2010.	November 2010

Table 2-2 Chronology of Key Base-Wide Events

Event	Date
Kirtland AFB submittal of a Groundwater Monitoring Workplan for the Stage 2 Abatement Plan for Nitrate-Contaminated Groundwater (ST-105) at Kirtland AFB, including one electronic version. The workplan outlines the proposed third annual monitoring activities, which is being conducted as part of the approved Stage 2 Abatement Plan for Nitrate-contaminated Groundwater at Kirtland AFB, dated April 2007.	November 2010
New Mexico Environment Department, Petroleum Storage Tank Bureau acceptance of Annual Report for Kirtland AFB Site 58, Albuquerque, New Mexico.	November 2010
New Mexico Environment Department, Hazardous Waste Bureau approval of January 2010 to June 2010 Interim Corrective Measures Report for Solid Waste Management Unit ST-70 (Former ST-219), dated March 2010.	November 2010
NMED, Hazardous Waste Bureau approval of Interim Corrective Measures Report for Solid Waste Management Unit ST-70 (Former ST-219) (Report), dated March 2010 detailing the operation and efficiency of the ST -70 SVE interim corrective measure.	November 2010
NMED Hazardous Waste Bureau decision regarding October 5, 2010 Class 3 permit modification request (October PMR) to amend the Closure Plans for the Open Burn (OB) and Open Detonation (OD) Units at Kirtland AFB under the KAFB's Hazardous Waste Facility Permits.	November 2010
NMED Notice of Disapproval, 2009 Resource Conservation and Recovery Act Facility Investigation Report for Solid Waste Management Unit, WP-026, Sewage Lagoons and Golf Course Main Pond, September 2009	November 2010
KAFB Well Completion Report for Monitoring Well KAFB-0626, Stage 2 Abatement Program for Nitrate-Contaminated Groundwater, Area of Concern, December 2010.	December 2010
Well Completion Report for Monitoring Wells KAFB-2008 and KAFB-2009, Installed at Area of Concern ST-105, Trichloroethene-Contaminated Groundwater, December 2010.	December 2010
KAFB request to NMED for a six-month extension to the 20-Dec-10 deadline in response to the NMED Notice of Disapproval, 2009 Resource Conservation and Recovery Act Facility Investigation Report for Solid Waste Management Unit, WP-026, Sewage Lagoons and Golf Course Main Pond, September 2009 .	December 2010
KAFB transmittal of attached signed certifications for the four (4) corrective action documents dealing with the Kirtland bulk fuels release remediation effort.	December 2010
KAFB submission to NMED of the Quality Assurance Project Plan (QAPP) for Long-Term Groundwater Monitoring at Solid Waste Management Unit (SWMU) 6-1 , Landfill (LF-001); SWMU 6-2, Landfill 2 (LF-002); and SWMU 6-4, Landfills, 4, 5, and 6 (LF-08), Final, January 2011.	January 2011
NMED review of the "Screening level Risk Evaluation for Petroleum Hydrocarbon Fuel Compounds in Subslab Soil Vapor Bulk Fuels Facility, Kirtland AFB," dated October 27, 2009. The initial soil-vapor analytical results indicate subsurface contamination could potentially result in unacceptable indoor air inhalation risk for workers that occupy Buildings 1032 and 1048. The Report concludes that additional data should be collected to more rigorously determine the air quality inside the buildings. KAFB has 90 days to submit a Work Plan.	January 2011

Table 2-2 Chronology of Key Base-Wide Events

Event	Date
Kirtland AFB submission of the Quarterly Remediation and Site Investigation Report for the Bulk Fuels Facility Spill for the period October 2010 through December 2010, dated February 2011. Includes transmittal letter dated February 25, 2011.	February 2011
KAFB Transmittal letter to US EPA of the Kirtland AFB's Phase II Comprehensive Site Evaluation of MMRP sites on the installation. As required by 10 USC §2710(c)(2), E.O. 12580, EO 13016 and OSWER Directive 9200.3-60, a copy of Kirtland AFB's Final Comprehensive Site Evaluation Phase II Report was submitted to the US EPA for review, comment and or records retention.	February 2011
KAFB transmittal letter to NMED and copy of the July 2010 to December 2010 Interim Corrective Measures Report For Solid Waste Management Unit ST-70, Buildings 481/482 Oil/Water Separators (Former ST-219), March 2011.	March 2011
KAFB Groundwater Investigation Work Plan, Bulk Fuels Facility Spill, Solid Waste Management Units ST-106 and SS-111, March 2011.	March 2011
KAFB transmittal to NMED of the Interim Measures Work Plan, Bulk Fuels Facility Spill, Solid Waste Management Units ST-106 and SS-111, March 2011.	March 2011
Vadose Zone Investigation Work Plan, Bulk Fuels Facility Spill, Solid Waste Management Units ST-106 and SS-111, March 2011.	March 2011
NMED approval of KAFB request for an extension request from regarding Solid Waste Management Unit WP-026, Sewage Lagoons and Golf Course Main Pond. KAFB requested a six-month time extension request due to the development and submission of work plans for the installation of two additional regional monitoring wells and four additional perched aquifer monitoring wells. KAFB is to submit the work plans no later than June 20, 2011.	March 2011
NMED comments on KAFB submittal Light Non-Aqueous Phase Liquid (LNAPL) Containment Interim Measure Work Plan for Kirtland AFB Bulk Fuels Facility Spill (Solid Waste Management Units (SWMUs) ST-106 and SS-111), dated November 2010.	March 2011
Meeting to discuss work plan response to comments Bulk Fuels Facility (BFF) Spill Solid Waste Management Units (SWMUs) ST-106 and SS-111, Kirtland AFB, March 15, 2011.	March 2011
NMED Approval of the Resource Conservation and Recovery Act (RCRA) Corrective Action (CA) Quarterly Report, Kirtland AFB, New Mexico, 01 October - 31 December 2010, 1-Mar-2010.	March 2011
NMED Approval of the Recovery Act (RCRA) Corrective Action Quarterly Report, Kirtland AFB, New Mexico, 01 July To 30 September 2010, received on October 28, 2010.	March 2011
NMED approval of the RCRA Corrective Action Quarterly Report Kirtland AFB, New Mexico, 01 April to 30 June 2010, received on October 28, 2010.	March 2011
Additional comments by NMED comments on KAFB submittal Light Non-Aqueous Phase Liquid (LNAPL) Containment Interim Measure Work Plan for Kirtland AFB Bulk Fuels Facility Spill (Solid Waste Management Units (SWMUs) ST-106 and SS-111), dated November 2010.	March 2011
KAFB submission of request to relocate four groundwater monitoring wells as described in NMED letter, SS-111, ST-106, dated 6 August 2010.	April 2011

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3. ENVIRONMENTAL RESTORATION PROGRAM

3.1 Regulatory Guidance

The Kirtland AFB ERP is a component of the Defense Environmental Restoration Program (DERP), which addresses the identification, investigation, and clean-up of environmental contamination resulting from hazardous substances and pollutants associated with past military activities. ERP sites receive funding through the Environmental Restoration Account (ERA) allocated by Congress. The Kirtland AFB ERP follows the regulatory guidance presented in the following regulations.

Federal Regulations:

- Occupational Safety and Health Act (OSHA);
- CERCLA;
- SARA;
- RCRA, as amended;
- Toxic Substances Control Act (TSCA);
- Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA);
- National Oil and Hazardous Substances Pollution Contingency Plan (NCP);
- DERP;
- Executive Orders (EO) 12580 and 13106;
- Clean Air Act (CAA);
- Clean Water Act (CWA);
- Safe Drinking Water Act (SDWA);
- National Defense Authorization Act (NDAA); and
- Department of Transportation (DOT) Regulations.

State of New Mexico Laws:

- Solid Waste Management Act (SWMA);
- Hazardous Waste Management Act (HWMA);
- Radioactive and Hazardous Materials Act (RHMA); and
- Radiation Protection Act (RPA).

3.2 ERP Process

The Kirtland AFB ERP follows protocols established within CERCLA, but it is regulated by the RCRA Part B Hazardous Waste Permit jointly issued by USEPA Region 6 and the NMED. Most of Kirtland AFB ERP sites are identified as SWMUs and are managed to meet the applicable requirements of the HSWA Module IV, under the Corrective Action Program required by the RCRA Part B Hazardous Waste Permit. The investigation and restoration (corrective action) approach is as follows:

- Conduct initial notification and site inspection;
- Conduct an assessment and prepare a SAR;
- Conduct a RFI ;
- Implement a CMS as needed for each identified site;
- Determine, design, and implement corrective actions needed on each site;
- Conduct IMs where necessary to prevent migration of contaminants and reduce contamination at the site and at any given time; and

- Operate and maintain corrective actions as needed at each site.

The responsibilities for site investigations and corrective measures are distributed among several contractors and federal contract service centers. Kirtland AFB has established the goal to have remedies in place for all ERP sites by 2012.

3.2.1 Regulatory Participants in the ERP Process

Federal Regulatory Agency:

USEPA Region 6 Main Office:
1445 Ross Avenue, Suite 1200
Dallas, Texas 75202
Phone (214) 665-6444
Fax (214) 665-7263
http://www.epa.gov/

State Regulatory Agency:

New Mexico Environment Department Hazardous Waste Bureau 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	New Mexico Environment Department 1190 St. Francis Drive Suite N4050 Santa Fe, New Mexico 87505 Phone - (800) 219-6157 Phone - (505) 827-2855 www.nmenv.state.nm.us	New Mexico Environment Department Albuquerque (District Office) 5500 San Antonio Dr., NE Albuquerque, NM 87109 Phone - (505) 222-9500 Fax - (505) 222-9510 www.nmenv.state.nm.us
Hazardous Waste Bureau (505) 476-6000	Groundwater Quality Bureau (505) 827-2918 Surface Water Quality Bureau (505) 827-0187 Air Quality Bureau (505) 476-4300	Petroleum Storage Bureau (505) 476-4397

3.2.2 Community Participants in the ERP Process

Local Stakeholders:
Citizen Action Group (CAG)
Siesta Hills Neighborhood Association
Albuquerque Bernalillo County Water Utility Authority (ABCWUA)
Raymond G. Murphy Veterans Administration (VA)

3.3 Restoration Advisory Board (RAB)/Citizen Advisory Board (CAB)

Section 324 of the National Defense Authorization Act of 1996 requires Kirtland AFB to conduct an assessment every 2 years to determine if there is sufficient and sustained community interest in forming a RAB. A RAB focuses on all base-wide environmental activities on the installation, while a Citizen Advisory Board (CAB) typically focuses on a particular issue that is of concern to the neighbor and/or stakeholder to the installation.

Participation in the RAB and/or CAB is strictly voluntary and members will not be financially compensated. Priority for RAB/CAB membership will be given to local residents who are directly impacted by environmental restoration activities at Kirtland AFB. Citizens are invited to learn about the RAB assessment process and how the exchange of information regarding environmental restoration activities occurs between the Kirtland AFB ERP and the local community. RAB/CAB forms include the Community Interest Form and Membership Application which can be found in Appendix B.

3.3.1 Background

The RAB/CAB is a community-based advisory body designed to act as a focal point for the exchange of information between the Air Force and the local community regarding environmental restoration activities. The RAB/CAB is composed of representatives from the community; interested groups; local, state and federal regulatory and government agencies; and the Air Force. RAB/CAB meetings are open to the public. Guidelines regarding the characteristics, composition, funding, and establishment of RABs are promulgated in the Air Force Instruction (AFI) 35-105, 26 January 2010 publication. Section 324 of the National Defense Authorization Act of 1996 provides a legal basis for the RAB concept and the DoD Technical Assistance for Public Participation Rule (TAPP), which helps attain RAB objectives. The RAB charter states the mission and establishes procedures for effective RAB operations at a given location.

RAB members serve two-year terms whereas service terms for CAB members is not specified. RAB/CAB members are encouraged to attend regularly scheduled meetings and those members that miss three or more consecutive meetings may be asked to resign. Duties and responsibilities will include reviewing and commenting on technical documents and activities associated with the environmental restoration program at Kirtland AFB. Members are expected to be available to community members and groups to share information and/or concerns between the community and the RAB/CAB.

3.3.2 Mandate for Reassessing Community Interest

In accordance with DoD Policy, 32 CFR §202 pages 27610-27620; US EPA guidance and the DoD Management Guidance for the DERP Management: Where RABs are not formed initially, the installation shall reassess community interest at least every 24 months or upon request by the community. Where the reassessment finds sufficient and sustained community interest, the installation shall establish a RAB. Where the reassessment does not find sufficient and sustained community interest in a RAB, the

installation shall document, in a memorandum for the record, the procedures followed in the reassessment and the findings of the reassessment. This document shall be included in the AR.

A RAB should be established if there is sufficient public interest as determined by:

- A minimum of 50 community members petition Kirtland to create a RAB; or
- Federal, State, Tribal, or local government representatives request the formation of a RAB; or
- The Installation Commander determines a RAB is necessary.

3.3.3 RAB Results

The Kirtland AFB CAB established in 1991 essentially stopped functioning as a formal working group prior to 1997 and evolved into a quarterly public meeting. Public participation did not suffer; however, a small core group of individuals from the CAG still actively participate in the CAB. The DOE and their contractor, SNL are associate units on Kirtland AFB. They conduct their own Environmental Restoration Program and previously held monthly public meetings utilizing a CAB. In 1999, Kirtland AFB and DOE/SNL began holding joint quarterly public meetings, bringing more public attention and involvement to both programs. Although the results of solicitations at public meetings indicate that there is not enough interest to form a RAB, broadened community outreach and awareness and the introduction of the MMRP could facilitate the formation of a RAB. DoD guidance requires revisiting the idea of forming a RAB every two years when one doesn't exist at an installation, and Kirtland AFB will continue to pursue this by expanding stakeholder participation in its restoration program.

On August 24, 2006, citizens were invited to learn about the RAB assessment process and how the exchange of information regarding environmental restoration activities occurs between the Kirtland AFB ERP and the local community. The meeting was held at the Manzano Mesa Multigenerational Center, 501 Elizabeth Street SE, Albuquerque, New Mexico 87123.

A RAB assessment was conducted August through October 2006. The results of the assessment concluded that sufficient and sustained community interest did not exist at that time.

On April 30, 2008, a RAB assessment was conducted through October of that same year. The results of the assessment were concluded that there is sufficient and sustained community interest on the topic of the Bulk Fuels Facility PSHs (SS-111/ST-106).

On February 24, 2009, Kirtland AFB established a CAB. Since the CAB was formed, the initial organizational development was discussed with the focus being on the path forward for addressing the Bulk Fuels Facility PSHs (SS-111/ST-106). On March 16, 2009, Kirtland AFB conducted a field trip for its CAB members and interested stakeholders to tour the Bulk Fuels Facility and various well locations on and off base.

To date, CAB members and all members of the public are invited and strongly encouraged to come join the ERP team to help plan the future stewardship of the environment on a quarterly basis are typically held at the Cesar Chavez Community Center.

4. COMMUNITY BACKGROUND

4.1 Demographic Data

In the 2000 U.S. Census data, the population, demographic, and housing information for Bernalillo and Valencia Counties can be found in Appendix C.

4.2 Neighborhood Associations

Neighborhoods associations adjacent to Kirtland AFB are provided below. The list is current as of April 7, 2011 per the City of Albuquerque Office of Neighborhood Coordination.

ELDER HOMESTEAD N.A. (EHS)
*Marian Jordan
816 Arizona SE/87108 (505) 268-5190
Carmen Pennington
1004 San Pedro SE/87108
marianjor@aol.com

JUAN TABO HILLS N.A. (JTH)
*Kevin Smith
1843 Red Rum Ct. SE/87123 (505) 440-3838
e-mail: 1ksmith@comcast.net
Tom Gregory
1705 Black Gold SE/87123
e-mail: tommygregory77@gmail.com
Website: www.jthna.com

MIRABELLA-MIRAVISTA N.A. (MMV)
*Joy Stein
427 Deschutes St. SE/87123 (505) 227-4387
e-mail: joy.m.stein@gmail.com
Josh Jacob
515 Deschutes St. SE/87123 (314) 640-5685
joshjacob@gmail.com

SIESTA HILLS N.A. (SAH)
Wayman Cole
1307 Odlum SE/87108
e-mail: mlwlcole@yahoo.com
Don Daigle
6412 Mitchell SE/87108 (505) 507-6411
dmdaigle76@comcast.net

TRUMBULL VILLAGE ASSOC. (TVA)
Joanne Landry
7501 Trumbull SE/87108 (505) 604-6761
e-mail: landry54@msn.com
Inez Senteno
945 Louisiana SE, Apt. B/87108
angelicmano@yahoo.com

WILLOW WOOD N.A. (WWD)
Frank Bushman
11101 Jewel Cave SE/87123 (505) 332-9330
e-mail: fbushman2@aol.com
Jim White
915 Wind River SE/87123 (505)294-5692
e-mail: JimWhite969@comcast.net
Website: www.hoamcoweb.com/willowwood

**Primary contact*

4.3 Community Centers

The Cesar Chavez Community Center has been the ideal meeting location for Kirtland AFB and its stakeholders. Community centers adjacent to Kirtland AFB are provided below. The list is current as of April 7, 2011.

Cesar Chavez Community Center (Southeast)
7505 Kathryn SE 87108
Louisiana & Kathryn
Phone: (505) 256-2680
FAX: (505) 256-2686

Heights Community Center (Southeast)
823 Buena Vista SE 87106
Coal & Buena Vista
Phone: 848-1334
FAX: (505) 764-6827

Herman Sanchez Community Center (Southeast)
Formerly East San Jose Community Center
1830 William SE 87102
Trumbull & William
Phone: (505) 848-1336
FAX: (505) 764-1787

Jack Candelaria Community Center (Southeast)
400 San Jose SE 87102
San Jose & Broadway
Phone: (505) 848-1325 (Center)
FAX: (505) 244-6613

Mesa Verde Community Center (Northeast)
7900 Marquette NE 87108
Marquette & Tennessee
Phone: (505) 256-2091
FAX: (505) 256-2087

Singing Arrow Community Center (Southeast)
13001 Singing Arrow SE 87123
Dorado & Singing Arrow
Phone: (505) 291-6200
FAX: (505) 291-6229

Thomas Bell Community Center (Southeast)
3001 University SE 87106
University & Gibson
Phone: (505) 848-1332 FAX: (505) 244-6632

Whittier Center (Southeast)
1100 Quincy SE 87108
Kathryn & San Mateo
Phone: (505) 256-2093
FAX: (505) 256-2018

5. COMMUNITY RELATIONS PROGRAM

This section describes the methodology that Kirtland AFB used to collect community input in order to develop this CRP. The results of past interviews suggest that the community views the environmental challenges at Kirtland AFB as minimal and perceive Kirtland AFB's credibility as neutral or positive.

5.1 Community Interviews

Conducting community interviews fulfilled two primary objectives; the first was to hear from members of the community how best to keep the public informed about environmental activities on Kirtland AFB; and the second objective was to evaluate the effectiveness of the current CRP so that adjustments could be made to ensure that future community outreach activities are successful. Interviews with members of the community were conducted during late July and early August 2004 for the implementation of the CRP dated April 2005. For these interviews, Kirtland AFB Public Affairs generated a proposed list of interviewees, which included local government representatives, members of DOE's former CAB, members of local groups, and other interested community members. The final interview schedule included 35 potential participants. A total of 15 interviews were completed after 20 individuals failed to return phone calls. All interviews were conducted via telephone for the interviewee's convenience and to provide them with an opportunity to elaborate on their responses.

Kirtland AFB prepared a discretionary five-year review pursuant to CERCLA §§ 120 and 121; the National Contingency Plan (NCP) and DERP 10 U.S. C. §2701. The purpose of this five-year review was to summarize the current status of the ERP sites at Kirtland AFB, evaluate the Installation's performance in completing response actions forecasted in the Management Action Plan dated May 2005 and determine whether the remedies selected and implemented at Kirtland AFB are expected to be protective of human health and the environment. Additionally, identify any issues that were found during the five-year review and provide recommendations to address them.

Activities to involve the community in the Final First Five-Year Review Report dated September 2010 were initiated in November 2009 with the memorandum to the CAB and the public notice, published in the Albuquerque Journal December 2010. The public was introduced to the five-year review process and invited to review the ERP Management Action Plan, dated May 2005. In addition, the public was invited to provide comments on the five-year review process and voice any concerns. The public comment period ran from November 29, 2009 through February 26, 2010. No other formal community interviews have been made since the five-year report was completed, with exception of the field activities for the Bulk Fuels project.

This CRP outlines the community relations and public participation that are part of the overall project requirements.

5.2 Interview Results

Public interviewees believe that Kirtland AFB officials would respond to their concerns in a forthright and timely manner should a threat to the community arise. Almost everyone suggested adding more outreach activities in order to increase community interest and involvement, especially at proposed drill locations for the fuel spill project. Presentations by the Kirtland AFB, public meetings, fact sheets, and an ERP web page were cited as the most effective activities. Overall, the public is generally pleased with the Air Force's environmental restoration efforts.

Kirtland AFB has presented detailed updates on the Bulk Fuels Facility ongoing remediation efforts. Sampling of the Kirtland AFB drinking water wells and the VA Hospital is ongoing. To date, wells at

both locations continue to show no impacts to water quality. Kirtland AFB and the ABCWUA are cooperating to conduct additional sampling of the nearest ABCWUA drinking water wells to verify no impacts to those wells. The four SVE remediation systems on base will continue to operate 24 hours a day, 7 days a week to remove petroleum product daily as plans are underway to connect additional extraction points to the existing SVE systems.

Kirtland AFB has indicated that the fuel plume, dissolved phase and vadose zone will be fully characterized at the end of the contract in September 2014. An aggressive Interim Measure will be in place to remove fuel from the groundwater and determine an optimal final remedy which will be presented to the public and the NMED. A public comment period and a public meeting will follow. It is the Air Force's goal and priority to remove the fuel and dissolved constituents from the ground and groundwater as quickly, safely, and effectively as possible.

6. COMMUNICATION ACTIVITIES AND TECHNIQUES

This section describes the activities used to achieve the goals and objectives of Section 1.3. Kirtland AFB will continue to keep the community informed of ongoing activities as needed, as well as any new environmental activities should they emerge based on the level of community interest and concern.

6.1 Public Meetings and Public Notice

Kirtland AFB ERP host two types of public meetings; a public meeting and a RAB/CAB meeting. The public meeting is currently held in conjunction with DOE's public meetings for SNL. RAB/CAB meetings are held quarterly to provide its CAB members with the chance to become actively involved in the cleanup process, while giving the Air Force valuable feedback to use in its decision-making processes.

Kirtland AFB uses public meetings as forums for public participation in the ERP and these meetings are held semi-annually. Public meetings are held to allow community members the opportunity to speak with the Air Force and an opportunity to review and comment on cleanup milestones at Kirtland AFB. Kirtland AFB uses visual aids, fact sheets and posters to explain the environmental cleanup activities and to encourage discussion on all environmental activities.

Public meeting dates, times, and locations are announced in public notices in the Albuquerque Journal. All meetings are held typically from 6:00 pm to 8:00 pm. Public notices describe proposed actions and announce any associated public meetings and/or public comment periods. Notices are published in the Albuquerque Journal newspaper, one of largest circulation in the area.

Below are the 2006 through 2011 meeting dates for when the public meetings were held or are scheduled to be held at the Cesar Chavez Community Center to discuss all environmental activities on Kirtland AFB and/or the Bulk Fuels Facility PSHs (SS-111/ST-106). Location of future meetings will be announced by the Kirtland AFB Public Affairs office and/or through the mailing list. The dates listed below are subject to change.

Public Meetings
CAB Meetings

2006	2007	2008	2009	2010	2011
January 19	April 17	April 30	February 24	February 17	February 15
April 20	October 16	October 16	March 16*	May 25	May 17
July 20			April 22	April 21	April 19
October 19			May 19	August 24	August 16
			October 20	October 20	October 18
			August 20	November 23	November 22
			November 18		

*Field trip

6.2 Public Comment Periods

Any person who wishes to comment should submit written or electronic mail (e-mail) comment(s) with the commenter's name and address to the respective address below, Kirtland AFB or the NMED. Public comment periods for CA provide a specified time frame in which the public can submit written comments on cleanup milestones, usually between 30-60 days in length, depending on current RCRA facility permit requirements; beginning and ending dates are announced in public notices. Public comment periods are provided for documents pertaining to permit modifications or for similar documentation related to the environmental clean-up processes. This allows citizens time to review these documents and express their opinions to Kirtland AFB on the findings. In addition, opportunities for public comment on other ERP documents are available upon request.

Written comments shall be based on all reasonably available information and include, to the extent practicable, all referenced factual materials. Persons having a disability and requiring assistance or auxiliary aid to participate in this process should contact New Mexico Environment Department Human Resources Bureau.

All written comments should be made to:

KIRTLAND AFB:	NMED:	ARRANGEMENTS FOR PERSONS WITH DISABILITIES:
377th Air Base Wing Public Affairs 2000 Wyoming Blvd SE Suite A-1 Kirtland AFB, NM 87117 377ABW.PA@kirtland.af.mil	New Mexico Environment Department Hazardous Waste Bureau 2905 Rodeo Park Drive East Bldg. 1 Santa Fe, New Mexico 87505-6303	New Mexico Environment Department Human Resources Bureau P.O. Box 5469 1190 St. Francis Drive, Santa Fe, New Mexico, 87502 *TDY users. Please call the New Mexico Relay Network 505) 275-7333.

Public comment periods are published along with the announcements and placed in the legal section of the Albuquerque Journal around the beginning date of the comment period.

6.3 Administrative Repository (AR)

The AR is required by CERCLA and the NCP. The AR provides the community with access to the documents and resources used by the Air Force to reach decisions about the individual site cleanup. The AR consists of internal and external reports, plans, and correspondence in hard copy containing information that forms the basis for the selection of a response action for a site, including verified sampling data, quality control and quality assurance (QA/QC) documentation, site inspection and evaluation reports, and health assessments. The AR also contains the proposed plans, as well as the decision documents and supporting information/correspondences with the NMED.

The AR is maintained on Kirtland AFB. For more information or arrange to review the AR, please contact the Kirtland AFB Public Affairs at (505) 846-5991 or by submitting a FOIA request to Kirtland AFB.

The AR is updated within 24 hours of receipt of documents as a best management practice (or as mandated by KAFB commander, Colonel Maness, as of 8 April 2011) and includes correspondence to and from the regulatory agency.

6.4 Information Repository (IR)

The IR provides the community with access to all documents and resources related to the environmental cleanup. The IR consists of a stand-alone computer that resides in the library and contains a database to access all ERP documents for public release and any final documents submitted to the regulatory agencies. A printer is attached for any printing needs. The IR also includes hard-copies of documents and electronic copies. The computer has no internet connectivity; however, ERP documents can be accessed by visiting the Kirtland AFB website http://www.kirtland.af.mil in the Environmental Issues section for Public Records. Copy paper is furnished and replenished by the Kirtland AFB ERP team. The IR location map can be found in Appendix D.

The Information Repository is located at the following location:

CNM-Montoya Campus
(formerly Technical Vocational Institute (TVI))
J-Building, Room 123
4700 Morris NE
Albuquerque NM, 87111
Phone (505) 224-5730

Hours of operation:
7:00 am – 8:00pm (Monday – Thursday)
7:00 am – 5:00pm (Friday)
9:00 am – 5:00pm (Saturday)

The IR is updated as documents/correspondence become available, on a weekly basis.

6.5 Public Poster Sessions

Public poster sessions are held as part of the NFA action and scheduled within the public comment period for CA to give the community members an opportunity to review and comment on cleanup milestones. This provides citizens with the chance to become actively involved in the cleanup process, while giving the Air Force valuable feedback to use in decision making. Kirtland AFB operates under a RCRA hazardous waste permit that regulates the treatment, storage and disposal of hazardous waste sites at Kirtland AFB, as well as addresses releases of hazardous wastes and hazardous constituents from SWMUs.

The RCRA permit directs investigations to determine if contaminants have been released to the environment and, if so, how sites will be cleaned up. After investigation and any needed cleanup, a site is evaluated by the NMED to determine if there is any risk to human health or the environment. If the NMED agrees that a site does not pose a risk, the site is considered appropriate for NFA and Kirtland AFB may initiate the NFA petition process.

The NFA determination has been based on the NMED's Technical Support Document (TSD) for exclusion/inclusion of SWMUs and AOCs, dated October 1999. The following list is NMED identified criteria in Table 4 of the TSD (NMED, 1999) by which the Permittees could also propose a SWMU or AOC for NFA:

1. The site does not exist. If it can be shown that the site does not exist, then a proposal may be made for NFA.
2. The site was not used for the management of hazardous constituents. If this can be shown, then a proposal may be made for NFA.
3. There was no release of hazardous constituents to the environment. If it can be shown that there was not, nor is there likely to be a release, then a proposal may be made for NFA.
4. There was a release, but a release assessment indicates that the concentrations of hazardous constituents are at acceptably low levels as determined by regulators.

5. The release assessment includes site characterization, release assessment sampling, and risk assessment.
6. There was a release, but the site was characterized and/or remediated under another authority, such as the New Mexico Underground Storage Tank (UST) Bureau, and documentation such as a closure letter is available, then the site may be proposed for NFA. Regulation of a site by another authority is not, necessarily, sufficient justification for a proposal for NFA.
7. There was a release, but the site has been remediated. Typically, the site would have been remediated by means of Voluntary Corrective Actions or Expedited Cleanups/Voluntary Corrective Measures. After remediation, evidence should show that concentrations of hazardous constituents are at acceptable levels as determined by regulators. If the site meets the criteria for remediation, then it may be proposed for NFA.

During the NFA petition process Kirtland AFB requests that the site be moved to an inactive status on the hazardous waste permit. An inactive status means that additional investigation, monitoring, or cleanup at the site is not needed at this time or in the future based upon the reasonably expected future land use. Although a site can be moved to an inactive status, it is never removed from the RCRA permit so it will always be able to be tracked by the Air Force and the NMED and reactivated if necessary. Even if Kirtland AFB and the NMED agree a site is appropriate for NFA, the RCRA permit modification process provides for public involvement and comment before the decision is finalized. This meeting fulfills the public meeting step of the process. A diagram and a table of the permit modification process can be found in Appendix E.

6.6 Media Affairs & Media Contacts

Regulatory requirements pursuant to CERCLA/RCRA require that a public notice be placed in a newspaper of general circulation with the release of the final Remedial Investigation/Feasibility Study (RI/FS) and the proposed plan. In addition, public notices issued with the proposed plan must offer an opportunity for a public meeting. Public notices are sent to the Albuquerque Journal. When appropriate, ads will also be placed in the Albuquerque Journal, the El Hispano Newspaper, and/or other media avenues, as appropriate and typically in English. Publications in Spanish or other languages will be placed as needed, depending on the site location and ERP activity.

Press conferences, media inquiries, news releases and answers to queries are coordinated through the Kirtland AFB Public Affairs. Media site visits are provided and arranged through Public Affairs as well. The Kirtland AFB Public Affairs works diligently with the local news media to share all restoration activities with the public.

A list of media contacts is as follows:

Television	**Radio Stations**	**Newspapers**
4 KOB www.kob.com 4 Broadcast Plaza SW, Albuquerque (505) 243-4411	KUNM MSC06 3520 1 University of New Mexico Albuquerque, NM 87131 (505) 277-5615 (888) 277-5615 kunm@kunm.org	Albuquerque Journal 7777 Jefferson Street NE Albuquerque, N.M., 87109 (505) 823-4444 http://www.abqjournal.com
KRQE www.krqe.com 13 Broadcast Plz SW, Albuquerque (505) 243-2285		El Hispano News 900 Park Ave. S.W., Albuquerque, NM 87102 (505)243.6119 el.hispano.news@hotmail.com

Television	Radio Stations	Newspapers
KNME www.knme.org 1130 University Boulevard Northeast, Albuquerque (505) 277-2121		
KOAT www.koat.com 3801 Carlisle Boulevard Northeast, Albuquerque (505) 884-7777		
KASY www.my50.tv 8341 Washington Street NE, Albuquerque (505) 797-1919		

6.7 Fact Sheets

Fact sheets contain information regarding various topics of concern including site history and site status; any site-specific issues which need to be addressed in a timely manner; and, to update the public on site-specific restoration issues. Fact sheets focus on a single site or issue to explain to the public technical aspects and milestones pertaining to the ERP or to announce upcoming activities or construction work. Fact sheets are updated and produced as needed and will continue to be prepared to report significant milestones associated with the ERP. Fact sheets, when produced, are made available to the public and stakeholders at scheduled meetings or available on the Kirtland AFB website. Examples of fact sheets can be found in Appendix F.

6.8 Mailing Lists

Kirtland AFB maintains a mailing list that contains the names, addresses and e-mail addresses of individuals who have identified themselves as interested in receiving information about the Kirtland AFB ERP. These individuals are invited to public and/or CAB meetings and the list currently includes approximately 300 individuals. The mailing list is updated as new contact information is received and after each public or CAB meeting is held.

6.9 Residential Newsletters/Flyers

Most neighborhood associations publish their own newsletters to inform its citizens of all activities in the neighborhood. The ERP team does not publish any newsletters; however the ERP team works diligently to distribute flyers out to community residents informing them of all off-base environmental activities that may impact their personal livelihoods. Examples of the residential newsletters/flyers can be found in Appendix F.

6.10 Base Tours

Base tour requests must be submitted no later than 30 days prior to the date of the tour. Requests must be submitted through the Kirtland AFB Public Affairs Office and are accepted at any time. Tours are coordinated one month in advance. Every effort will be made to honor a tour request but, ultimately,

Kirtland AFB must work around the daily operations schedule. If mission dictates, a tour may be cancelled at any time, without notice due to mission requirements. Tours are given Monday through Friday only. No tours will be given on weekends or federal holidays. Tours are free of charge.

For additional information, call Kirtland AFB Public Affairs Office at (505) 846-5991.

6.11 Kirtland AFB Website

Citizens may review Air Force ERP documents by looking for the Public Records link within the Environmental Issues section, by visiting the Kirtland AFB website at http://www.kirtland.af.mil. The Environmental Issues section presents environmental information on the Bulk Fuels fuel leak, environmental assessments and water quality. The Kirtland AFB website is accessible from any location with internet access.

6.12 Public Affairs Information Line

The Public Affairs information line is provided to enable citizens to get the latest information available when they want it, rather than having to wait for a meeting and receive feedback directly from the Air Force. Requests can be made in writing or by phone for all inquiries to the Kirtland AFB. The telephone number is (505) 846-5991. The line is answered during normal business hours. An answering system is provided for any calls received after hours.

Responses will be provided within 24 hours from the date of receipt excluding federal holidays. If circumstances will not allow this response timeline to be met, an explanation of the delay will be provided immediately by the Kirtland AFB Public Affairs office.

7. FREEDOM OF INFORMATION ACT (FOIA)

The 377th Mission Support Group is responsible for processing requests for Kirtland AFB records under the FOIA provisions. Information can be found on http://www.kirtland.af.mil/library/foia.asp. Written requests may be received by postal service, facsimile or electronically. Requests received by facsimile or electronically must have a mailing address included since it may not be practical to provide a substantive response electronically.

The Air Force reading room can be viewed at http://www.foia.af.mil/reading/. The AF Reading Room site is the single site for all AF Reading Room records. The 1996 amendments to the FOIA mandate publicly accessible "electronic reading rooms" with agency FOIA response materials and other information routinely available to the public.

7.1 What is the FOIA?

FOIA generally provides that any person has a right, enforceable in court, to obtain access to federal agency records, except to the extent that such records (or portions of them) are protected from public disclosure by one of nine exemptions, or by one of three special law enforcement record exclusions.

The principles of government openness and accountability underlying the FOIA are inherent in the democratic ideal: "The basic purpose of the FOIA is to ensure an informed citizenry, vital to the functioning of a democratic society, needed to check against corruption and to hold the governors accountable to the governed."

7.2 Who can submit a FOIA request?

Members of the public, including foreign citizens, military and civilian personnel acting as private citizens, organizations and businesses, and individual members of the Congress for themselves or constituents, may request records in writing. It is important to remember that the Freedom of Information Act applies only to federal agencies. It does not create a right of access to records held by Congress, the courts, state or local government agencies, or by private businesses or individuals. Each state has its own public access laws that should be consulted for access to state and local records.

7.3 What are the fees for processing a FOIA request?

The FOIA allows fee charges based on the requester's category. There are three categories: commercial (pay search, review, and reproduction fees); educational, non-commercial scientific institution, and news media (pay reproduction fees; first 100 pages provided at no cost); and others (pay search and reproduction fees; first two hours search and 100 pages provided at no cost).

For information on FOIA fees, go to www.dod.mil/pubs/foi/dfoipo/docs/foiafees.pdf.

Fee Waivers: If you are advised or expect that a fee will be charged, you may request in writing a waiver of those fees if the disclosure of the requested information is in the public interest because it is likely to contribute significantly to public understanding of the operations and activities of the government and is not primarily in the commercial interest of the requester. The mere fact that you are a non-profit organization or a member of the media does not in and of itself qualify for a fee waiver. In addition, a requester's inability to pay is not a legal basis for granting a fee waiver.

7.4 Where to Send a FOIA Request?

For fastest response times, the Air Force has decentralized its FOIA program. If you want to submit a FOIA inquiry online, please send an email to FOIA.kirtland@kirtland.af.mil. If you prefer not to submit online, you can mail or fax your request to Kirtland AFB FOIA Office.

377 MSG/SCOF (FOIA)
2051 Wyoming Blvd., S.E.
Kirtland AFB NM 87117
(505) 846-7717
Fax (505) 846-0742

7.5 How to Make a FOIA Request?

Describe the records you want as specifically as possible, and let the office know how much you are willing to pay. Furnish any facts or clues about the time, place, persons, events, subjects, or other details of the information or records you want. That will help the office decide where to search and determine what records pertain to your request. It can also save you and the government time and money, and you may get what you want faster. There is no special form to complete. Mark your request and envelope "FOIA."

7.6 FOIA Handbook

The DoD FOIA Handbook has been revised and is available on the Defense Freedom of Information Policy Office site at http://www.foia.af.mil/handbook/index.asp.

This handbook tells you how to obtain information from the Air Force and the different ways to do so. It explains how to submit a FOIA request, where to send it, what types of information and records are available, and gives you our average response times. The Air Force lists categories of records that the law exempts from release and procedures for appealing those decisions.

The four basic guidelines for submitting a FOIA request. (Reference DoD 5400.7-R_AFMAN 33-302, paragraph C1.4.2):

1.) Indicate that it is a FOIA request.
2.) Clearly identify the record(s) being sought and be specific on the type of documents. Avoid terms such as "requesting any and all documents" since this type of request generally requires clarification and responsive documents can include excessive costs for search and releasable documents. (*NOTE: Recommend asking for "all releasable information" in your request. This allows the FOIA office to redact or remove information generally exempted under the FOIA program and process your request quicker. FOIA provides access to records and "is not" a forum for answering questions.)*
3.) Indicate a willingness to pay fees associated with the processing the request or, in the alternative, why a waiver may be appropriate (see DoD 5400.7-R_AFMAN 33-302, section C6.1.4). For fee waivers; state an actual dollar amount versus a willingness to pay reasonable costs. This avoids guessing what is considered reasonable and you can be contacted should processing costs exceed your limit.
4.) Include a complete mailing address and consider providing a telephone number and/or e-mail address. Should questions arise you will be contacted.

Response Time: Normally, you can expect a response to your FOIA request within 20 business days from the date the proper FOIA office receives it. If special situations exist, the FOIA office will contact you with an estimated completion date and explain the reason for delay. The Air Force works requests on a first-in, first-out basis.

Appeal Request: You may file an administrative appeal with the Air Force if records responses to your appeal are withheld in full or partially denied or if your request for expedited processing or a fee waiver is denied. Your appeal must be received within sixty (60) days from the date of your final response letter. You may submit an appeal online or by writing to the office that provided you with the final decision. Please be specific why you are submitting the appeal and provide any additional information if possible.

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REFERENCES

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NMED 1999. *Technical Support Document, Exclusion/Inclusion of Solid Waste Management Units, Permit Module VII, Corrective Action for Solid Waste*. New Mexico. October 27.

Section 324 National Defense Authorization Act of 1996.

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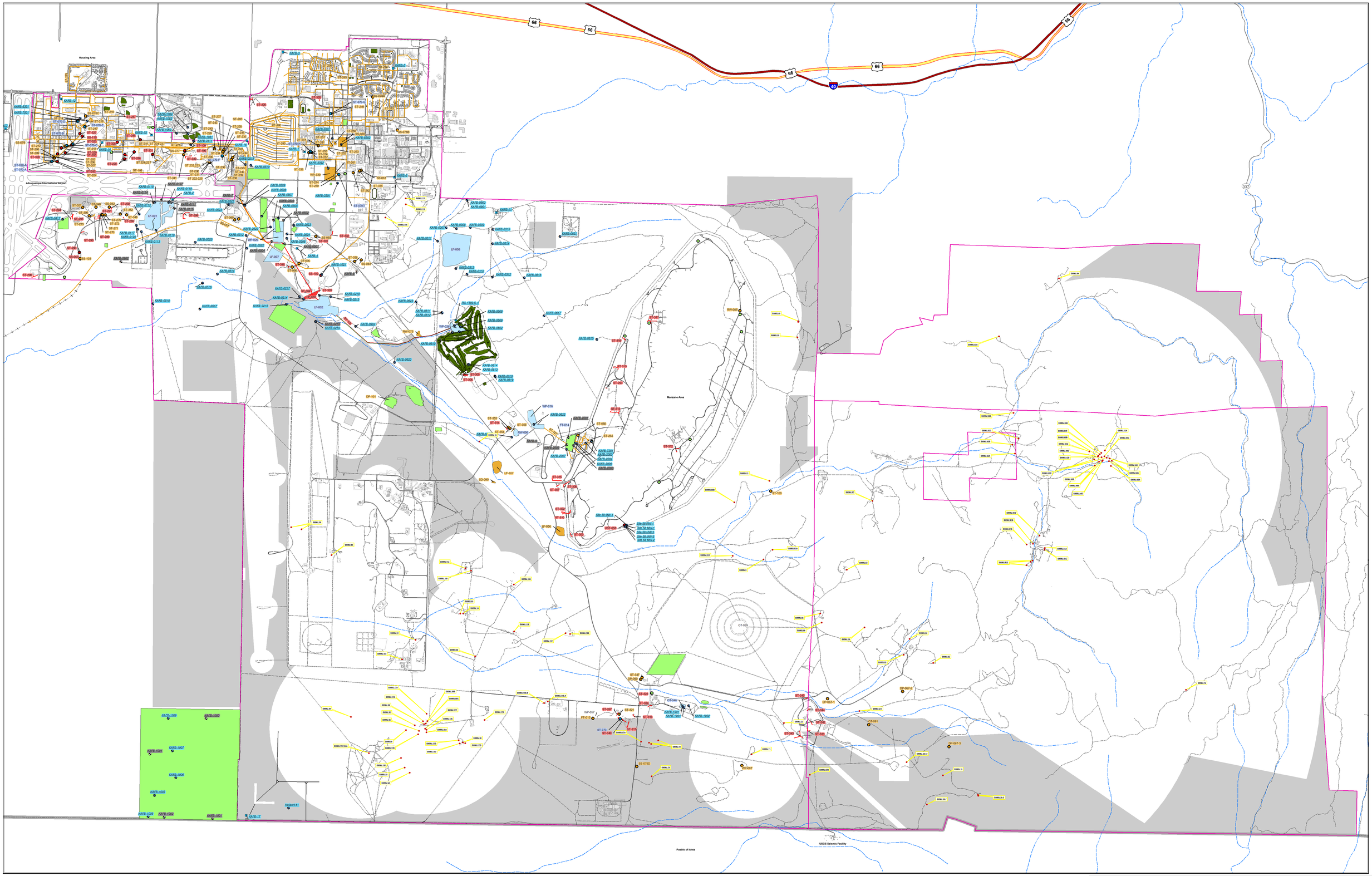
APPENDIX A

Site Map



Legend:

- Kirtland Air Force Base Boundary
- Pueblo of Isleta Boundary
- Intermittent Water Corridor
- Recreation Area
- MRAs

Road Classification

- Limited Access
- Highways
- Secondary Roads

Environmental Compliance Program

ECP Sites

- Active
- No Further Action
- Active
- No Further Action
- Active
- No Further Action

Environmental Restoration Program

ERP Sites

- Active
- No Further Action
- Active
- No Further Action

Wells

- Active Monitoring Well
- Inactive Monitoring Well
- Active Production Well
- Inactive Production Well

Environmental Compliance Program

Active

No Further Action

Environmental Restoration Program

Active

No Further Action

Wells

Active

Inactive

N W E S

0.5 0.25 0 0.5 Miles

1 0.5 0 1 Kilometers

KIRTLAND AIR FORCE BASE
ENVIRONMENTAL RESTORATION SECTION

KIRTLAND AIR FORCE BASE
Environmental Restoration Program (ERP)

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APPENDIX B

RAB/CAB Forms

Kirtland Air Force Base

Membership Application

Conditions of Membership

Restoration Advisory Board (RAB) members serve two-year terms and attend regularly scheduled RAB/CAB meetings. Members who miss three or more consecutive meetings may be asked to resign.

Citizen Advisory Board (CAB) typically focuses on a particular issue that is of concern to the neighbor/stakeholder of the installation. Meetings will be held on an as needed basis and/or established by the RAB/CAB members.

Duties and responsibilities will include reviewing and commenting on technical documents and activities associated with the environmental restoration program at Kirtland Air Force Base. Members are expected to be available to community members and groups to share information and/or concerns between the community and the RAB/CAB.

Participation in the RAB and/or CAB is strictly voluntary and members will not be financially compensated. Priority for RAB/CAB membership will be given to local residents who are directly impacted by environmental restoration activities at Kirtland Air Force Base.

Privacy Act Notice

Authority: 10 U.S.C. Section 2705(c) and 42 U.S.C. Section 9620(f), State and local participation in cleanup of federal facilities.

Principal Purpose: To identify members of the local community who are interested in participation in the formation of a RAB and/or CAB.

Routine Uses: The requested information will be used to develop a list of interested persons from which the community members of the RAB/CAB will be selected. The information will also be used by the Air Force to contact the individual who are selected.

Disclosure of the requested information is voluntary. Failure to provide all the requested information may prevent selection for the RAB/CAB.

Please complete the following:

Name: _____

Address: _____

Phone: _____

(home) (work)

If you are affiliated with an organization, please identify:

_____

Briefly state why you would like to be considered for a RAB and/or CAB membership. (Please include your knowledge of your participation with Kirtland AFB.)

_____

_____

_____

(continue on an additional page if needed)

_____ Please check here if you would like to be considered for the community co-chair position. The community co-chair will be selected by the community RAB/CAB Membership staff.

_____ Please check here if you are willing to voluntarily serve on the RAB and/or CAB. (please circle one or both)

By submitting this signed application, you agree to the conditions stated on this application form and acknowledge the time commitment this position will require. It also indicates that you have read and understand the Privacy Act information shown on this application.

Applicant Signature: _____

Date: _____

Return the completed application by mail or fax to the address below or by bringing it to the meeting. This application can be duplicated as necessary.

Wayne Bitner
Chief, Restoration Section
377th ABW/CEANR
2050 Wyoming Blvd., Suite 118
Kirtland AFB, NM 87117-5270
Fax (505) 853-3484

ROLES AND RESPONSIBILITIES

Department of Defense Installation Co-Chair

1. The DoD installation co-chair should coordinate with the community co-chair to prepare and distribute an agenda prior to each RAB/CAB meeting. If the RAB/CAB will address restoration related to base closure activities, the DoD and community co-chair should coordinate with the BRAC Cleanup Team, the Base Transition Coordinator, and the reuse committee.
2. The DoD installation co-chair should ensure that DoD participates in an open and constructive manner.
3. The DoD installation co-chair should attend all meetings and ensure that the RAB/CAB has the opportunity to participate in the restoration decision process.
4. The DoD installation co-chair should ensure that community issues and concerns related to restoration are addressed when raised.
5. The DoD installation co-chair should ensure documents distributed to the RAB/CAB are also made available to the general public.
6. The DoD installation co-chair with assistance from the RAB/CAB should ensure that an accurate list of interested/affected parties is developed and maintained.
7. The DoD installation co-chair should provide relevant policies and guidance documents to the RAB/CAB in order to enhance the RAB/CAB's operation.
8. The DoD installation co-chair should ensure that adequate administrative support to the RAB/CAB is provided.
9. The DoD installation co-chair should refer issues not related to restoration to appropriate installation official for them to address.
10. The DoD installation co-chair should report back to the installation.

Community Co-Chair

1. The community co-chair should coordinate with the DoD installation co-chair and RAB/CAB community members to prepare an agenda prior to each RAB/CAB meeting.
2. The community co-chair should ensure that community members participate in an open and constructive manner.
3. The community co-chair should ensure that community issues and concerns related to restoration are raised.
4. The community co-chair should assist with the dissemination of information to the general public.
5. The community co-chair should report back to the community.
6. The community co-chair is expected to serve without compensation.

RAB/CAB Community Members

1. The RAB/CAB community members are expected to attend meetings.
2. The RAB/CAB community members are expected to provide advice and comment on restoration issues to the decision makers.
3. The RAB/CAB community members should represent and communicate community interests and concerns to the RAB/CAB.
4. The RAB/CAB community members should act as a conduit for the exchange of information between the community, DoD installation, and environmental oversight agencies regarding the installation's restoration and reuse programs.
5. The RAB/CAB community members should review, evaluate, and comment on documents and other such materials related to installation restoration and closure, where applicable.
6. The RAB/CAB community members are expected to serve without compensation on the RAB/CAB.

State Regulatory Agency Member

1. The state member should attend RAB/CAB meetings.
2. The state member should serve as an information, referral and resource bank for communities, installations and agencies regarding installation restoration.
3. The state member should review documents and other materials related to restoration.
4. The state member should ensure that state environmental standards and regulations are identified and addressed by the DoD installation.
5. The state member should facilitate flexible and innovative resolutions of environmental issues and concerns.
6. The state member should assist in education and training for the RAB/CAB members.

U.S. Environmental Protection Agency (EPA) Member

1. The EPA member should attend RAB/CAB meetings.
2. The EPA member should serve as an information, referral and resource bank for communities, installations and agencies regarding installation restoration.
3. The EPA member should facilitate flexible and innovative resolutions of environmental issues and concerns.
4. The EPA member should ensure that federal environmental standards and regulations are identified and addressed by the DoD installation.
5. The EPA member should assist in education and training for the RAB/CAB members.

Kirtland Air Force Base (AFB)
Environmental Restoration Program (ERP)
Community Interest Form

Note: Forms will be reviewed only by Kirtland AFB ERP staff and will not solicit your mailing information to others.

If you need additional information, please contact Mr. Wayne Bitner at (505) 853-3484.

1. Please tell us which of the following apply to you: (check all that apply)

____	Local Resident/Neighbor/Stakeholder	____	Government/State Employee
____	Albuquerque NHA	____	Contractor
____	Citizen Advisory Group member	____	Other interested party

2. Please tell us how much you know about the Kirtland AFB ERP mission and activities:

____	Well informed	____	Not informed
____	Somewhat informed	____	Do not care

3. Please tell us what issues/topics are of most concern to you as a neighbor/stakeholder at Kirtland AFB: (Please be specific)
   1. _____
   2. _____
   3. _____
   4. _____
   5.

4. Please tell us if you have read or heard about Kirtland AFB ERP through the following sources: (check all that apply)

____	Base installation newspaper	____	Kirtland AFB website
____	Local newspaper (ABQ Journal)	____	Friend/Neighbor
____	Attended public meetings	____	DOE Forums/Meetings
____	Television	____	Other

☐ **I am interested in the formation of a formal RAB / CAB (please circle one or both). My contact information as follows:**

Name: _____
Company: (if applicable) _____
Address: _____
City, State, and Zip Code: _____
Email Address: _____

Please return this form to Mr. Wayne Bitner, Restoration Chief by fax (505) 853-1647 or mail to: 377th MSG/CEANR, 2050 Wyoming Blvd. Ste. 118, Kirtland AFB, NM 87117 or by bringing it to the public meeting. You may also express your interest by sending an email to: .Bitner@kirtland.af.mil

APPENDIX C

Demographic Data

ACS Demographic and Housing Estimates: 2005-2009
Data Set: 2005-2009 American Community Survey 5-Year Estimates
Survey: American Community Survey
Geographic Area: Bernalillo County, New Mexico

NOTE. Although the American Community Survey (ACS) produces population, demographic and housing unit estimates, it is the Census Bureau's Population Estimates Program that produces and disseminates the estimates of the population for the nation, states, counties, cities and towns and estimates of housing units for states and counties.

For more information on confidentiality protection, sampling error, nonsampling error, and definitions, see Survey Methodology.

ACS Demographic and Housing Estimates	Estimate	Margin of Error (+/-)	Percent	Margin of Error (+/-)
SEX AND AGE				
Total population	626,822	*****	626,822	(X)
Male	307,843	*****	49.1%	*****
Female	318,979	*****	50.9%	*****
Under 5 years	46,912	*****	7.5%	*****
5 to 9 years	41,211	1,025	6.6%	0.2
10 to 14 years	39,999	1,024	6.4%	0.2
15 to 19 years	40,790	106	6.5%	0.1
20 to 24 years	46,401	107	7.4%	0.1
25 to 34 years	98,425	*****	15.7%	*****
35 to 44 years	84,094	*****	13.4%	*****
45 to 54 years	87,931	*****	14.0%	*****
55 to 59 years	37,294	753	5.9%	0.1
60 to 64 years	28,991	752	4.6%	0.1
65 to 74 years	37,981	*****	6.1%	*****
75 to 84 years	26,326	533	4.2%	0.1
85 years and over	10,467	534	1.7%	0.1
Median age (years)	35.0	0.1	(X)	(X)
18 years and over	474,149	*****	75.6%	*****
21 years and over	448,154	718	71.5%	0.1
62 years and over	90,569	594	14.4%	0.1
65 years and over	74,774	*****	11.9%	*****
18 years and over	474,149	*****	474,149	(X)
Male	230,300	*****	48.6%	*****
Female	243,849	*****	51.4%	*****
65 years and over	74,774	*****	74,774	(X)
Male	31,860	*****	42.6%	*****
Female	42,914	*****	57.4%	*****
RACE				
Total population	626,822	*****	626,822	(X)
One race	604,800	1,690	96.5%	0.3
Two or more races	22,022	1,690	3.5%	0.3
One race	604,800	1,690	96.5%	0.3
White	434,450	3,789	69.3%	0.6
Black or African American	19,377	759	3.1%	0.1
American Indian and Alaska Native	30,513	1,143	4.9%	0.2
Cherokee tribal grouping	290	130	0.0%	0.1
Chippewa tribal grouping	141	106	0.0%	0.1
Navajo tribal grouping	14,057	1,199	2.2%	0.2
Sioux tribal grouping	463	271	0.1%	0.1
Asian	14,097	466	2.2%	0.1
Asian Indian	2,119	494	0.3%	0.1
Chinese	3,584	579	0.6%	0.1
Filipino	1,677	419	0.3%	0.1
Japanese	1,013	222	0.2%	0.1
Korean	1,115	346	0.2%	0.1
Vietnamese	3,221	489	0.5%	0.1
Other Asian	1,368	366	0.2%	0.1
Native Hawaiian and Other Pacific Islander	220	139	0.0%	0.1
Native Hawaiian	126	119	0.0%	0.1

ACS Demographic and Housing Estimates	Estimate	Margin of Error (+/-)	Percent	Margin of Error (+/-)
Guamanian or Chamorro	61	65	0.0%	0.1
Samoan	17	27	0.0%	0.1
Other Pacific Islander	16	25	0.0%	0.1
Some other race	106,143	3,689	16.9%	0.6
Two or more races	22,022	1,690	3.5%	0.3
White and Black or African American	2,904	614	0.5%	0.1
White and American Indian and Alaska Native	5,065	772	0.8%	0.1
White and Asian	1,975	450	0.3%	0.1
Black or African American and American Indian and Alaska Native	542	262	0.1%	0.1
Race alone or in combination with one or more other races				
Total population	626,822	*****	626,822	(X)
White	453,339	3,803	72.3%	0.6
Black or African American	24,019	681	3.8%	0.1
American Indian and Alaska Native	38,149	1,119	6.1%	0.2
Asian	17,127	377	2.7%	0.1
Native Hawaiian and Other Pacific Islander	740	243	0.1%	0.1
Some other race	116,435	3,898	18.6%	0.6
HISPANIC OR LATINO AND RACE				
Total population	626,822	*****	626,822	(X)
Hispanic or Latino (of any race)	286,081	*****	45.6%	*****
Mexican	137,335	3,500	21.9%	0.6
Puerto Rican	3,071	784	0.5%	0.1
Cuban	2,158	650	0.3%	0.1
Other Hispanic or Latino	143,517	3,531	22.9%	0.6
Not Hispanic or Latino	340,741	*****	54.4%	*****
White alone	271,103	461	43.3%	0.1
Black or African American alone	17,482	564	2.8%	0.1
American Indian and Alaska Native alone	26,444	744	4.2%	0.1
Asian alone	13,609	413	2.2%	0.1
Native Hawaiian and Other Pacific Islander alone	164	100	0.0%	0.1
Some other race alone	2,251	513	0.4%	0.1
Two or more races	9,688	999	1.5%	0.2
Two races including Some other race	795	197	0.1%	0.1
Two races excluding Some other race, and Three or more races	8,893	990	1.4%	0.2
Total housing units	276,183	927	(X)	(X)

Source: U.S. Census Bureau, 2005-2009 American Community Survey

Data are based on a sample and are subject to sampling variability. The degree of uncertainty for an estimate arising from sampling variability is represented through the use of a margin of error. The value shown here is the 90 percent margin of error. The margin of error can be interpreted roughly as providing a 90 percent probability that the interval defined by the estimate minus the margin of error and the estimate plus the margin of error (the lower and upper confidence bounds) contains the true value. In addition to sampling variability, the ACS estimates are subject to nonsampling error (for a discussion of nonsampling variability, see http://www.census.gov/acs/www/data_documentation/documentation_main/Accuracy of the Data). The effect of nonsampling error is not represented in these tables.

Notes:

·For more information on understanding race and Hispanic origin data, please see the Census 2000 Brief entitled, http://www.census.gov/prod/2001pubs/c2kbr01-1.pdfOverview of Race and Hispanic Origin, issued March 2001. (pdf format)

·The ACS questions on Hispanic origin and race were revised in 2008 to make them consistent with the Census 2010 question wording. Any changes in estimates for 2008 and beyond may be due to demographic changes, as well as factors including questionnaire changes, differences in ACS population controls, and methodological differences in the population estimates, and therefore should be used with caution. For a summary of questionnaire changes see ://www.census.gov/acs/www/methodology/questionnaire_changes/. For more information about changes in the estimates see ://www.census.gov/population/www/socdemo/hispanic/reports.html.

·While the 2005-2009 American Community Survey (ACS) data generally reflect the November 2008 Office of Management and Budget (OMB) definitions of metropolitan and micropolitan statistical areas; in certain instances the names, codes, and boundaries of the principal cities shown in ACS tables may differ from the OMB definitions due to differences in the effective dates of the geographic entities.
·Estimates of urban and rural population, housing units, and characteristics reflect boundaries of urban areas defined based on Census 2000 data. Boundaries for urban areas have not been updated since Census 2000. As a result, data for urban and rural areas from the ACS do not necessarily reflect the results of ongoing urbanization.

Explanation of Symbols:
1. An '**' entry in the margin of error column indicates that either no sample observations or too few sample observations were available to compute a standard error and thus the margin of error. A statistical test is not appropriate.
2. An '-' entry in the estimate column indicates that either no sample observations or too few sample observations were available to compute an estimate, or a ratio of medians cannot be calculated because one or both of the median estimates falls in the lowest interval or upper interval of an open-ended distribution.
3. An '-' following a median estimate means the median falls in the lowest interval of an open-ended distribution.
4. An '+' following a median estimate means the median falls in the upper interval of an open-ended distribution.
5. An '***' entry in the margin of error column indicates that the median falls in the lowest interval or upper interval of an open-ended distribution. A statistical test is not appropriate.
6. An '*****' entry in the margin of error column indicates that the estimate is controlled. A statistical test for sampling variability is not appropriate.
7. An 'N' entry in the estimate and margin of error columns indicates that data for this geographic area cannot be displayed because the number of sample cases is too small.
8. An '(X)' means that the estimate is not applicable or not available.

ACS Demographic and Housing Estimates: 2005-2009
Data Set: 2005-2009 American Community Survey 5-Year Estimates
Survey: American Community Survey
Geographic Area: Valencia County, New Mexico

NOTE. Although the American Community Survey (ACS) produces population, demographic and housing unit estimates, it is the Census Bureau's Population Estimates Program that produces and disseminates the estimates of the population for the nation, states, counties, cities and towns and estimates of housing units for states and counties.

For more information on confidentiality protection, sampling error, nonsampling error, and definitions, see Survey Methodology.

ACS Demographic and Housing Estimates	Estimate	Margin of Error (+/-)	Percent	Margin of Error (+/-)
SEX AND AGE				
Total population	70,974	*****	70,974	(X)
Male	35,946	200	50.6%	0.3
Female	35,028	200	49.4%	0.3
Under 5 years	4,945	129	7.0%	0.2
5 to 9 years	5,175	345	7.3%	0.5
10 to 14 years	5,338	339	7.5%	0.5
15 to 19 years	5,653	146	8.0%	0.2
20 to 24 years	4,949	156	7.0%	0.2
25 to 34 years	8,307	88	11.7%	0.1
35 to 44 years	10,137	146	14.3%	0.2
45 to 54 years	10,291	131	14.5%	0.2
55 to 59 years	4,780	302	6.7%	0.4
60 to 64 years	3,252	285	4.6%	0.4
65 to 74 years	4,740	101	6.7%	0.1
75 to 84 years	2,755	142	3.9%	0.2
85 years and over	652	135	0.9%	0.2
Median age (years)	36.0	0.3	(X)	(X)
18 years and over	52,023	77	73.3%	0.1
21 years and over	48,481	291	68.3%	0.4
62 years and over	10,092	295	14.2%	0.4
65 years and over	8,147	94	11.5%	0.1
18 years and over	52,023	77	52,023	(X)
Male	26,235	165	50.4%	0.3
Female	25,788	166	49.6%	0.3
65 years and over	8,147	94	8,147	(X)
Male	3,720	80	45.7%	0.7
Female	4,427	60	54.3%	0.7
RACE				
Total population	70,974	*****	70,974	(X)
One race	67,963	540	95.8%	0.8
Two or more races	3,011	540	4.2%	0.8
One race	67,963	540	95.8%	0.8
White	43,045	1,299	60.6%	1.8
Black or African American	1,066	145	1.5%	0.2
American Indian and Alaska Native	2,746	341	3.9%	0.5
Cherokee tribal grouping	45	61	0.1%	0.1
Chippewa tribal grouping	217	173	0.3%	0.2
Navajo tribal grouping	537	200	0.8%	0.3
Sioux tribal grouping	0	127	0.0%	0.1
Asian	590	359	0.8%	0.5
Asian Indian	0	127	0.0%	0.1
Chinese	166	114	0.2%	0.2
Filipino	284	340	0.4%	0.5
Japanese	34	24	0.0%	0.1
Korean	41	38	0.1%	0.1
Vietnamese	46	51	0.1%	0.1
Other Asian	19	27	0.0%	0.1
Native Hawaiian and Other Pacific Islander	67	47	0.1%	0.1
Native Hawaiian	24	29	0.0%	0.1

ACS Demographic and Housing Estimates	Estimate	Margin of Error (+/-)	Percent	Margin of Error (+/-)
Guamanian or Chamorro	13	22	0.0%	0.1
Samoan	0	127	0.0%	0.1
Other Pacific Islander	30	35	0.0%	0.1
Some other race	20,449	1,197	28.8%	1.7
Two or more races	3,011	540	4.2%	0.8
White and Black or African American	183	130	0.3%	0.2
White and American Indian and Alaska Native	318	118	0.4%	0.2
White and Asian	177	93	0.2%	0.1
Black or African American and American Indian and Alaska Native	0	127	0.0%	0.1
Race alone or in combination with one or more other races				
Total population	70,974	*****	70,974	(X)
White	45,704	1,228	64.4%	1.7
Black or African American	1,416	143	2.0%	0.2
American Indian and Alaska Native	3,396	417	4.8%	0.6
Asian	817	339	1.2%	0.5
Native Hawaiian and Other Pacific Islander	115	76	0.2%	0.1
Some other race	22,682	1,327	32.0%	1.9
HISPANIC OR LATINO AND RACE				
Total population	70,974	*****	70,974	(X)
Hispanic or Latino (of any race)	39,695	*****	55.9%	*****
Mexican	14,611	1,120	20.6%	1.6
Puerto Rican	201	106	0.3%	0.1
Cuban	34	33	0.0%	0.1
Other Hispanic or Latino	24,849	1,126	35.0%	1.6
Not Hispanic or Latino	31,279	*****	44.1%	*****
White alone	26,800	300	37.8%	0.4
Black or African American alone	978	130	1.4%	0.2
American Indian and Alaska Native alone	2,034	132	2.9%	0.2
Asian alone	323	90	0.5%	0.1
Native Hawaiian and Other Pacific Islander alone	41	36	0.1%	0.1
Some other race alone	288	191	0.4%	0.3
Two or more races	815	263	1.1%	0.4
Two races including Some other race	208	182	0.3%	0.3
Two races excluding Some other race, and Three or more races	607	190	0.9%	0.3
Total housing units	26,628	126	(X)	(X)

Source: U.S. Census Bureau, 2005-2009 American Community Survey

Data are based on a sample and are subject to sampling variability. The degree of uncertainty for an estimate arising from sampling variability is represented through the use of a margin of error. The value shown here is the 90 percent margin of error. The margin of error can be interpreted roughly as providing a 90 percent probability that the interval defined by the estimate minus the margin of error and the estimate plus the margin of error (the lower and upper confidence bounds) contains the true value. In addition to sampling variability, the ACS estimates are subject to nonsampling error (for a discussion of nonsampling variability, see http://www.census.gov/acs/www/data_documentation/documentation_main/Accuracy of the Data). The effect of nonsampling error is not represented in these tables.

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·While the 2005-2009 American Community Survey (ACS) data generally reflect the November 2008 Office of Management and Budget (OMB) definitions of metropolitan and micropolitan statistical areas; in certain instances the names, codes, and boundaries of the principal cities shown in ACS tables may differ from the OMB definitions due to differences in the effective dates of the geographic entities.
·Estimates of urban and rural population, housing units, and characteristics reflect boundaries of urban areas defined based on Census 2000 data. Boundaries for urban areas have not been updated since Census 2000. As a result, data for urban and rural areas from the ACS do not necessarily reflect the results of ongoing urbanization.

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2. An '-' entry in the estimate column indicates that either no sample observations or too few sample observations were available to compute an estimate, or a ratio of medians cannot be calculated because one or both of the median estimates falls in the lowest interval or upper interval of an open-ended distribution.
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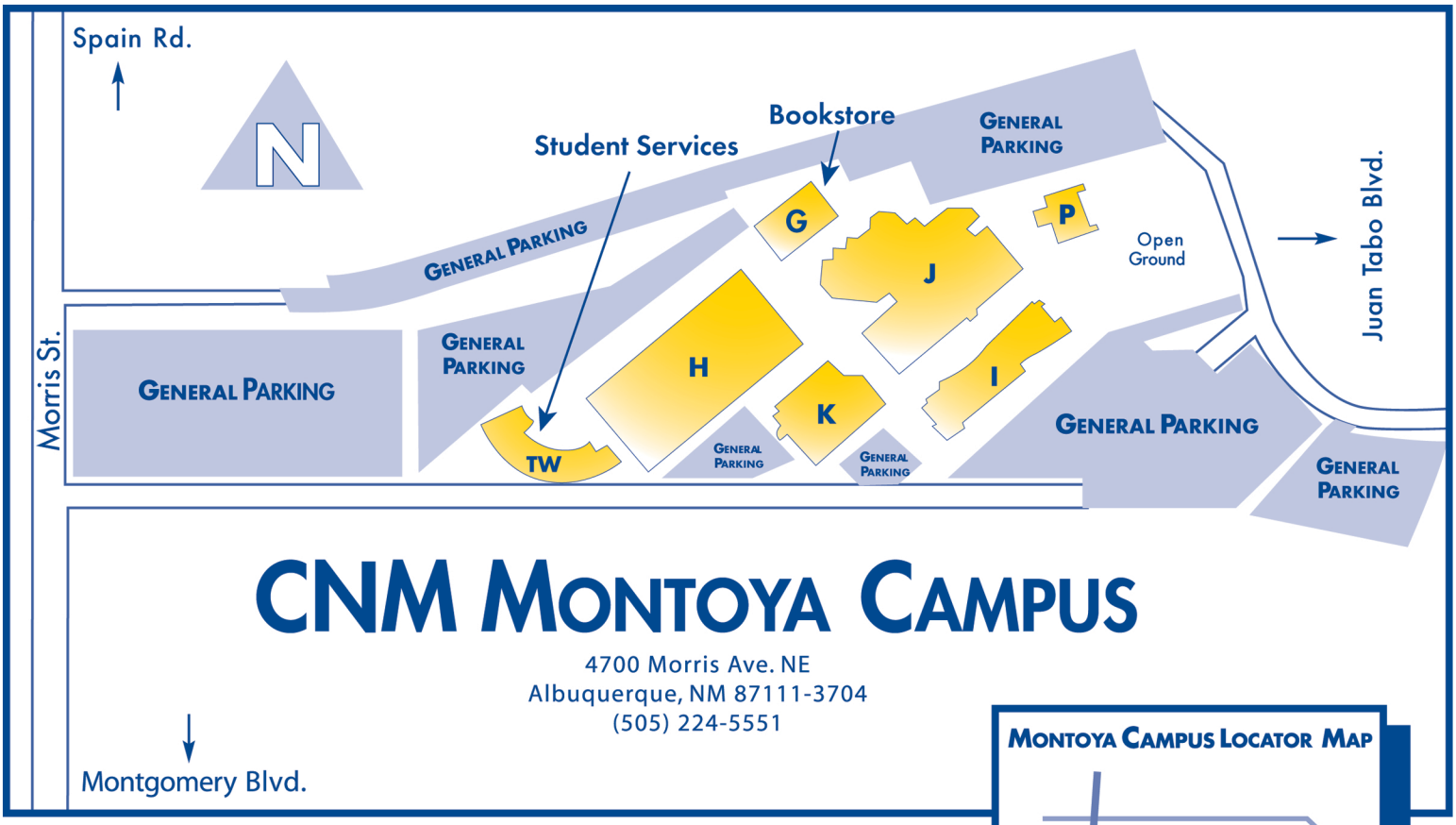
6. An '*****' entry in the margin of error column indicates that the estimate is controlled. A statistical test for sampling variability is not appropriate.
7. An 'N' entry in the estimate and margin of error columns indicates that data for this geographic area cannot be displayed because the number of sample cases is too small.
8. An '(X)' means that the estimate is not applicable or not available.

APPENDIX D

IR Location Map



CNM Montoya Campus

4700 Morris Ave. NE
Albuquerque, NM 87111-3704
(505) 224-5551

G: G Building
Bookstore

H: H Building
Food Court

I: I Building

J: J Building
CNM Library J-123
Math Assistance Learning Lab J-102
Tutoring Center J-107

K: K Building

P: P Building (Maintenance)

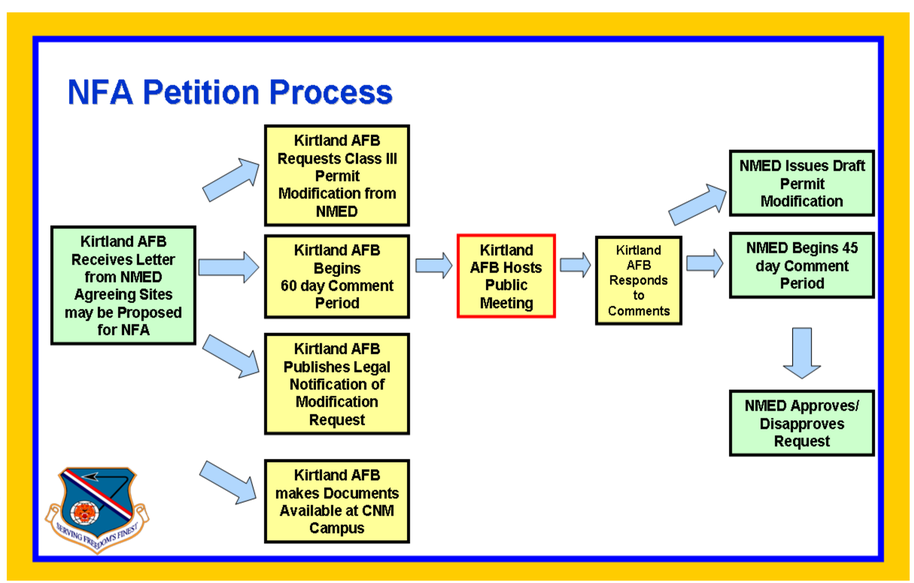
TW: Tom Wiley Hall
Student Services

APPENDIX E

Permit Modification Process

The Kirtland Air Force Base RCRA Permit and the No Further Action Process

- Kirtland Air Force Base (AFB) operates under a hazardous waste permit (Resource Conservation and Recovery Act [RCRA] permit) that regulates hazardous waste sites at the base. These sites are formally called Solid Waste Management Units (SWMUs).
- The RCRA permit directs investigations to determine if contaminants have been released to the environment and, if so, how sites will be cleaned up.
- After investigation and any needed cleanup, a site is evaluated by the New Mexico Environment Department (NMED) to determine if there is any risk to human health or the environment.
- If the NMED agrees that a site does not pose a risk, the site is considered appropriate for No Further Action (NFA) and Kirtland AFB may initiate the NFA petition process.
- During the NFA petition process Kirtland AFB requests that the site be moved to an inactive status on the hazardous waste permit.
  - An inactive status means that additional investigation, monitoring, or cleanup at the site is not needed.
  - Although a site can be moved to an inactive status, it is never removed from the RCRA permit so it will always be able to be tracked by the Air Force and the NMED and reactivated if necessary.
- Even if Kirtland AFB and the NMED agree a site is appropriate for NFA, the RCRA permit process provides for public involvement and comment before the decision is finalized.
- The chart to the left shows the various steps in the formal permit modification process.
- This meeting fulfills the Public Meeting step of the process.



We are here to help answer your questions!

Please take this opportunity to ask questions about the Kirtland AFB permit, the NFA process, or the sites currently being requested for NFA.
This meeting is intended to provide information to the public.

Current Kirtland Air Force Base RCRA Permit Modification Request

- **Kirtland AFB is currently requesting that a total of 24 individual sites be approved for NFA and moved to the inactive portion of their RCRA permit.**
- **All sites have been evaluated, investigated, or have been subject to corrective actions; the chemicals currently present at the sites have been compared to the required NMED screening levels and are below risk levels.**
- **NMED has five criteria based on which a site is evaluated for NFA. If a site meets any one of those criteria then the NMED considers the site acceptable for NFA.**
- **The 24 sites being proposed for NFA as part of the current permit modification qualify under one of the following three NFA criteria:**

  NFA Criterion 1: ***The site cannot be located, does not exist, or is a duplicate site .***

  NFA Criterion 2: ***The site was never used for the management (that is, generation, treatment, storage, or disposal) of Resource Conservation and Recovery Act (RCRA) solid or hazardous wastes and/or constituents or other Comprehensive Environmental Response, Conservation and Liability Act (CERCLA) hazardous substances.***

  NFA Criterion 5: ***The site has been characterized or remediated in accordance with current applicable State or Federal regulations, and the available data indicate that contaminants at the site pose an acceptable level of risk under current and projected future land use.***

- **NMED agrees that each site does not represent an unacceptable risk to human health or the environment and that the sites are suitable for NFA.**
- **The sites that are being requested for NFA in Kirtland AFB's 1 February 2007, Class 3 Permit Modification Request are listed below.**
  - ***SWMU 10-21-A, Septic System Building 525 (ST-287)***
  - ***SWMU 10-21-B, Septic System Building 619 (ST-290)***
  - ***SWMU 10-21-B, Septic System Building 622 (ST-292)***
  - ***SWMU 10-21-C, Septic System Building 638 (ST-295)***
  - ***SWMU 10-21-D, Septic System Building 702 (ST-296)***
  - ***SWMU 10-21-D, Septic System Building 707 (ST-297)***
  - ***SWMU 10-21-E, Septic System Building 20199 (ST-300)***
  - ***SWMU 10-21-F, Septic System Building 20560 (ST-301)***
  - ***SWMU 10-21-G, Septic System Building 20599 (ST-302)***
  - ***SWMU 10-21-H, Septic System Building 20749 (ST-303)***
  - ***SWMU 10-21-I, Septic System Building 20797 (ST-304)***
  - ***SWMU 10-21-J, Septic System Building 28054 (ST-305)***
  - ***SWMU 10-21-J, Septic System Building 28050 (ST-306)***
  - ***SWMU 10-21-K, Septic System Building 30101 (ST-307)***
  - ***SWMU 10-21-L, Septic System Building 37511 (ST-308)***
  - ***SWMU 10-21-K, Septic System Building 30102 (Former ST-315)***
  - ***SWMU 10-21-T, Septic System CERF Building 57011 (ST-317)***
  - ***SWMU 10-21-W, Septic System Building 20149 (ST-320)***
  - ***SWMU 10-21-X, Septic System Building 29042 (ST-323)***
  - ***SWMU 10-21-Y, Septic System Building 29051 (ST-324)***
  - ***SWMU 10-21-AA, Septic System SOR Building 66029 (ST-342)***
  - ***SWMU 10-21-AA, Septic System SOR Building 66006 (ST-345)***
  - ***SWMU 10-21-BB, Trestle Site Septic Tank (ST-346)***
  - ***SWMU 6-3, Landfill 3 (LF-007)***

SERVING FREEDOM'S FINEST

EXAMPLE

APPENDIX F

Fact Sheets

Bulk Fuels Facility Spill Project

U.S. Air Force, Kirtland Air Force Base

Off loading rack

Remedial Investigation (RI) Update

Site History

The Bulk Fuels Facility is located in the north-western portion of Kirtland Air Force Base (AFB) in Albuquerque, New Mexico. The Facility and associated infrastructure operated from 1953 until 1999. During this time, the fueling area was separated into a tank holding area where bulk shipments of fuel were received and a fuel loading area where individual fuels trucks were filled. Kirtland AFB removed the facility from service in 1999 due to line leakage identified along the offloading rack below the ground surface.

The fuel leak was identified by Kirtland AFB in 1999, and the exact history of the leaks or releases is unknown. Releases could have occurred when fuel was transferred from railcars to the pump house, and then to the bulk fuel storage containers at the south end of the site. Initially, it was thought that the leak only affected surface soil around the identified source area. Kirtland AFB learned through additional investigation activities conducted between 2004 and 2007 that the leaked fuel had reached the groundwater table.

Kirtland AFB installed the first soil vapor extraction unit in 2003 to begin treating soil contamination related to the fuel spill. Soil remediation continued from 2004 to 2007. Due to fuel being detected on the water table in December 2007 off Kirtland AFB, additional vapor extraction units were installed at various points above the fuel plume.

Present Day Activities

Investigation activities determined that the fuel contamination migrated north of Kirtland AFB. In order to comply with New Mexico Environment Department-Hazardous Waste Bureau requirements, understand the extent of contamination and how far contamination has migrated from the original site, additional groundwater and soil vapor monitoring wells both on and off base are being installed to further investigate the contamination. New wells will be installed in the Siesta Hills and Elder Homestead neighborhoods in the next few months. These wells will then be sampled quarterly to fill in information gaps so a final remedy can be identified to address the fuel leak.

New well installation & development:	January – April 2011
Well sampling:	January 2011-2014; once wells are installed, they will be sampled on a quarterly basis
Groundwater investigation report	2014-2015

Overall Approximate Schedule

Questions or Concerns?

To report concerns or get more information about this project, please call or e-mail the Kirtland AFB Public Affairs Office at:

Kirtland AFB
(505) 846-5991
377abw.pa@kirtland.af.mil

Proyecto del vertido en las instalaciones de depósitos de combustible

Fuerza Aérea de los Estados Unidos, Base Aérea de Kirtland

Off loading rack

Información actualizada sobre la Investigación correctiva

Antecedentes del sitio

La Instalación de depósitos de combustible está situada en la parte noroeste de la Base Aérea de Kirtland (AFB) en Albuquerque, Nuevo México. Las instalaciones y su infraestructura estuvieron operativas desde 1953 hasta 1999. Durante ese tiempo, la zona de combustibles estaba separada en una zona que alojaba los dépósitos donde se recibían los cargamentos de combustible en volumen, y una zona de carga de combustible donde se llenaban los camiones de combustible. La base aérea de Kirtland abandonó el uso de la instalación en 1999 al detectarse una fuga en una tubería a lo largo del bastidor de descarga bajo la superficie.

La base aérea de Kirtland detectó la fuga de combustible en 1999 y se desconoce la cronología y el origen exactos de las fugas o vertidos. Los vertidos podrían haberse producido al trasladar el combustible desde los automotores hasta la estación de bombeo, y posteriormente a los bidones de almacenamiento de combustible en el extremo sur de la instalación. Al principio, se pensó que la fuga sólo afectaba al suelo de la superficie alrededor de la zona de origen identificada. La base aérea de Kirtland averiguó gracias otras actividades de investigación realizadas entre 2004 y 2007 que la fuga de combustible había alcanzado la capa freática.

La base aérea de Kirtland instaló la primera unidad de extracción de vapores del suelo en 2003 para comenzar a tratar la contaminación del suelo relacionada con el vertido de combustible. La limpieza del suelo continuó de 2004 a 2007. Dado que se detectó combustible en la capa freática en diciembre de 2007 fuera de los límites de la base aérea de Kirtland, se instalaron más unidades de extracción de vapores en diversos puntos por encima de la pluma de contaminación de combustible.

Actividades actuales

Las tareas de investigación determinaron que la contaminación por combustible había migrado al norte de la base aérea de Kirtland. A fin de cumplir los requisitos de la Oficina para el Desecho de Materiales Peligrosos-Departamento del Medio Ambiente de Nuevo México, comprender el alcance de la contaminación y el grado de extensión de la contaminación fuera de lugar de origen, se están instalando nuevos pozos de supervisión del agua subterránea y de vapores del suelo tanto dentro como fuera de la base, con el fin de investigar la contaminación en más profundidad. En los próximos meses se instalarán nuevos pozos en los vecindarios de Siesta Hills y Elder Homestead. Posteriormente se tomarán muestras de estos pozos cada tres meses a fin de completar la información e identificar una solución definitiva para contener la fuga de combustible.

Calendario general aproximado

Instalación y creación de nuevos pozos:	Enero – Abril 2011
Toma de muestras en los pozos:	Enero 2011-2014; una vez instalados los pozos, se tomarán muestras cada tres meses
Informe de investigación del agua subterránea	2014-2015

¿Preguntas o inquietudes?

Para comunicarnos sus inquietudes o si desea más información sobre este proyecto, llame por teléfono o envíe un mensaje electrónico a la oficina de asuntos públicos de la base aérea de Kirtland (Kirtland AFB Public Affairs Office):

Kirtland AFB
(505) 846-5991
377abw.pa@kirtland.af.mil

Construction Notice

U.S. Air Force, Kirtland Air Force Base

Drill rig similar to that used for monitoring well installation

Finished monitoring well

What?

Kirtland Air Force Base (Kirtland AFB) is continuing to investigate the fuel leak at the Kirtland AFB Bulk Fuels Facility. As part of these efforts, the U.S. Air Force, Kirtland AFB, and their contractor, Shaw Environment and Infrastructure, Inc. (Shaw) will be constructing new groundwater sampling and monitoring wells in the Siesta Hills and Elder Homestead neighborhoods.

- Work will start in the next two weeks, and last about three weeks.
- Work will be done during work hours, 8:00 am to 5:00 pm 7 days a week except major holidays and every other weekend.
- There will be noise, parking, and traffic impacts. We will rope off the work area to protect the community residents and the public from construction dangers and do our best to reduce impacts to the area. A security guard will be posted at the drill rig overnight to guard against accidents and vandalism.

Drinking water being provided by the Albuquerque Bernalillo County Water Utility Authority is safe to drink and use.

Why?

A fuel leak was identified by Kirtland AFB in 1999. Initially, it was thought that the leak only affected surface soil around the identified source area on base. In 2007, Kirtland AFB learned that the leaked fuel had reached the groundwater table.

This resulted in investigation activities that showed that the fuel contamination extended outside of the northern boundary of Kirtland AFB. In order to comply with New Mexico Environment Department-Hazardous Waste Bureau requirements, understand the extent of contamination and how far contamination has migrated from the original site, additional groundwater and soil vapor monitoring wells both on and off base are being installed to further investigate the contamination.

Activities and Approximate Schedule

New well installation & development:	January – April 2011
Well sampling:	January 2011-2014; once wells are installed, they will be sampled on a quarterly basis

Who?

To report concerns or get more information about this project, please call or e-mail the Kirtland AFB Public Affairs office at:

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Aviso de construcción

Fuerza Aérea de los Estados Unidos, Base Aérea de Kirtland

Equipo de perforación similar al utilizado para la instalación de pozos de supervisión

Pozo de supervisión finalizado

¿Qué?

La base aérea de Kirtland (Kirtland AFB) sigue su investigación de la fuga de combustible ocurrida en las instalaciones de los depósitos de combustible de Kirtland AFB. Dentro de esta tarea, la Fuerza Aérea de los EE. UU., la Base Aérea de Kirtland y la empresa contratada por ésta, Shaw Environment and Infrastructure, Inc. (Shaw) construirán nuevos pozos de supervisión y del agua subterránea en los vecindarios de Siesta Hills y Elder Homestead.

- Las obras comenzarán en las próximas dos semanas y durarán alrededor de tres semanas.
- El trabajo se realizará durante el horario laboral, de 8:00 am a 5:00 pm, los 7 días de la semana, excepto los días festivos importantes y fines de semana alternos.
- Los trabajos causarán ruido y afectarán al tráfico y el estacionamiento. Se acordonará la zona de trabajo a fin de proteger a los residentes de la comunidad y al público de los peligros derivados de la construcción y haremos todo lo posible por reducir el impacto en la zona. Durante la noche habrá un guardia de seguridad apostado junto al equipo de perforación para proteger las instalaciones de posibles accidentes o actos de vandalismo.

La autoridad de servicios de abastecimiento de agua del condado Albuquerque Bernalillo suministra el agua potable y su consumo y uso es seguro.

¿Por qué?

En 1999 se detectó una fuga de combustible en la base aérea de Kirtland. Al principio, se pensó que la fuga afectaba solamente al suelo de la superficie alrededor de la zona de origen identificada en la base. En 2007, la base aérea de Kirtland supo que la fuga de combustible había alcanzado la capa freática.

Esto dio lugar a una serie de actividades de investigación que demostraron que la contaminación por combustible se habia extendido más allá del límite norte de la base áerea de Kirtland. A fin de cumplir los requisitos de la Oficina para el Desecho de Materiales Peligrosos-Departamento del Medio Ambiente de Nuevo México, comprender el alcance de la contaminación y el grado de extensión de la contaminación fuera de lugar de origen, se están instalando nuevos pozos de supervisión del agua subterránea y de vapores del suelo tanto dentro como fuera de la base, con el fin de investigar la contaminación en más profundidad.

Actividades y calendario aproximado

Instalación y creación de nuevos pozos:	Enero – Abril 2011
Toma de muestras en los pozos:	Enero 2011-2014; una vez instalados los pozos, se tomarán muestras cada tres meses

¿Quién?

Para comunicarnos sus inquietudes o si desea más información sobre este proyecto, llame por teléfono o envíe un mensaje electrónico a la oficina de asuntos públicos de la base aérea de Kirtland (Kirtland AFB Public Affairs):

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(505) 846-5991
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POINTS OF CONTACT

Kirtland AFB

377 ABW/PA – Public Affairs

(505) 846-5991

FUEL PLUME HOTLINE

(505) 853-7779

Citizens may review Air Force Environmental Restoration Program (ERP) documents at the Kirtland AFB Information Repository (IR) located at the Central New Mexico (CNM) Community College-Montoya Campus Library, 4700 Morris NE, (505) 224-5721

or

by visiting the Kirtland AFB website at http://www.kirtland.af.mil in the Environmental Issues section for Public Records.

UXOINFO.com The Authority on Unexploded Ordnance Technology, News, and Information

Kirtland AFB Streamlines Munitions Response Process

Posted At : June 28, 2007 6:40 AM | Posted By : Admin
Related Categories: UXO Cleanup

Thirty-three potential Military Munitions Response Program (MMRP) sites are located on Kirtland AFB over an area of approximately 15,812 acres. Access to most of these sites is controlled by physical factors (signage and inaccessibility), but even with these controls in place there has been occasional military and civilian exposure to UXO items located at the ground surface in the area. Because these sites are slated for future response actions under the MMRP, no attempts had been made previously to remove the UXO items.

During FY06, a Wide Area Assessment (WAA) was conducted at the Kirtland MMRP sites. A field reconnaissance carried out as part of the WAA required the assistance of Explosive Ordnance Disposal (EOD) teams when several UXO items were encountered.

Hazardous munitions items previously present at Kirtland AFB shown in the image below.

Subsequently, the Kirtland EOD team proposed to expand its initial efforts and remove other visible UXO items present within remote areas of Kirtland AFB. Although the typical responsibilities of a base EOD team do not include the cleanup of munitions response sites located on their base, the EOD team at Kirtland saw an opportunity to reduce potential exposure of installation personnel to these UXO items while providing needed training to the EOD teams. The removal effort, named the UXO Intervention and Recovery Project, would also reduce costs of any subsequent munitions responses conducted at the MMRP sites by eliminating the need to hire private contractors to remove the visible UXO items.

Execution of the project required close collaboration between the Kirtland AFB MMRP team, the EOD Flight, the Air Force Safety Center (AFSC), Air Force Materiel Command, and Headquarters USAF. The project was not designed to fully clear or remediate the areas and obtain the certificate of clearance required to release the land for public use, but to remove as many perceived munitions hazards as practical in a two-week period with the limited funding allocated for the task.

The EOD team was able to successfully remove 1,065 munitions items totaling 12,611 pounds across 2,010 acres. Through the implementation of thorough Quality Assurance/Quality Control oversight during the demilitarization process, most materials could be recycled. The most successful aspect of the clean up, however, was the savings in time and cost for the Air Force, as AFSC was able to gain approval from the Department of Defense Explosive Safety Board (DDESB) to perform the surface clearance without having to submit an Explosive Safety Submission. With this approval from the DDESB, the total time

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from funding allocation to completion of field operations was less than two months, a time savings of at least six months. Additionally, the project was completed at a cost of approximately $120,000, a cost savings of approximately $480K over what would have been required if the Air Force had to conduct the same level of removal utilizing private contractors under its MMRP. Further, Kirtland AFB was able to support the Air Force mission by providing necessary training to the EOD Flight. This success at Kirtland AFB highlights the importance of innovative thinking and teamwork to streamlining results in the Air Force MMRP.

Munitions items recovered by Kirtland EOD personnel shown in the image below.

Article Submitted by: Mr. Wayne Bitner, Environmental Restoration Kirtland AFB, New Mexico.

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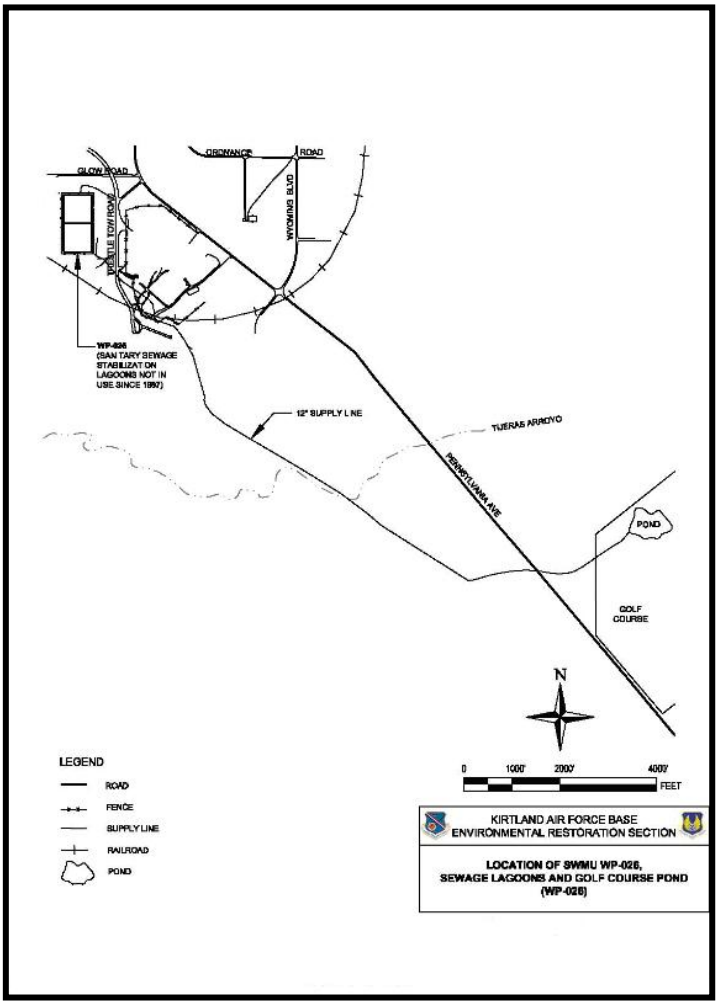
Fact Sheet
Kirtland AFB WP-26 Golf Course Main Pond
January 2007

Site Location and Description

Solid Waste Management Unite (SWMU) WP-026 is made up of two geographically distinct locations, the former sewage lagoons and the Golf Course Main Pond (GCMP). These two areas are part of the same site because the waste stream for each was the same.



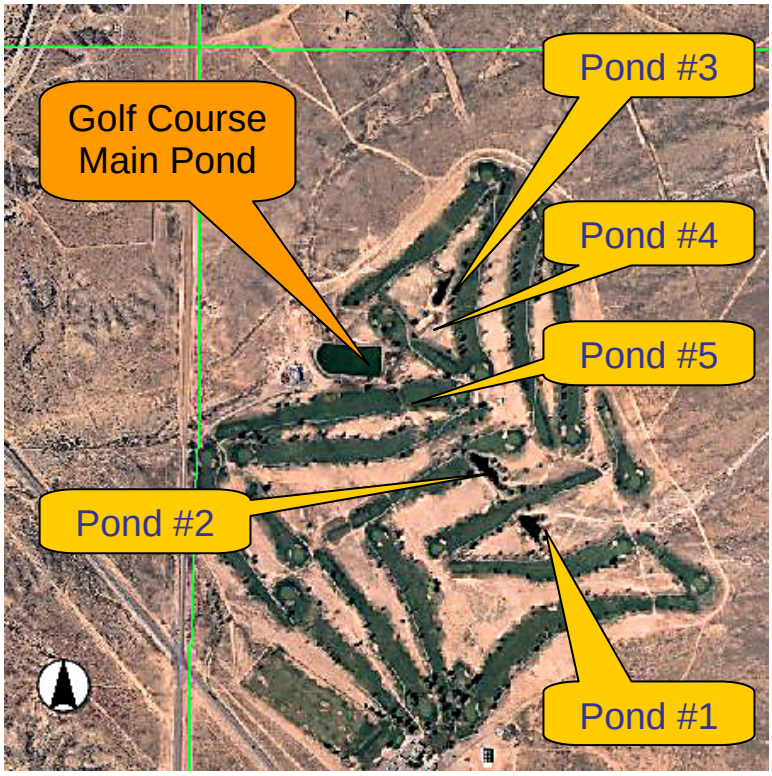
The former sewage lagoons are located 1.5 miles southeast of the east end of the main runway at the Albuquerque International Sunport. The sewage lagoons were constructed in 1962 and comprised unlined north and south square cells separated by an earthen wall. Each lagoon covered approximately 7 acres (14 acres for both sewage lagoons). Two pipes discharged raw sewage into the center of each lagoon. Liquid levels in each lagoon were contained by an elevated soil berm surrounding the perimeter. The lagoons shared a common berm containing a pipe connecting the lagoons, which allowed liquids to pass freely between the north and south lagoons. The sewage lagoons acted as settling ponds for raw sewage and provided treatment by facultative microorganisms.

The sewage lagoons were closed in 1987, and are no longer used for any purpose.

The GCMP is located in the northwestern portion of the Tijeras Arroyo Golf Course. The pond was constructed by the USAF in 1962 and covers approximately 2.61 acres. The pond was used to store sewage effluent from 1962 through 1987 and received approximately 330 million gallons of effluent from April through October each year from the sewage lagoons. Sewage effluent from the sewage lagoons was combined with water from a production well and then used as irrigation water for the Tijeras Arroyo Golf Course. This irrigation system was abandoned in 1987. In 1998, the GCMP was redesigned and brought back into use as part of an interim Corrective Measure (ICM) for WP -026. The ICM was performed to install a liner beneath the pond and a groundwater recovery system to

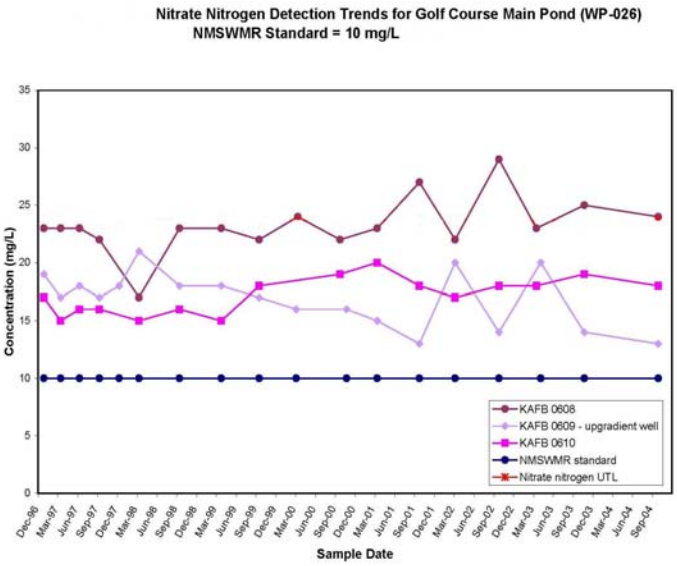
capture nitrate-contaminated groundwater in the vicinity of the pond and recycle it for beneficial use. The recovered groundwater was pumped from several extraction wells and discharged to the reconditioned pond, along with potable water from Production Well KAFB-4, and then applied to the Tijeras Arroyo Golf Course. In 2002, as part of Interim Stage II Nitrate Abatement Plan activities, KAFB-4 was taken offline from the recovery system to eliminate the possible cross contamination of the potable water source, and a new section of pipeline was installed to connect Production Well KAFB-7 to the pond. Activities were performed to initiate hydraulic control of nitrate-contaminated groundwater by utilizing Production Well KAFB-7, which is located at the leading edge of a nitrate groundwater plume.

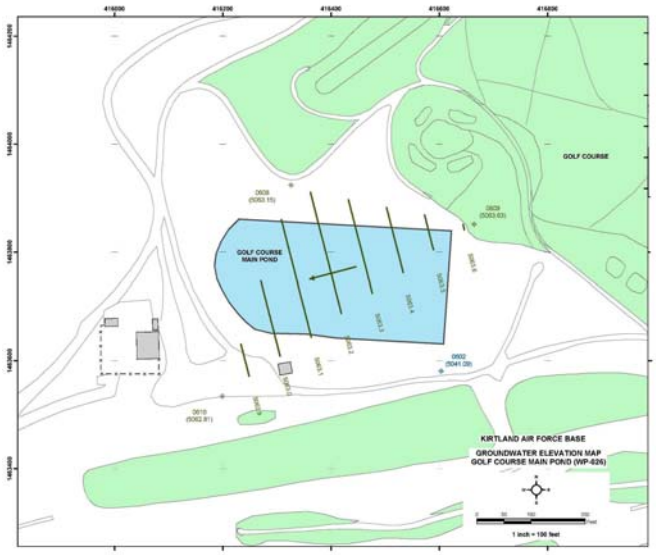
Three of the monitoring wells, KAFB-0608, -0609, and -0610, are sampled as part of the Long Term Groundwater Monitoring (LTM) Program. Depth to groundwater at the lagoons ranges from 474 to 491 ft bgs, while at the pond, depths range from 305 to 329 ft bgs.



ERP/RCRA History

- November 26, 1991, NMED approved the closure plan for the sewage lagoons. Closure process required Kirtland AFB to conduct a soil survey and quarterly groundwater sampling.
- On May 13, 1993, the NMED approved closure plans to perform a soil investigation by installing soil borings.
- August 12, 1993, Kirtland AFB filed for clean closure of the sewage lagoons and golf course pond.
- September 27, 1993, NMED denied clean closure of the sewage lagoons due to chromium levels that
- exceeded regulatory limits in some groundwater samples collected from wells at the site. Kirtland AFB was required to address the issue in a post-closure plan.
- July 2, 1999, the Assessment and Abatement Section of the NMED Ground Water Quality Bureau required Kirtland AFB to complete a Stage 1 Abatement Plan to investigate nitrate-impacted groundwater at the former sewage lagoons (WP-026), the Tijeras Arroyo Golf Course pond (WP-026), and a City of Albuquerque sanitary sewer line break.
- In July 2003, Kirtland AFB submitted a Stage 1 Abatement Report for ST-105 documenting nitrate contamination of groundwater.
- The Sewage Lagoons and the Golf Course Main Pond are not listed in the Kirtland AFB Hazardous Waste Permit and are currently in post-closure care and regulated by New Mexico Environment Department Ground Water Bureau.





Field Investigations and Nature and Extent of Contamination

A series of investigations have been performed since 1988 at the golf course pond. Samples have been collected from dry-pond sediment, soil beneath the pond and from the golf course, and the ground water beneath the site.

Soil investigations indicated the presence of nitrate-impacted soil in the vadose zone below the golf course pond. Nitrate has been detected in Monitoring Wells KAFB-0608 through KAFB-0610 during the past 2 years at concentrations (15 to 23 µg/L) exceeding NMWQCC and NMSWMR standards (10 mg/L). The lateral and vertical extents of elevated concentrations of nitrates in groundwater have not been fully defined at WP-026.

Golf Course Main Pond LTM Program (1996-2002)

The LTM Program was initiated at the golf course pond in December 1996 and consists of gauging four groundwater monitoring wells (KAFB-0602, -0608, -0609, and -0610) and sampling three of these wells. The three wells sampled included one upgradient well (KAFB-0610) and two downgradient wells (KAFB-0608 and KAFB-0609). Following the 2002 monitoring event, KAFB-0609 is now considered to be an upgradient well.

These nitrate exceedances may be attributable to application of fertilizer at the golf course. Nitrate as nitrogen and total nitrogen concentrations have historically exceeded the NMSWMR health-based groundwater standards in all wells sampled at the golf course pond, including the upgradient well.

ICM (1999)

The objective of the ICM at the golf course pond was to capture nitrate-contaminated groundwater and to reapply it to the golf course for beneficial use as irrigation water. The ICM activities conducted at WP-026 consisted of installation the extraction well and reconstruction of the pond including, the installation of a 40-mil HDPE liner; and deployment of submersible pumps in the recovery well and three additional groundwater monitoring wells. A 12-inch diameter groundwater extraction well (RG-1589-S-4) was installed and then developed to extract nitrate-contaminated groundwater from the aquifer. A 4-inch diameter pipeline was installed to connect the groundwater extraction well to the pond. Soil samples for waste characterization were collected from 30 random locations across the pond from the 0 to 6-inch depth interval. Analytical results indicated that the surface soil from the pond was not characteristically hazardous. Existing Monitoring Wells KAFB-0602, -0609, and -0610 were plumbed into the system and equipped with submersible pumps. To further

supplement the water supply in the pond for adequate irrigation of the golf course and to ensure that the pond bottom will always be covered with water to protect the liner, KAFB-4 was also plumbed into the pond.

Golf Course Main Pond Repair (2003 and 2006)

In 2003, the south bank of the golf course pond was repaired to prevent further erosion. Recovery well RG-1589-S-4 located adjacent to the pond was cleaned in an attempt to increase production. Following redevelopment activities, the well yield (approximately 3 gpm) did not significantly improve.

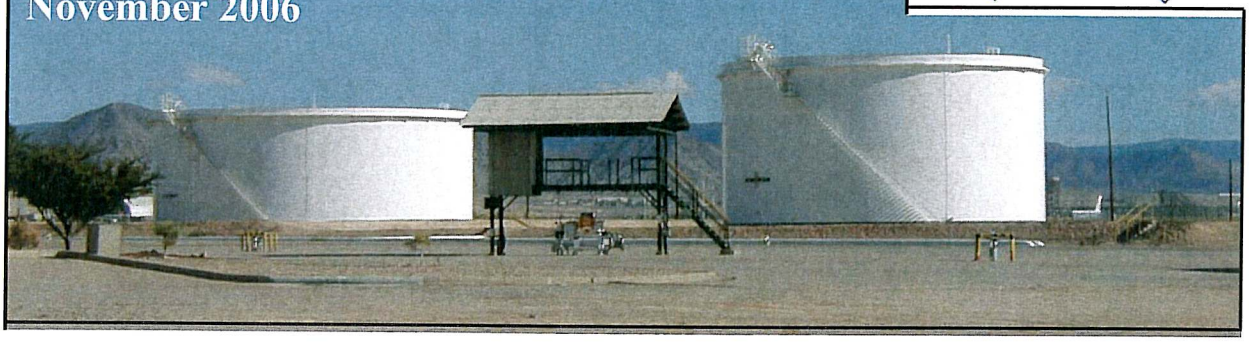
Status

On May 14, 2004, the NMED indicated that the installation of additional monitoring wells may be necessary to further define the extent of TCE impacts on groundwater in the perched zone. Kirtland AFB responded to the RSI on July 13, 2004. In the response, Kirtland AFB indicated that additional RFI activities at the sewage lagoons, including monitoring well installation, will be conducted in FY2004. Kirtland AFB also indicated that Monitoring Well KAFB-0507 was sampled in FY2002 because the well was installed as part of ST-105 TCE investigations.

Groundwater monitoring under the LTM Program will continue for this site to support the assessment of any potential future impacts to groundwater at the site. Implementation of the Interim Stage 2 Abatement Plan for nitrate-impacted groundwater will continue under site activities for ST-105 Nitrate. The Stage 2 Abatement Plan includes hydraulic control of the nitrate plume utilizing Production Well KAFB-7, which is located at the leading edge of the plume. The presence of nitrate in groundwater beneath WP-026 is currently being addressed under investigations for ST-105 Nitrate. TCE impacts on groundwater at WP-026 will be further addressed under investigations for WP-026. An RFI work plan, to include a soil gas survey, a geophys ical survey, subsurface soil sampling, installation of monitoring wells, and sampling of groundwater to define the areal extent of TCE at the former sewage lagoons, was submitted to the NMED HWB for approval in July 2004. Kirtland AFB is currently awaiting approval of the RFI work plan by the NMED.

A series of site investigations have been performed at the Bulk Fuels Facility since 2000. Investigation findings are summarized below.

Fact Sheet
Kirtland AFB ST-106 Bulk Fuels Facility
Soil Vapor Extraction and Treatment System
November 2006



Background

A soil vapor extraction (SVE) and treatment system is installed at Site ST-106, the Bulk Fuels Storage Facility, within the western part of Kirtland AFB, Albuquerque, New Mexico. The site currently contains bulk storage for jet fuel (JP-8), diesel fuel, and unleaded gasoline. Jet fuel is stored in two above-ground storage tanks (2.1 and 4.2 million gallon), diesel fuel is stored in two above-ground storage tanks (5,000 and 10,000 gallon), and unleaded gasoline is stored in one 10,000-gallon above-ground storage tank. The site formerly had a large fuel offloading rack (Building 2405, constructed in 1952) which had an annual throughput of approximately 20 to 25 million gallons of product. Fuel was historically delivered to the site in railcars via two onsite railroad spurs (on either side of the offloading rack), which are no longer present. Fuel delivered to the offloading rack (Building 2405) was conveyed to a pump house (Building 1033), which is still in place, via two 14-inch-diameter below-ground transfer pipelines. Fuel was then pumped to the above-ground storage tanks via piping of varying sizes, both above and below ground. The fuel offloading rack originally transferred aviation gasoline (AVGAS) and later transferred the less volatile JP-4 fuel and subsequently the even less volatile JP-8 fuel which replaced JP-4 in March/April 1993.

A leak in the 14-inch-diameter transfer piping was identified during integrity testing in November 1999, prompting a cessation of use of the offloading rack (2000) and its dismantling (2002). While fuel released during the integrity testing was immediately remediated, it is unknown how long the piping had been in a state of failure, and an unknown volume of fuel has

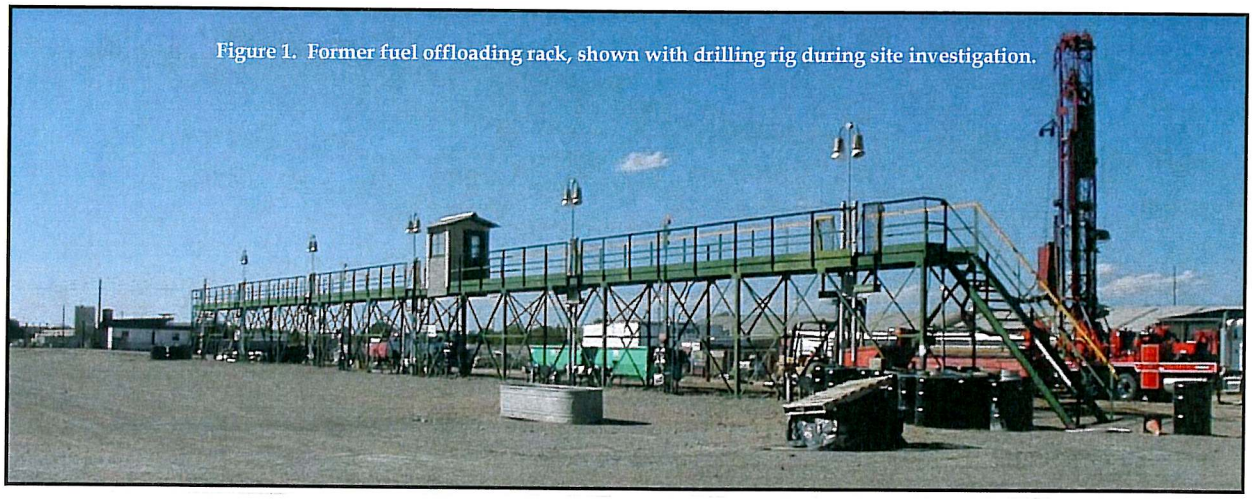


Figure 1. Former fuel offloading rack, shown with drilling rig during site investigation.

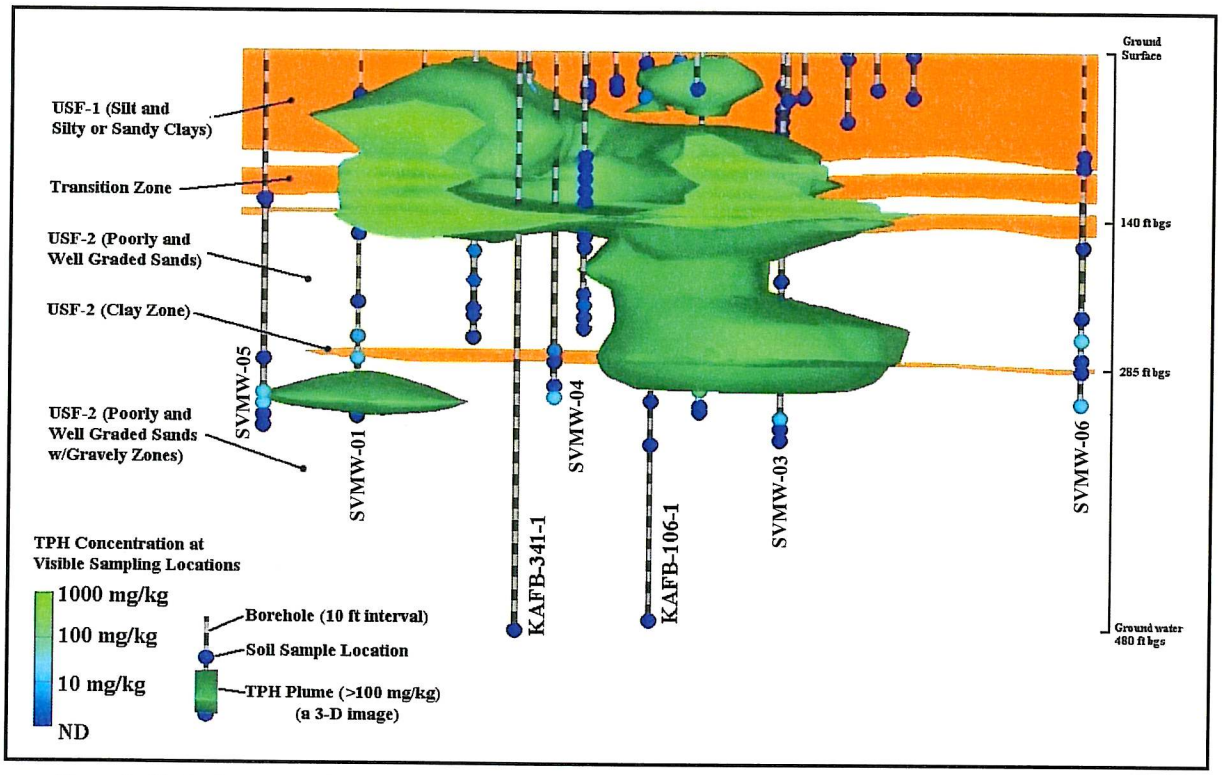


Figure 2. Geologic cross section and estimated extent of subsurface soil contamination. Iso-surface illustrates Total Recoverable Petroleum Hydrocarbon (TPH) soil concentrations exceeding 100 mg/kg. View is horizontal from the south with no vertical exaggeration.

been released at the site.

Field Investigations

A series of site investigations have been performed at the Bulk Fuels Facility since 2000. Investigation findings are summarized below.

Petroleum Hydrocarbons in Soil

- Maximum TPH soil concentration beneath east end of fuel rack was 114,000 milligrams per kilogram (mg/kg) at 270 ft bgs
- Maximum TPH soil concentration beneath west end of fuel rack was 81,000 mg/kg at 105 ft bgs
- Total extent of TPH in soil greater than 100 mg/kg is approximately 4.5 acres to a depth of approximately 310 ft bgs
- Detection of BTEX compounds suggests that JP-4 is present, indicating that a portion of TPH found in soil was released prior to 1993 when JP-4 was replaced by JP-8, which does not contain BTEX

Petroleum Hydrocarbons in Soil Vapor and Groundwater

- The soil vapor plume is present at distances at least 1,100 feet northwest of fuel rack, based on analytical sampling within the open, unsaturated screen of groundwater monitoring well KAFB-1063
- The soil vapor plume appears to exist over an area of approximately 50 acres, through entire vadose zone

- Low levels of petroleum hydrocarbons have been detected in groundwater monitoring wells KAFB-1061, -1062, -1064, and -3411

Soil Vapor Extraction and Treatment System Construction

Following a successful pilot-scale soil vapor extraction (SVE) test, eight additional soil vapor extraction wells were installed at four locations near the eastern and western ends of the former fuel offloading rack. The additional soil vapor extraction wells were located to complement the original pilot-scale test extraction well. One shallow extraction well and one deep extraction well were nested within each of the four boreholes. The extraction wells were constructed with stainless steel casings and well screens and completed with 15-foot screened intervals at depths ranging between 45 and 460 ft bgs.

Each of the nine soil vapor extraction wells was plumbed to a central manifold at which flow from each well can be controlled, monitored, and sampled. The manifold allows hydrocarbon vapors from all active extraction wells to be uniformly mixed prior to being fed to the SVE treatment system. A 500-gallon propane tank was installed within a protective barrier adjacent to the pad, and subterranean piping was installed to provide propane as needed to the treatment unit.

Soil Vapor Treatment Technology

The soil vapor extraction and treatment system consists of a trailer mounted pair of internal combustion engines (ICE), with onboard computer controls to optimally mix subsurface petroleum vapors, ambient dilution air, and propane to fuel the engines.

<u>Treatment System Components</u>

- Remediation Service International (RSI) Model V-4 ICE treatment system
- Dual big-block V-8 Ford engines, 460-cubic-inch displacement each, modified to RSI specifications
- Catalytic converters for treatment of exhaust gases
- Computer-controlled carburetor for mixing of soil vapor, ambient air, and supplemental propane
- Onboard, liquid-draw propane metering (propane for supplemental fuel source and system startup)
- Onboard computer and data logging for engine parameters, system flows, and vapor destruction
- Onboard dry-chemical agent fire detection and suppression system

Figure 4. Soil vapor extraction well manifold (left) and one of two vapor extraction and treatment engines (right).

ICE Operational Theory

- Engine manifold vacuum is applied to active soil vapor extraction wells through manifold valves
- Hydrocarbon soil vapors drawn through manifold piping and system moisture knock-out tanks
- Computer-controlled carburetor optimizes soil vapor, ambient dilution air, and propane mixture
- Ambient dilution air used to provide sufficient oxygen and dilution of soil vapors for ideal burn ratio
- Supplemental propane used for system startup and balancing of variable soil vapor concentrations
- Hydrocarbon soil vapors burned as fuel to operate engines
- Exhaust gasses polished through catalytic converters, destroying over 99% of hydrocarbon vapors

System Operation and Optimization

- Extraction well sampling ports at manifold monitored monthly for pressure (vacuum), oxygen (O_2), carbon dioxide (CO_2), carbon monoxide (CO), and hydrocarbons using Horiba emissions analyzer
- Soil vapor monitoring wells monitored quarterly for pressure, O_2, CO_2, CO, and hydrocarbons
- Quarterly lab analysis of ICE influent and effluent vapor streams
- Individual well flow-control valves adjusted in an effort to maximize flow of subsurface vapors and minimize use of ambient dilution air and supplemental propane
- Adjacent soil vapor monitoring wells used as venting wells to allow atmospheric O_2 to enter the subsurface under system vacuum. Increased subsurface O_2 requires less ambient dilution air, allowing for increased subsurface vapor flow to system and increased cleanup rates
- **Over 95,000 gallons of petroleum hydrocarbons extracted and destroyed to date**

Air Force Print News Today
Air Force news from around the world

Environmental restoration teams get to work on base

by Sheila Rupp
Nucleus journalist

11/17/2006 - **KIRTLAND AIR FORCE BASE, N.M.** -- Starting out as Albuquerque Army Air Base in the 1941, Kirtland has a long history, which also means that there has been an accumulation of waste products and items that are not considered environmentally sound today.

The Environmental Restoration Program has been remedying the problems that the past brought to the base. The ERP is a venture of the Environmental Management Branch of the 377th Mission Support Group. Members of Team Kirtland, including Air Force personnel, contractors and regulators have worked together to advance 163 sites to No Further Action status with the state of New Mexico in the last three years, Carl Lanz, chief of the restoration program, said.

NFA status means that the state has deemed the area sound and requires no further improvements to the site.

A former fire training area on the west side of the base received NFA status in September 2003. The area had a fuel storage tank and fire training activities were held in two unlined fire pits twice a week. Contaminated fuel, waste oil and other solvents were ignited and extinguished with aqueous film forming foam and any remains were allowed to evaporate or permeate the ground. Between 2001 and 2002, a four-inch thick MatCon™ cover was installed to prevent contamination at the site.

The restoration team is working on bringing other sites to NFA status as well, such as septic tank systems.

"We have been using a concerted research effort on a number of sites to make a determination on historical site use. This will allow us to show the New Mexico Environmental Department that past use was taken into consideration before applying analytical methods to looking septic system contaminants," said Wayne Bitner of environmental restoration.

There are also currently strong efforts to repair covers on landfills. Most of the landfills on base have six foot thick evapotranspiration covers that allow certain infiltrations of water to allow for grass growth, but do not allow moisture permeation. Several of the covers are undergoing repairs due to erosion because of heavy rains received this summer.

Possibly the most visible project to those with base access is the renovations to the golf course main pond.

A liner was installed underneath the pond in 1998, but it was discovered that the liner had been compromised because of vegetation growing through the liner. Restorations to the main pond liner and five small ponds are current projects. The construction should be completed by the end of November.

The golf course staff uses water in the pond to irrigate the course. The pond has nitrate levels just below the threshold limits for the state of New Mexico.

Mr. Lanz said the golf course project is a wonderful example of environmentally- sound and economic improvements.

"We're reusing water for the irrigation of the golf course, the golf course doesn't need to purchase fertilizer and we're making the improvements to the liner so it's not compromised in the future," he said.

The entire Environmental Restoration Program is an ongoing project to bring Kirtland sites up to current state environmental standards and beyond.

"It's been a successful program because it's a good team effort. The people involved are dedicated to the program and dedicated to Kirtland Air Force Base," Mr. Lanz said.

September 2006

ERP UPDATE

U.S. AIR FORCE

KIRTLAND AIR FORCE BASE ENVIRONMETAL RESTORATION PROGRAM NEWSLETTER

Major Landfill Projects Completed

Two covers on time, below budget

Two major landfill cover projects, Landfills 001 and 002, here have reached completion and a ceremony marking the event was held June 30 at the entrance to LF-002. In attendance were the contractors who performed the work, base, state and other officials.

The covers are part of the Kirtland Air Force Base Environmental Restoration Program and are being carried out by the Restoration Section, Environmental Management Branch of the 377th Mission Support Group's Civil Engineer Division.

Oversight of the projects was conducted by the U.S. Army Corps of Engineers, Albuquerque District. Regulatory authority of the base's Hazardous and Solid Waste Amendment module of the Resource Conservation and Recovery Act permit is through the New Mexico Environment Department, Hazardous Waste Bureau. The company contracted to do the work was Tetra Tech EC, Inc., with offices in Morris Plains, N. J., Lakewood, Colo., and Albuquerque.

The covers are scientifically designed natural earth covers and engineered to essentially act as a sponge to prevent water from leaching into the waste contained in the landfills and carrying any possible contaminants to the groundwater. The natural cover works especially well in arid climates such as exists here in New Mexico.

Heavy equipment operated by Tetra Tech EC, Inc., puts the finishing touches on the cap at Landfill-002. The cap is an engineered natural earth cover.

The cover consists of three layers placed on top of the

See Landfills Page 2

Conceptual Design and cross section of the landfills showing how the cover material will be placed.

A soil screening operation set up adjacent to the Trestle Facility to obtain cover material for Landfills 001 and 002 resulted in cost savings for the projects. LF-002 is located to the right of the screening operation.

Landfills from page 1

landfill waste with a minimum six-inch native soil and subgrade, followed by three feet of a silt and sandy-clay mixture and lastly a vegetative cover consisting of native plants and grasses. Rain water is contained within the second layer and is absorbed by the plants and grasses. Excess water is diverted through runoff channels placed throughout the cover system that flows to a catch basin.

Landfills 001 and 002 were completed in July ahead of schedule and below the current budget with nearly $2 million returned to the Air Force. Much of the cost savings came from cover material that was obtained on base between the two landfills on the hillside adjacent to the Trestle Facility. Use of on-base soil came about due to cooperation with the base's Civil Engineer Division and Chugach Management Services, Joint Venture. The soil had to meet certain scientific specifications so tests were done and approved by the Corps of Engineers and NMED. A screening operation was then set up at the site. According to the contractor this was a huge savings as apposed to having purchased soil trucked in from off the base.

Bob Borges (left), U.S. Army Corps of Engineers, Albuquerque District and Ruben Juarez, Construction Superintendent for Tetra Tech EC, Inc. stand outside of Landfill 002. Teamwork between the Army Corps, contractors, state regulators as well as the base Civil Engineer and Chugach Management Services, Joint Venture contributed to the success of the project.

LF-001 is located south of the Albuquerque International Airport on Southgate Road. Disposal records date back to 1951, but it was used primarily between 1960 and 1975 for general waste disposal. Waste is buried between 10 and 30 feet over approximately 57 acres.

LF-002 is below the Trestle Facility along the Tijeras Arroyo and was in operation between 1942 and 1965 as a general refuse and construction and demolition debris landfill. Waste burial ranges from nine to 20 feet over 37 acres.

A third landfill, LF-008, also received an ET cover as a voluntary corrective measure and was completed in 2005. It is located adjacent to the base's existing landfill, southeast of the Eubank Gate entrance to the base. LF-008 covers approximately 65 acres with waste buried to 30 feet.

All of the ET covered landfills are fenced and long-term groundwater monitoring will continue for 30-years from completion of the respective projects.

Success of the operation, according to Carl Lanz, Restoration Section chief, was due, in large part, to the cooperation and teamwork of all the players involved.

Information on all of our Environmental Restoration Program activities is located in the base's Information Repository and can be viewed at the Central New Mexico Community College (formerly TVI), Montoya Campus library, 4700 Morris NE in Albuquerque or by calling the Restoration Section on Kirtland AFB at (505) 853-6534.

Military Munitions Response Program

On October 1, 2004, the United States Air Force officially launched the Military Munitions Response Program (MMRP). The program affects 57 active Air Force installations nationwide, including Kirtland Air Force Base.

The mission of the Air Force MMRP is to take actions to address unexploded ordnance (UXO), discarded military munitions (DMM), and munitions constituents (MC) on munitions response sites (MRSs). These MRSs include former ranges and other sites used for military training, weapons systems testing, and munitions treatment.

The Air Force has been doing environmental restoration under the Installation Restoration Program (IRP) for 20 years and will ***maximize efficiencies and lessons learned*** in developing and executing the Air Force MMRP. The Air Force MMRP provides a focused program to protect human health and the environment, and to address the UXO, DMM, or MC present at munitions response sites.

Initial investigations show that there are 26 MRSs on Kirtland AFB. The Air Force is dedicated to protecting human health and the environment by making these sites ***safe to reuse***. The Air Force will ***prioritize MRSs*** according to environmental, health, and safety considerations; current and future planned resource use; and site attributes.

Currently, the MRSs at Kirtland are indicated by markings on a site map and are mostly located on a part of the base that is designated for official business by the Installation Commander. Contractors and others working in the areas receive safety briefings on the hazards of UXO.

The Comprehensive Site Evaluation (CSE), which began in 2005, serves as the initial site assessment for the Air Force MMRP. The CSE process investigates safety issues posed by munitions and explosives of concern (MEC), as well as the environmental hazards posed by MC. The CSE also addresses hazardous wastes, pollutants and contaminants of concern.

A pile of spent munitions found in a remote part of the base will be cleaned up by the base's Explosive Ordnance Disposal team and a contractor.

The above Explosives Safety poster was designed to educate the public and other Stakeholders on the possible ordnance that have been found on and around the base, especially for the safety of recreational enthusiasts in the Otero Canyon area.

During the first phase of the CSE, the Air Force conducted historical records reviews, interviews, and visual surveys to determine whether MEC and MC are present and pose a threat to human health and the environment. The Air Force also will identify new munitions response areas and determine which actions are necessary to restore each MRS according to anticipated future land use.

Phase one of the CSE was completed in 2005 and the report is currently under review and expected to be released soon.

The Phase two contract should be awarded and get under way during the first quarter of FY 2007.

For more information on the Air Force MMRP, contact Mr. Carl Lanz, Chief of the Restoration Section of the Environmental Management Branch at (505) 853-6534.

A FLASH FROM THE PAST

Participants of the first Earth Day in 1970 made a daring statement that if something wasn't done about the abuse of the environment there would be no earth in 20 years. Citizens, as well as politicians, started listening and change began to take place.

Today, your Air Force takes the matter of protecting our environment seriously. With every decision made about Kirtland Air Force Base, whether construction, demolition, training, or anything having an impact on the base's mission, one question must be answered. What affect will this have on the environment? The goal it to have everyone on the base, at every level, asking themselves this question both on the job and off.

Biennial RAB Assessment Conducted

The Environmental Restoration Program here has a requirement to conduct a Restoration Advisory Board assessment every two years when a formal RAB does not exist for the base.

An assessment was conducted in 2004 which did not result in the establishment of a formal RAB. In order for a formal RAB to be established there must be sufficient and sustained community interest. After considerable advertising and notification through the facility mailing list only three members of the public responded and were interested in forming a RAB. The procedures followed in the assessment and the conclusions were recorded in a memorandum and placed in the ERP Administrative Record.

Our most recent assessment was held last month at the Manzano Mesa Multigenerational Center. This meeting was held separate from our Quarterly Public Meeting with only three members of the public attending. We intend to leave this assessment open through our next QPM in October allowing our community members one last chance to come forward to establish a formal RAB. Again we did extensive advertising, mailings with added Neighborhood Associations and held a separate meeting which was done after our last QPM. Several people expressed an interest but when we held the meeting we did not have a sufficient and sustained community interest. We will make one more attempt at our next QPM on October 19th and then make a final decision.

DOE Plans Semi-Annual Public Meetings

The United States Department of Energy is sending a courtesy notification to the New Mexico Environment Department stating that their current quarterly public meetings for their Environmental Restoration Project will be held on a semi-annual basis beginning in October.

The main reason for the change according to John Gould, DOE, is that most of their project is complete with the exception of long-term environmental stewardship and a couple of other projects that would not warrant holding meetings on a quarterly basis.

"We simply would not have enough to present," Mr. Gould said.

DoD will continue with quarterly meetings and DOE will still meet jointly in October and April each year.

ERP UPDATE

Carl Lanz, P.G.
Restoration Section Chief

Steve Milligan
Environmental Public Affairs/Editor
Karen Martin
Editorial Assistant

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AIR FORCE SERVICES
AERO CLUB
FLIGHT TRAINING CENTER

Be Driven to Fly

Through November, the more you fly the better your chances are to win a trip for two to a NASCAR race or an actual NASCAR hood from the Air Force car. You can also win David Clarke headsets, $300 flight scholarships or flight bags. Attendance at your aero club monthly safety meeting increases your chance to win.

Most Air Force Aero Clubs offer structured training courses in single and multi-engine aircraft, including private pilot, instrument pilot, commercial pilot and air transport pilot. Stop by or contact your local Aero Club to find out how taking to the air could make you a winner, sending you off to the races. Call 846-7698.

Blood Drives

United Blood Services

Blood drives for the Kirtland community are in the Bloodmobile:

- **Tuesda,y** 10 a.m.-2 p.m., NMVAHCS in front of Bldg. 1 by VA hospital
- **Tuesday,** 7:30-11 a.m., Sandia Labs, at the motorpool
- **Sept. 5,** 7:30 a.m.-1 p.m., Sandia Labs, Bldg. 823, Steve Schiff Auditorium
- **Sept. 7,** 7-10 a.m., National Training Center, E street Parking Area
- **Sept. 12,** 7:30 a.m.-1 p.m., Sandia Labs, at the motorpool
- **Sept. 19,** 7:30 a.m.-1 p.m., Sandia Labs, Bldg. 823, Steve Schiff Auditorium

ASBP

Armed services' upcoming blood drives are sponsored by William Beaumont Army Medical Center, Fort Bliss, Texas, Sept. 12, 8 a.m.-4 p.m., and Sept. 13, from 10 a.m.-6 p.m. at the Rio Grande Conference Center.

Clubs

Cub Scouts

Cub Scout Pack 460 is continuing its fall round up for new scouts and adult volunteers to keep our pack strong and vibrant. Boys in first through fifth grade can be Cub Scouts. Pack 460 is affiliated with Sandia Base Elementary School, but anyone may join. For more information, call Rad Robb at 853-6766.

AFCEA invites new members

Are you an "IT" or Intel-related individual searching for a professional organization to network in? Look no further, the Armed Forces Communications-Electronics Association is your answer.

AFCEA serves as a bridge between government requirements and industry capabilities, representing the top government, industry and military professionals in the fields of information technology, communications and intelligence.

For more information on AFCEA, visit the Web site at www.abq-afcea.org or contact Maj. Robert B. Jayme at 846-7847 or e-mail: robert.jayme@afotec.af.mil.

Air Force Club Membership Drive

Air Force Club membership just got more exciting as two club members will win a brand new H3 Hummer.

The two H3s are being given away to show Air Force Clubs' appreciation to its members. All new members who sign up for club membership during the annual membership drive from Sept. 1 through Nov. 31 are eligible to win one of the H3 Hummers. The second H3 will be given away to someone who was a member as of Thursday.

To sign up for membership stop by the Mountain View Club, 846-5165.

Protestant Women of the Chapel

Join the Protestant Women of the Chapel.for their kickoff international brunch Sept. 6, from 9:30-11:30 a.m. The brunch is a potluck so bring your favorite international dish. The brunch will be at the Rio Grande Community Center. Looking for a place to plug in, need encouragement & fellowship with other Christian women? Join the Protestant Women of the Chapel every Wednesday from 9:30-11:30 a.m. for Bible studies, special programs, worship and fellowship in the Chapel Annex. There is also an evening Bible study from 6:30-8:30 p.m. Wednesdays beginning Sept. 13 at the Chapel, and it coincides with the daytime study. For information call Clara Austin 255-5342 or Sheila Rupp at 266-0388.

Arts & Crafts

The plaques and frames shops are located on the southeast corner of Wyoming Boulevard and F Avenue, open Monday and Friday, 10 a.m.-3 p.m., Tuesday, Wednesday and Thursday, 10 a.m.-6 p.m. Call 846-1067 or 846-1070.

Classes

Monday, Beginning Drawing, $23, 5-7 p.m. Call 853-3004.

Children/Parents

Operation K*I*D*S

The first ever Kirtland OPERATION K*I*D*S will be held in Coyote Canyon Saturday from 7 a.m. to about 3 p.m. This program for children aged 5-16 will give dependents a first-hand look at what their parents go through when deployed. Children 8 and under must be accompanied by a parent. Call Tech. Sgt. Bobbi Jo Stumpf for information at 846-4504.

Give Parents A Break

The Give Parents A Break Program is a referral program set up through the Air Force Aid Society. Give Parents A Break is scheduled for Sept. 1 from 6:30-10:30 p.m. For more information and requirements, please call the Gibson Child Development Center at 846-1103 or the Maxwell Child Development Center at 853-5521.

Mildly Ill Child Care

The Mildly Ill program is for children age 12 and under with illnesses that prevent them from using their usual group care. Call 846-1802.

Return Home Care

Receive 16 hours of free child care for each child for children ages 12 and under, when returning home after 30 days or more of deployment. Call 846-1802.

Infant/Toddler/Parent Play Groups

Family Advocacy sponsors two play groups weekly. Beginning Sept. 6 the groups will meet Wednesdays from 10:30 a.m.-noon at the Youth Center and Fridays from 10:30 a.m.-noon at the Maxwell Child Development Center. Come talk to other adults, watch children interact and find out about infant-toddler resources on and off base. For more information call 846-0139.

NOTICE OF PUBLIC MEETING

United States Department of Defense (DoD)
Restoration Advisory Board (RAB)
Assessment Meeting

The next Public Meeting will be:
Thursday, August 24th, 6:30-7:15 p.m.

Citizens are invited to learn about the RAB assessment process and the exchange of information between the Kirtland Air Force Base (KAFB) and the local community regarding environmental restoration activities. Section 324 of the National Defense Authorization Act of 1996 requires KAFB to conduct an assessment every 2 years to determine if there is sufficient and sustained community interest in forming a RAB.

Manzano Mesa Multigenerational Center
501 Elizabeth Street SE
Albuquerque, NM 87123
(Off of Southern between Eubank & Juan Tabo)

The meeting will be hosted by the KAFB Environmental Restoration Program (ERP) and will present the following information:

- **Purpose of RAB, RAB Requirements, and RAB Membership**
- **Program Status**

For more information, please contact Carl Lanz, Restoration Chief at (505) 853-6534.

Citizens may review Air Force ERP documents at the Kirtland AFB Information Repository at the Central New Mexico Community College (formerly TVI), Montoya campus library reference desk, 4700 Morris Street NE.

Military Munitions Response Program

FACT SHEET

Comprehensive Site Evaluation

October 2005

THE AIR FORCE

- Is dedicated to protecting human health and the environment by making MRSs *safe to reuse*.
- Is developing the MMRP by *maximizing efficiencies* and lessons learned from 20 years of environmental restoration experience.
- Will *prioritize MRSs* according to environmental, health, and safety considerations; current and future planned resource use; and site attributes.

FOR MORE INFORMATION

Please contact the U.S. Air Force's Office of the Civil Engineer, Environmental Division, Restoration Branch (HQ USAF/ILEVR) by writing to HQ USAF/ILEVR, 1260 Air Force Pentagon, Washington, D.C. 22030-1260 or by calling 703-607-0223.

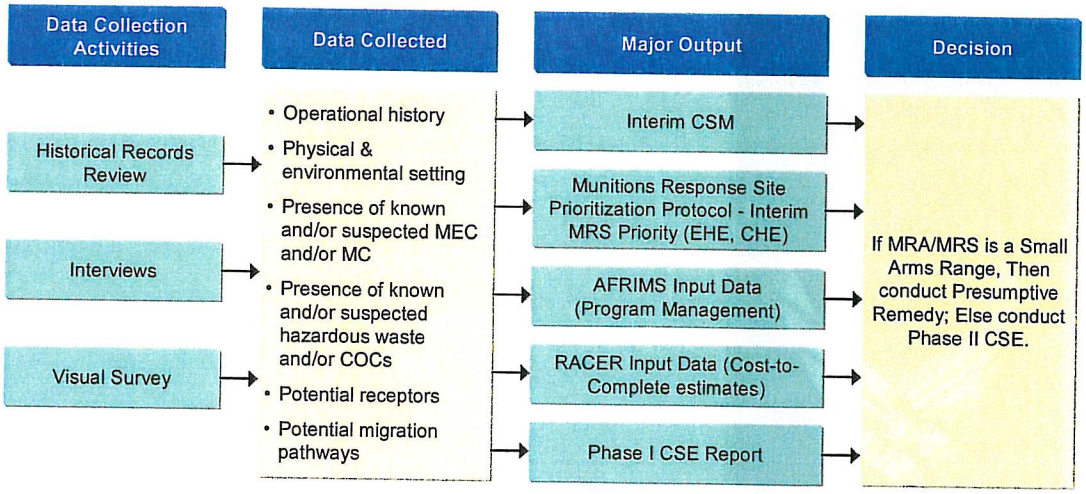
The Air Force developed the Comprehensive Site Evaluation (CSE) to serve as the initial munitions response action of its Military Munitions Response Program (MMRP). The goal of the CSE is to obtain sufficient data to support Air Force decision-making with regards to effectively managing its munitions response sites (MRSs), while protecting human health and the environment.

The CSE is a holistic process that investigates explosive safety issues created by the potential presence of munitions and explosives of concern (MEC), as well as the environmental hazards posed by the presence of munitions constituents (MC). The CSE also addresses hazardous wastes, pollutants and contaminants of concern (COC) when these items are known or suspected to be present at an MRS.

The CSE Phase I and Phase II obtains historical, anecdotal, visual, analytical, and geophysical data that is used to generate the following output:
1) a conceptual site model (CSM) to evaluate/communicate potential hazards and support decision making;
2) a recommendation on whether or not further munitions response action is required;
3) a "MRS Priority" to prioritize the site for further actions;
4) Hazard Ranking System (HRS) data elements;
5) input data required for cost estimating; and
6) input data required for program management functions.
The CSE Phase I and Phase II processes are summarized in the figures below and on the following page.

The Air Force sees implementation of the CSE as the

CSE Phase I

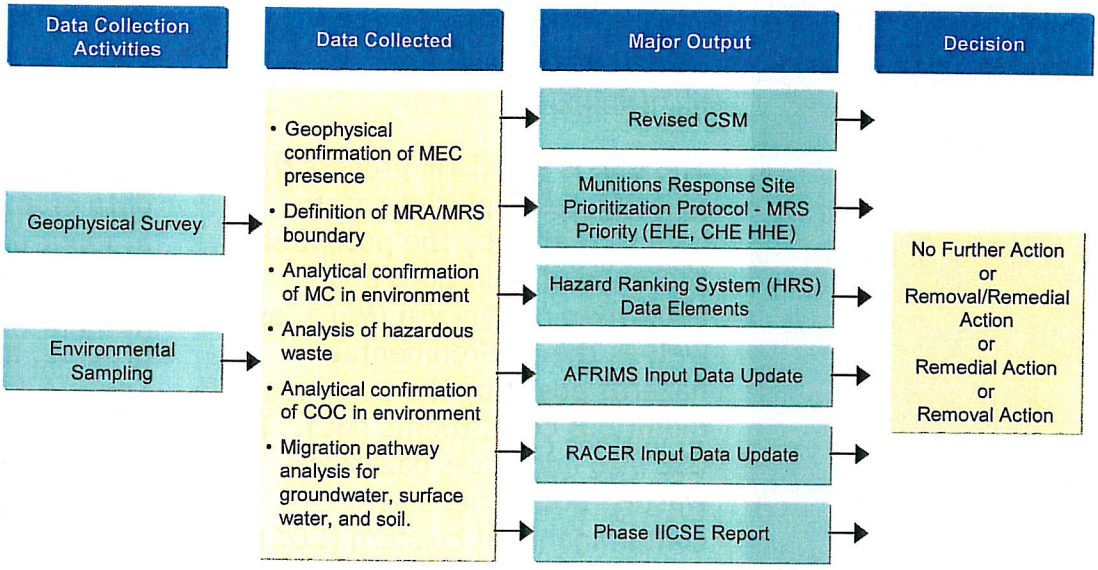


Comprehensive Site Evaluation (cont'd)

October 2005

first step in a performance-based, knowledge-driven approach for the Air Force MMRP as a whole. This approach will focus program efforts on achieving end results (as opposed to meeting artificial milestones), and provide high-quality, consistent data to support Air Force decision-making. The Air Force will solicit stakeholder participation throughout the CSE process.

CSE Phase II



FOR MORE INFORMATION

Please contact the U.S. Air Force's Office of the Civil Engineer, Environmental Division, Restoration Branch (HQ USAF/ILEVR) by writing to HQ USAF/ILEVR, 1260 Air Force Pentagon, Washington, D.C. 22030-1260 or by calling 703-607-0223.

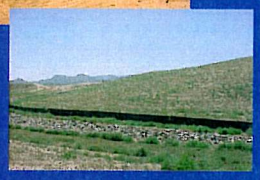
KIRTLAND AIR FORCE BASE
EVAPOTRANSPIRATION LANDFILL COVER
COST-EFFECTIVE LANDFILL CLOSURE AT LF-008

Landfill in 2000

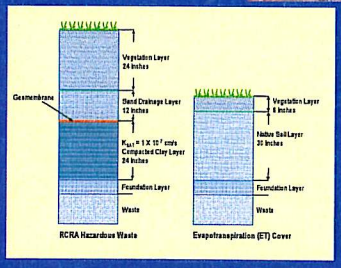
Site Background
- Operated between 1964 and 1989
- Actually three adjacent landfills
- 65 acres with waste to 40 ft
- 2,350,000 cy waste volume
- Groundwater depth greater than 450 feet
- ET cover selected as preferred alternative in CMS

Evapotranspiration (ET) Cover Conceptual Design

ET Cover Construction
- Cover constructed July 2001 to January 2003
- Site reseeded July 2003
- 5 erosion control channels/ditches and 3 down-chutes
- 3 sediment basins, 3 pipe culverts, and berms
- 481,000 cy subgrade and cover material placed



Physical Comparison of ET vs. RCRA Subtitle C Covers
- Both covers minimize percolation of precipitation into waste
- ET cover comprised entirely of natural materials
- ET cover at KAFB installed for less than one-half the cost of RCRA Subtitle C Cover



Monitoring and Maintenance
- Routine inspections, maintenance, and repairs
- Sample and gauge 10 monitoring wells for post-closure care

SUMMARY
- ET cover at Kirtland AFB provides equivalent level of protection as a RCRA Subtitle C cover
- ET cover is a cost-effective substitute for a conventional RCRA Subtitle C cover at Kirtland AFB.
- ET covers are cost effective at Kirtland AFB for several reasons:
  - Dry, warm climate and abundant solar radiation
  - Most precipitation occurs during late summer when plant growth (transpiration) and solar radiation (evaporation) are also peaking
  - Abundant supply of suitable soil adjacent to base vs. importing clay and synthetic materials
  - Construction costs for homogeneous cover are inherently lower than multi-layered composite RCRA Subtitle C cover

Landfill in 2007

U.S. AIR FORCE

ALTERNATIVE EVAPOTRANSPIRATION LANDFILL COVERS
COST-EFFECTIVE LANDFILL CLOSURE
KIRTLAND AFB, NM

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Steve Rowe P.E., USACE, Omaha District
Jerry Sillerud, USAF, Kirtland AFB

Kirtland Air Force Base Site Background Information

Three large landfills are being closed in accordance with Environmental Protection Agency (EPA) and New Mexico Environment Department (NMED) Guidance and the Kirtland AFB Hazardous Waste Permit. These landfills include Environmental Restoration Program sites LF-001, LF-002 and LF-008 at Kirtland Air force Base (KAFB) as shown in Figure 1. The corrective action process outlined therein has been followed to ensure that appropriate corrective measures are implemented to protect human health and the environment. Although there are no definitive records of hazardous waste disposal at these sites, the closure design generally follows RCRA guidance for hazardous waste facilities.

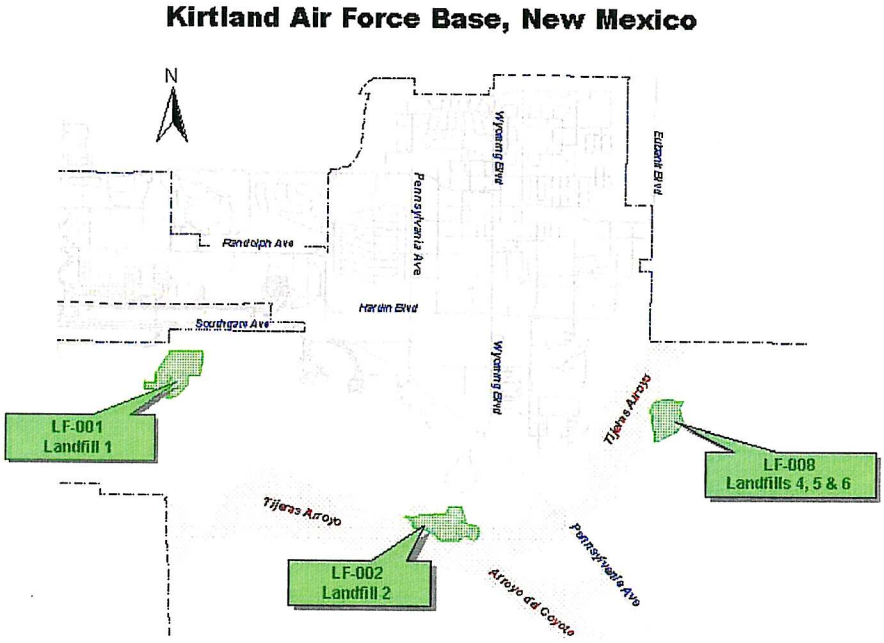

Figure 1 – Landfill Locations at Kirtland AFB

LF-001 operated between 1960 and 1975 as a trench-and-fill landfill. No records of the quantities or nature of materials disposed have been recovered. Interviews, air photos, and site investigations indicate that the landfill contains general refuse, construction and demolition debris and, possibly, hazardous waste. These materials were buried at depths ranging from 10 to 30 ft over approximately 57 acres. The estimated volume of waste is 602,000 cubic yards (c.y.). Groundwater occurs at an average depth of 430 ft below the surface and there is no evidence of groundwater contamination beneath the landfill based on long-term monitoring data.

LF-002 operated between 1942 and 1965 also as a trench-and-fill landfill that currently covers approximately 37 acres. This landfill is located adjacent to the Tijeras Arroyo where past concerns over its location within a flood plain resulted in the design and construction of a substantial gabion erosion control system. Again, there are no disposal records for this landfill but research and site investigations indicate this landfill contains materials similar to LF-001, including the possibility of hazardous waste. The estimated volume of waste in this landfill is

1,320,000 c.y. Groundwater occurs at an average depth of 400 ft below the surface and there is no evidence of groundwater contamination beneath the landfill based on long-term monitoring data.

LF-008 operated between 1964 and 1989 as a general-use landfill and actually consisted of three adjacent landfills. It covers approximately 65 acres and contains an estimated 2,350,000 cubic yards of waste to depths up to up to 40 ft. Some hazardous materials may have been disposed of at this site in the mid-1980s although the predominance of waste was construction and demolition debris. The alternative ET cover system is already in place at this landfill. Groundwater (regional aquifer) occurs at an average depth of 450 ft below the surface and there is no evidence of groundwater contamination beneath the landfill based on long-term monitoring data.

Description of an ET Cover System

An ET cover differs from a conventional RCRA Subtitle C hazardous waste cover in several important aspects, but it provides the equivalent function of eliminating virtually all percolation of precipitation into the waste. Figure 2 provides a typical cross-section through a RCRA hazardous waste cover and the equivalent ET cover designed for all three sites and already in place at LF-008. Essentially an ET cover is a 36-inch-thick homogeneous, lightly compacted, layer of soil placed directly on top of the foundation or subgrade layer which overlies the waste. The upper 6 inches of the ET cover is considered the vegetation layer, and its loose compaction encourages plant growth and root development which contributes to the evapotranspiration of precipitation. Conversely, the RCRA hazardous waste cover is a multi-layer system of highly compacted low permeability clay, a geomembrane to provide an additional barrier to infiltration of water, a sand drainage layer to promote drainage away from and reduce the buildup of water on top of the geomembrane, compacted clay layers, and a vegetation soil layer. Because of the simpler construction, lower material quantity requirements, and the local availability of acceptable soil required for the ET cover, there is a substantial cost differential in favor of the ET cover system for the landfills at Kirtland AFB.

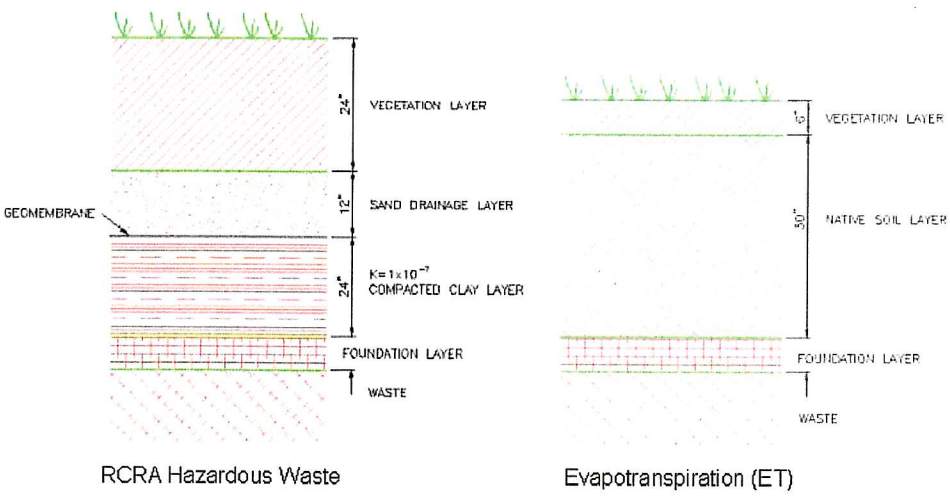

Figure 2 – Cross-Sections of RCRA Hazardous Waste and ET Soil Covers

The scientific and engineering concepts that relate to an ET cover system design have been developed primarily by soil scientists and agricultural engineers; and only in the past few years have civil/geotechnical engineers adapted these principals to landfill cover design and implementation. The term *evapotranspiration cover* tells the story. In effect, an ET cover behaves similar to a sponge as it absorbs water as it infiltrates. As long as the infiltration into the ET cover does not exceed the cover's storage capacity, the absorbed water is "held" until evaporation and transpiration remove the water. This cyclical process can occur indefinitely over time; thereby creating a completely natural, long lasting, and cost effective cover system.

The following mass balance equation expresses the theoretical approach to the water balance that occurs in an ET cover system:

$$PRC = P - OF - \Delta S - (E + T)$$

where:

PRC	=	percolation through the bottom of the cover
P	=	precipitation
OF	=	overland flow (runoff)
ΔS	=	change in soil moisture storage
E	=	evaporation
T	=	transpiration

The UNSAT-H Model is a computer code that simulates one-dimensional moisture movement through unsaturated soils and it was used to numerically model percolation through the 3-ft-thick ET cover system. By utilizing the UNSAT-H model, a variety of different cover conditions and configurations were simulated to arrive at a satisfactory design which met the specified criteria. The key in modeling to support a design was that the ET cover was required to meet a RCRA hazardous waste cover equivalency of allowing less than 3 millimeters per year (mm/yr) of percolation. The variable parameters that were evaluated in the modeling included cover thickness, soil compaction, vegetation coverage, and soil type. The results of the modeling showed that the ET cover exceeds the minimum equivalency criteria as long as soil classified as SM, SC, SC-SM, or CL-ML was used, the cover thickness was 2 ft or greater, and the vegetation coverage was at least 10%. However, as a practical matter per NMED guidance, a minimum 3 ft thick cover is required. As a result, the equivalency modeling for demonstrated that 3-ft cover thickness meets the percolation criteria of 3 mm/yr, and is actually lower by a factor of 2 to 10. The key parameters that favor this cover alternative at KAFB include the dry climate (low precipitation), high solar radiation, and the favorable soil types which are readily available.

The input parameters required for the UNSAT-H modeling include saturated hydraulic conductivity (Ksat); unsaturated hydraulic properties of the soil (also known as the van Genuchten parameters); climatic and data; and initial soil moisture content conditions. The first two sets of input parameters were generated by performing laboratory tests on representative samples of cover soil from the ET cover soil source areas.

Saturated hydraulic conductivity is a routine geotechnical soils test where the permeability of the soil is measured under saturated conditions. This test method is the standard for evaluating the suitability of compacted clay liners for conventional RCRA liners; however, it is but one data point necessary to model the efficacy of the ET cover.

The unsaturated hydraulic properties of soil that are used to define the van Genuchten parameters and the unsaturated hydraulic conductivity of the ET cover soil require a series of specialized hydraulic property tests to be performed. The van Genuchten soil parameters are a mathematical relationship between the volumetric moisture content of the soil and the negative matrix potential (or suction) of the water in the soil.

Constructability Factors Relative to ET Cover Construction

Past experience indicates that sandier soils, in general, perform better in the construction of an ET cover rather than predominantly silty or clayey soils. Even though our modeling results are favorable for the CL-ML soil, SM, SC or SC-SM soils are preferred because of constructability concerns. Sandy soils can be uniformly moisture conditioned during construction and are much easier to work with compared to silty or clayey soils; and sandy soils are less likely to exhibit desiccation cracking after construction is complete.

In contrast to the construction of typical RCRA hazardous waste compacted clay covers requiring low saturated permeability achieved by 90% to 95% compaction, the optimum compaction for an ET cover is approximately 85%. The lower compaction requirement supports establishing vegetation in a looser soil which is more important than the marginal reduction in hydraulic conductivity properties gained from a higher compaction. Because it is easy to overcompact the soil, construction at LF-008 required lighter compaction equipment, thicker loose lifts (12 inches), and fewer passes to achieve compaction requirements. Practicality requires that it is occasionally necessary to loosen the soil between lifts; and for these purposes discing equipment is used.

Another constructability issue confronted during construction of an ET cover occurs in establishing vegetation. Seed bed preparation is important, and at LF-008 the top 6–8 inches of soil had to be ripped and disced after placement and compaction of soil and before the conventional agricultural drill was able to plant the seed and crimp the mulch. This final loosening of the surface does not materially impact the soil properties from the ET

cover performance perspective based on in-place density testing completed after vegetation efforts; but it dramatically improves the seed planting, initial germination, and establishment.

Conclusions

The ET cover is a cost-effective substitute for a conventional RCRA hazardous waste cover system at KAFB. The ET cover will provide equal, or better, protection from percolating precipitation and, because the cover is entirely comprised of native soil material and homogeneous, it should last longer than a RCRA cover composed multiple layers, including man-made materials. The actual cost per acre for the ET cover at LF-008 approximated $100,000; whereas the potential cost for a RCRA hazardous waste cover could exceed that by a factor of two or more. Even as a conservative estimate, the ET covers will for the three landfills combined will end up costing less than one-half of the estimated RCRA hazardous waste cover, equating to a probable savings to KAFB of at least $15 million.

The primary reasons why the ET covers are favorable for use at KAFB include the dry climate with abundant solar radiation and the abundant supply of suitable ET cover soil located near the Base. The material costs are relatively low because only a 3-ft cover thickness of homogeneous material is required and the related acquisition and transportation costs are reasonable. Construction costs for a homogeneous soil cover are inherently lower than for a cover comprised of multiple layers including geosynthetic materials.

Test pad construction before full-scale construction is important in order to determine the soil conditioning moisture content and technique, lift thickness, and optimum number of passes with the compaction equipment which are all related to choosing the optimum compaction equipment. In most cases over-compaction is more likely to occur than under-compaction, so it is critical to select the proper equipment and methodology for construction during the test pad phase. To ensure that the soil was not over-compacted which could, in turn, inhibit revegetation and plant growth, the compaction specification requires a minimum compaction of 85% and up to a maximum of 90%.

Based on the results of the ET cover construction at LF-008, the requirement for performing Ksat tests on the ET cover soil for construction at LF-001 and LF-002 as it will be placed was eliminated. While Ksat testing is a standard requirement for conventional RCRA hazardous waste covers and other liners containing low permeability clay for percolation control, it is unnecessary for alternative covers systems including ET soil covers. The Ksat tests are problematic and inherent testing peculiarities exist because field conditions cannot be duplicated for an undisturbed soil sample that is collected in the field and is then tested in the laboratory. These tests also require several days to perform and may cause construction delays if there are any problems with the results. In addition, there are also significant cost savings related to the tests themselves as realized by eliminating the testing requirement.

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Kirtland Air Force Base

Ordnance & Explosives Safety Education Program

Recognize

Recognize it! Have you found something that could be UXO? Leave it alone. Don't touch it. Don't throw anything at it.

Retreat

If you have found something that could be UXO, leave it alone and leave the area. It does not matter how old and rusty or shiny and new UXO is, UXO is dangerous and could injure you. Don't take any chances.
Leave it alone.

Report

If you have found something that could be UXO, report what you saw and where you saw it to an adult, Sheriff's Dept or call 911. Reporting it can save another person from injury. Report anything you think could be UXO.

Report Suspected Unexploded Ordnance (UXO) to:

Bernalillo County
Sheriff's Office
(505) 798-7000

Valencia County
Sheriff's Office
(505) 866-2460

Kirtland AFB
Command Post
(505) 846-3777

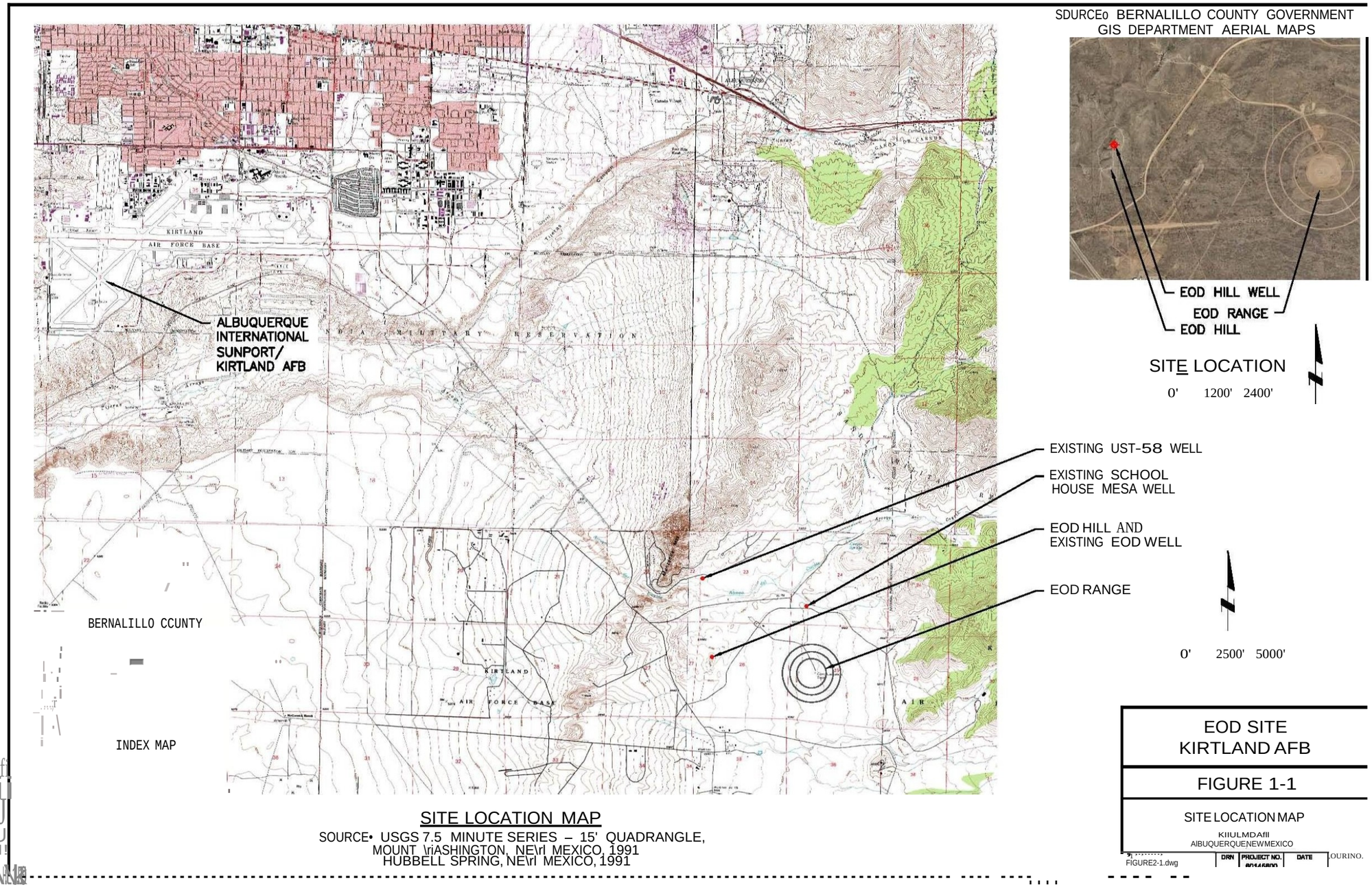
For more information contact:
US Army Corps of Engineers
Office of the Chief of Safety
(505) 342-3175

Photographer: Dennis Carlson

Poster designed by Lynne Larsen

APPENDIX I: Figures

Figure 1-1: Site Location Map



SITE LOCATION MAP

SOURCE• USGS 7.5 MINUTE SERIES – 15' QUADRANGLE,
MOUNT \riASHINGTON, NE\rl MEXICO, 1991
HUBBELL SPRING, NE\rl MEXICO, 1991

Figure 2-1: Site Plan

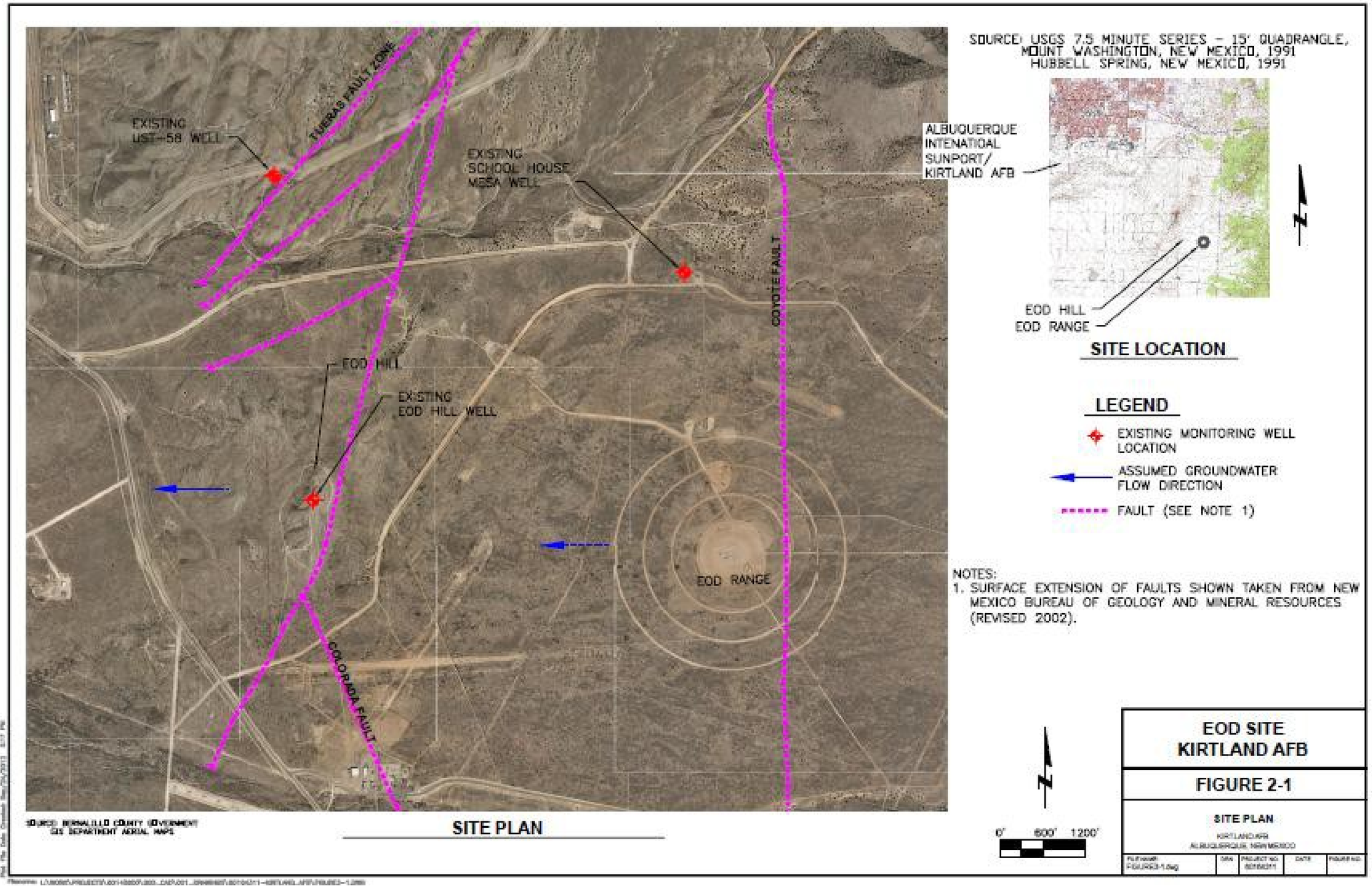
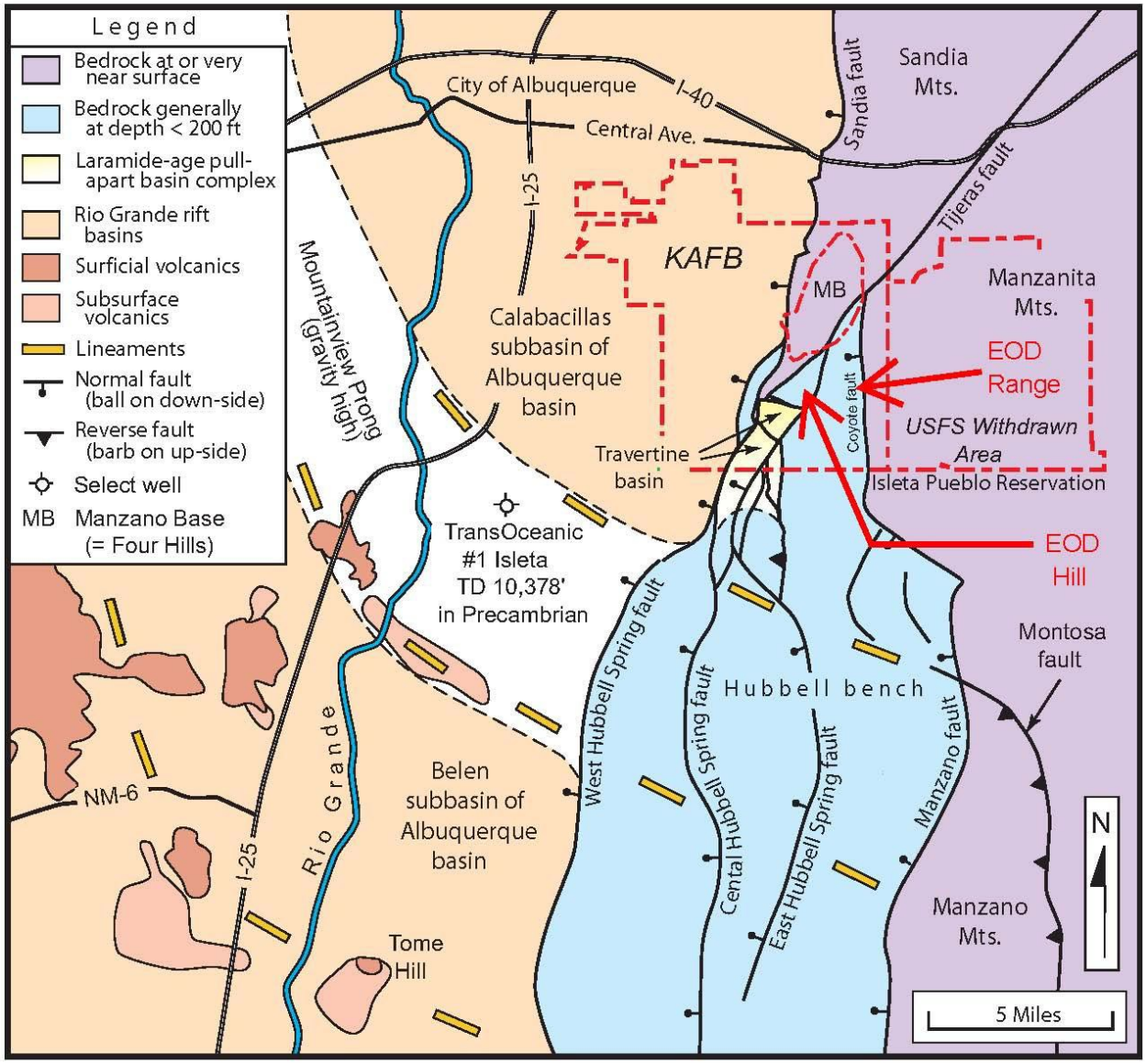


Figure 2-3: Structural Provinces of Kirtland AFB and Vicinity



840857.04050000 A2
Source: SNL 2003

Figure 2-4: Geologic Plan and Cross Section

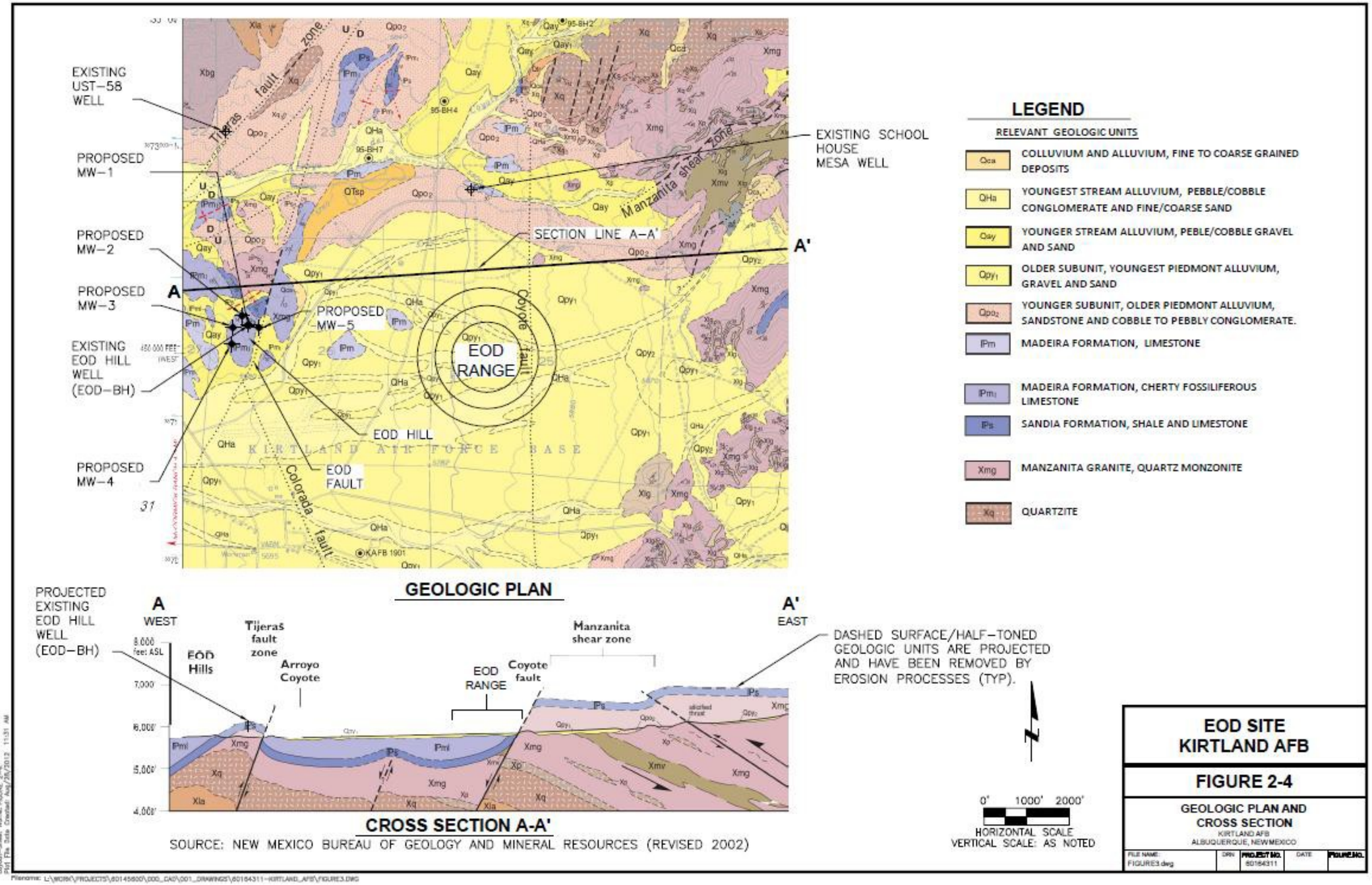
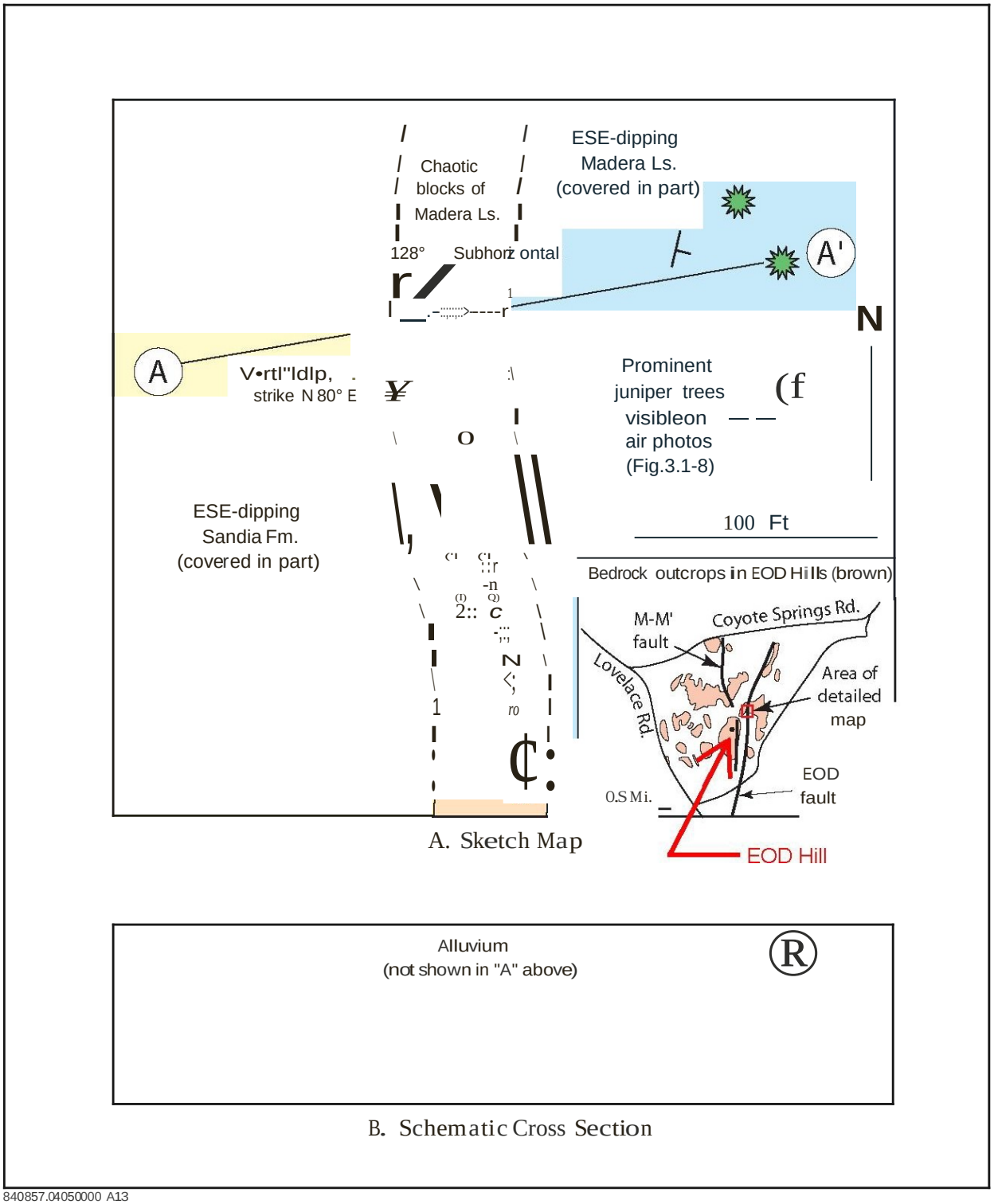


Figure 2-5: EOD Fault Zone on East Side of EOD Hills



840857.04050000 A13
Source SNL 2003

Figure 2-6: Geology of EOD Hills Area

Figure 2-7: Fracture Trends Geology of EOD Hills Area

Figure 2-8: Seismic Refraction Array Locations EOD Hills Area

Figure 3-1: Proposed Groundwater Monitoring Well Locations - EOD Hill Area

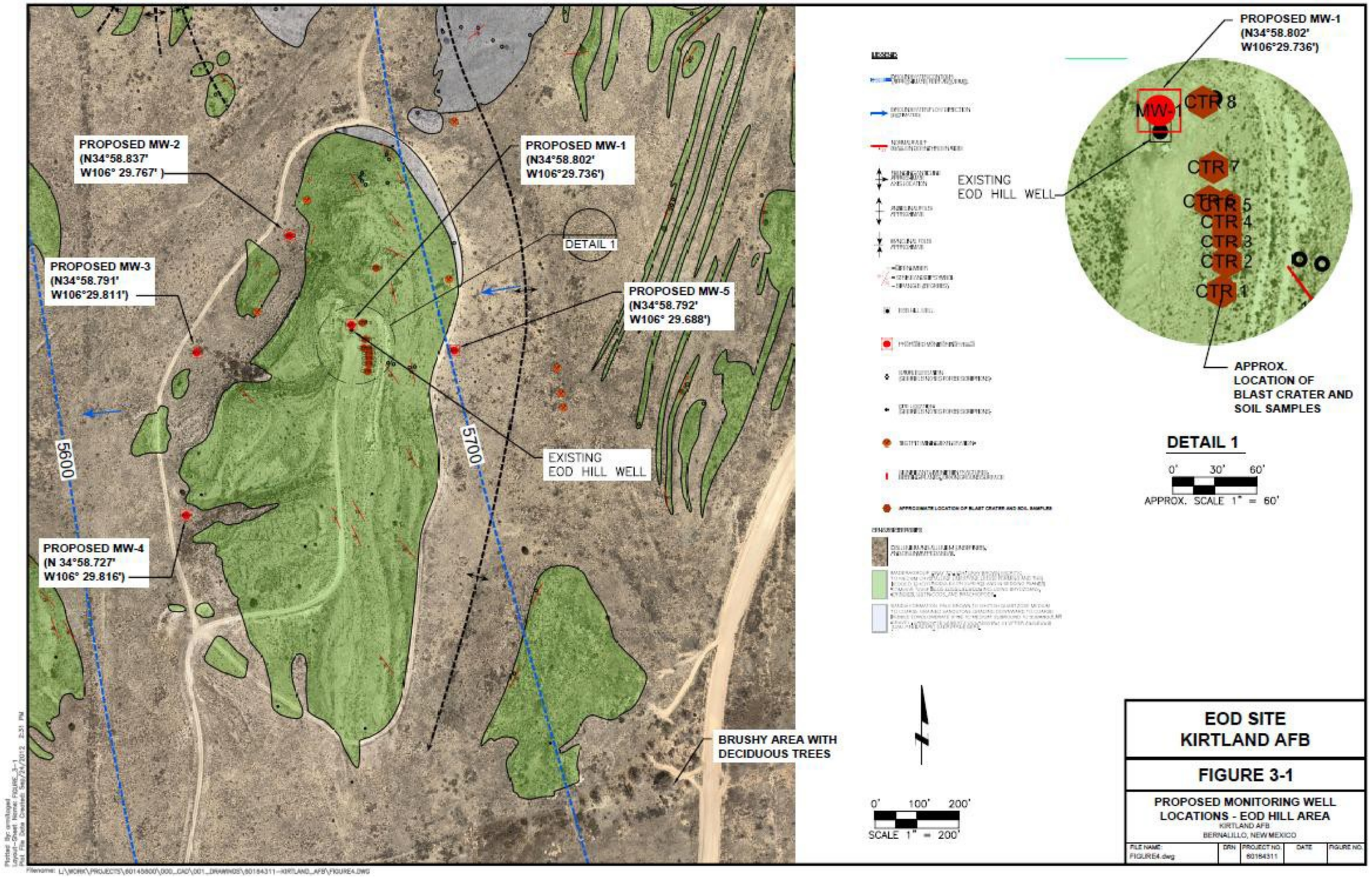
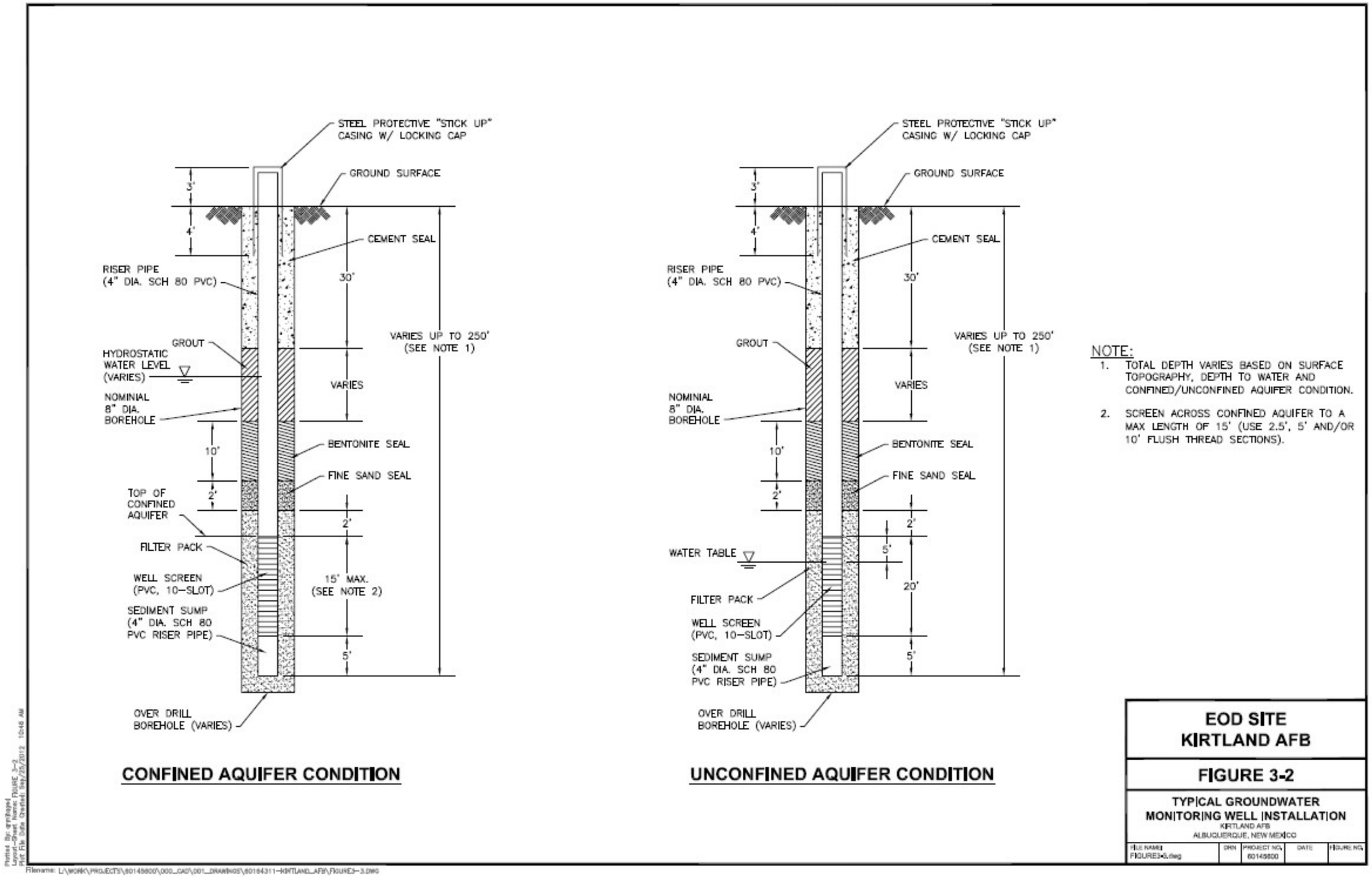


Figure 3-2: Typical Groundwater Monitoring Well Construction

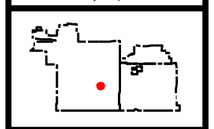


8 Craters

— Roads

Figure 3-3

Key Map



Based on 2010 imagery

N

0 2 4 8 12
Meters

0 5 10 20 30 40
Feet

1 centimeter = 4.5 meters
1 inch = 37.5 feet

KIRTLAND AFB, NM

REVISION HISTORY

REV	DATE	DESCRIPTION	INITIAL

DEPARTMENT AIR FORCE
AIR FORCE MATERIAL COMMAND

EOD Hill Craters
KIRTLA ND AIR FORCE BASE
ALBUQUERQUE NEW MEXICO

SUBMITTED BY:
APPROVED BY:
DATE: June, 2009
DRAWN BY: G. Kretsher
SCALE:
SHEET OF
SHEET NO.