DOE/EA-1603

Draft Environmental Assessment for the Expansion of Permitted Land and Operations at the 9940 Complex and Thunder Range at Sandia National Laboratories/ New Mexico

National Nuclear Security Administration
Sandia Site Office

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U. S. Department of Energy
National Nuclear Security Administration
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COVER SHEET

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ABBREVIATIONS AND ACRONYMS

acre	ac
ATEF	Advanced Training Evolution Facility
ACGIH	American Conference of Governmental Industrial Hygienists
CAA	Clean Air Act
cm/yr	centimeter per year
CO	carbon monoxide
dBA	A-weighted frequency scale
DNL	day-night average sound
DoD	U.S. Department of Defense
DOE	U.S. Department of Energy
EPA	Environmental Protection Agency
ER	Environmental Restoration
ESA	*Endangered Species Act*
ºF	degrees Fahrenheit
ft	foot
HAP	hazardous air pollutant
HMWMF	Hazardous Mixed Waste Management Facility
HMX	octogen
KAFB	Kirtland Air Force Base
kg	kilogram
kPa	kilopascal
lb	pound
LTES	Long Term Environmental Stewardship
MBTA	Migratory Bird Treaty Act
$\mu g/m^3$	micrograms per cubic meter
µmho/cm	micromhos per centimeter (unit of specific conductance)
mg	milligram
mg/L	milligram per liter
NAAQS	National Ambient Air Quality Standards
NEPA	*National Environmental Policy Act*
NFA	No Further Action
NHPA	*National Historic Preservation Act*
NMAC	New Mexico Administrative Code
NMAQS	New Mexico Air Quality Standards
NMDGF	New Mexico Department of Game and Fish
NMED	New Mexico Environment Department

ABBREVIATIONS AND ACRONYMS (continued)

NNSA	National Nuclear Security Administration
OBODM	Open Burn/Open Detonation Model
OEL	Occupational Exposure Level
OSHA	Occupational Safety and Health Administration
PM_{10}	particulate matter (diameter equal to or less than 10 microns)
$PM_{2.5}$	respirable particulate matter (diameter equal to or less than 2.5 microns)
ppm	parts per million
psi	pounds per square inch
RDX	cyclotrimethylenetrinitramine
SNL	Sandia National Laboratories
SNL/NM	Sandia National Laboratories/New Mexico
SOC	Species of Concern
SPL	Sound Pressure Level
SSO	Sandia Site Office
SWMU	Solid Waste Management Unit
SWEIS	Site-Wide Environmental Impact Statement
TA	Technical Area
TNT	trinitrotoluene
U.S.	United States
USAF	United States Air Force
WCA	Wildlife Conservation Act
WFO	work-for-others

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1.0 PURPOSE AND NEED FOR AGENCY ACTION

1.1. BACKGROUND

The United States (U.S.) Department of Energy (DOE) has statutory responsibilities for nuclear weapons research and design, development of other energy technologies, and basic scientific research. Sandia National Laboratories (SNL) is one of several national laboratories within the DOE complex and is composed of four geographically separate facilities: Albuquerque, New Mexico; Tonopah, Nevada; Kauai, Hawaii; and Livermore, California. This Environmental Assessment (EA) concerns potential actions at Sandia National Laboratories/New Mexico (SNL/NM). The U.S. Air Force (USAF) is a cooperating agency in the preparation of this EA.

SNL/NM is a government-owned, contractor-operated facility owned by the DOE, National Nuclear Security Administration (NNSA), and is managed and operated by the Sandia Corporation. Most SNL/NM operations are on approximately 8,800 acres (ac) of federal land on Kirtland Air Force Base (KAFB), southeast of Albuquerque. Land on KAFB is owned by the USAF, the DOE, the Bureau of Land Management, and the U.S. Forest Service. This EA analyzes the potential impacts of expanding DOE operations at the 9940 Complex and Thunder Range. Both areas are on USAF land and approximately 540 acres are currently used by DOE under existing land use permits between the DOE and the USAF. An additional area of approximately 1,140 ac is being analyzed for potential use by DOE.

The 9940 Complex is currently a 12.3-ac site used by DOE under a land use permit from the USAF. Historical use of the site, dating from 1964, included arming, fusing, and firing of explosives and testing of explosives systems components. Today the land is used for training of the Nuclear Emergency Response community and for research on energetic materials. The proposed expansion of the 9940 Complex is divided into three areas: 1) the 9940 Expansion-East of approximately 450 ac (including the existing 12.3 ac), 2) the 9940 Expansion-West of approximately 445 ac (including 9930 and 9950 complexes, and 3) a training corridor of approximately 265 ac. The Thunder Range testing area is an approximately 520-ac site in use by the DOE under a land use permit from the USAF. Thunder Range historically was used for explosives testing activities such as Shock Tube tests, Rotating Flyer Plate testing, and ground blasts, also dating from 1964.

A large increase in the size, quantity, and type of non-DOE/NNSA Work-for-Others (WFO) activities at these sites require an expansion of permitted land. This need for a larger area is driven by both the nature and the volume of the potential work. Outdoor explosive work requires a relatively large area to allow pressure waves from impulse noise events to dissipate. Some types of training exercises also require large sites for realistic simulations and to protect the sensitive nature of activities.

1.1.1. General Site Description

The area of the proposed expansion of permitted land and operations at the 9940 Complex and Thunder Range is located on Kirtland Air Force Base (KAFB), Albuquerque, New Mexico, in the southwestern corner of the Coyote Test Field and adjacent to the southeastern corner of Technical Area (TA)-III.

1.1.1.1. Albuquerque

Albuquerque is located in Bernalillo County, in north-central New Mexico, and is the largest city in the state, with an estimated 2005 population of approximately 494,236 (Census 2007). The Sandia Mountains rise steeply immediately north and east of the city, with the Manzanita and Manzano Mountains extending to the southeast. The Rio Grande runs southward through Albuquerque and is the primary river traversing central New Mexico. Nearby communities include Rio Rancho and Corrales to the northwest, the Pueblo of Sandia and town of Bernalillo to the north, and the Pueblo of Isleta and communities of Los Lunas and Belen to the south (DOE 1999).

1.1.1.2. KAFB and SNL/NM

SNL/NM is located within KAFB, approximately 7 miles (mi) southeast of downtown Albuquerque. KAFB is situated primarily on alluvial fan sediments to the west and within the foothills of the Manzanita and Manzano Mountains. The alluvial fan sediments slope gently to the west to the Rio Grande. There are five TAs at SNL/NM that cover approximately 2,560 ac of DOE-owned land. TAs-I, -II, and -IV encompass approximately 645 ac; TA-III encompasses approximately 1,890 ac; and TA-V encompasses approximately 25 ac (DOE 1999).

1.1.1.3. Coyote Test Field

The Coyote Test Field is a large area within KAFB that contains a variety of remote testing sites and facilities. The area is comprised of mostly open, flat to undulating, grassland terrain in the west, to more mountainous topography in the east. Approximately 173 structures consisting of laboratory buildings, mobile offices, and numerous storage areas are found widely dispersed throughout the area (DOE 1999).

1.2. PURPOSE AND NEED

The U. S. Government's expanding technology requirements and increased pressure on the federal budget demand reduced duplication and more efficient use of limited resources. DOE/NNSA has expressed statutory responsibilities to make resources at its national laboratories available to non-DOE/NNSA entities, including the Department of Homeland Security and the U.S. intelligence community, through the DOE/NNSA WFO Program. The Sandia Corporation (Sandia) performs WFO, with DOE's approval, when 1) the work is consistent with or complementary to DOE/NNSA's mission at SNL, 2) the work will not adversely impact the execution of assigned DOE/NNSA programs, 3) the work will not create a detrimental future burden on DOE/NNSA resources, and 4) the work will not place Sandia in direct competition with the domestic private sector.

DOE has recently experienced a large increase in demand for explosives testing and training at SNL/NM under the WFO program. Projections indicate that this trend will continue, and that requested explosives testing and training activities will become more diverse. The increase in quantity and diversity of these activities results in a corresponding need for additional permitted land to support such expanded operations. This expansion is needed to support increased rapid response energetics testing and specialized training for national security missions planned to be conducted at the SNL/NM 9940 Complex and Thunder Range.

2.0 ALTERNATIVES

This chapter describes the No Action Alternative, the Proposed Action, and alternatives considered but eliminated from further study. The No Action Alternative involves continuing operations at the 9940 Complex and Thunder Range as described in the SNL/NM Site-Wide Environmental Impact Statement (SWEIS) (DOE 1999) and subsequent *National Environmental Policy Act* (NEPA) documentation. The Proposed Action is an expansion of permitted land and operations at the 9940 Complex and Thunder Range, including site development and operational activities.

2.1. NO ACTION ALTERNATIVE

Under the No Action Alternative, the expansion of the 9940 Complex and Thunder Range would not take place. Operations at the 9940 Complex and Thunder Range would continue as described in the Expanded Operations Alternative of the SNL/NM SWEIS (DOE 1999) and subsequent NEPA documentation. The No Action Alternative would result in no change to the existing conditions.

This alternative would not facilitate the anticipated expansion of energetics testing and training activities under the WFO program. The current 12.3-acre area at the 9940 Complex is not adequate for training activities that require force deployment, or those involving more than a few participants. In addition, the limit of 50-pounds (lb) TNT-equivalent per explosive event makes the area unsuitable for large-scale explosives testing. While the existing permitted area at Thunder Range is large enough to support a variety of testing and training activities, there is limited ability to perform activities simultaneously (e.g., explosives testing and training at separate areas) because of the large area needed to dissipate impulse noise generated by large explosive tests. Simultaneous activities would be required with increased demand for these types of activities.

2.2. PROPOSED ACTION

Under the Proposed Action, the 9940 Complex and Thunder Range expansion would include approximately 1,680 ac of USAF-owned land located in the southwest corner of the Coyote Test Field, adjacent to TA-III. The 1,680 ac-area is referred to in this EA as the project area. A general location map for SNL/NM is shown in Figure 2.2-1, and the locations of the USAF-owned areas proposed for permitting and expanding operations at the 9940 Complex and Thunder Range are shown in Figure 2.2-2.

The Proposed Action consists of site development and operational activities related to a set of proposed training areas and explosive testing areas in the four portions of the project area: 9940 Expansion–East, Thunder Range, Corridor, and 9940 Expansion–West (Figure 2.2-2). A total of 10 training areas and 13 explosive testing areas are described, which include one existing training area (9940 Complex) and two existing explosive testing areas (9940 Complex and Thunder Range 1/1A). Table 2.2-1 lists these training and explosive areas; locations are shown in Figure 2.2-2. Explosive charges of up to 10 lb could be detonated anywhere within training area boundaries (except for Thunder Range [T-Range] 3, which is only permitted to 5 lb). Charges of greater than 10 lb would be limited to designated explosive testing areas. Approximately 175 ac of the 1,680 ac-project area would be used as training and explosive testing areas. The remaining acreage would serve primarily as buffer and safety zones.

The types of training and testing activities to be performed could vary greatly, depending on the requirements of each entity requesting the activity. Typical training activities could include the use of explosives to enter a building (see “assault house”, Section 2.2.1.2, below), destroy a structure, and could

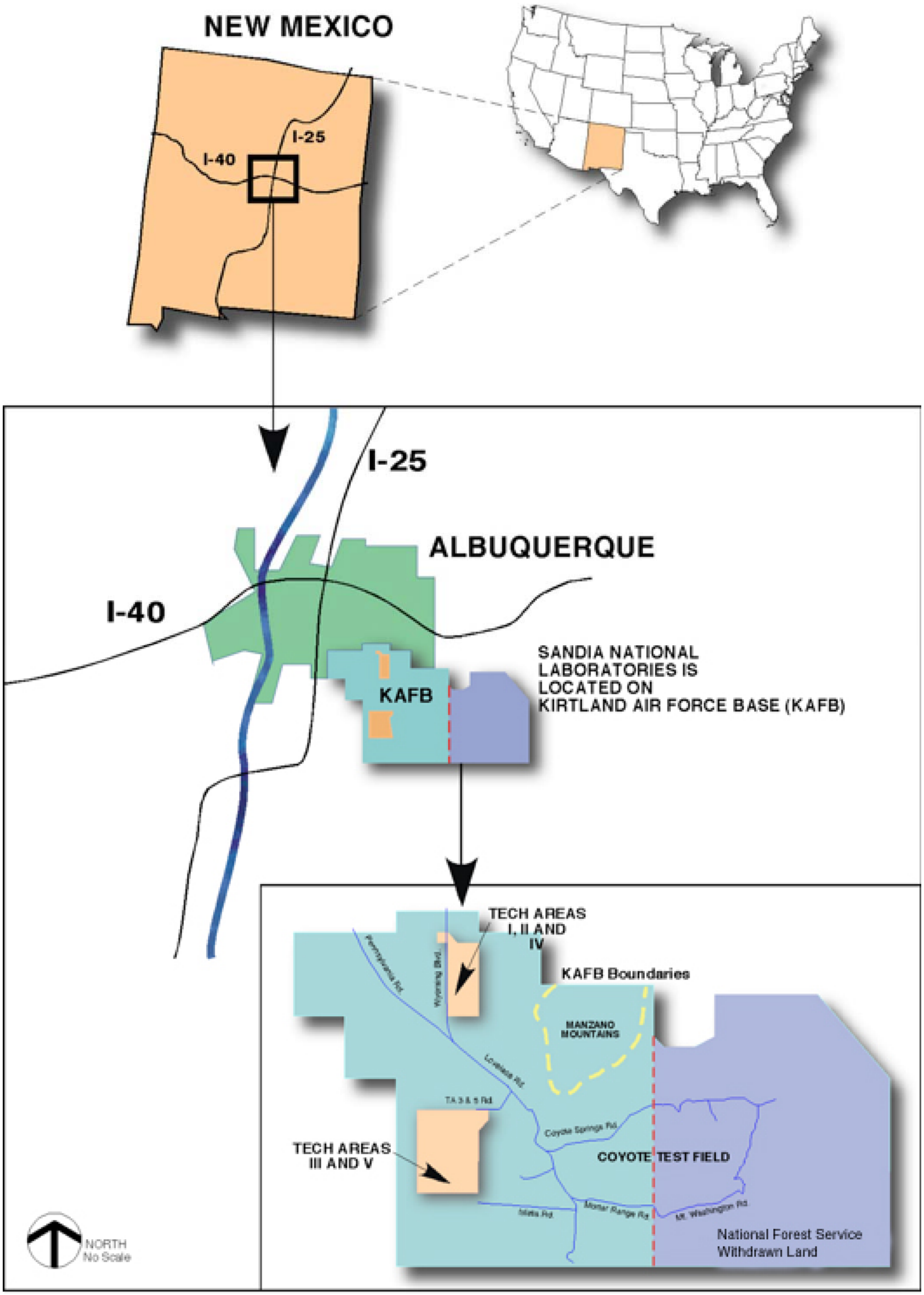


FIGURE 2.2-1 Location Map of KAFB and SNL/NM Technical Areas

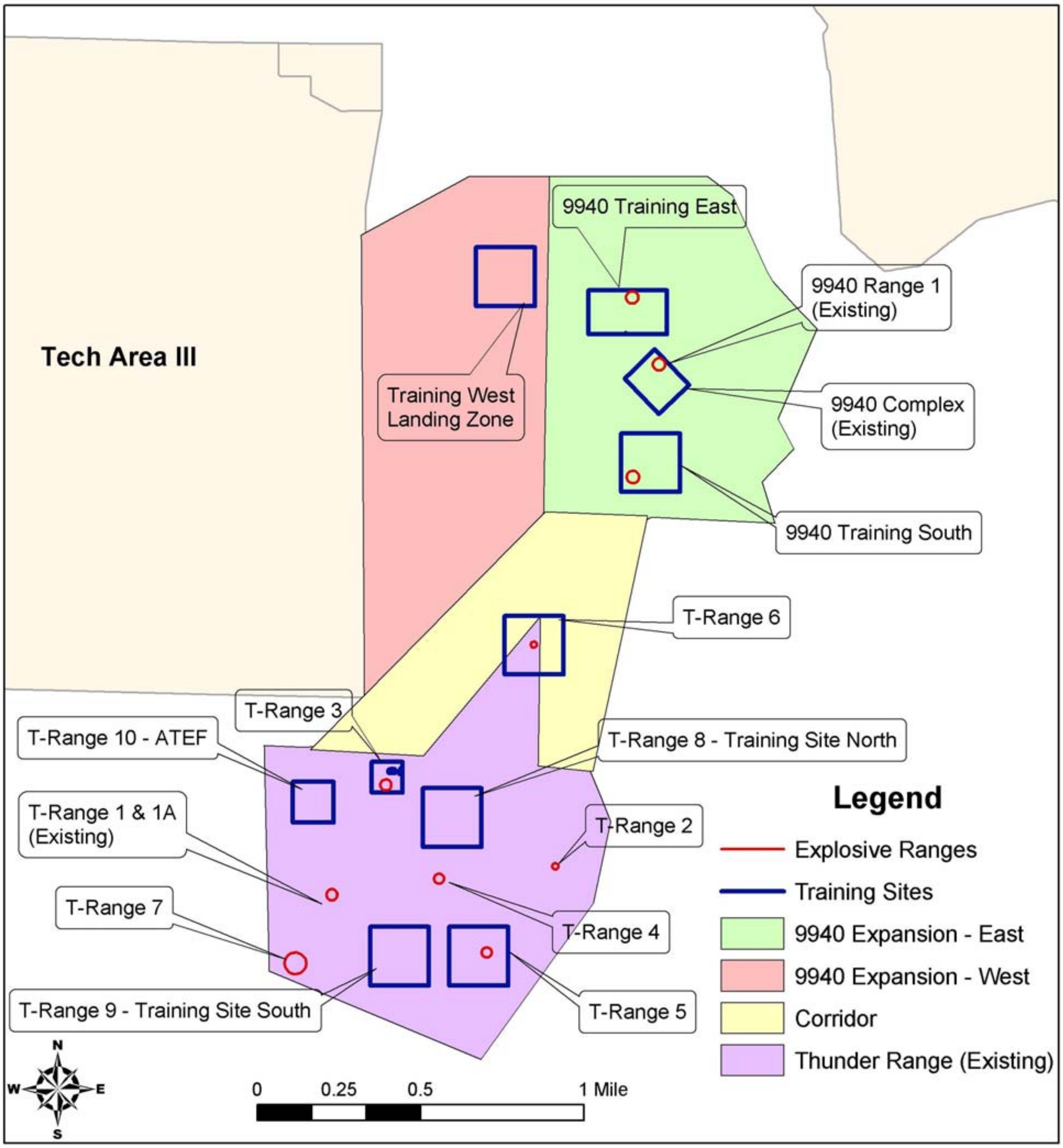


FIGURE 2.2-2 Location Map of the Proposed Project Area

TABLE 2.2-1 Summary of Training and Explosive Testing Areas under the Proposed Action

Area Name	Training Area	Explosive Testing Area
9940 Expansion–East		
9940 Complex (expansion of existing complex and explosive testing area)	Yes (expansion of current 12.3-ac complex to approximately 15 ac)	Yes (existing 9940 Range 1)
9940 Training South	Yes (20 ac)	Yes
9940 Training East	Yes (20 ac)	Yes
Thunder Range		
Thunder Range 1/1A	No	Yes (existing)
Thunder Range 2	No	Yes
Thunder Range 3	Yes (10 ac)	Yes
Thunder Range 4	No	Yes
Thunder Range 5	Yes (20 ac)	Yes
Thunder Range 6	Yes (approximately 8-ac portion in Thunder Range; approximately 12 ac extends into Corridor)	Yes (Thunder Range portion only)
Thunder Range 7	No	Yes
Thunder Range 8—Training Site North	Yes (20 ac)	Yes
Thunder Range 9—Training Site South	Yes (20 ac)	Yes
Thunder Range 10—Advanced Training Evolution Facility (ATEF)	Yes (10 ac)	Yes
Corridor		
Thunder Range 6 (see above)	—	—
9940 Expansion–West		
Training West Landing Zone	Yes (20 ac)	No

Source: Original

involve deployment of a force across the project area. Typical testing activities could include determining the effects of a given amount of explosives on structures, optimal placement of explosives to destroy a structure, and effectiveness of different explosive compositions.

The following is a summary of site development and operational activities under the Proposed Action for the four portions of the project area.

9940 Expansion–East (approximately 450 ac). This area would consist of the current 9940 Complex (12.3 ac), already permitted to DOE for use by SNL, and an additional 438 ac of surrounding land. The area of the current 9940 Complex would undergo security upgrades and expansion to approximately 15 ac to encompass a new office building. The 9940 Expansion–East would support two new 20-ac training areas and two new explosive testing areas (one within each new training area). Much of the 9940 Expansion–East land would serve as buffer space.

Thunder Range (approximately 520 ac). This area would support one explosive testing area already permitted to DOE for use by SNL, nine new explosive testing areas, four 20-ac training sites, a 10-ac Advanced Training Evolution Facility (ATEF) site, a 10-ac training site associated with T-Range 3, and office space.

There would be an explosive testing area at each of the six training areas and four additional explosive testing areas outside the training areas. The explosive testing areas would be located as follows:

- T-Range 1 is an explosive testing area that exists under the current permitted operations. T-Range 1 also includes T-Range 1A, a below-grade testing area surrounded by a berm.

- T-Range 2 would be on the east side of Thunder Range, east of Building 9965.
- T-Range 3 would be the area around the bunker immediately south of Magazine Road.
- T-Range 4 would be approximately midway between Building 9965 and T-Range 1, and immediately south of the road connecting the two.
- T-Range 5 would be in the existing breaching range, also known as the sabotage range, located southwest of Building 9965.
- T-Range 6 would be north of Magazine Road, in the area near Building 9929, and would include a gas gun.
- T-Range 7 would be southwest of T-Range 1.
- T-Range 8 would be located within the boundaries of Training Site North (site not designated).
- T-Range 9 would be located within the boundaries of Training Site South (site not designated).
- T-Range 10 would be located within the boundaries of the ATEF (site not designated).

Corridor (approximately 265 ac). The function of the corridor is to reduce encroachment by other activities onto the test and training areas, and as a designated area for foot traffic between the 9940 Expansion–West and Thunder Range during some training exercises. Outside of the portion of training area surrounding T-Range 6 that overlaps the corridor from Thunder Range, the only activities that would be allowed within the corridor are foot traffic and vehicle traffic restricted to designated roads.

9940 Expansion–West (approximately 445 ac). This land would serve as a deployment pathway for training as well as buffer space. It would support one 20-ac training area which would also serve as a helicopter landing zone. No explosive testing areas or structures would be located in this area.

2.2.1. Site Development

Site development refers to preparation of the site required to make the site suitable for general training and test activities as described for the Proposed Action. This preparation includes ground preparation, placing or construction of new structures, and development of supporting infrastructure, including utilities and roads. Temporary structures placed or constructed for specific training or test events, or event series, including earthen structures, are part of the site operations described in Section 2.2.2, Operations. Site development could begin shortly after completion of the NEPA process, but could be phased in over a period of years based on demand for specific capabilities. If anticipated demand does not materialize for certain capabilities, some of the site development activities described in this section may not take place.

Site development activities would be performed using the standards and mitigations described below. All earthwork and dust suppression would be performed in accordance with regulations and law.

All site development activities in the project area would stay within the boundaries delineated as training or testing sites in the Proposed Action description to avoid harm to known biological resources and archaeological sites. Any future activities extending beyond the physical boundaries or scope of activities described in the Proposed Action would require appropriate evaluation and consultation in compliance with corresponding regulatory requirements. These activities would be coordinated with appropriate personnel via the SSO NEPA process.

Prior to the start of any activity, at any point in time in the project area, a biological survey would need to be conducted. Necessary mitigation activities and arrangements would be planned and coordinated with

SNL/NM biologists and in conjunction with SSO. To reduce the effects of site development activities on raptors, nest boxes and roosting locations would be constructed at locations outside the project area. All site development activities would take place within designated areas, prescreened to avoid protected species, and would be localized as much as possible to lessen the potential for ecological impacts.

All site development activities would take into account the location of the known archaeological sites in the area and avoid them. Should additional evidence of previously unknown archaeological sites—either subsurface deposits or previously unidentified surface sites—be revealed, work would be halted and a qualified archaeologist would be brought in. The immediate vicinity of the resource would be secured, and SNL/NM Environmental Programs & Assurance personnel would be notified, who would then contact SSO.

Prior to work, all required permits would be obtained, such as those for air, storm water discharge, surface discharge, or topsoil disturbance. The Fugitive Dust Control permits would be updated accordingly, as necessary, to ensure that the entire disturbed acreage is included in the programmatic permits. A compliance plan would be drafted to ensure the project maintains compliance with the requirements in the programmatic permits.

Buildings. Structures built or placed for occupation by personnel or permanent storage would be designed and constructed according to applicable Federal regulations as stated in the SNL contract.

Training and Test Structures. Structures used for training or testing would be temporary, except for the “assault house” that would be constructed at Thunder Range. Temporary structures are discussed in Section 2.2.2; the “assault house” is described in Section 2.2.1.2, Thunder Range. The “assault house” would serve a highly specialized training purpose and would be designed and constructed to standards appropriate for that need.

Roads. The Systems Assessment and Research Organization would obtain and follow recommendations of the SNL Facilities Management and Operations Center on how to construct or repair roads. Other subject matter experts would be contacted to check for flood zones to make sure that the new roads would withstand a flood, and ensure that the roads are not in the area of burial grounds, archaeological sites, Environmental Restoration (ER) sites, or special status species. The roads would be graded to a width of approximately 10 feet (ft) to 25 ft so trucks could safely pass in the road. The roads would be stabilized for dust control and soil erosion; this may involve gravel or recycled concrete, magnesium chloride, or some other approved method. The roads would not need to be paved. The locations of the proposed and existing roads are shown in Figure 2.2-3.

Utilities. Power, water, sewer, and communications connections would be confined to previously disturbed areas, to the extent practicable, and would avoid known archaeological sites.

Safety and Security. Security fences, other barriers, and surveillance systems would be constructed or installed only within designated training areas or in the immediate vicinity of explosive testing areas. Security fences may be erected to prevent access to an area for safety reasons, the sensitive nature of training or test events, or both. Security fences could be 3-strand wire or chain link, depending on the need. Barriers could consist of earthen berms, concrete barriers, or other structures designed to increase safety, security, or mitigate noise from training or testing. Surveillance systems could consist of sensors, alarms, and/or cameras, and may be linked to a central monitoring location.

Ground Preparation. Ground preparation would occur only within proposed training ranges. Clearing of vegetation and grading of the ground, including roads, would be limited to the minimum area required to

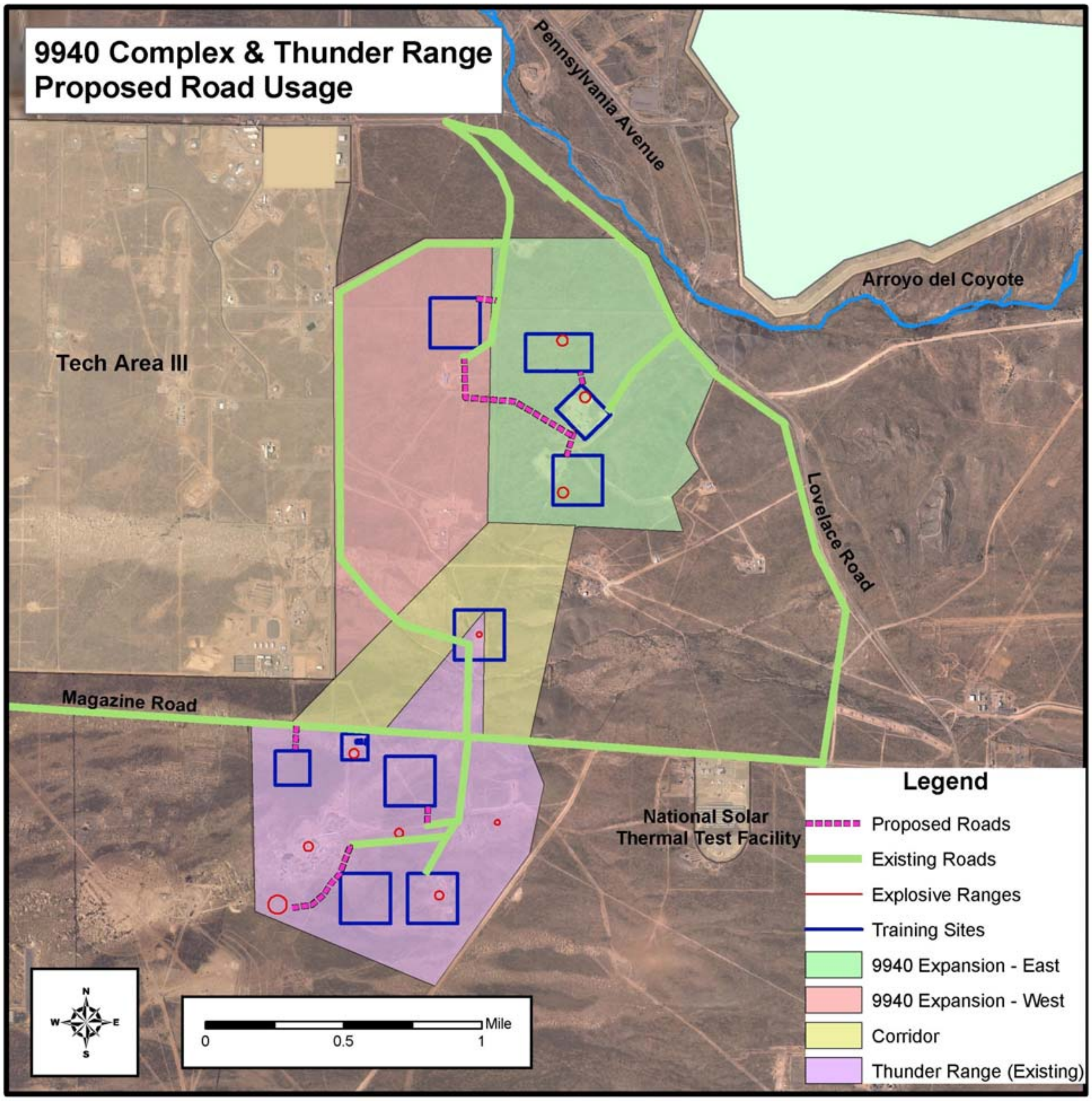


FIGURE 2.2-3 Existing and Proposed Roads to Training Sites and Explosive Ranges

support operations. Equipment used in site development activities would be parked within previously disturbed areas or the proposed training areas to avoid disturbing more ground than necessary. To limit the amount of erosion in cleared areas from storm-water runoff, specific erosion and sedimentation controls would be utilized, such as drainage features that minimize runoff and silt transport. A sediment control plan would be developed for ground disturbance.

2.2.1.1. 9940 Expansion – East

Site development activities within the 9940 Expansion–East area would consist of the following:

- **Buildings**. One building would be constructed west of the current 9940 Complex offices, with offices for up to 40 people, electronics laboratories, fabrication laboratories, and meeting rooms. The building would be up to 200 ft by 100 ft by 25 ft, providing office space for the anticipated work force and laboratories.

- **Training and Test Structures**. No permanent training or test structures would be placed or constructed in this area.
- **Roads**. Roads would be constructed from the current 9940 Complex area to 9940 Training South (approximately 800 ft) and 9940 Training East (approximately 500 ft; Figure 2.2-3). An additional road, allowing access to the Training West Landing Zone, would be constructed along the current power-line corridor that extends westward from the 9940 Complex toward the 9950 Complex (approximately 1,500 ft within the 9940 Expansion–East area).
- **Utilities**. No additional utilities would be extended to this area.
- **Safety and Security**. The existing 9940 Complex fence line would be altered to encompass the new building and put the existing parking area outside the fence. There would be an additional fence between the building and the rest of the limited area to provide for personnel control during explosive testing. The future 9940 Complex would maintain the current 12-ac site as a limited area. The 9940 Control Bunker would be upgraded from a limited area to a Sensitive Compartmented Information Facility, providing the infrastructure to securely generate and manage the classified information needed in future business.
- **Ground Preparation**. Clearing of vegetation and grading would take place at the two training areas. Although potentially the entire 20 ac of each training area could be cleared and graded, if needed, through NEPA process coordination, these activities are likely to take place over a smaller portion of each area. Future activities utilizing the entire 20 ac of each training area would be subject to additional NEPA review.

2.2.1.2. Thunder Range

Site development activities within Thunder Range would consist of the following:

- **Buildings**. Existing Building 9965 would be configured as a control room for Thunder Range operations.

  A new explosive storage area would be sited north of Building 9965 and east of the entry road. Four above-ground explosive storage structures (approximately 15 ft by 20 ft) and one assembly structure (approximately 20 ft by 20 ft) would be placed inside the storage area.
- **Training and Test Structures**. An “assault house” would be constructed on T-Range 5, approximately 5,000 square ft total, and two stories high. It would have replaceable fixtures such as doors, windows, walls, and flooring, which may be damaged or destroyed by explosives during training. The building exoskeleton would be reinforced to remain intact through multiple training exercises. No other permanent training or test structures would be placed or constructed in the Thunder Range area.
- **Roads**. Primary access to Thunder Range is from Magazine Road and several unnamed and unpaved, though regularly maintained, roads to the south (Figure 2.2-3). The proposed training and explosive testing areas would be accessed by four new roads: a 300-ft road from Magazine Road south to the ATEF; a 150-ft road connecting Training Site North to an existing unnamed road; a 300-ft road connecting Training Site South to an existing unnamed road, and a 600-ft road connecting T-Range 7 to the road entering Training Site South.

- **Utilities**. Existing transformers and power transmission lines would be repaired, re-energized, and, if necessary, reconductored. No additional water or sewer would go to the area. Trailers temporarily moved to Thunder Range training sites would use portable toilets.
- **Safety and Security**. A permanent security fence would be placed around the explosive storage area. Intruder detection systems may also be required.
- **Ground Preparation**. Clearing of vegetation and grading would take place at the six training areas and four explosive testing areas. Although potentially the entire surface of each training area could be cleared and graded, if needed, through NEPA process coordination, these activities are likely to take place over a smaller portion of each area. Future activities utilizing the entire 20 ac of each area would be subject to additional NEPA review.

2.2.1.3. Corridor

Site development activities within the Corridor area would consist of the following:

- **Buildings**. No permanent buildings would be constructed in this area.
- **Training and Test Structures**. No permanent training or test structures would be placed or constructed in this area.
- **Roads**. Primary vehicle access to the corridor area is from Magazine Road or an unnamed road extending north-south along the eastern edge of TA-III. No new roads would be constructed in this area.
- **Utilities**. No additional utilities would be extended to this area.
- **Safety and Security**. No permanent safety and security infrastructure would be placed in this area.
- **Ground Preparation**. Clearing of vegetation and grading would take place at the training area for T-Range 6. Although potentially the entire 20 ac of T-Range 6 could be cleared and graded, if needed, through NEPA process coordination, these activities are likely to take place over a smaller portion of the area. Future activities utilizing the entire 20 ac area would be subject to additional NEPA review.

2.2.1.4. 9940 Expansion–West

Site development activities within the 9940 Expansion–West area would consist of the following:

- **Buildings**. No buildings would be constructed or placed in this area.
- **Training and Test Structures**. No permanent training or test structures would be placed or constructed in this area.
- **Roads**. A road would be constructed that is the continuation of the road described for the 9940 Expansion–East area, along the current power-line corridor that extends westward from the 9940 Complex toward the 9950 Complex (approximately 500 ft within the 9940 Expansion–West area). This road would then extend north (approximately 500 ft) to connect with the existing access road to the 9950 Complex. A road would be constructed to this access road to enter Training West (approximately 100 ft).
- **Utilities**. No additional utilities would be extended to this area.
- **Safety and Security**. No permanent safety and security infrastructure would be placed in this area.
- **Ground Preparation**. Clearing of vegetation and grading would not take place within this area.

2.2.2. Operations

2.2.2.1. Training and Testing Common Elements and Mitigations

Under the Proposed Action, energetic systems training and testing would be expanded at the 9940 Complex and Thunder Range. Both training and testing activities require the use of explosives, water, and methods for vegetation control, as described below.

Explosives

All activities would be subject to per-event explosive weight limits and number of total events. These limits are listed in Tables 2.2-2 and 2.2-3 and are expressed as TNT (trinitrotoluene) equivalents. The TNT equivalent is defined in the DOE Explosives Safety Manual as "a measure of the blast effects from explosion of a given quantity of material expressed in terms of the weight of TNT that would produce the same blast effects when detonated" (SNL 2006b). The annual maximum TNT-equivalent quantity that could be used under the Proposed Action is 48,875 lb.

TABLE 2.2-2 Per-Event Explosive Limits at Training and Explosive Testing Areas under the Proposed Action

Location	TNT Equivalent Limit Per Event (lb)
9940 Complex	50
9940 Training South	50
9940 Training East	50
9940 Training West	0
Thunder Range—Range 1	100
Thunder Range—Range 1A	1,100
Thunder Range—Range 2	50
Thunder Range—Range 3	5
Thunder Range—Range 4	350
Thunder Range—Range 5	50
Thunder Range—Range 6	130
Thunder Range—Range 7	2,000
Thunder Range—Range 8 (Training Site North)	50
Thunder Range—Range 9 (Training Site South)	50
Thunder Range—Range 10 (ATEF)	50

Source: McKinley 2007
lb = pounds

TABLE 2.2-3 Annual Number of Explosive Events under the Proposed Action

	Explosive Weight (lb TNT equivalent)						
Area	>0-1	>1-5	>5-20	>20-50	>50-100	>100-500	>500
9940 Expansion–East	600	275	70	30	0	0	0
9940 Expansion–West	0	0	0	0	0	0	0
Corridor	0	0	0	0	0	0	0
Thunder Range	1000	300	100	50	20	10	15

Source: McKinley 2007

Water

Water would be used for dust suppression, fire suppression, and domestic purposes at permanent facilities. Quantities of water used at each area are listed in Table 2.2-4. The facility would be required to maintain a record of the quantity of water used and periodically transmit that information to the SNL Environmental Programs & Assurance Department to assure water use is kept to a minimum.

TABLE 2.2-4 Annual Water Use under the Proposed Action

Location	Annual Water Use (gallons)
9940 Expansion–East	300,000
Thunder Range	150,000
Corridor	15,000
9940 Expansion–West	15,000
Total	480,000

Source: McKinley 2007

Vegetation Control

The ground surface within training and testing areas would be kept free of potential vegetation fire hazards by spraying, picking, and cutting. Some areas would be sprayed with a vegetation controller to prevent growth and potential fire propagation in training and explosive testing areas.

Mitigations

There are many mitigating actions already in use to minimize the potential environmental and human health impact of explosive testing and operations. All of the existing mitigations and requirements would continue under the Proposed Action. Access control through the use of area fencing and gates across roads, and sign-out sheets to log traffic when on location in explosive areas, would be used for the new training and testing areas. Signage and warning lights would continue to be used. Compliance with the range-specific Explosives Site Plan and scheduling of range activities with the KAFB Controlled Firing Area Committee are mandatory for these activities, as well as compliance with the *DOE Explosives Safety Manual* and *Sandia Explosives Safety Manual*.

A secured firing area (danger zone) would be established for each test to protect personnel from hazardous blast overpressure, firebrands, fragments, or projectiles from an explosives shot or gun firing. The danger zone would be determined by the application of the principles outlined in DoD 6055.9-STD. The size of the danger zone for protection from fragments would vary with the type of test. Berms or other barriers could be used to protect against low-angle fragments.

For larger tests, additional mitigation measures would be employed to minimize the potential for on- and off-site noise impacts of the Proposed Action. Explosive tests of greater than 20-pounds (lb) trinitrotoluene (TNT) equivalent would be contingent on go/no-go criteria related to wind, temperature, time of day, and cloud cover. Other explosive test thresholds would be range-dependent. Table 2.2-5 lists explosive testing areas and the maximum quantities for unmitigated blasts that could occur at each. These quantities are based on receptor distances noted in the table. Receptors are non-involved individuals or structures potentially subject to a sound pressure level of 140 dB or greater. Individuals associated with the 9940 Complex and those taking part in exercises within the project area are assumed to be involved individuals for all tests. Structures not included are those within the project area.

Mitigation measures would be designed to ensure insignificant off-site impacts and minimize the potential for on-site impacts to human health and property. These measures could include one or more of the following:

TABLE 2.2-5 Nearest Receptors and Unmitigated Explosive Limits by Explosive Test Range

Range	Explosive Test Range Limit (lb TNT equivalent)	Nearest Non-Involved Receptor	Distance to Receptor in mi (m)	Unmitigated Explosive Limit (lb TNT equivalent)
9940 Complex	50	Lovelace Road	0.41 (660)	30
9940 Training South	50	9930 Complex	0.28 (450)	10
9940 Training East	50	Lovelace Road, 9950 Complex	0.38 (620)	25
9940 Training West	0	N/A	N/A	N/A
Thunder Range—Range 1	100	TA-III	0.65 (1,050)	—
Thunder Range—Range 1A	1,100	TA-III	0.65 (1,050)	100
Thunder Range—Range 2	50	National Solar Thermal Test Facility	0.68 (1,090)	—
Thunder Range—Range 3	5	TA-III	0.33 (540)	—
Thunder Range—Range 4	350	TA-III	0.67 (1,070)	100
Thunder Range—Range 5	50	Pueblo of Isleta Boundary	0.82 (1,320)	—
Thunder Range—Range 6	130	9920 Complex	0.36 (580)	20
Thunder Range—Range 7	2,000	Pueblo of Isleta Boundary	0.77 (1,240)	100
Thunder Range—Range 8 (Training Site North)	50	TA-III	0.38 (620)	25
Thunder Range—Range 9 (Training Site South)	50	Pueblo of Isleta Boundary	0.80 (1,290)	—
Thunder Range—Range 10 (ATEF)	50	TA-III	0.28 (450)	10

— = Unmitigated limit equal to or greater than range limit
lb = pounds
m = meters
mi = miles
N/A = Not applicable (no explosives used at range)
TA = Technical Area

- Pre-test sound propagation modeling with go/no-go thresholds. The sound propagation model would employ the most current available meteorological data and forecasts.
- Placement of berms or other barriers to attenuate or redirect noise.
- Expansion of the access-controlled area.
- Communication with non-involved facilities to ensure use of personal protective equipment or otherwise protect non-involved personnel from noise impacts (e.g., by remaining indoors). Note that the 9920, 9930, and 9950 complexes are also explosive testing areas, with procedures and personal protective equipment in place for explosive tests.

Tests of greater than 100-lb TNT equivalent would require pre-test sound propagation modeling with go/no-go thresholds. Tests of greater than 350-lb TNT equivalent would also require placement of multiple noise monitors as a check against model results. Substantial discrepancies between measured and modeled noise would be reviewed by meteorological and noise subject matter experts to determine whether mitigation measures should be adjusted, including changing go/no-go thresholds and/or addition of near-real-time atmospheric monitoring.

Two wells within or immediately adjacent to the project area, CTF-MW2 and CTF-MW3, which are currently not being sampled, would be incorporated into the groundwater surveillance network. Perchlorate and explosives would be added to the list of constituents analyzed at these two wells and wells in the vicinity of the site. Metals and nitrates would also be analyzed as part of the routine groundwater surveillance sampling.

2.2.2.2. Training Activities

Training activities would be performed within the nine new designated training areas and the 9940 Complex. Other portions of the proposed permitted area could be used for deployment of trainees to enhance training realism. Any deployment and transit areas would avoid archaeological sites, important biological resources, and utilize previously disturbed areas to the greatest possible extent (see Section 3.6.1, Terrestrial Vegetation, for the locations of disturbed areas).

Training exercises typically involve detonation of small amounts of explosives, and travel over training areas on foot or with rubber-tired vehicles. Ground disturbance, including vegetation removal and grading at training areas, could take place for individual training exercises. Temporary structures could also be erected on training areas to simulate facilities. These structures could include the following:

- Towers (free standing or guy-wire supported)
- Buildings, typically concrete block
- Mobile structures, such as mobile offices or transportainers (freight containers, typically 8 ft wide, 8.5 ft tall, and 20 ft long)
- Other structures, such as tubes
- Earthen structures, such as berms, pits, or trenches
- Barriers or other safety or security devices

These structures would undergo demolition and removal after completion of the training exercise, although intact structures, mobile offices, or transportainers could remain within training areas for anticipated subsequent training exercises.

Radiation sources could be used during training. These would be small sealed sources and golden static X-ray.

With the exception of movement on foot across the project area, training activities would take place within the training ranges defined in the Proposed Action. Personnel participating in training exercises would not disturb the ground or pick up, remove, or damage any materials in the area. Personnel would be informed and/or reminded of this during the introduction to training activities.

The Training West Landing Zone would allow landing of helicopters for personnel deployment. These deployment exercises would be relatively infrequent, approximately one per year. Helicopters would land directly on the ground surface within the Training West Landing Zone. The condition of the landing area would be evaluated for dust potential prior to any helicopter exercise. If dust would be easily suspended, the landing area would be watered prior to the exercise.

2.2.2.3. Testing Activities

Testing activities would be done at explosive ranges. Quantities of explosives per testing event could range from less than 1-lb to 2,000-lb TNT equivalent (Table 2.2-2). Testing could also involve temporary structures described in Section 2.2.2.2, Training Activities. These structures would undergo demolition and removal upon completion of the test, although mobile offices or transportainers could remain for anticipated subsequent tests.

Flash X-ray radiation sources could be used during testing events.

2.2.3. Project Termination and Decommissioning

A decommissioning strategy needs to be produced and implemented to ensure that proper closure processes, including sampling and cleanup, have been planned and funding for associated costs secured. After project activities have been completed, the site would be cleaned and decommissioned in accordance with applicable standards and regulations.

After the Long-Term Environmental Stewardship (LTES) Life-Cycle Cost Model is implemented around 2009, the 9940 Complex and Thunder Range project owners would ensure proper implementation of this cost model within the scope-of-work activities associated with this Environmental Assessment.

Where decommissioning, demolition, or environmental restoration activities would be planned, actions would be taken such as backfilling, reducing side slopes, applying topsoil, reseeding, and establishing plant growth to restore the area to its state when originally permitted to DOE.

Demolition activities would remain within the project boundaries. Prior to demolition, if historical significance has not previously been determined, buildings would be evaluated for eligibility for the National Register of Historic Places, and consultation would occur with the New Mexico State Historic Preservation Office in compliance with Section 106 of the *National Historic Preservation Act* (NHPA).

2.3. Alternatives Considered But Eliminated From Further Study

An alternative considered, but not analyzed in detail, and eliminated from further consideration, is the following:

Perform expanded training and testing activities at an SNL location other than SNL/NM: One of the criteria for performing WFO is that the work is consistent with or complementary to DOE/NNSA's mission at SNL. The type of energetic materials work described in the Proposed Action is not consistent with or complementary to missions at other SNL locations.

Decrease the proposed expansion area to include the proposed area without the corridor and/or additional land to the TA-III fence line: Part of the purpose of the expansion would be to allow sufficient area to support all future needs for continued and increased training, information gathering, and practical experience for trainees. Without the corridor area and land to the TA-III fence line, the ability to add the "practical experience" element to these training exercises would be severely curtailed. This alternative would not meet the purpose and need for the project.

3.0 AFFECTED ENVIRONMENT

The following sections include discussions of the local environment currently and potentially affected by the proposed expansion of the 9940 Complex and Thunder Range. The resource areas described are specific to SNL/NM site-wide conditions, and, where applicable, specific to the proposed land expansion area located in the Coyote Test Field.

3.1. LAND RESOURCES

3.1.1. Land Use

3.1.1.1. Land Ownership

Land ownership on Kirtland Air Force Base (KAFB) is divided among the U.S. Air Force (USAF), U.S. Department of Energy (DOE), the U.S. Bureau of Land Management, and the U.S. Forest Service. The USAF and DOE are the principal land users within KAFB. Land use is established through coordination and planning agreements between these agencies. DOE owns only a small portion of the land it needs, including SNL/NM, which uses approximately 17 percent of Federal land on KAFB (DOE 1999). The 9940 Complex and Thunder Range are currently operated under a land use permit from the USAF/KAFB; a land use permit would be required for the additional acreage in the proposed action.

The region of influence would be the land in and around the Coyote Test Field. The region represents potential impact areas differentiated by onsite, including USAF-owned land, or offsite land resources. Onsite resources are lands used for SNL/NM and USAF activities within KAFB. Offsite resources consist of land immediately adjacent to KAFB and include areas belonging to the Pueblo of Isleta, City of Albuquerque, and State of New Mexico.

3.1.1.2. Nearby SNL/NM Facilities

TA-III

TA-III is located approximately five mi south of TA-I. The facilities located in this technical area are primarily devoted to waste management, physical testing, and simulating a variety of natural and induced environments. Most of the structures in TA-III are grouped together in small complexes and separated by open space. Much of the area remains as open space characterized by flat to undulating grassland terrain (DOE 1999).

TA-V

TA-V is located on approximately 25 acres (ac) adjacent to the northeast corner of TA-III. In addition to DOE-owned lands within the boundaries of TA-V, approximately 6 ac are permitted to the DOE by the USAF to provide additional security. TA-V is a relatively small research area consisting of about 35 closely grouped structures where nuclear facilities are located (DOE 1999).

3.1.1.3. Coyote Test Field Facilities

Thunder Range

Current permitted land at the 9940 Complex and Thunder Range is used as an explosive test range. The 9940 Expansion–East area is currently used only in the area of the 9940 Complex for explosive testing. Thunder Range currently and has historically been used for explosive testing. The corridor between the 9940 Complex and Thunder Range is currently not used. The 9940 Expansion–West is also currently not used (SNL 2006a).

National Solar Thermal Test Facility

Located southeast of Thunder Range is the National Solar Thermal Test Facility, also known as the Solar Tower. The National Solar Thermal Test Facility is an area of approximately 115 ac that includes solar furnaces, parabolic dishes, parabolic troughs, and a field of 218 computer-controlled heliostats which reflect concentrated solar energy onto a tower 200-ft tall. The site was built and instrumented to provide test facilities for a variety of solar and non-solar applications (SNL 2003b).

Explosive Applications Laboratory

The Explosives Applications Laboratory is located southwest of the 9940 Complex in Building 9930. The complex includes laboratory space and explosives storage bunkers. The facility is used for the design, assembly, and testing of explosive experiments in support of SNL-wide programs. The Explosives Applications Laboratory supports field test arming and firing, warhead development, development of emergency destruct systems, and the development of explosive components and systems (DOE 2006a).

Explosive Device Test Facility

The Explosive Device Test Facility is located southeast of the 9940 Complex in Building 9939. Mostly small-scale explosive testing is performed in this building. Hydrogen peroxide testing is also performed here (Gonzalez 2007).

Explosive Test Facility

The Explosive Test Facility is located southwest of the 9940 Complex in Building 9920. Explosives testing and training are performed at this site. An explosive chamber and 1,050-pound (lb)-capacity storage area can also be found in this facility. Additional operations include machining and fabrication (Gonzalez 2007).

Explosives Processes Machining Complex

Located southeast of the 9940 Complex is the Explosives Processes Machining Complex, Building 9960. Within the facility, raw explosives are machined into a variety of shapes, and complex assembly and disassembly of explosive devices is performed. Explosives machining is done by remotely operated equipment (SNL 2007a).

Shock Thermodynamic Applied Research Facility

The Shock Thermodynamic Applied Research Facility, Building 9956, is located northwest of the 9940 Complex. This facility is a collection of four research guns within a main gun building and four work areas. The building is situated within a security locked/camera monitored 2-ac fenced-in complex. Building 9950, part of the Shock Thermodynamic Applied Research Facility complex, is an earthen-covered explosive testing area; the interior has been converted to office space (Reinhart 2007).

3.1.1.4. Nearby Air Force Facilities

Starfire Optical Range

The Starfire Optical Range is a portion of land in the southwest part of the USFS Withdrawn Area and is located southeast of Thunder Range. It was established in 1976 to test new high-energy lasers. Work requiring industrial use of the land focuses on field experiments and analyses that enable laser technologies to be used in applications such as optical communications with satellites. In addition to its primary research charter, the Starfire Optical Range also supports field experiments by other groups in and outside of the Air Force Research Laboratory (SNL/NM 2004).

Chestnut Site

Located southwest of Thunder Range is the Conventional High Explosives & Simulation Test Site, which is also shown on maps as Chestnut Site or Range. Chestnut Range continues to be used as an active explosives testing site by USAF and its contractors (SNL 2003b).

3.1.1.5. Nearby Off-Site Areas

Mesa del Sol

The Mesa del Sol area is an approximately 13,000-ac parcel of mostly vacant land, virtually all of which is held in trust by the New Mexico State Land Office for the benefit of the University of New Mexico and New Mexico Public Schools. The development of the mixed-use pedestrian-oriented planned community, which includes a number of districts and activity centers surrounded by large areas of open space, is underway. DOE maintains a 100-year lease (effective 2001) for a buffer zone along the west side of TA-III. This buffer zone, named La Semilla, separates activities that take place on KAFB from the Mesa del Sol planned community. The lease prohibits land uses within the buffer zone that would conflict with SNL//NM activities.

Pueblo of Isleta

The southern portion of KAFB borders a wide expanse of open rangeland owned by the Pueblo of Isleta. The majority of reservation land consists of mixed rangeland. Residential or commercial development does not occur on the Pueblo of Isleta lands that border the KAFB boundary to the south. (SNL/NM 2004).

The locations of the areas listed above are shown in Figure 3.1-1.

3.1.1.6. ER Sites

The DOE created the ER Project to identify, assess, and remediate sites potentially contaminated by past spill, release, and disposal activities. The remediation and cleanup of areas of past contamination at SNL/NM are regulated by the *Resource Conservation and Recovery Act*, as amended by the *Hazardous and Solid Waste Amendments of 1984*. Hazardous and Solid Waste Amendment requirements apply to ER sites, or Solid Waste Management Units (SWMUs) at SNL/NM. A SWMU is any unit “from which hazardous constituents might migrate, irrespective of whether the units were intended for the management of solid and or hazardous waste” (SNL/NM 2004).

The primary goals of the ER Project activities were to ensure that risks to human health and the environment posed by inactive sites be either remediated to regulatory cleanup levels, or be identified as requiring No Further Action (NFA) (DOE 1996). The majority of ER sites have been granted NFA status under a risk-based scenario. Risks to human health and the ecosystem were calculated according to guidance from the U.S. Environmental Protection Agency (EPA) and the New Mexico Environment Department (NMED). Risk has been calculated for sites with residual contamination. The level of contamination remaining and the appropriate land use category (i.e., industrial use, residential use, or recreational) are used as input to determine any remaining risk to human health and the ecosystem. This method is used to ensure these calculated risks are small enough to warrant NFA status (SNL/NM 2004).

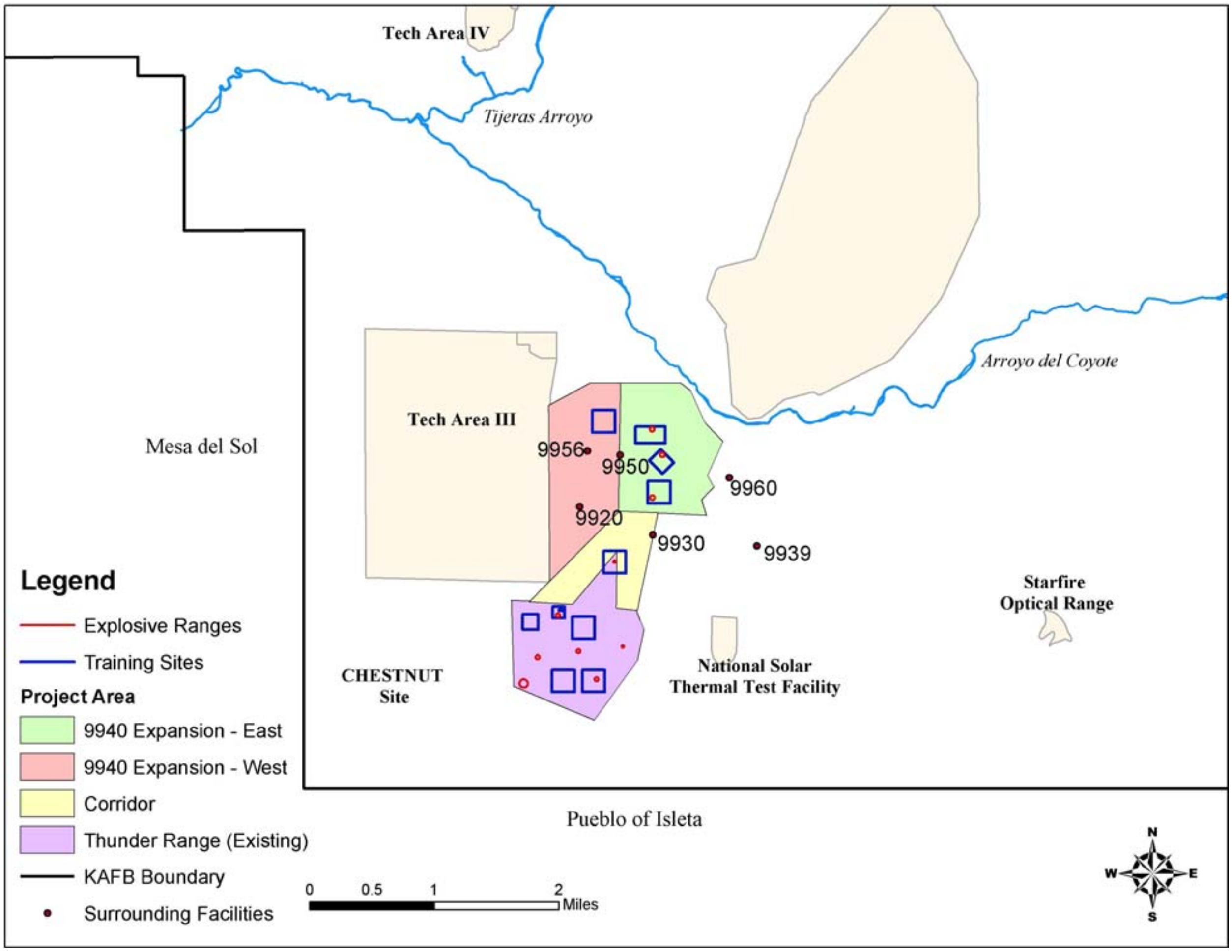


FIGURE 3.1-1 Locations of Nearby On-Site and Off-Site Facilities

The ER sites located within the project area, their NMED permitted land use status, and the remaining contaminants of concern at the sites are listed in Table 3.1-1. Only three of the sites are classified for industrial land use. The locations of all of the ER sites in the project area are shown in Figure 3.1-2. Of the sites listed, only ER Site #6A, and a portion of ER Site #85, are located outside currently-permitted DOE land. All other sites are located on DOE-permitted land.

3.1.2. Wildland Fire Management

Considerable combustible material exists in the project area in the form of grasses and small shrubs. The 9940 Complex and Thunder Range currently have seven onsite personnel trained in wildland fire fighting who have the necessary safety personal protective equipment and other required equipment needed to fight a wildland fire within training and explosive testing areas. Through the appropriate work-flow process, the 9940 Complex and Thunder Range personnel determine the possibility of a fire from an explosive test or training activity. If a small possibility exists, the trained wildland fire-fighting team is alerted, and water trucks are readily available. If there is a large possibility that a fire may occur, the 9940 Complex and Thunder Range personnel alert the Emergency Operations Center and KAFB fire department. Approval from SSO is required in the event of a large possibility of a wildland fire. The onsite wildland fire-fighting trained team is standing by with the appropriate equipment and is ready to respond. In the event of a wildland fire, the team evaluates the situation to determine whether the fire can safely burn out on its own. If not, the team evaluates whether the fire can be put out by onsite personnel, or if help is needed. If help is needed, the Explosives Operator and Safety Monitor would immediately evacuate all personnel from the area and call emergency response from the nearest telephone or activate a fire alarm from the nearest pull station. The 9940 Complex and Thunder Range safety plans require a 30-minute fire watch for all heat-related activities, and a 60-minute fire watch for high-fire-danger activities (McKinley 2007).

TABLE 3.1-1 Land Use Determinations for Former Legacy Sites in the Vicinity of the Project Area

ER Site Number	NMED Permitted Land Use [a]	Remaining Contaminants of Concern
6 & 6A	Residential	Arsenic, polycyclic aromatic hydrocarbons
14	Residential	Arsenic
17	Industrial	Depleted Uranium
38	Residential	None
53	Residential	None
56	Residential	None
85	Residential	Arsenic
86	Residential	Cadmium, Copper, Nickel
89	Residential	Arsenic
90	Residential	None
91	Industrial	Arsenic, Lead, Selenium
101	Residential	None
108	Residential	None
109	Industrial	Arsenic, Cadmium, Selenium
112	Residential	None
139	Residential	None
140	Residential	None
141	Residential	None
146	Residential	None
148	Residential	None
151	Residential	None
152	Residential	None
153	Residential	None
193	Residential	None
194	Residential	None

[a] Some former legacy sites did not have contamination. Others were cleaned up either to residential-or industrial-risk-based standards under New Mexico regulations. Risk assessments were completed for the sites with contamination; and the allowable land use, as permitted by the NMED, is indicated.

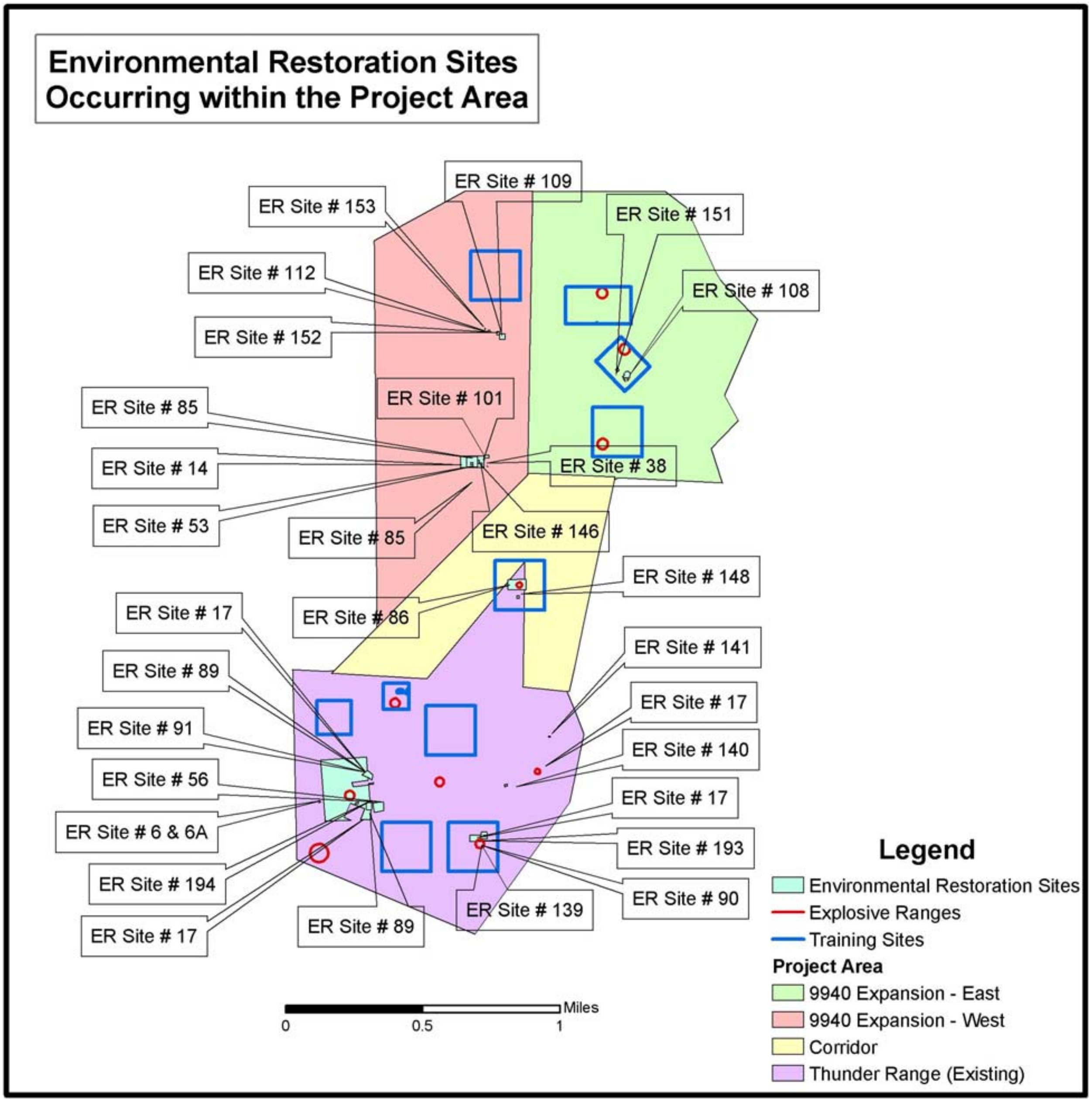


FIGURE 3.1-2 Environmental Restoration Sites Occurring within the Project Area

3.1.3. Vegetation Control

Vegetation in the project area includes grasslands typical of the middle Rio Grande Valley. Vegetation is controlled in all explosive areas. The ground is kept free of potential vegetation fire hazards at all times by spraying, picking, and cutting. Some areas are sprayed with a vegetation controller to prevent growth of unwanted vegetation and to minimize fire risk and propagation potential in explosive testing areas. The 9940 Complex and Thunder Range personnel mow the vegetation surrounding fences twice a year as a fire prevention requirement (McKinley 2007).

3.2. Geology, Topography, and Soils

3.2.1. Geology

The KAFB area is situated in the eastern portion of the Albuquerque Basin. This basin is approximately 90 mi long and 40 mi wide, and is bound by the Sandia Mountains and the Manzano Uplift to the east, the Lucero Uplift and Puerco Plateau to the west, the Nacimiento Mountains and the Jemez Uplift to the north, and the Socorro Basin to the south (SNL/NM 2004).

The Albuquerque Basin is bordered by major faults. Large-scale faulting, deepening of the basin, and uplift and tilting of the mountain areas occurred approximately 15 to 5.3 million years ago. Since then, basin deposits have been laid down in a complex sequence of sedimentary and volcanic rocks. Faults within and bordering the basin exhibit evidence of late Pleistocene and possibly Holocene displacement. Overall structural relief between the Precambrian strata within the inner trough to the top of the eastern margin uplift is about 6 mi (SNL/NM 2004).

KAFB is located in a structurally complex area. A number of major regional faults intersect within the area, resulting in a diverse pattern of fault trends and displacements. There is no record of movement on these faults in historic times and no evidence of movement during the last 10,000 years (SNL/NM 2004).

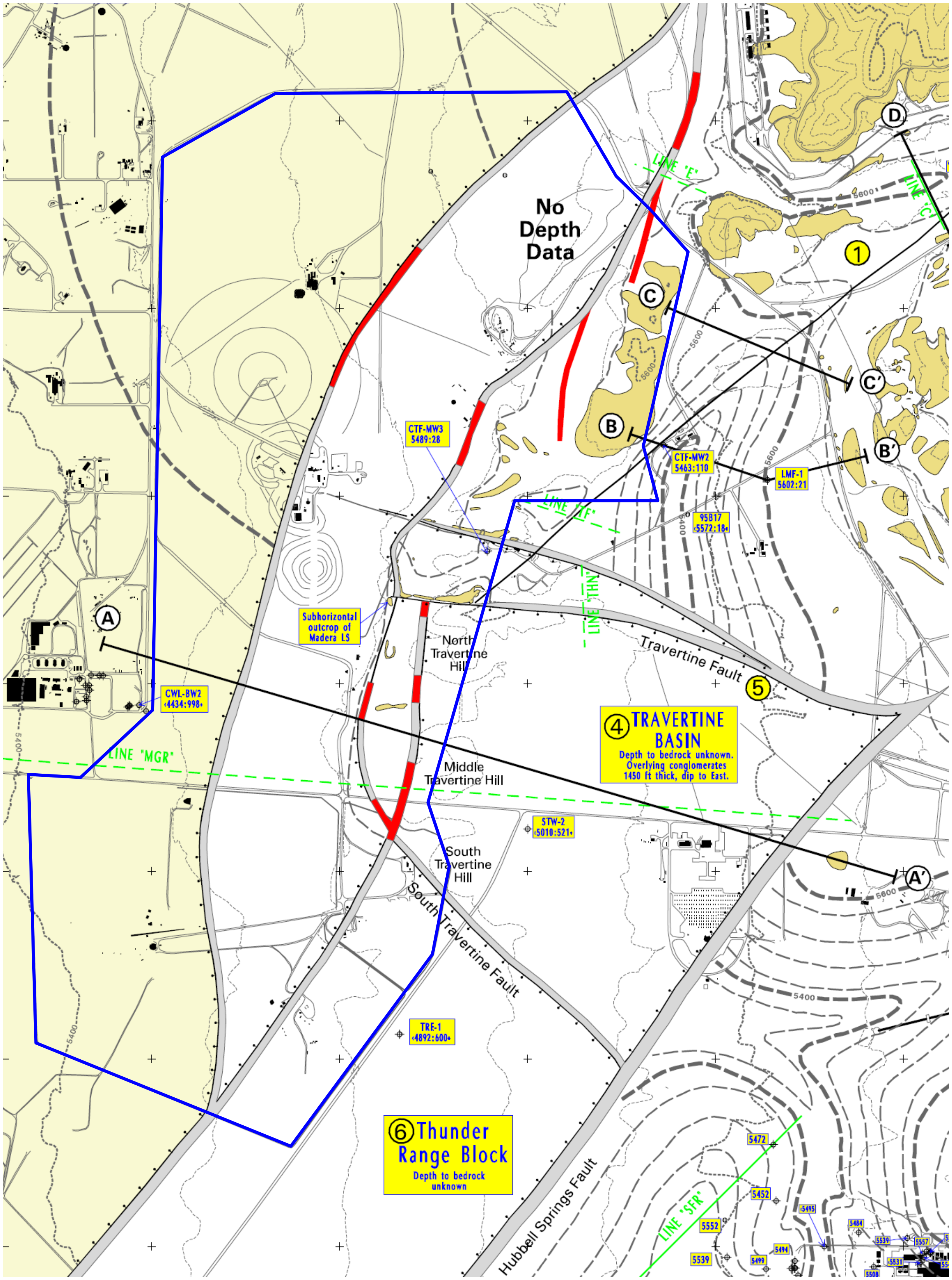
The project area is bisected by the Sandia Fault, a north- to northeast-trending, west-dipping normal fault along the eastern margin of the Albuquerque Basin (Figure 3.2-1). The southern extent of the fault is difficult to ascertain because it intersects or merges with the Tijeras Fault zone and the Hubbell Springs Fault (SNL/NM 2004). To the east of the Sandia Fault, within the project area, lie several intersecting faults including the Tijeras Fault, Travertine Fault, and South Travertine Fault. The southeastern edge of the project area lies within the Travertine Basin, an area bounded on the west by the Tijeras Fault, on the north by the Travertine Fault, and on the east by the Hubbell Springs Fault (SNL 2003a). A geologic cross section through the central part of the project area is shown in Figure 3.2-2.

To the west of the Sandia Fault is the Calabacillas subbasin of the Albuquerque Basin, which underlies nearly all of the cities of Albuquerque and Rio Rancho to the north (SNL 2003a, Connell 2006).

3.2.2. Topography

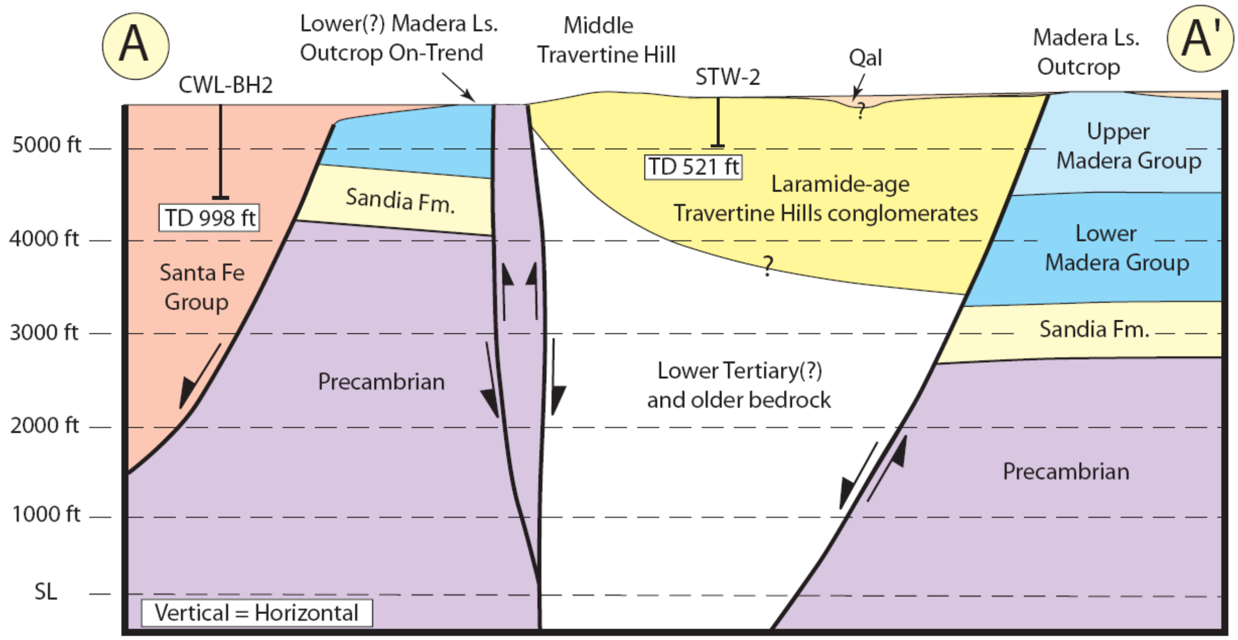
The western portion of KAFB, including the project area, is located on gently-sloping alluvial fan deposits of the Albuquerque Basin. The eastern portion of KAFB is located in the Manzanita Mountains, an area characterized by steep slopes and canyons.

The majority of the project area is relatively flat, sloping westward at a rate of approximately 100 vertical ft per mi. Along the eastern edge of the project area are several hills. The northernmost hill, approximately 0.4 mi east of Building 9940, stands approximately 50 ft above the surrounding landscape. The other three hills, near Magazine Road, stand between 60 and 100 ft above the surrounding landscape. Elevations in the project area range from approximately 5,410 ft above mean sea level in the southwestern portion to approximately 5,620 ft at the hills along the eastern edge (USGS 1990). Two small, unnamed arroyos cut through the project area in a general east to west direction. Neither arroyo averages more than a few feet deep, with maximum depths of about 10 ft (USGS 1990). These two arroyos become indistinct as the terrain flattens near the boundary with TA-III. For additional information regarding site drainage, see Section 3.5.1, Surface Water.



(Source: SNL 2003a)

FIGURE 3.2-1 Faults and Bedrock Elevations within and near Project Area



Source: SNL 2003a

FIGURE 3.2-2 Geologic Cross Section through Project Area near Magazine Road (see Figure 3.2-1 for cross-section location)

3.2.3. Soils

Surface soils at KAFB are developed in fluvial, alluvial-fan, colluvial, and eolian surficial deposits. Variations in soil properties reflect differences in sediment characteristics, length of exposure to surficial weathering, and local climate (SNL/NM 2004).

Within the project area, several soil types have been identified, all of which are fine to very fine sandy loams or loamy sands (USDA SCS 1977):

- **Tome very fine sandy loam**. The Tome Series consists of deep, well-drained soils that formed in alluvial sediments derived from limestone and shale on broad alluvial fans. These soils are present along the unnamed arroyos that cut east to west through the central portion of the project area.
- **Tijeras gravelly fine sandy loam**. The Tijeras Series consists of deep, well-drained soils that formed in decomposed granitic alluvium on old alluvium fans. These soils are present in the north-central portion of the project area and in Thunder Range.
- **Madurez loamy fine sand**. The Madurez Series consists of deep, well-drained soils that formed on piedmonts in old, unconsolidated alluvium modified by wind. These soils are present along the western portion of the project area.
- **Wink fine sand fine sandy loam**. The Wink Series consists of deep, well-drained soils that formed in old, unconsolidated alluvium modified by wind on piedmonts. These soils are present in the area of the 9940 Complex and the southern portion of Thunder Range.

With the exception of the Madurez loamy fine sand, these soils have medium runoff and a moderate potential for water erosion. The Madurez loamy fine sand has slow runoff and severe potential for soil blowing; potential for water erosion is not identified (USDA SCS 1977).

3.3. CLIMATE AND AIR QUALITY

3.3.1. Meteorology and Climate

3.3.1.1. Meteorology

The topography of this area greatly influences meteorological conditions, in which potential air contaminants may be dispersed. During the winter months, temperature inversions are slow to mix out, or may not mix out, limiting dispersion and dilution of air pollutants in the Albuquerque Basin by trapping pollution near the surface. Temperature inversions also play an important role in noise propagation from explosive blasts. At the local level, the most important aspect of meteorology and meteorological variability across SNL/NM is the wind. Wind influences the transport and dispersion of pollutants, and carries or focuses noise and blast pressures.

Wind at SNL/NM is influenced by the proximity to topographic features such as mountains, canyons, and arroyos. Canyons and arroyos act to channel or funnel wind, and mountains create an upslope-downslope diurnal pattern to wind flows. Winds tend to blow toward the mountains or up the Rio Grande Valley during the day, and nocturnal winds tend to blow down the mountains towards the Rio Grande Valley (SNL 2005).

SNL/NM has conducted meteorological monitoring since January 1994. The Chemical Waste Landfill tower (CW1), near the southeastern corner of TA-III, is the closest tower to represent local surface conditions for the project area. The A36 tower in the northern part of TA-III may also be used to provide corroborative data. The temperature and humidity in this vicinity follow the climatic tendencies listed above. A five-year (1999–2003) windrose that identifies surface wind conditions during the day, when most planned explosive activities would take place, is shown in Figure 3.3-1. The figure shows a predominance of winds from the southwesterly directions.

3.3.1.2. Regional Climate

Large diurnal temperature ranges, summer monsoons, and frequent drying winds are characteristic of the regional climate in the Albuquerque Basin and Sandia and Manzano Mountains. Temperatures are typical of mid-latitude dry continental climates with summer high temperatures in the basin in the 90s degrees Fahrenheit (ºF) and winter high temperatures around 50ºF. Daily low temperatures range from the 60s ºF in the summer to the low 20s ºF in the winter. The dry continental climate also produces low average humidity in the late spring and summer prior to the onset of the monsoon season. Daytime relative humidity can be between 10 and 20 percent in the spring and early summer, with an average humidity near 30 percent. Wintertime relative humidity generally averages between 50 and 60 percent (SNL 2005).

Precipitation varies across the region, with many locations in the higher elevations of the mountains receiving twice the annual rainfall of locations in the Albuquerque Basin. Most precipitation falls between July and October, and mainly in the form of brief, heavy rain showers. Average annual precipitation based on 10 years of data collected from 1995 to 2004 is around 8.5 inches at SNL/NM with 10.9 inches in the lower foothills. The winter season in the Albuquerque Basin and around SNL/NM is generally dry, with an average of less than 1.5 inches of precipitation falling between December and February. Spring is characterized by strong winds that average over 10 mi per hour with gusts frequently near 50 mi per hour.

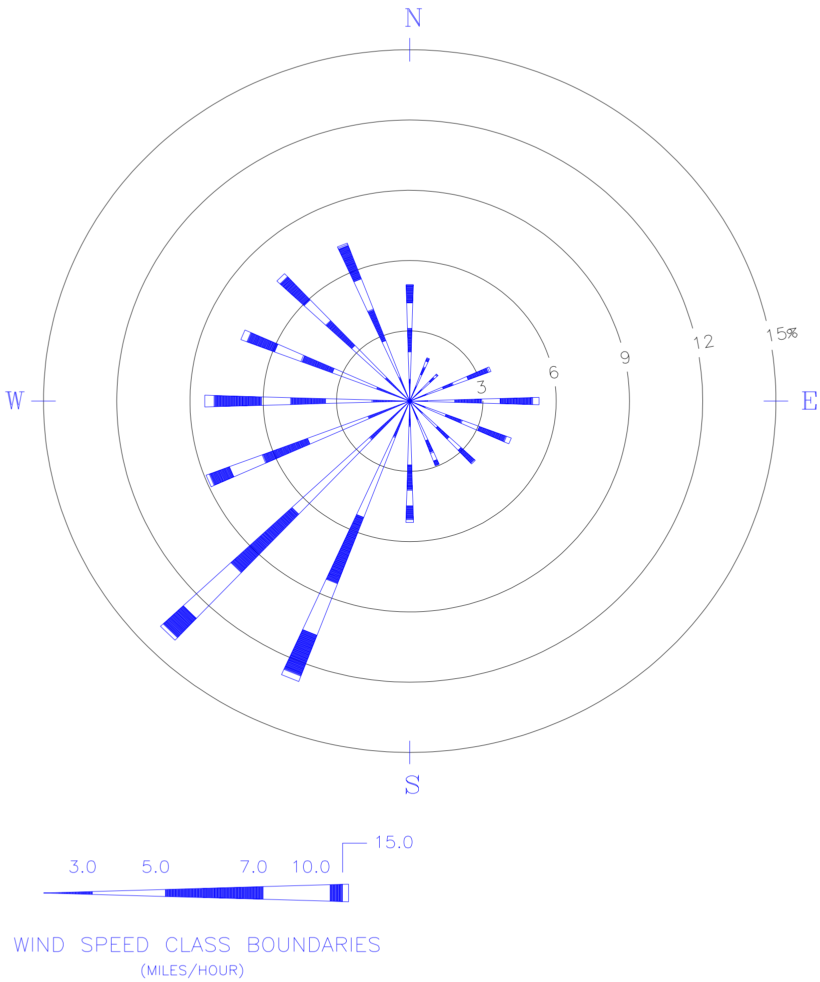


FIGURE 3.3-1 Five-Year (1999–2003) Daytime Windrose for CW1, Identifying the Percentage of Time the Wind is Blowing from a Certain Direction

3.3.2. Air Quality

The *Clean Air Act* (CAA) provides for the establishment of national air quality standards to protect public health and the environment from the harmful effects of air pollution. The act requires the establishment of national standards of performance for new stationary sources of emissions, limitations for a new or modified structure that emits or may emit an air pollutant, and standards for emission of hazardous air pollutants. In addition, the CAA requires that specific emission increases be evaluated to prevent a significant deterioration in air quality.

The EPA is the Federal regulating authority for the CAA. The EPA publishes regulations in the Code of Federal Regulations, and these regulations set limits for SNL/NM to follow. SNL/NM is located in EPA Region VI, which is headquartered in Dallas, Texas. The EPA enforces the Federal regulations and the NMED enforces state requirements. The state of New Mexico has adopted many parts of the CAA and Federal regulations into the New Mexico Administrative Code (NMAC) and has been delegated authority for enforcing the rules at the state level. The New Mexico State Legislature has granted the Albuquerque/Bernalillo County Air Quality Control Board, the authority and responsibility to prevent or abate air pollution in Bernalillo County. Further, its regulations are part of the NMAC and have status as regulations of the State of New Mexico. The Albuquerque Environmental Health Department's Air

Quality Division serves as the administrative agency for the Albuquerque/Bernalillo County Air Quality Control Board.

SNL/NM is considered a major air emission source for criteria air pollutants under the CAA, since it emits more than 100 tons per year of nitrogen oxides and carbon monoxide. Combustion units are the primary source of criteria pollutants emitted at SNL/NM.

Local and national air quality standards including air monitoring results for the 2006 calendar year at SNL/NM are listed in Table 3.3-1. The monitoring results listed here may be considered representative of the SNL/NM background, though local average concentrations in the vicinity of the project area would generally be lower than the concentrations listed here, due to sources found near the monitoring station. The Criteria Pollutant Monitoring Station in TA-I is considered to provide worst-case background, due to the high volume of vehicular traffic, and local sources such as the steam plant, motor pool, and transportation operations and activities.

TABLE 3.3-1 New Mexico Air Quality Standards (NMAQS) and National Ambient Air Quality Standards (NAAQS) Compared to SNL/NM 2006 Monitoring Results

Criteria Pollutant	Averaging	Unit	NMAQS Standard	NAAQS Standard	Maximum or Measured Concentrations
Carbon Monoxide	1 hour 8 hours	ppm ppm	13.1 8.7	35 9	3.14 2.52
Nitrogen Dioxide	24 hours Annual	ppm ppm	0.10 0.05	- 0.053	0.040 0.012
Sulfur Dioxide [a]	3 hours 24 hours Annual	ppm ppm ppm	- 0.10 0.02	0.50 0.14 0.03	0.025 0.004 <0.001
Ozone	8 hour	ppm	-	0.080	0.073
PM_{10}	24 hours	μg/m³	-	150	36
$PM_{2.5}$	24 hours Annual	μg/m³ μg/m³	- -	35 15.0	22.3 9.2
Lead	Any quarter	μg/m³	1.5	1.5	0.0018
Hydrogen Sulfide	1 hour	ppm	0.01	-	not measured [b]
Total Suspended Particulates	24 hours 30 day Annual	μg/m³ μg/m³ μg/m³	150 90 60	- - -	not measured [c]

Source: SNL 2007
ppm = parts per million
μg/m³ = micrograms per cubic meter
PM_{10} = particulate matter (diameter equal to or less than 10 microns)
$PM_{2.5}$ = respirable particulate matter (diameter equal to or less than 2.5 microns)
[a] Standards are defined in μg/m³ and have been converted to ppm
[b] Not measured because there are no sources of hydrogen sulfide at SNL/NM
[c] Not measured because there is no Federal standard and PM10 and PM2.5 serve as indicators. There are no SNL/NM activities that generate significant amounts of suspended particulates.

A review of Table 3.3-1 shows that the air in the vicinity of SNL/NM is within all air quality standards. Pollutants are only measured at SNL/NM if there is a source that can generate the specific pollutant, or if the pollutant is generally high in the Albuquerque region (e.g., ozone).

PM_{10} and $PM_{2.5}$ are considered one criteria pollutant of particulate matter of the six criteria pollutants regulated under the National Ambient Air Quality Standards (NAAQS). Bernalillo County is currently in maintenance status for the carbon monoxide (CO) standard. In 1978, Bernalillo County was designated as a moderate non-attainment area for CO due to violations of the NAAQS. The county remained a non-attainment area for the next 18 years. In 1996, the County was redesignated as an attainment area under maintenance for CO. Since then, Bernalillo County has received EPA approval for the county CO Limited Maintenance Plan, which eliminates the need to apply conformity requirements found in 20 NMAC 11.45. SNL/NM is still subject to Federal conformity rule requirements because of the maintenance classification.

3.3.3. Air Quality Permits and Regulatory Requirements

As required by the City of Albuquerque “Open Burning” regulation, permits are required for aboveground detonation of over 20 lb of explosives. There are two multiple-use burn permits for the project area, one for the 9940 Complex and one for Thunder Range. The existing 9940 Complex open burn permit is for up to 10 tests each, up to 200 lb of explosives (TNT equivalent). Thunder Range is permitted for up to 50 tests each, up to 200 lb of explosives. Both permits are for calendar year 2007. If a test were to require more than 200 lb, application and approval of a single-event permit would be required from the City of Albuquerque (20 NMAC 11.21). The project tracks the number of tests and amount of explosives per test, which ensures compliance with the existing multiple–use burn permit. If a modification needs to be made to an existing permit, or if a single-event permit is required for a specific test, the Air Quality Compliance program would assist in preparation of the permit application and delivery of the permit to DOE/SSO. After the permit is issued by the City of Albuquerque, the permit is reviewed, and a permit summary agreement is created that specifies requirements and responsibilities for both the project and the Air Quality Compliance Program.

As required by City of Albuquerque “Fugitive Dust Control” regulation, fugitive dust control permits apply to projects that disturb greater than three-quarters of an acre of soil. There are two Fugitive Dust Control Permits for this area, one for the 9940 Complex and one for Thunder Range. These permits cover the on-going activities at these sites that disturb more than three-quarters of an acre. The existing 9940 Complex test site permit expires in 2010, and the Thunder Range permit expires in 2009.

3.4. NOISE

3.4.1. Definitions

Noise is sound that is undesirable because it interferes with speech or communication, is intense enough to damage hearing, or is otherwise unwanted. Sound is a form of energy that travels as invisible pressure vibrations in various media. Because one main medium of acoustic transmission is air, acoustic wave propagation is highly influenced by meteorology. These influential factors include ground surface and air temperature, temperature gradients, relative humidity, turbulence, and wind patterns, both at the surface and up through elevations in which the pressure wave travels. In general, as the acoustic wave propagates outward from a source, the sound pressure diminishes with increasing distance from the source. Under certain meteorological conditions, sound pressures higher than expected could be focused at locations away from the source.

The auditory system of the human ear is particularly sensitive to acoustic vibrations. Noise is categorized into two types: *steady-state noise*, which is characterized as longer duration and lower intensity, such as a running motor, and *impulse or impact noise*, which is characterized by short duration and high intensity, such as the detonation of high explosives. Sound levels are computed over a 24-hour period and adjusted for nighttime annoyances to produce the day-night average sound level (DNL). DNL is the community noise measurement recommended by EPA.

The intensity of sound is measured in decibel units. In sound measurements relative to human auditory limits, the decibel scale is modified into an A-weighted frequency scale (dBA). A-weighting is necessary to compare the range of noise humans can hear, since the human ear is less sensitive at low frequencies than at high frequencies. A DNL of 65 dBA is most commonly used for noise planning purposes. Areas exposed to DNL above 65 dBA are generally not considered suitable for residential use. A DNL of 55 dBA was identified by EPA as a level below which there are effectively no adverse impacts.

Vibration is defined as motion in which an object moves back and forth from its rest position when it is acted upon by an external force. For ground vibrations, the threshold level at which minor structural damage may begin to occur in 0.01 percent of structures is set at 2.0 inches per second. The maximum ground-borne vibration level recommended by the U.S. Bureau of Mines to prevent threshold damage is 0.5 inches per second. Human perception of vibration is thought to be between 0.02 and 0.08 inches per second. Vibrations are also caused by acoustic waves. Noise from explosive detonations can cause buildings and windows to vibrate, which is perceived by the occupants as shaking of the structure and rattling of the windows. Many vibrations created by the quantity of explosives used in testing at SNL/NM result from the acoustic wave vibrations to windows, and do not result from ground vibrations. The probability of test vibrations causing structural damage is minimal.

3.4.2. Noise Standards and Requirements

The *Noise Pollution and Abatement Act of 1970* required the EPA to establish the Office of Noise and Abatement Control. The *Noise Control Act* was legislated in 1972 to ensure that environments are free from noises that jeopardize the health and welfare of Americans. Congress has not funded the Office of Noise and Abatement Control since 1982 based on the argument that noise pollution is best handled at the state and local levels. Albuquerque's noise control ordinance regulates noise in the city, and the Environmental Health Department's Consumer Protection Division personnel are responsible for enforcing the ordinance. The ordinance stipulates a property-line value, in which the noise level emitted must not exceed 50 decibels or 10 decibels above the ambient level, whichever is greater.

Occupational exposures are established by standards of the Occupational Health and Safety Administration (OSHA) in the form of a threshold limit value. While DOE is not regulated by OSHA, SNL/NM complies with 10 CFR 851 and follows guidelines published by the American Conference of Governmental Industrial Hygienists (ACGIH) in a booklet entitled “2007 Threshold Limit Values for Chemical Substances and Physical Agents.” The threshold limit value is administratively defined as the sound level to which a worker may be exposed for a specific work period without probable adverse effects on hearing acuity. The threshold limit value for continuous noise is 85 dBA for an 8-hour work day. A threshold limit value for impulsive noise during an 8-hour workday is not fixed, because the allowable number of impulses per day varies, depending on the peak pressure and duration of each impulse. However, no exposure to impulse noise in excess of a peak C-weighted level 140 dB should be allowed to unprotected hearing. Occupational exposures are controlled at SNL/NM by protective measures and include ground hazard areas that restrict personnel, the use of hearing protection, and shielding or evacuation.

The *Department of Defense Design Criteria Standard—Noise Limits* (MIL-STD-1474D) establishes guidelines and requirements for numerous applications dealing with explosives (DoD 1997). The ACGIH defers to the MIL-STD-1474D for impulse noise hearing protection guidelines.

3.4.3. Noise at the 9940 Complex and Thunder Range

The background noise at SNL/NM, the 9940 Complex, and Thunder Range is dominated by the noise from civil and military aircraft approaching or departing Albuquerque International Sunport. Major runways are oriented east/west and north/south. Landing and takeoff flight patterns pass directly over SNL/NM, as well as many of the residential areas adjacent to KAFB. The next most significant noise source is motor vehicles. In addition, other sources of noise contribute to the background level such as generators that are occasionally used at the 9940 Complex and Thunder Range. The explosives used at the 9940 Complex and Thunder Range produce sound of short duration, usually of less than 3 seconds per event.

Information compiled for the 1999 SWEIS identifies the range of background noise levels associated with SNL/NM related activities such as generators, vehicles, and non-explosive-type operations is from 50 to 70 dBA.

To provide a point of reference, decibel levels of common components of everyday life and human thresholds are listed in Table 3.4-1.

TABLE 3.4-1 Common Noise, Environments, and the Approximate Associated Sound Levels

Common Noises	Sound Level
Jet engine	140 dBA
Threshold of pain	120-130 dBA
Accelerating motorcycle at a few feet	110 dBA
Loud automobile horn at 10 ft	100 dBA
Noisy urban street	90 dBA
Continuous exposure likely to degrade hearing	85 dBA
Range of speech	50 to 70 dBA
Average office	50 dBA
Human whisper	20 dBA
Threshold of human audibility	0 dBA

Source: DOE 1999

3.5. WATER RESOURCES

3.5.1. Surface Water

No perennial surface water exists at the 9940 Complex and Thunder Range. Surface water occurs primarily during rainstorms as short-lived, unconfined sheet flow that rapidly infiltrates into the soil.

A few dry stream beds, called arroyos, may flow intermittently during rainstorms. During most rainfall events, the runoff infiltrates into the soil on site. During larger storms (10 year or greater), water ponds in low areas west of Thunder Range, where it infiltrates into the soil within one to two days. There is no indication that any runoff ever reaches Arroyo del Coyote or Tijeras Arroyo, even under extreme events.

None of the arroyos at the site can be traced to a major drainage feature, such as Arroyo del Coyote or Tijeras Arroyo. The two most prominent arroyos in the area are unnamed. These two arroyos flow in a generally westerly direction and become indistinct as the terrain flattens near the boundary with TA-III. There are no Waters of the U.S. on Thunder Range, as currently defined by the EPA; however, some of the water features on Thunder Range, under the current definition of Surface Waters of the State, could be classified as Surface Waters of the State.

3.5.2. Groundwater

Groundwater underlying KAFB consists of three distinct hydrogeologic systems: the Albuquerque Basin, Tijeras Fault complex, and foothills and canyons. The primary division is between the east and west sides of the Tijeras Fault complex. The Tijeras fault complex is a transitional zone between two distinct groundwater systems, a regional aquifer with the unconsolidated sediments of the Albuquerque Basin, and a relatively shallow groundwater system within the alluvium and bedrock of the foothills along the eastern fringe of the basin. The water table of the basin aquifer immediately west of TA-III within KAFB is approximately 500 ft below ground surface. The basin aquifer is the primary source of drinking water for the Albuquerque metropolitan area, including KAFB. East of the Tijeras Fault complex, a thin layer of alluvium covers the bedrock. The hydrogeology in this area is not well documented, due to the limited borehole data for subsurface geology, and the general complexity of the geology, as demonstrated by the numerous faults identified in this area. East of the Tijeras Fault complex, the depth to groundwater ranges from about 50 to 300 ft. Many of the monitoring wells in this region are completed in fractured bedrock at relatively shallow levels and produce modest yields of groundwater (SNL 2006).

The project area is within the transitional zone for the two groundwater systems, and overlies the Tijeras Fault complex that runs diagonally from east to west across the central portion of KAFB. Based on the information obtained from monitor wells, the depth to bedrock is approximately 120 ft below ground surface in the northeast portion of the project area near Building 9960. Groundwater in this vicinity is confined with water at approximately 95 ft below ground surface. The effective elevation of groundwater is 5,532 ft above mean sea level, which is 44 ft below ground surface at this location (SNL/NM 2005). A second borehole located one-half mi southeast, near Building 9930, drilled to 430 ft, did not reach bedrock. Depth to water table at this location is 302 ft below ground surface (SNL/NM 2005). Existing wells along the southeast and the south boundary of the project area demonstrate the water table at an elevation of 5,319 ft above mean sea level and 5,330 ft above mean sea level, respectively. The geology of the project area and water table data suggest that groundwater flow in the northern portion of the project area is constrained by the southwest trend of the fault system and has a primary southwest component. In the southern part of the project area, where bedrock is below the depth of the installed wells, the hydrogeologic matrix is alluvial sediments. In this area, the groundwater flow direction is determined by the significant gradient between the water table of the foothills groundwater system and the regional water table in the central portion of the Albuquerque Basin. There is a consequent groundwater flow direction to the west and northwest component induced by the water table drawdown from groundwater production in the northern portion of KAFB, and the adjoining City of Albuquerque well field.

The water quality in the northern portion of the project area is very high in total dissolved solids. Specific conductivity values are typically in excess of 2,500 micromhos per centimeter (μmho/cm [unit of specific conductance]). In the southern part of the project area, specific conductivity values are typically at 1,300 to 1,100 μmho/cm. Calcium and chloride concentration are the primary contributors to the high total dissolved solids values. This is expected in the transition from a bedrock groundwater system to an unconsolidated alluvial groundwater reservoir matrix. Regional aquifer values for specific conductivity are generally in the 400- to 500-μmho/cm range. Groundwater alkalinity values are also significantly higher in the project area, ranging from 1,400 milligrams per liter (mg/L) (as calcium carbonate) in the north to 400 mg/L (as calcium carbonate) in the south. Regional values in the basin aquifer are around

140 mg/L (as calcium carbonate). Arsenic concentrations in the groundwater are in the 60 parts per billion to 70 parts per billion range in the northern bedrock wells whereas levels in the remainder of the project area are generally less than two parts per billion (SNL 2005a). No organic compounds above regulatory limits have been detected in the groundwater in the project area. There are no drinking water supply wells in the project area. The nearest drinking water supply well is approximately 3 mi to the north.

3.6. BIOLOGICAL RESOURCES

3.6.1. Terrestrial Vegetation

The project area can generally be classified as Grassland Vegetation (Dick-Peddie, 1993). The majority of the area is composed of the Grama-Dropseed Series (*Bouteloua eriopoda-Sporobolus contractus*) and the Grama-Galleta Series (*Bouteloua eriopoda-Pleuraphis jamesii*). Both of these Plains-Mesa grassland series types contain black grama grass, which is diagnostic of a climax, or mature, plant community. Other common grasses include sideoats grama (*Bouteloua curtipendula*), mesa dropseed (*Sporobolus flexuosus*), New Mexico needlegrass (*Hesperostipa neomexicana*), bush muhly (*Muhlenbergia porteri*), and ring muhly (*Muhlenbergia torreyi*) (SNL/NM Plant Database 2007).

Shrubby vegetation belonging to the Shrub-Mixed Grass Series of the Desert-Grassland type is present in the project area. Two arroyos dominated by four-wing saltbush (*Atriplex canescens*) cut through the northern portion of the area. Clusters of winterfat (*Krascheninnikovia lanata*) and occasionally snakeweed (*Gutierrezia sarothrae)* are scattered throughout the area. Russian thistle (*Salsola tragus*) is pervasive across most of the proposed site. Appendix A lists vegetation that occurs in the general area of the proposed project (SNL/NM Plant Database 2007).

There are several bare areas with no vegetation. These bare areas are mostly in association with buildings, test pads, bunkers, and roadways within the project area. These and other highly-disturbed areas are shown in Figure 3.6-1.

3.6.2. Terrestrial Wildlife

Wildlife communities on KAFB are typical of those found in central New Mexico (Stephens and Associates 1996). The composition of these communities is dependent on the quality and quantity of available habitat that matches the needs of each wildlife species. A wide diversity of wildlife has been documented in or near the project area, including red-tailed hawks (*Buteo jamaicensis*), burrowing owls (*Athene cunicularia*), and American kestrels (*Falco sparverius*). Other birds common in the area include horned larks (*Eremophila alpestris*), loggerhead shrikes (*Lanius ludovicianus*), and Western meadowlarks (*Sturnella neglecta*) (SNL/NM Wildlife Database 2007).

The little striped whiptail (*Aspidoscelis inornata*), greater short-horned lizard (*Phrynosoma hernandesi*), and side-blotched lizard (*Uta stansburiana*) are common reptiles in the area. Amphibians include Couch’s spadefoot toad (*Scaphiopus couchii*), and the New Mexico spadefoot toad *(Spea multiplicata).* Mammals common to the area are desert cottontail (*Sylvilagus audubonii*), coyote (*Canis latrans*) and Ord’s kangaroo rat (*Dipodomys ordii*). Gunnison's prairie dogs (*Cynomys gunnisoni*) have been observed on the western portion of the project area. A listing of wildlife that has been documented in the general area of the proposed project is provided in Appendix A (SNL/NM Wildlife Database 2007).

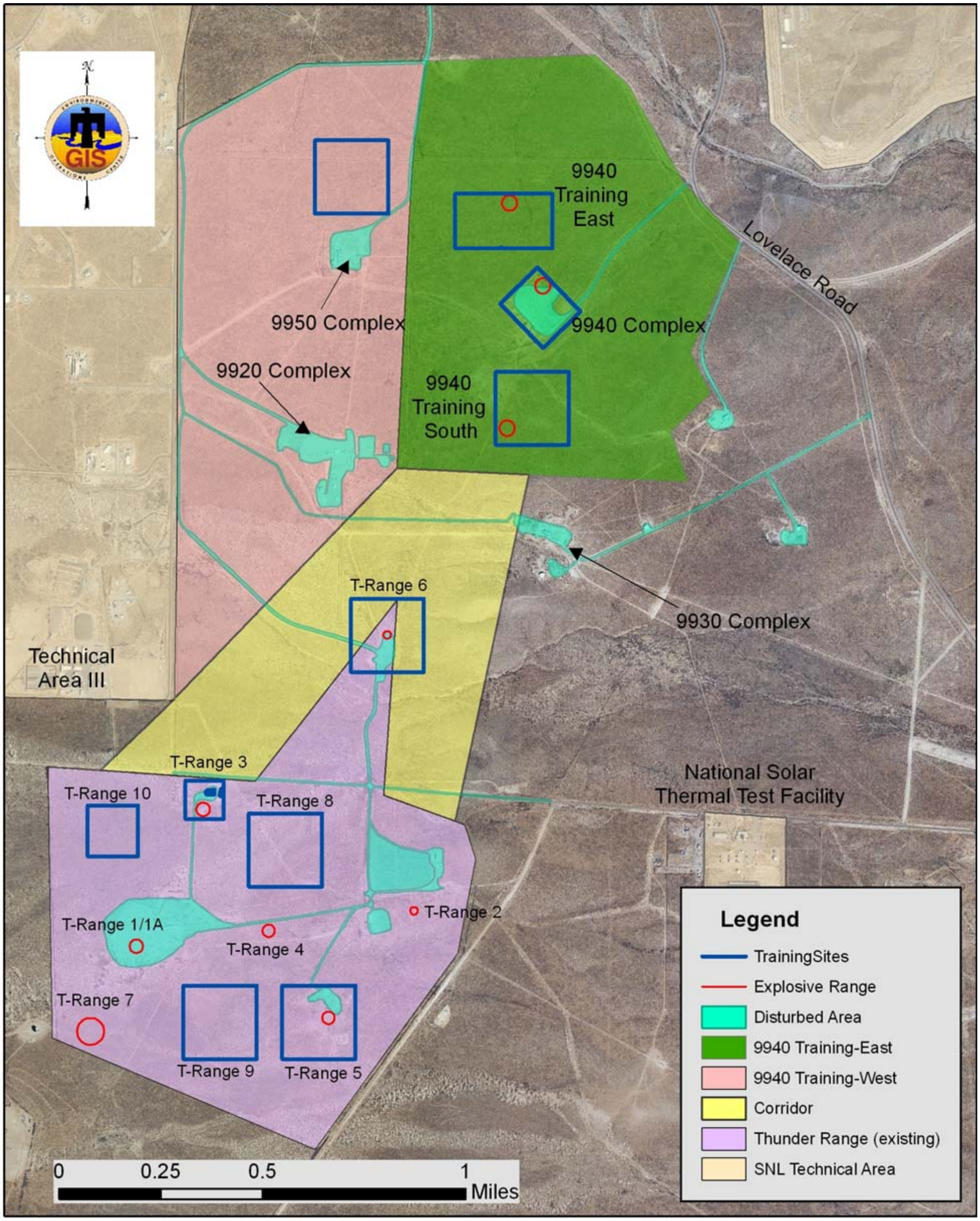


FIGURE 3.6-1 Disturbed Areas within the Project Area

3.6.3. Threatened and Endangered Species

Certain plant and animals species are protected by the Federal government under the *Endangered Species Act* (ESA) or by the State of New Mexico under the Wildlife Conservation Act (WCA) or by the *New Mexico Endangered Plant Species Act*. The United States Fish and Wildlife Service has the responsibility to identify and conserve species protected under the ESA. These species are listed as either threatened or endangered. In addition, the United States Fish and Wildlife Service identifies species that are candidates for listing. The New Mexico Department of Game and Fish (NMDGF) is responsible for species protected by the WCA. The New Mexico Energy, Minerals, and Natural Resources Department maintains listings of state threatened and endangered plants, which are protected under the New Mexico Endangered Plant Species Act.

The categorization of "sensitive" or "species of concern" (SOC) carries no legal requirements or protections. Species designated as sensitive or as species of concern have been identified as species that deserve special consideration in management and planning. These designations are also to alert land managers to the need for caution in management where these taxa may be affected (NMDGF 2006).

Protected and sensitive species that have been documented within the project area or have the potential to occur are listed in Table 3.6-1.

Migrating birds are protected under the *Migratory Bird Treaty Act* (MBTA). The MBTA prohibits the take of migratory birds, their nests, and their eggs. Disturbance, relocation, or removal of an occupied nest (e.g., burrowing owls) would require a permit from the United States Fish and Wildlife Service.

In addition to the ESA, WCA, and the MBTA, all species of horned toads, vultures, hawks, owls, songbirds, and insectivorous birds are protected by the State of New Mexico (NM State Wildlife Policy 1978).

Partners in Flight is a cooperative effort among Federal, State, and local government agencies, and other groups in the western hemisphere to conserve bird populations in a coordinated manner. Partners in Flight has identified priority bird species of concern for New Mexico, predominantly breeding species. Partners in Flight is a wildlife management planning tool, it carries no legal protections. Species that meet these criteria and are found within the project area include the following: black-throated sparrow, pinyon jay, western bluebird, black-chinned sparrow, crissal thrasher, gray vireo, gray flycatcher, dusky flycatcher, and plumbeous vireo. Of these, the black-throated sparrow, pinyon jay, western bluebird, black-chinned sparrow, and crissal thrasher are high responsibility species, where their occurrences in New Mexico are important for the species survival.

3.6.4. Areas of Biological Conservation

As part of the DOE commitment to environmental protection and the Environmental Management System currently in place at SNL/NM, areas that have the potential to support wildlife species that are considered unique or under management consideration by the New Mexico Department of Game and Fish should be conserved. This includes raptor species, horned lizards, and Gunnison's prairie dog.

TABLE 3.6-1 Documented or Potential Sensitive Species within the Project Area

PLANTS			
Common Name	Scientific Name	Federal	State of NM
Santa Fe milkvetch	*Astragalus feensis*	SOC	SOC
ANIMALS			
Birds			
Common Name	Scientific Name	Federal	State of NM
Bald eagle	*Coccyzus americanus occidentalis*	----	Threatened
Peregrine falcon	*Falco peregrinus*	SOC	Threatened
Southwest willow flycatcher	*Empidonax traillii extimus*	Endangered	Endangered
Northern goshawk	*Accipiter gentilis atricapillus*	SOC	Sensitive
Western burrowing owl	*Athene cunicularia hypugaea*	SOC	----
Mountain plover	*Charadrius montanus*	SOC	Sensitive
Loggerhead shrike	*Lanius ludovicianus excubitorides*	----	Sensitive
Baird's sparrow	*Ammodramus bairdii*	SOC	Threatened
Bell's vireo	*Vireo bellii arizonae*	SOC	Threatened
Gray vireo	*Vireo vicinior*	----	Threatened
Mammals			
Common Name	Scientific Name	Federal	State of NM
Pale Townsend's big-eared bat	*Corynorhinus townsendii pallescens*	SOC	Sensitive
Occult little brown myotis bat	*Myotis lucifugus occultus*	----	Sensitive
Big free-tailed bat	*Nyctinomops macrotis*	----	Sensitive
Fringed myotis bat	*Myotis thysanodes thysanodes*	----	Sensitive
Long-legged myotis bat	*Myotis volans interior*	----	Sensitive
Western small-footed myotis bat	*Myotis ciliolabrum melanorhinus*	----	Sensitive
Spotted bat	*Euderma maculatum*	----	Threatened
Gunnison's prairie dog	*Cynomys gunnisoni gunnisoni*	----	Sensitive
Ringtail	*Bassariscus astutus arizonensis*	----	Sensitive
Invertebrates			
Common Name	Scientific Name	Federal	State of NM
Slate millipede	*Comanchelus chihuanus*	SOC	----

Sources: SNL/NM Plant Database 2007, SNL/NM Wildlife Database 2007

3.7. CULTURAL RESOURCES

Cultural resources include archaeological, traditional, and built environmental resources, including districts, sites, buildings, structures, or objects from both the prehistoric and historic eras of human history. Federal, State, and local laws direct the preservation and protection of cultural resources that are historically significant. The primary acts that apply to cultural resources are the following:

- *National Historic Preservation Act of 1966* (NHPA),
- *Archaeological Resources Protection Act* (ARPA),
- *American Indian Religious Freedom Act* (AIRFA), and
- *Native American Graves Protection and Repatriation Act of 1990* (NAGPRA).

The NHPA specifically requires that projects funded by Federal money, that take place on Federal lands, or that require permits issued by Federal agencies, not threaten historic properties. Sections 106 and 110 of NHPA define the process for evaluating properties and the potential impact of undertakings on them.

Resources are surveyed and evaluated for eligibility for the National Register of Historic Places under a set of guidelines provided by the Secretary of the Interior. NHPA further defines options to mitigate or avoid adverse effects on resources that are found eligible for the National Register.

Both prehistoric and historic resources appear within the project area. In the past three decades, SNL/NM and the USAF have conducted occasional pedestrian archaeological surveys in the area, both as large overviews of the site and in support of specific projects. These surveys are used to determine locations of archeological sites, including prehistoric and historic resources. SNL/NM supported project-specific surveys in the project area, including a 1991 survey by Chambers Group, Inc., in support of a road near Building 9920, and a 1995 cultural resources investigation by the Butler Service Group of environmental restoration sites, including the project area (Hoagland 1992, Hoagland 1995). The most recent comprehensive archaeological surveys of the area were completed for the USAF by TRC Mariah Associates, Inc., in 1996, and AMEC Earth and Environmental in 2001 (TRC 1997, AMEC 2002). Additionally, historic building surveys of the original Thunder Range test site and the cluster of properties at the 9940 Complex were completed in 2005 and 2006, respectively.

3.7.1. Archaeological Sites

As listed in Table 3.7-1, there are eleven identified archaeological sites within the boundary of the proposed site, and eight located outside of, but close to the boundary. These indicate that, until very recently in history, the human presence in the area consisted of individuals and groups traversing the relatively open space between the Rio Grande Valley and the Manzano Mountains foothills. There are indications of temporary campsites in the area that date from the Pre-Historic Paleo-Indian period through the early Historic eras. These sites contain evidence of tool use and some subsistence activities consistent with hunting, animal grazing, and movement between settlements and agricultural areas (TRC 1996, AMEC 2002).

The arrival of the Spanish in the 16th century did not immediately alter the use of the area, although settlements in the valley eventually increased the overall population in the vicinity. By the mid-19th century, the U.S. Army had a strong presence in the region, supporting an increase in mining and homesteading. Archaeological sites in and near the project area include evidence of small mining claims that date approximately from the late 19th century. Homesteading, which grew into the early 20th century, is represented in the area, with evidence of corrals and building foundations. The majority of the activity from mining and homesteading was located east of the project area, in the Manzano foothills and canyons, but the rock outcroppings and grasslands in the project area were clearly used (AMEC 2002, Van Citters 2005).

The archaeological surveys—particularly those completed in 2001—were thorough, but it is worth noting that archaeological resources may be buried with little or no indication on the surface of their presence. Evidence at several of the identified archaeological sites indicates subsurface deposits. No excavation has taken place, although pin flag probes were done in at least one case, with a strong likelihood of a subsurface deposit (AMEC 2002).

TABLE 3.7-1 Archaeological Site Eligibility for the National Register of Historic Places within or near the Project Area Boundary

	Site Number	Eligibility
Within Boundary	134238	eligible
	134243	eligible
	134244	not eligible
	134245	not eligible
	134246	eligible
	134249	eligible
	134250	eligible
	134251	eligible
	134252	not eligible
	48096	eligible
	89044	not determined
	Site Number	*Eligibility*
Outside but Near Boundary	134239	eligible
	134241	eligible
	134247	eligible
	134253	eligible
	134254	not eligible
	134255	eligible
	134257	eligible
	134600	not eligible

Sources: TRC 1997, AMEC 2002

3.7.2. Architectural Sites within Project Area

In addition to the prehistoric and historic archaeological sites, there are fifty-eight buildings within the boundary of the project area and seventeen outside, but near it. These are listed in Appendix B, which indicates the status of their eligibility for the National Register. The buildings are used by SNL/NM as explosives test facilities with varying specialties. They are grouped in clusters that include a host or primary control and/or office building, supporting storage and equipment buildings, and test structures. There is significant distance between the clusters, reflecting the requirements for explosives handling and testing.

In 1941, the Federal government began taking land for the U.S. Army, creating a military reservation that eventually became KAFB. During World War II, the affected area was part of the land used for proximity fuze research and testing. Archaeological sites include evidence of the buildings and structures used in the proximity fuze research (AMEC 2002, Van Citters 2003, 2005). The test facilities in the affected area date from the late 1950s and 1960s. Additional buildings and structures have been added over time. The buildings used for testing have been evaluated for National Register eligibility as they face demolition or renovation, in accordance with Section 106 of the NHPA. Of the buildings within the affected area, only those within the 9940 Complex and within the original Thunder Range site have been surveyed.

In 2005, Thunder Range was determined by the DOE/NNSA, in consultation with the New Mexico State Historic Preservation Officer, to be historically significant, but lacking in integrity for its period of significance. The buildings associated with Thunder Range thus were not eligible for the National Register (SHPO 2005a). In 2005, a few buildings in the 9940 Complex were similarly surveyed and determined not eligible for the National Register (SHPO 2005). The remaining test facilities in the affected area have not been surveyed.

3.7.3. Wildland Fire Management for Cultural Resources

Wildland fire management within KAFB and thus within the project area is provided by the KAFB Fire Department. KAFB has developed a draft Wildland Fire Management Plan, but has not implemented it. The KAFB Integrated Natural Resources Management Plan (KAFB 2007) emphasizes coordination between cultural resource and natural resource management, stressing the importance of cultural resource considerations in overall land management.

3.8. WASTE MANAGEMENT

3.8.1. Nonhazardous Waste and Hazardous Waste

Current 9940 Complex Thunder Range operations typically generate nonhazardous and hazardous wastes. Nonhazardous waste consists of materials such as office paper, cardboard, plastic, glass, scrap metal, packaging materials, wood, and test debris. Current operations generate solid waste at a rate of approximately 4,050 cubic ft annually. Solid waste is generated typically from office operations, explosive testing and training. Explosive testing and training typically requires fabricating test structures or venues. These structures are usually destroyed or rendered unusable at the completion of the test or training event (Scharrer 2007).

The 9940 Complex and Thunder Range operations currently generate a total of approximately 110 lb/year (yr) (50 kg/yr) of hazardous waste. Hazardous waste is stored at or near the point of generation, as required by the *Resource Conservation and Recovery Act*, 40 Code of Federal Regulations 262.34, prior to being transported to the Hazardous Waste Management Facility. Typical types of hazardous waste are paint, adhesives, oils, epoxies, solvents and light bulbs (DOE 1999).

3.8.2. Radioactive Waste

Sealed, electroplated radioactive check sources are used for some exercises; however, they are retrieved and stored immediately following each exercise. Thus, no radioactive or mixed waste is currently generated by the 9940 Complex-related activities.

3.8.3. Waste Disposal and Recycling

A significant portion of waste material generated during operations is recycled through the SNL/NM recycling program. Remaining nonhazardous waste is removed and taken to the SNL/NM Solid Waste Transfer Facility where it is sorted, baled, and transported for disposal in local commercial and municipal landfills.

3.9. UTILITIES AND INFRASTRUCTURE

3.9.1. Power

Voltage power lines extend from near the mid-point of the TA-III eastern boundary to Building 9950, then to the 9940 Complex. From the Building 9950 area, there is a spur to Building 9920. A main line from the Building 9940 area extends to the 9965 Complex in Thunder Range, with a branch off to the Building 9930 area, eventually running to the 9936 and 9939 facilities. There is an underground electrical line that runs from the TA-V complex diagonally to a series of bunkers that are southeast of the 9936 and 9939 facilities. From Building 9965 there is a line that extends west to the Shock Tube area.

Gas service is provided by a main gas line that originates near the mid-point of TA-II and runs southeast to the south of the 9920 and 9930 complexes, and continues further to the southeast.

A main communication line originates near the mid-point of TA-III, runs southeast to the 9920 and 9930 complexes, and eventually runs to the National Solar Thermal Test Facility. A spur line extends to the 9950 area. The 9940 Complex communications system operates with laser or microwave service (Alsup 2007).

3.9.2. Potable Water

Water is provided by a loop-shaped main water line that exists in the area. The water line extends northwest from the Lovelace facility to the 9965 area (near proposed T-Range 2), and then north to the 9940 Complex with a main water line running west to the south of the 9920 area, and southeast to the 9930 Complex, where a 700,000-gallon water tower exists. Another main water line runs from the 9940 Complex to northwest to the 9950 Complex and southeast to the 9960 area (Alsup 2007).

3.9.3. Sewer

Sewer service is provided by a main sewer line that is originates near the mid-point of TA-III, branches to serve the 9950 and 9940 complexes, and continues southeast. Near the TA-III boundary, another branch leads southwest and serves the 9920 and 9930 complexes. An additional main sewer line is located near the southeast corner of TA-III, and runs through the existing Thunder Range, serving the 9965 site (T-Range 2), the National Solar Thermal Test Facility, and ends at the Lovelace facility (Alsup 2007).

3.9.4. Roads

The project area is accessed by traveling south on Pennsylvania Avenue from the Tijeras Arroyo (bridge) to the intersection with Lovelace Road. A paved road runs approximately 3 mi south from the Lovelace Road and Pennsylvania Avenue. intersection to Isleta Road. At Isleta Road, one can proceed southwest on a paved road for approximately 2.0 mi and arrive at the 9965 Complex, which is just west of T-Range 2.

The 9940 Complex is accessed by a one-half-mi dirt road connecting to Lovelace Road. T-Ranges 1 through 5 are accessed through existing dirt road networks in the existing Thunder Range area. An additional road connects the west end of the paved Isleta Road (north of 9965 and T-Range 2), extends to T-Range 6, runs along the east side of the TA-III dirt perimeter road, and eventually extends up to Pennsylvania Avenue for a distance of over 2 mi.

The 9940 Expansion West area is near a one-half-mi dirt side road that serves the 9950 Complex. The overall loop distance using existing paved and dirt roads, running along Pennsylvania Avenue, down Lovelace Road, west on Isleta Road, to the dirt road, north on the dirt road by TA-III, and back to Pennsylvania Avenue, is about 8.7 mi. About 5.2 mi are paved, and the remaining 3.5 mi are dirt.

Paved road widths are nominal two-way standard roads, approximately 24 ft. Short, graded dirt roads would be created to allow entrances into Training Site South, Training Site North, ATEF, 9940 Training South, 9940 Training East, and Training West. These roads could be as narrow as 10-ft (Alsup 2007).

4.0 ENVIRONMENTAL CONSEQUENCES

This chapter describes and compares the environmental consequences of the No Action Alternative and the Proposed Action for the expansion of the permitted land and operations at the 9940 Complex and Thunder Range. Descriptions of the No Action Alternative and Proposed Action are provided in Chapter 2 of this environmental assessment, and affected aspects of the environment are discussed in Chapter 3. The following sections compare potential environmental consequences of the two alternatives. Other aspects of the environment were considered in the scoping of the analysis; however, only those potentially affected by the proposed project are discussed in this chapter.

Description of the projected environmental effects of the No Action Alternative is based on information available from the SNL/NM SWEIS. Under the No Action Alternative, operations would continue at the 9940 Complex and Thunder Range as described in the SNL/NM Site-wide Environmental Impact Statement (SWEIS) (DOE 1999), and the Supplement Analysis to the SWEIS (DOE 2006).

Site development of the expanded 9940 Complex and Thunder Range area under the Proposed Action would result in short-term environmental effects. However, these effects would be minimal and confined to relatively small areas for short periods of time.

Operations under the Proposed Action would be an expansion of current operations at the 9940 Complex and Thunder Range, adding new research capabilities and the ability to more effectively provide rapid response energetics testing and specialized training for national security missions of SNL/NM. The following sections describe the environmental consequences of increased operations that could result from implementation of the Proposed Action.

4.1. LAND RESOURCES

4.1.1. No Action

There would be no impact to land resources as a result of the No Action Alternative. Operations would continue at the 9940 Complex and Thunder Range as described in the SNL/NM SWEIS and subsequent NEPA documentation (DOE 1999, 2006).

4.1.2. Proposed Action

Under the Proposed Action, SNL/NM would build new structures, conduct explosive testing operations, and perform energetic systems research training at the 9940 Complex and Thunder Range. From these activities, there would be no additional impacts to existing land resources. Although the potential exists for land to be altered to accommodate new training and explosive sites, all site development and operational activities would be of similar nature to the existing structures and activities in the area.

At locations on the permitted land where operations would be declining or shut down by the Systems Assessment and Research Organization, SNL/NM would continue to hold the site to complete any necessary environmental restoration actions. Before returning land, the Systems Assessment and Research Organization would be responsible for conducting any demolition work and restoring it to its condition when originally permitted to DOE by the USAF (DOE 1999).

4.2. Geology, Topography, and Soils

4.2.1. Geology

4.2.1.1. No Action

There would be no impact to the geology as a result of the No Action Alternative. Operations would continue at the 9940 Complex and Thunder Range as described in the SNL/NM SWEIS and subsequent NEPA documentation (DOE 1999, 2006).

4.2.1.2. Proposed Action

There would be no impact to geology under the Proposed Action. Surface or near-surface detonation of explosives would not cause destruction or alteration of geologic resources. Thunder Range has traditionally been used as an area of explosive testing. Per shot quantities under the Proposed Action would not exceed the maximum quantity of explosives covered in the SNL/NM SWEIS Preferred Alternative (4,000 lb trinitrotoluene [TNT] equivalent per shot).

4.2.2. Topography

4.2.2.1. No Action

There would be no substantial changes to topography under the No Action Alternative. Minor earth-moving operations could be performed on an as-needed basis for individual tests or other operations. These operations at the 9940 Complex and Thunder Range are covered under the SNL/NM SWEIS and subsequent NEPA documentation (DOE 1999, 2006).

4.2.2.2. Proposed Action

Under the Proposed Action, grading could take place at any of the designated training areas or explosive testing areas. Grading would be cut and fill, minimizing any transport of material to or from the site. Berms, pits, or trenches may be constructed on a temporary or permanent basis. None of these activities would cause a significant impact to the topography of the area.

4.2.3. Soils

4.2.3.1. No Action

There would be no substantial changes to soil under the No Action Alternative. Minor soil disturbance could result from earth-moving operations performed on an as-needed basis for individual tests or other operations. These operations at the 9940 Complex and Thunder Range are covered under the SNL/NM SWEIS and subsequent NEPA documentation (DOE 1999, 2006).

4.2.3.2. Proposed Action

Under the Proposed Action, grading could take place at any of the designated training areas or explosive testing areas. Grading would be cut and fill, minimizing any transport of material to or from the site. Berms, pits, or trenches may be constructed on a temporary or permanent basis. Soils are deep in this area, and none of these activities would cause a significant impact to soil profiles.

Soils moved at ER sites would only be moved within the boundaries of the ER site to avoid the potential for contamination of other areas. If sufficient soil is not available onsite, clean soil would be brought in from onsite or offsite areas.

4.3. AIR QUALITY

4.3.1. No Action

There would be no increased impact to air quality as a result of the No Action Alternative. Operations would continue at the 9940 Complex and Thunder Range as described in the SNL/NM SWEIS and subsequent NEPA documentation, with no increase in explosive detonations, travel on dirt roads, or construction activities. Current operations have minimal emissions from these activities and no significant impacts to air quality.

4.3.2. Proposed Action

Air emissions under the Proposed Action would result from both site development and operations. Site development emissions would come from construction-type activities, such as the operation equipment and earth moving during site preparation. Operations emissions would come from transportation activities associated with moving the explosives along dirt roads and the detonation or deflagration of explosives. Criteria and hazardous air pollutant emissions are expected from the detonation of explosives, and particulate emissions are expected from the vehicle traffic on unpaved roads. Appendix C includes the methodologies and calculations that support this section.

4.3.2.1. Site Development

During construction, temporary and localized increases in atmospheric concentrations of nitrogen dioxide, carbon monoxide, sulfur dioxide, volatile organic compounds, and particulate matter would result from exhaust emissions of workers' vehicles, heavy construction vehicles, and other machinery, equipment, and tools. Air quality impacts would result from airborne particulates (fugitive dust) arising from earthwork during site preparation and construction. Dust suppression techniques, such as spraying water to reduce fugitive dust emissions, would be used as required by SNL Facilities Engineering, and additional measures, such as silt fences, would be used where required. In addition, land clearing, filling, grading, earth-moving, or excavation activities would cease during periods of high winds to prevent excessive amounts of fugitive dust. Disturbance of areas greater than three-quarters of an acre would require a 20 NMAC 11–20 soil disturbance permit that requires application of specific dust suppression methods.

The impacts from the short-term and local air emissions would not exceed the NAAQS or the New Mexico Air Quality Standards (NMAQS). Site development impacts on air quality would be minimal beyond the development location and insignificant at off-site locations.

4.3.2.2. Operations

The two main types of activities that have the potential to create local air contaminants from site operations are vehicle transportation on dirt roads and explosives testing. These activities each create different types of air pollutants or constituents and would have different spatial extents and locations of potential impacts.

Transportation Activity Impacts

Particulate emissions from dirt roads (such as particulate matter of diameter equal to or less than 10 microns [PM_{10}]) were estimated using the standard equation from EPA AP-42 *Chapter 13.2.2 Unpaved Roads* (EPA 1995) for light-duty vehicles traveling dirt roads (see Section 1 of Appendix C for details). The calculated emission factor is 0.235 pounds (lb) of PM_{10} per average vehicle mile traveled.

A 50-percent surface-treatment control was assumed when calculating the emission factor, because current practices include road dust control. Current practices at the 9940 Complex include the use of chemical polymer stabilization on the roadways to reduce the amount of fugitive dust. The use of this substance, or equivalent, would be required for all new roads under the Proposed Action.

Air Quality Compliance Verification

To verify compliance with air quality standards, an emission rate was calculated and run through an EPA screening model (SCREEN). The emission rate for particulate matter was calculated using New Mexico Environmental Department modeling guidelines (NMED 2007). The current vehicle usage at the existing facilities was doubled to account for potential growth at the 9940 Complex and Thunder Range. The estimated emission rate of PM_{10} from the unpaved roadways at the 9940 Complex and Thunder Range is 0.091 grams/second.

The model was run to determine the potential maximum concentration of PM_{10} in micrograms per cubic meter at the nearest KAFB boundary. Table 4.3-1 lists the modeling results along with the significance levels and the NAAQS for PM_{10}. The concentration modeled using SCREEN indicated that transportation activities at the project area would not exceed air quality standards significance levels. The results also indicate that no detailed dispersion modeling is required.

TABLE 4.3-1 Potential PM_{10} Impacts from Transportation Activities

Maximum 1-hour Concentration (at nearest boundary)	26	µg/m^3
Maximum 24-hour Concentration	3.9	µg/m^3
Maximum Annual Concentration	0.78	µg/m^3
NAAQS PM_{10}		
24-hour	150	µg/m^3
PM_{10} Significance Levels		
24-Hour	5	µg/m^3
Annual	1	µg/m^3

Source: NMED 2007
µg/m^3 = micrograms per cubic meter

Potential On-Site Near-Field Impacts

Road dust would mainly be a short-term and local impact on air quality. The maximum potential emissions may be produced by vehicles traveling 6,100 cumulative miles on dirt roads, producing approximately 1,435 lb of particulate matter for the entire year, that would generally be suspended for a short time (i.e., minutes) before settling to the ground.

Explosive Detonation Air Quality Impacts

The detonation or testing activities of the Proposed Action would create emissions based on the composition of the explosive material, and the location or placement of the material (e.g., ground surface, doorway), and the test object, if applicable. In terms of mass, most of the emissions would be from combustion of the energetic material as part of the detonation. Energetic compounds are composed mainly of carbon, hydrogen, nitrogen, and oxygen. In general, the primary air emissions are products of combustion that typically include the following:

- Carbon monoxide
- Carbon dioxide
- Nitrogen and nitrogen oxides
- Water
- Sulfur dioxide

- Methane
- Particulate matter

Secondary air emissions include various products of incomplete combustion that may include the energetic material, organic byproducts, metals, cyanides, and sulfides (EPA 2002). There is also a potential for the release of very small quantities of dioxins and furans, and hydrogen chloride gas if chlorinated energetics are used. Many of the common explosive materials that would be used under the Proposed Action do not include chlorides. When the material is placed on the ground, particulate matter from the soil can be lofted and suspended into the plume, and residue of the material may be left on the ground in vicinity of the detonation area or crater. Particulate matter suspended from the soil by the blast is not included in this analysis. The potential for suspended particulate matter, or “soil ejecta”, from explosive detonations is a function of the soil structure, recent weather, the mitigation measures used, and the test surface configuration. Most of the soil ejecta from detonation craters fall within 3 to 5 crater radii of the detonation location (EPA 2002).

Plume Constituent Air Dispersion Modeling

Emissions from explosive detonations were calculated for all proposed maximum explosive quantities listed in Table 2.2-2. Emissions from smaller quantities of explosives were also calculated because approximately 98 percent of the activities under the Proposed Action would use quantities near or below 50 lb. Results of the modeled quantities are included in Appendix C.

The calculations were provided by the U.S. EPA-approved air dispersion model Open Burn/Open Detonation Model (OBODM). Using the three explosives supported by the OBODM (TNT, cyclotrimethylenetrinitramine [RDX], and Composite B), emission factors for criteria pollutants and pertinent hazardous air pollutants (HAPs) chemicals were identified for each explosive and are listed in Table 4.3-2. Emission factors are factors that can be multiplied by any quantity of the specific explosive to calculate the potential quantity of pollutant. The highest emission factor found for the above explosives was used to estimate impacts. The OBODM was used to calculate peak concentrations, time-averaged concentrations, and particulate deposition. The HAPs were evaluated according to the NMED protocol identified in air permitting regulation 20 NMAC 2.72 to screen for significant levels. See Section 2 of Appendix C for details on HAP screening methodology, and Section 3 for OBODM parameters and results.

TABLE 4.3-2 Potential Contaminants and Emission Factors for Explosive Detonations

Pollutant	TNT [a]	RDX [a]	Comp B [a]	Criteria	HAP
1,3 butadiene	0.0000017	---	---	---	Yes
Barium	0.0082	---	---	---	Yes
Benzene	0.0000041	0.000069		---	Yes
Carbon monoxide	0.01	0.031		Yes	---
Cadmium	0.00004	---	---	---	Yes
Carbon tetrachloride	---	---	0.00000036	---	Yes
Chromium	0.000023	---	---	---	Yes
Copper	0.0005	---	---	---	Yes
Ethylbenzene	0.00000047	---	0.000002	---	Yes
Lead	0.000009	---	---	---	Yes
Nitric oxide	0.0097	0.0009	0.0093	Yes	---
Nitrogen dioxide	0.00076	0.0006	0.00019	Yes	---
Methylene chloride	0.00018	---	0.00014	---	Yes
PM_{10}	0.093	---	0.012	Yes	---
Sulfur dioxide	0.00014	---	0.00013	Yes	---
Styrene	0.0000015	---	---	---	Yes
Tetrachloroethylene	---	---	0.000018	---	Yes
Toluene	0.0000051	---	0.000006	---	Yes
n-Hexane	0.00000093	---	0.00000055	---	Yes

Source: Original
[a] Yellow highlights indicate the emission factors used in the analyses.

Air Quality Compliance Verification

A 2,000-lb TNT equivalent explosive test was used to determine compliance with air quality standards or criteria established in the NMED modeling guidelines (NMED 2007). T-Range 7 is the closest range to the KAFB boundary. The model results for all constituents of concern are listed in Table 4.3-3. Constituents of concern include compounds that failed the screening criteria as identified in Appendix C, or are listed as criteria pollutant gases. The criteria pollutant results for 1-hour concentrations were converted to 3-hour, 24-hour, and annual ambient air concentrations by multiplying by the appropriate conversion factor. Occupational Exposure Level (OEL) concentrations are divided by 100 and are used for constituents that do not have EPA significance levels. OELs are generally for 8-hour concentrations. The OEL/100 concentrations are compared to modeled air concentrations to assure potential air concentrations do not pose an inhalation hazard as prescribed in the NMED modeling guidelines. The OEL/100 concentrations listed in Table 4.3-3 are for an 8-hour exposure, while the modeled concentrations are 1-hour concentrations. An 8-hour conversion was not included in the guidelines, so the comparison is conservative since an 8-hour concentration at the boundary would be significantly less than the 1-hour concentration. The maximum concentrations listed in Table 4.3-3 indicate that emissions from a large scale test do not violate air quality standards or significance levels. The results also indicate that no additional dispersion modeling is required for air quality compliance.

TABLE 4.3-3 Concentrations of Constituents of Concern from a 2,000-lb Explosive Detonation

Constituent of Concern	Averaging Period	Maximum Concentration Modeled to KAFB boundary ($\mu g/m^3$)	Significance Level or OEL/100 Concentration [a] ($\mu g/m^3$)	Concentration Below Significance Level?
Carbon Monoxide	1-hour	5.3	2,000	Yes
Cadmium	1-hour	0.00187	0.1*	Yes
Barium	1-hour	4.75	5.0*	Yes
Nitrogen Oxides	annual	0.7	1.0	Yes
	24-hour	3.5	5.0	Yes
PM_{10}	annual	0.67	1.0	Yes
	24-hour	3.33	5.0	Yes
Sulfur Dioxide	annual	0.0009	1.0	Yes
	24-hour	0.0045	5.0	Yes
	3-hour	0.0212	25.0	Yes

Source: Original

Potential Accumulation of Air Impacts

Evaluating the impacts to the ambient air quality based on the NMED/EPA air quality standards was the initial evaluation of the air impact assessment for the Proposed Action. Repeated small-scale testing may produce lower emission quantities for thousands of tests that may accumulate into minimal impacts over time. This accumulation would not be found in the air, due to plume dispersion and gravitational settling of particulate matter. Plume constituents would be deposited over time and accumulate in the soil. The actual transport and deposition of plume constituents would take multiple trajectories over time based on atmospheric conditions, wind speed, wind direction, and the particle mass. Table 4.3-4 lists deposition results from the OBODM of various explosive quantities below the maximum 2,000-lb limit. PM_{10} was assumed to consist of 50 percent carbon black, 25 percent lead, and 25 percent aluminum oxide. While aluminum oxide is generally used in propellants and not explosives, it can also serve as a surrogate for the lighter metals that may be associated with test objects.

Potential Near-Field Impact from Small Quantity Blasts

To identify potential near field impacts from cumulative deposition, tests using up to 50 lb of explosives were modeled because this quantity represents approximately 98 percent of the potential tests in the Proposed Action. Information listed in Table 4.3-4 identifies maximum deposition of particulate matter from tests up to 50 lb would extend approximately 300 meters from the test location. The maximum deposition of cadmium, with larger particle sizes and material density, extends to approximately 150 meters. Deposition would occur beyond these downwind locations; however, potential concentrations would diminish rapidly with distance. Cumulative deposition is estimated using the results in Table 4.3-4, assuming constant wind and particulate parameters, and the maximum proposed number of shots in Table 2.2-3.

TABLE 4.3-4 Maximum Concentrations and Distance of Particulate Matter and Cadmium Deposition Produced by Gravitational Settling for Various Explosive Quantities

Constituent	2,000-lb Detonation		500-lb Detonation		100-lb Detonation	
	μg/m²	Distance from detonation (m)	μg/m²	Distance from detonation (m)	μg/m²	Distance from detonation (m)
PM_{10}	NA	NA	1,181	500	NA	NA
Cadmium	379.06	1,600	189.9	300	85.633	200
Constituent	50-lb Detonation		20-lb Detonation		5-lb Detonation	
	μg/m²	Distance from detonation (m)	μg/m²	Distance from detonation (m)	μg/m²	Distance from detonation (m)
PM_{10}	371.5	300	233.8	250	79.5	150
Cadmium	78.8	150	50.5	100	39.3	50

Source: Original
NA = not analyzed

Although Thunder Range includes 10 explosive testing areas, the calculations for cumulative deposition assume that all the tests on the range occur at one location to evaluate potential maximum impacts. Cadmium is used to estimate cumulative deposition of solid pollutants, because cadmium has the most restrictive soil-screening threshold (NMED 2006). The maximum annual cumulative deposition from 1,450 explosive tests up to 50 lb at one location is approximately 60 milligrams/square meter (Appendix C, Section 4).

The Industrial/Occupational Soil Screening level for cadmium is 564 mg/kilogram (kg). Assuming the metals would stay in the soil, it would take approximately 700 years of tests for the in-situ cadmium to accumulate to soil screening thresholds using current laboratory quantitative limits and soil sampling methodologies (Appendix C, Section 4). Upon termination of the land use permit, soil cleanup would take place in accordance with standards applicable at that time.

Potential Impacts from Large-Quantity Blasts

Larger-quantity blasts are tests of greater than 50 to 2,000 lb under the Proposed Action. Table 4.3-4 identifies that particulate matter, including cadmium, may be deposited approximately twice as far with larger detonations than with detonations of 50 lb. To estimate maximum impacts from the larger-quantity blasts, 15 2,000-lb blasts, 10 500-lb blasts, and 20 100-lb blasts were used. The annual cumulative deposition of cadmium from these blasts is 9.30 milligrams/square meter, with the maximum deposition of cadmium extending from approximately 200 to 1,600 meters. Deposition of heavy metals from the larger blasts would have less impact on soil concentrations than the more numerous smaller blasts.

In addition to the pollutants emitted from explosive detonations, explosive residue may be found in the soil in close proximity to the specific test location. Open detonation field tests conducted at Dugway Proving Ground, Utah, indicated that 97 to 98 percent of the measured residue constituents in soil occurred within the crater (EPA 2002). Procedures that would be used under the Proposed Action include the cleanup of all visible debris at the test location. This clean-up would be crucial in minimizing potential soil contamination from explosive blasts.

4.4. NOISE

4.4.1. No Action

There would be no noise impacts as a result of the No Action Alternative. Operations would continue at the 9940 Complex and Thunder Range as described in the SNL/NM SWEIS and subsequent NEPA documentation. There would be no increase in explosive detonations or increase in temporary construction and site development activities. There would be no additional noise or vibration impacts over existing operations.

4.4.2. Proposed Action

Noise and vibrations under the Proposed Action would result from two main aspects of site activities: site development activities, including temporary operation of equipment, transportation activities, and construction associated with site development; and operations activities, including noise and vibrations from the actual explosive testing and operations. This section describes the potential noise and vibration impacts from the site development activities for increased operations and from the proposed explosive detonations. See Appendix D for details concerning the methodology, calculations, and impact tables used in this section.

4.4.3. Site Development

There would be short-term and local noise and vibration impacts from construction activities, portable generators, and transportation activities. These impacts would be minor and are considered normal for construction-type operations. Typical construction equipment and noise levels associated with the equipment are listed in Table 4.4-1.

TABLE 4.4-1 Typical Construction Equipment Noise Levels

Equipment	Noise Level at 15 meters (dBA, Leq [a])
Backhoe	80
Shovel	82
Bulldozer	85
Scraper	89
Truck	88
Paver	89
Pump	76
Generator	81
Compressor	81
Jack hammer	88
Pile driver	101

Source: EPA 1971

[a] Leq is continuous equivalent noise level

Noise from these localized sources would decrease by 6 decibels dBA with each doubling of distance from the source to a potential receptor (NPC 2007). An estimated noise level for vehicle traffic is generally considered less than 80 decibels, which gives an impact zone of approximately 12 meters.

The near-field on-site impacts are considered occupational exposures. Occupational exposures would be mitigated through compliance with 10 CFR 851 in which SNL/NM complies with OSHA standards and American Conference of Industrial Hygienists guidelines, as identified in the SNL Environment, Safety and Health Manual.

Using the typical reduction in noise levels over distance, there would be no off-site noise or vibration impacts under the Proposed Action for site development of any location in the project area.

4.4.3.1. Operations

Noise and vibration are generated from the overpressure produced by explosive detonations. The noises produced by explosive detonations are impulse noises, generally lasting less than 1 or 2 seconds. Infrequent impulse noises, when averaged into the day-night average sound (DNL) as identified in Section 3.4.1, Definitions, would be lost in the average, as they represent a few seconds in the day. Potential on-site and off-site impacts are identified by impulse noise limits and peak overpressures. It should be noted that air traffic from the Albuquerque International Sunport has a longer time duration and greater frequency of occurrence, and would influence the DNL at off-site locations more than the occasional impulse noise from explosive detonations under the Proposed Action.

The sound pressure level (SPL) incident to a location is a function of the amount of explosive used in the blast and the distance to the location of interest. Tables 4.4-2 and 4.4-3 list the peak overpressures considered for potential impacts and the quantity of explosives used in this impact assessment. Refer to Table 2.2-3 for the number of explosive events under the Proposed Action. Table 4.4-4 lists the calculated impact radii for potential and maximum explosive quantities and specific overpressures. The results in Table 4.4-4 are calculated assuming no mitigation and an unknown state of the atmosphere. Table 4.4-4 is referred to when identifying impacts for specific locations. It should be noted that the impulse noise limit criteria of 140 decibels is an OSHA limit that no worker should be exposed to without hearing protection.

TABLE 4.4-2 Peak Overpressure and Sound Pressure Level Thresholds Considered for Potential Impacts

Damage or Threshold Criteria	Peak Overpressure		SPL
	psi	kPa	dB
Impulse noise limit (140 decibels)	0.029	0.20	140
Cracked window (1 in 10,000)	0.029	0.20	140
Broken window	0.10	0.70	151
Light aircraft damage (in-flight)	0.20	1.40	156
Structural damage (building)	1.0	6.90	170
Small mammal injury (open)	2.0	13.8	177
Human eardrum rupture	3.0	20.7	180
Bird in flight injury	5.0	34.5	185
Burrowed small mammal injury	6.5	45.0	187
Lethal to small mammals (open)	8.0	55.2	189

Source: DOE 2007
psi = lb per square inch
kPa = kilopascal
SPL = sound pressure level
dB = decibels

TABLE 4.4-3 Quantities of Explosives Considered in Impact Analysis

Explosive Quantity	
lb	kg
1	0.5
5	2.3
10	4.5
20	9.1
50	22.7
100	45.4
350	158.8
500	226.8
1,100	499.0
2,000	907.2

Source: Original
kg = kilogram
lb = pound

TABLE 4.4-4 Matrix of Calculated Radii (in meters) for All Overpressures and Explosive Quantities

Explosive Quantity (lb)	Peak Overpressure (kPa) [a]								
	0.2	0.7	1.4	6.9	13.8	20.7	34.5	45	55.2
1	208	67	36	8	4	3	2	2	1
5	356	114	61	14	8	5	3	3	2
10	449	144	77	18	10	7	4	3	3
20	566	181	96	23	12	8	5	4	3
50	768	246	131	31	16	11	7	6	5
100	967	310	165	39	21	14	9	7	6
350	1,469	470	250	59	31	22	14	11	9
500	1,654	530	282	66	35	24	15	12	10
1,100	2,151	689	367	86	46	32	20	16	13
2,000	2,626	841	448	105	56	39	24	19	16

Source: Original
kPa = kilopascal
lb = pound
[a] Table 4.4-2 lists the type of potential damage or threshold for the identified overpressure.

Meteorology may have a profound effect on the SPL or overpressure exposure under nonstandard or nongradient atmospheric conditions. Temperature inversions may act to enhance the distance over which sound waves travel, and the prevailing wind direction and wind speed affect the magnitude of sound that reaches a specific location. The variation of temperature and wind velocity gradient can work collectively or independently to cause sound waves to converge to produce noise levels at specific locations that are greater than would otherwise be predicted by the scaled distance relationship, a phenomenon known as sound focusing. To account for potential focusing which could amplify the impacts, a factor of two may be applied to the distances for the specific overpressure of interest (ANSI 1983). It should be noted that under extremely rare focusing events that would include night-time operations, impacts may be underestimated by a factor of three. The atmosphere may also act to reduce the SPLs and overpressures at certain locations.

To characterize ground vibrations that may be produced by the blasts, the threshold for structural damage is used. The safe distance for a ground particle velocity of less than 2.0 inches/second, below which no structural building damage is noted, can be computed based on the square of the explosive yield (Nicholls 1971). Table 4.4-5 lists the radii beyond which no structural damage should occur for given quantities of explosives.

TABLE 4.4-5 Vibration Radius for Each Proposed Explosive Test Limit (TNT Equivalent)

Per Shot Limit (lb)	Radius (meters)
5	34
50	108
100	152
130	174
350	285
1,100	506
2,000	682

Source: Original
lb = pound

9940 Expansion–East Impacts

There are three locations where training activities or explosive tests operations are proposed. All three locations have a maximum proposed limit of 50 lb of explosives as listed in Table 2.2-2 (Section 2.2.2, Operations). The maximum limit is based on safety requirements, with most activities at these locations using much less than 50 lb of explosives (listed in Table 2.2-3).

Impact radii from explosive activities are listed in Table 4.4-4. Impacts for explosive tests with TNT equivalent weights of 30 lb or less at the 9940 Complex, 10 lb or less at 9940 Training South, and 25 lb or less at 9940 Training East, would generally not have the potential to affect non-involved personnel. Figure 4.4-1 shows the potential impact area (140-decibel OSHA impulse noise limit) for these tests under a standard atmosphere. For tests above these thresholds, noise impacts have the potential to extend to non-involved personnel, with the maximum impulse noise threshold extending into the 9950 or 9930 complexes, and/or Lovelace Road, depending on the test location and the atmospheric conditions that would be present the day of the test. If a focusing atmosphere were present, the noise limit threshold could extend to 1.5 kilometers, requiring additional coordination with potentially impacted on-site facilities, including the southern tip of Manzano Base. The window breakage does not extend to non-involved receptor locations under most atmospheric conditions, but may extend to the borders of the 9930 and 9950 complexes under a focusing atmosphere.

Mitigations would be required for tests exceeding TNT-equivalent weights of 30 lb at the 9940 Complex, 10 lb at 9940 Training South, and 25 lb at 9940 Training East. These mitigations are described in Section 2.2.2, Operations. The ground vibration radius extends to 108 meters for a 50-lb test, indicating there are no concerns for structural damage for nearby facilities and off-site locations for tests of 50 lb or less.

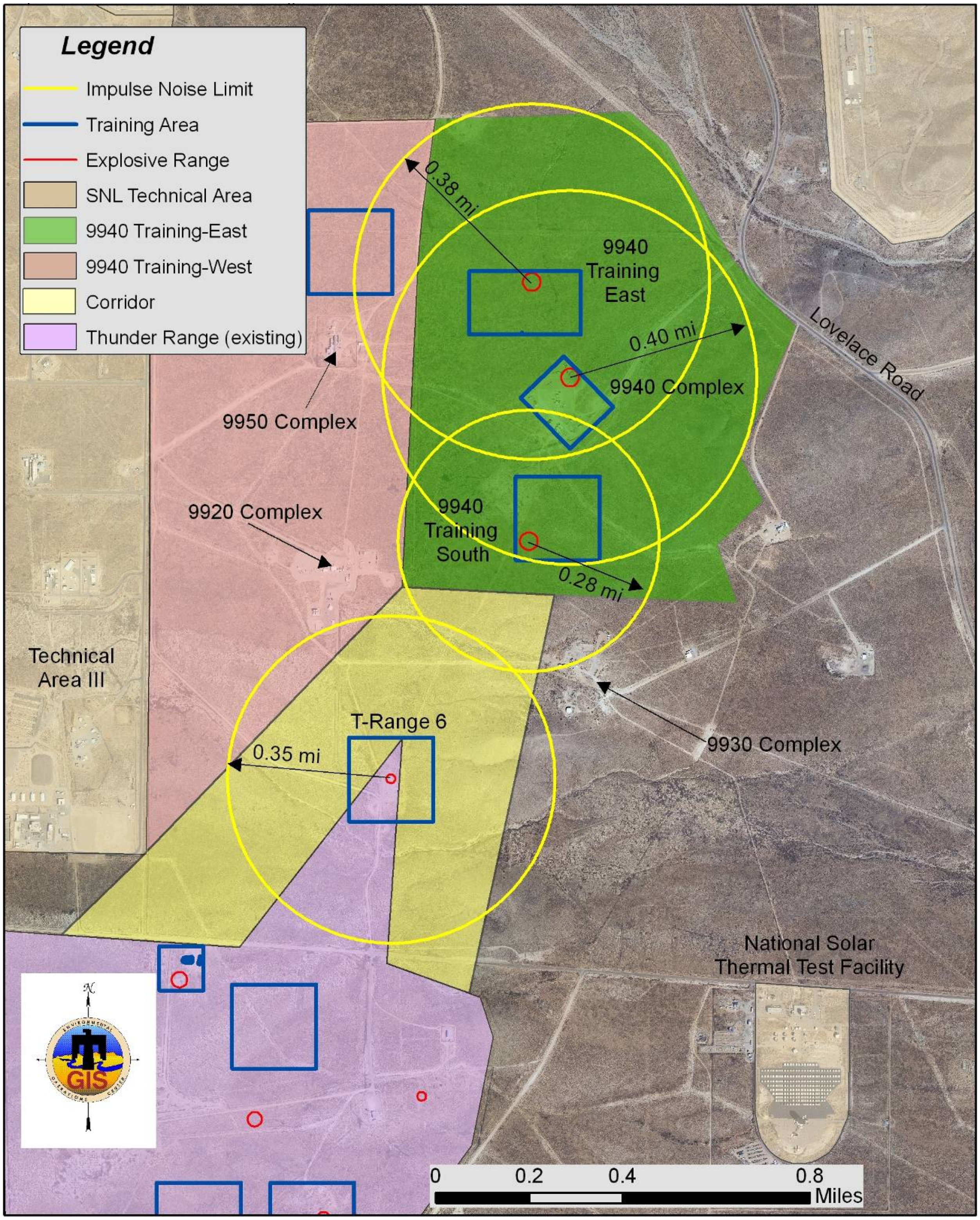


FIGURE 4.4-1 Impulse Noise Limits for Maximum Unmitigated Explosive Quantities at 9940 Areas and T-Range 6, and Relationship to Nearby Receptors

Thunder Range Impacts

There are multiple locations at Thunder Range where explosive tests or operations are proposed. The locations and test range numbers are shown in Figure 2.2-2. The maximum explosive limit for each area varies, though most activities would use much less than 50 lb of explosives during operations as listed in Table 2.2-3. Impact radii from explosive activities are listed in Table 4.4-4. Areas of potential impulse noise impact (exceeding 140-decibel OSHA impulse noise limit) for maximum unmitigated explosive quantities are shown in Figures 4.4-1 through 4.4-4, based on limits listed in Table 2.2-5. Tests above these limits would be subject to mitigations described in Section 2.2.2, Operations.

Potential On-Site Near-Field Impacts

In general, explosive tests using 50 lb or less TNT equivalent would not impact non-involved receptors. The exceptions to this are tests at T-Ranges 3, 6, 8 (Training Site North), and 10 (ATEF).

T-Ranges 3, 8, and 10 are in the vicinity of TA-III, particularly the Radioactive and Mixed Waste Management Facility (RMWMF) located in the southeast corner of TA-III. T-Range 3 has a maximum limit of 5 lb, and, while close to the RMWMF facility, would have minimal potential to generate SPLs above 140 decibels, even with a focusing atmosphere present. T-Ranges 8 and10 have a greater potential to impact the RMWMF and outdoor personnel due to the 50-lb maximum quantities proposed. Even with a standard atmosphere, a 50-lb unmitigated explosion may produce SPLs that exceed the impulse noise limit. Unmitigated noise threshold impacts from a 25-lb test at T-Range 8 or a 10-lb test at T-Range 10 would generally not extend into TA-III.

T-Range 6 is in the vicinity of both the 9920 and 9930 complexes and has the potential to impact non-involved personnel with tests of greater than 20-lb TNT equivalent; these tests would be subject to mitigations described in Section 2.2.2, Operations.

T-Ranges 2, 5, and 9 (Training Site South), with 50-lb limits, do not impact nearby facilities with operations under a standard atmosphere. With atmospheric focusing, SPLs at the noise impulse limit may extend into the area where outdoor personnel are working at the National Solar Thermal Test Facility. To minimize potential impacts to outdoor personnel and identify the potential for atmospheric sound focusing, explosive tests of greater than 20-lb TNT equivalent would be contingent on go/no-go criteria related to wind, temperature, time of day, and cloud cover, as described in Section 2.2.2, Operations.

Larger-Quantity Blasts

The test ranges with the greatest potential to produce on-site impacts requiring additional coordination and control are T-Ranges 1A and 7, with proposed quantities of 1,100 and 2,000 lb per test, respectively. Under unmitigated test situations, outdoor personnel at TA-III could be exposed to SPLs that exceed the impulse noise limit at quantities greater than 350 lb. Note that even for large quantity tests, the radius for potential impacts to small mammals (non-human) using Tables 4.4-2 and 4.4-4 is less than 60 meters for a 2,000-lb test. For the 97 percent of the tests that involve 50 lb or less of explosives, small mammal impacts extend from the test location to a maximum of 16 meters. A sound and blast propagation model would be used for all tests over 100 lb to identify the potential for focusing and control the operations as described in Section 2.2.2, Operations.

The ground vibration radius extends to 682 meters for a 2,000-lb test, indicating there are no concerns for structural damage from ground vibrations for nearby facilities and off-site locations for tests at T-Ranges 1A and 7.

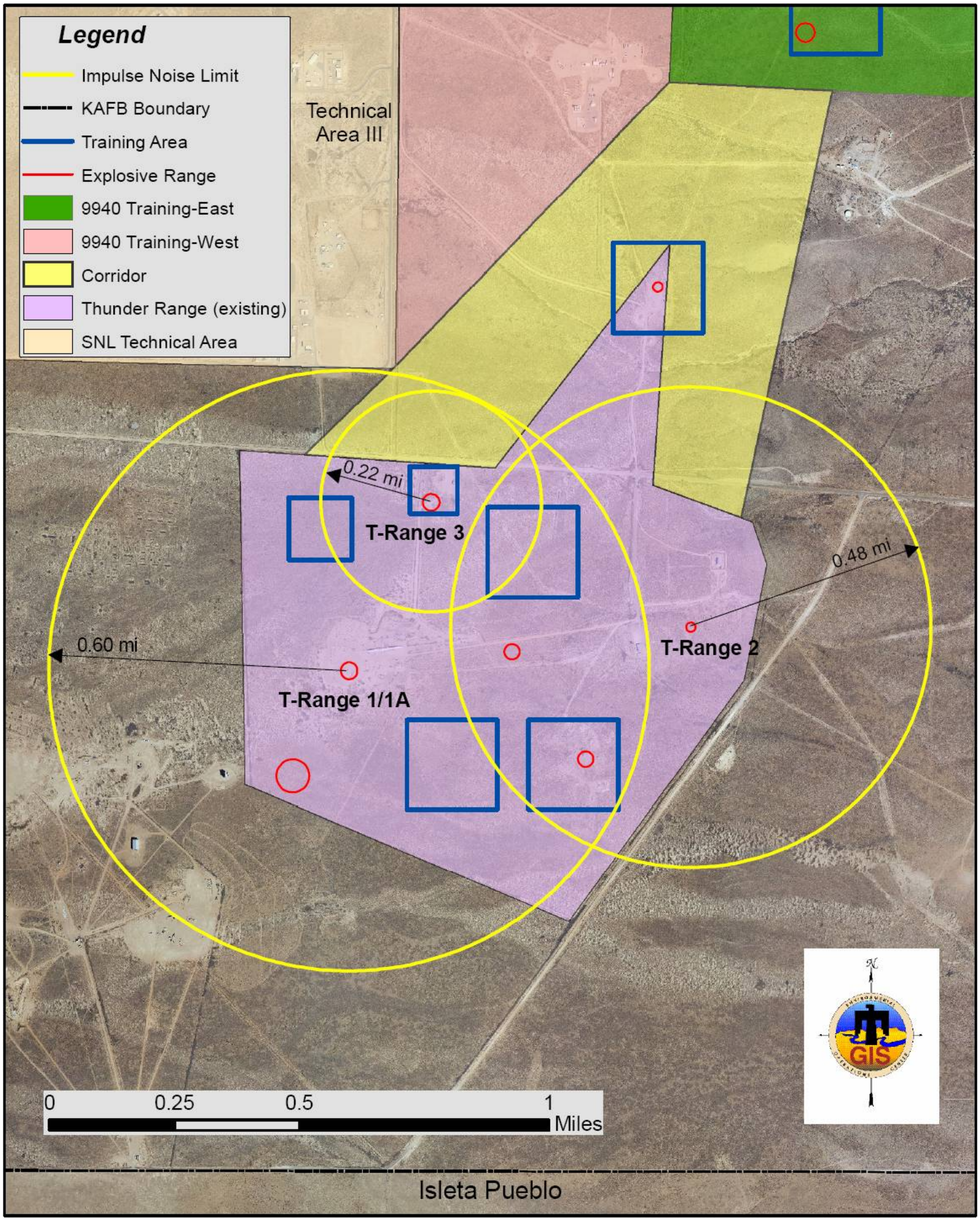


FIGURE 4.4-2 Impulse Noise Limits for Maximum Unmitigated Explosive Quantities at T-Ranges 1/1A, 2, and 3, and Relationship to Nearby Receptors

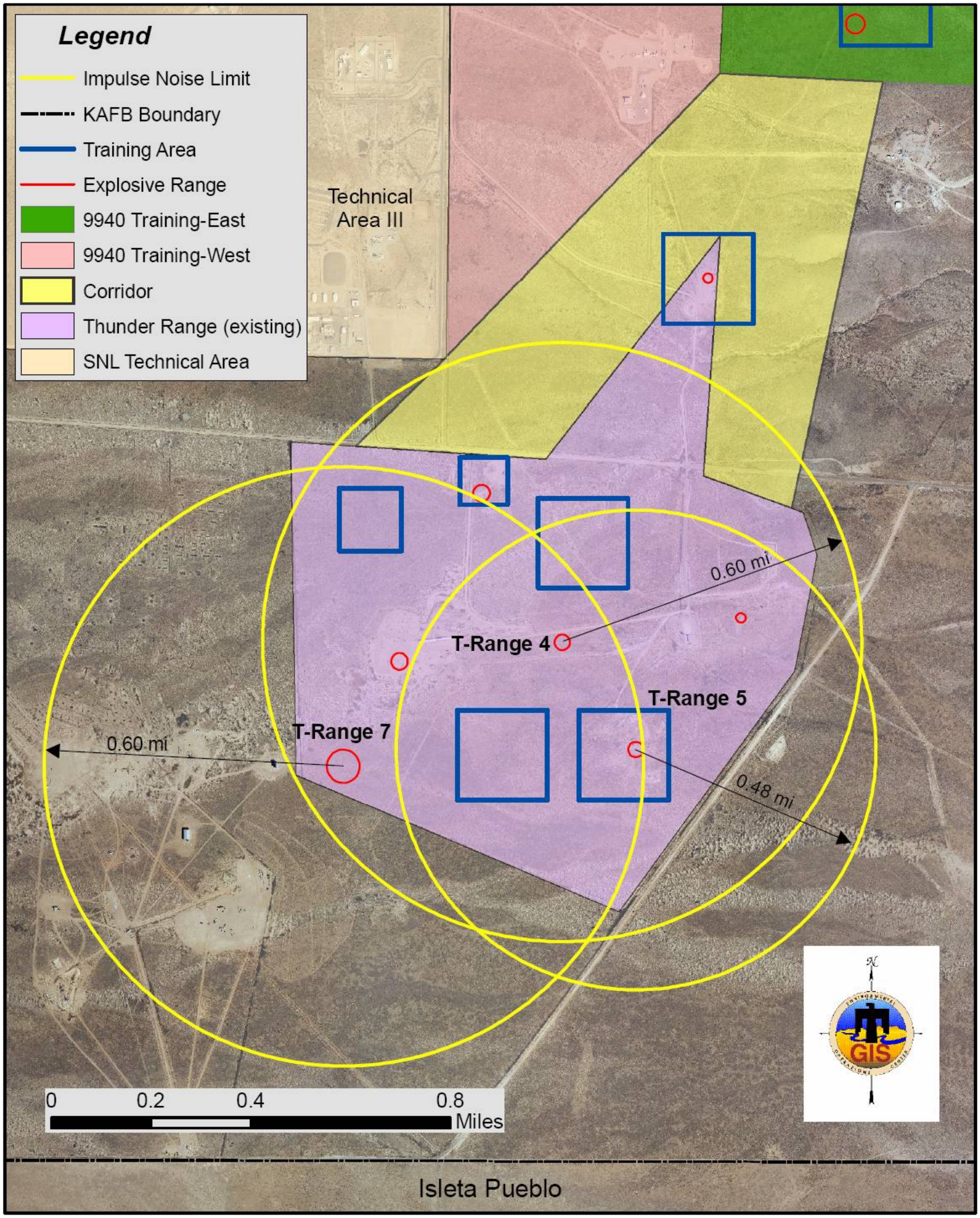


FIGURE 4.4-3 Impulse Noise Limits for Maximum Unmitigated Explosive Quantities at T-Ranges 4, 5, and 7, and Relationship to Nearby Receptors

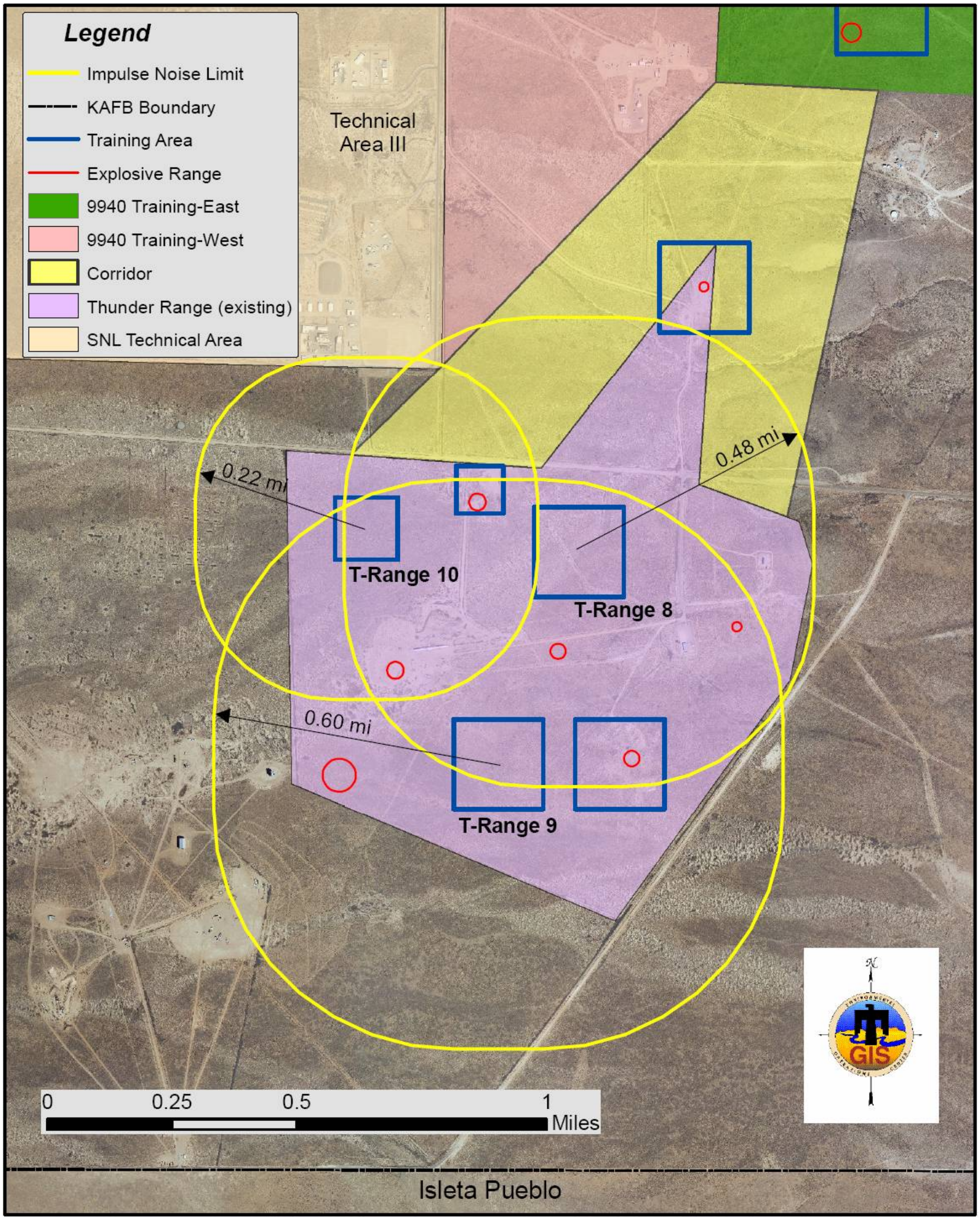


FIGURE 4.4-4 Impulse Noise Limits for Maximum Unmitigated Explosive Quantities at T-Ranges 8, 9, and 10, and Relationship to Nearby Receptors

Corridor Impacts

No explosives would be used in the Corridor, though the training area that surrounds the explosive site on T-Range 6 extends into the Corridor. Potential impacts from T-Range 6 are discussed in the Thunder Range Impacts section, above. Off-site noise and vibration impacts from operations within the Corridor would be insignificant, with minimal on-site noise and/or vibration associated with vehicle use.

9940 Expansion–West Impacts

Noise from operations at the 9940 Expansion–West would be infrequent helicopter operations to deploy personnel associated with training activities. No explosives would be used for the proposed activities at this site. Helicopters would hover to unload personnel once per day for a maximum period of approximately 2 weeks. Off-site impacts would be insignificant, with minimal on-site noise and/or vibration for the few minutes that the helicopter hovers. Operations for training may occasionally include landings.

Noise from helicopters would have a short-term duration due to approaches and departures, and a peak sound level as the helicopter hovers. A sound-exposure-level measurement takes into account the loudness and duration of a noise event. Table 4.4-6 lists sound exposure levels of various special operations helicopters that may be used in training exercises. It is anticipated that the Hueys and Pave Hawks would be the helicopters generally used, but the larger aircraft are included for operational flexibility.

TABLE 4.4-6 Sound Pressure Level Decibel Values for Special Operations Helicopters at Various Altitudes [a]

Altitude (ft)	Osprey (V-22)	PaveLow (53-J)	Huey (H-1N)	PaveHawk
200	105.2	104.7	101.8	95.8
500	100.7	100.3	96.0	89.3
1000	96.9	96.7	91.4	85.0
2000	92.5	92.5	86.6	79.6
3150	89.1	89.4	83.1	75.7
5000	85.2	85.7	79.4	71.2

Source: KAFB 2000

[a] Sound Pressure Levels determined from actual over-flight noise measurements and various methods of analysis

The flight path would be restricted, with a no-fly zone near TA-V. The information from Table 4.4-6 can also be used to estimate off-flight path sound pressure levels. The closest facility to the helicopter operations area is 9950, which is approximately 1,140 ft from 9940 Training West. The maximum potential noise exposure would be 105.2 decibels, if the aircraft flies directly overhead 200 ft aboveground on the approach to the operations pad. While the helicopter hovers, the noise exposure would decrease to approximately 96.9 decibels or less, using the table value for 1,000 ft. The distance to TA-V from the helicopter operations area is approximately 2,430 ft. Sound pressure levels in TA-V would be less than 92.5 decibels during hovering operations.

4.5. WATER RESOURCES

4.5.1. Surface Water

4.5.1.1. No Action

There would be no impact to surface water as a result of the No Action Alternative. Operations would continue at the 9940 Complex and Thunder Range as described in the SNL/NM SWEIS and subsequent NEPA documentation (DOE 1999, 2006).

4.5.1.2. Proposed Action

Site Development

Development of testing and training areas in the project area would result in the clearing of vegetation in large areas, rendering these areas susceptible to erosion during construction and training activities. Suspended sediments carried in storm-water runoff from precipitation events during construction periods could impact local drainage features if best management practices are not properly implemented. The potential effects on surface water, if they occurred, would be limited to these local areas and would not impact the Arroyo del Coyote, Tijeras Arroyo, or the Rio Grande, or any feature defined as a Waters of the U.S.; however, New Mexico has redefined Surface Waters of the State, and several features near some of the testing and training areas may be considered Surface Waters of the State. Because Surface Waters of the State can be regulated by the EPA, construction areas would require a National Pollutant Discharge Elimination System Storm Water Discharge permit prior to construction. This permit would require that both a Storm-Water Pollution Prevention Plan and Sediment Control Plan be prepared and a Notice of Intent to discharge storm water to be filed with EPA. Specific erosion and sedimentation controls, and other best management practices required by the permit would limit the amount of erosion that occurs on site, and restrict potential impacts to the immediate area. Therefore, no significant impacts to surface waters would occur. Also, since no wetlands or Waters of the U.S. are present, no impacts to these resources would occur.

Construction of the proposed test and training areas would increase demands on water supplies during the construction period. Water would be needed for a variety of construction activities including, but not limited to drinking water supply for construction crews, wetting construction sites for dust suppression, and possibly concrete mixing. This increase in water demand would be temporary and minimal.

Operations

The new testing and training areas would increase the overall proportion of compacted (semi-impervious) surfaces within the watershed, which has the potential to increase the quantity of runoff. Storm-water control features preventing the degradation of the water quality of local drainages would be included in the design of each site. Such controls would include drainage features that minimize runoff and silt transport. Incorporation of post-construction storm water controls within the Sediment Control Plan created for Thunder Range development would minimize long-term impacts to surface water and allow for groundwater recharge. Therefore, no significant impacts to surface water would occur as a result of post-construction operations of the facility.

Dust suppression for operation of the complex would be an ongoing water use, but the quantity of water needed for this purpose would be minimal. SNL/NM has an internal surface discharge program that includes permitting the discharge of water for dust suppression.

Some testing activities would result in the deposition of contaminants over relative large areas. Concentrated areas of the contaminants would be cleaned up after testing, but it is assumed some contamination would remain for extended periods. Due to the low potential for sediment transport in these areas, the threat of contaminant migration due to storm-water runoff is minimal and since no wetlands, perennial surface water, or Waters of the U.S. are present, no impacts to these resources would occur. There are features at the site that may qualify as Surface Waters of the State and could be minimally impacted by some operations. In order to minimize impacts to potential Surface Waters of the State, construction activities would require a Pollution Prevention Plan, a Sediment Control Plan and an NPDES Permit. Also, tests that result in the deposition of surface contaminants would be required to be permitted under the SNL/NM surface discharge program. Before a permit is issued, the materials that would be deposited on the surface would be evaluated for environmental impacts, and mitigation requirements would be issued in the permit thus minimizing impacts.

4.5.2. Groundwater

4.5.2.1. No Action

There would be no impact to groundwater as a result of the No Action Alternative. Operations would continue at the 9940 Complex and Thunder Range as described in the SNL/NM SWEIS and subsequent NEPA documentation (DOE 1999, 2006).

4.5.2.2. Proposed Action

Detonation of explosives for training or testing would result in the deposition of explosive residue and metal debris on the surface of the ground. Detonation of military ordnance produces residues of explosives chemical constituents on the soil surface. The residue left from a high-order detonation (complete detonation of the explosive) is typically very small and may be analogous to a sorbed surface layer on soil particles. Low-order detonations (incomplete detonation of the explosive) occur infrequently, but may disperse distinct solid-phase energetic material as fine particulates to large masses (Phelan, Parker, Romero, and Barnett 2000).

EPA lifetime exposure drinking-water health advisory limits for TNT, RDX, and HMX are 2, 2, and 400 micrograms/liter, respectively. Similarly, a reference dose for perchlorate has been established by the EPA. This reference dose has been translated into an action level by the EPA of 24.6 parts per billion. Specific groundwater maximum contamination levels have not been established by NMED. The NMED considers high explosives (2.4 DNT, 2.6 DNT, HMX, RDX, and TNT) and perchlorate as potential toxic pollutants. A toxic pollutant means a water contaminant or combination of water contaminants in concentration(s) that may be toxic to humans, animals, or plants, or increase the lifetime risk of cancer by more than one cancer in 100,000 persons (NMAC 20.6.2).

Residual explosive compounds and metal particles would be dissolved by surface water and infiltrate into the soil. Taking into consideration the extensive evaporation characteristic of the arid climate, the estimated net recharge rate in the project area is 0.002 to 0.71 centimeters/yr. The movement of explosive contaminants, including perchlorate, within the soil column is extremely slow (0.03 to 118 centimeters/yr) (SNL 2006c). Of greatest concern are perchlorate and RDX. Perchlorate is very soluble and is not appreciably attenuated in the soil column by adsorption or degradation. RDX is not as soluble, but similarly, is not effectively attenuated (Webb, Phelan, et al. 2000).

Explosive compounds that are deposited onto the soil surface could eventually find their way to groundwater. Depth to groundwater ranges from 40 ft below ground surface in the northern portion of the project area to 300 ft below ground surface in the central part. It is unlikely that the concentrations of explosives in groundwater would exceed the EPA human health advisory or the current EPA action level for perchlorate, if soil depositions are maintained below NMED action levels for the specific compound. Any contamination of groundwater by a potential toxic pollutant must be reported to the NMED, unless it can be demonstrated that the concentrations present do not constitute a toxic threat to humans, animals, or plants, and present a human cancer risk of less than 1 in 100,000.

4.6. Biological Resources

4.6.1. No Action

There would be no impact to the biological resources, the existing conditions of the vegetation and animal communities would not be altered as a result of the No Action Alternative. Operations would continue at the 9940 Complex and Thunder Range as described in the SNL/NM SWEIS and subsequent NEPA documentation (DOE 1999, 2006).

4.6.2. Proposed Action

The Proposed Action could result in impacts to the existing plant and animal life in the proposed project area. Site development and operations could disturb the habitats of protected species. Below are descriptions of the species and habitats that could be affected.

The western boundary of the project area contains loggerhead shrike habitat and is actively used as nesting territory for these birds. Loggerhead shrikes are listed as a sensitive species by the State of New Mexico.

Raptor habitat exists across the entire project area. Numerous raptors, such as red-tailed hawks, Swainson's hawks, and golden eagles, utilize the area regularly. Barn owls and Great horned owls utilize the area regularly for nesting activity. The project area is also a known nesting habitat for many small birds, including horned larks, and eastern and western meadowlarks. All species of raptors are protected by the State of New Mexico. All birds are protected under the *Migratory Bird Treaty Act*.

Burrowing owls are known to occur in the project area. Burrowing owls frequently utilize and nest in prairie dog holes. A prairie dog colony is located in the west-central portion of the project area. All species of owls are protected by the State of New Mexico.

The project area provides habitat for wintering sparrows, and other birds, such as horned larks, Brewer's sparrows, and both meadowlarks. All species of songbirds and insectivorous birds are protected by the State of New Mexico.

Horned lizards are known to occur throughout the project area. All species of horned lizards are protected by the State of New Mexico.

To avoid significant adverse impacts to protected species, prior to the start of any activity, at any point in time in the project area, a biological survey would be conducted. Any necessary mitigation activities and arrangements would be planned and coordinated with SNL/NM biologists and in conjunction with SSO. To reduce the effects of site development activities on raptors, nest boxes and roosting locations would be constructed at locations outside the project area. All site development activities would take place within designated areas, prescreened to avoid protected species, and would be localized as much as possible to lessen the potential for adverse impacts to protected species.

4.7. CULTURAL RESOURCES

4.7.1. No Action

There would be no impact to cultural resources as a result of the No Action Alternative. Operations would continue at the 9940 Complex and Thunder Range as described in the SNL/NM SWEIS and subsequent NEPA documentation (DOE 1999, 2006). Existing protocols and practices regarding the identification and protection of cultural resources would be maintained.

4.7.2. Proposed Action

The Proposed Action could have a significant impact on archaeological sites during site development, operations, or project termination and decommissioning activities. Significant impacts are avoidable through planning and deliberate avoidance of known sites. Potential impacts are described in the sections below.

No activities planned under the Proposed Action would affect buildings within or near the project area until project termination. Any future activities that involve building modification, renovation, or demolition would require appropriate evaluation and consultation in compliance with Section 106 of the NHPA.

4.7.2.1. Site Development

The activities involved in site development result in ground disturbance and, therefore, are potential threats to archaeological sites. There are no known archaeological sites in the areas of the proposed new buildings, roads, and training areas, but there is a possibility of previously unidentified surface and subsurface sites. Construction activities may reveal and threaten subsurface deposits. New fencing and fence relocation may reveal and threaten subsurface deposits. Ground preparation may also reveal and threaten additional archaeological sites on the surface.

4.7.2.2. Operations

The proposed training areas do not contain any identified archaeological sites. However, use of the area may reveal and threaten previously unidentified surface sites. Additionally, there is a possibility that subsurface deposits from either the prehistoric or historic period may be present in the area; these could be revealed and threatened by training and explosives testing activities.

The explosives ranges identified in the Proposed Action do not contain any identified archaeological sites. Preparing for explosives tests and test detonations may reveal previously unidentified surface or subsurface deposits.

4.7.2.3. Project Termination and Decommissioning

The risk to identified archaeological sites is minimal during project terminating and decommissioning, as the related work would take place in previously disturbed areas.

4.8. WASTE AND MATERIALS MANAGEMENT

4.8.1. No Action

No change in waste generation would result from the No Action Alternative. All waste would continue to be managed by the SNL/NM waste management program as described in the SNL/NM SWEIS and subsequent NEPA documentation (DOE 1999, 2006). Under the No Action Alternative, the 9940 Complex and Thunder Range would continue to generate a total of approximately 110 lb/yr (50 kg/yr) of hazardous waste.

4.8.2. Proposed Action

The 9940 Complex and Thunder Range operations under the Proposed Action would generate non-hazardous (solid waste), hazardous waste, and very minor quantities of low-level radioactive wastes, typically sealed sources.

4.8.2.1. Nonhazardous Waste

Nonhazardous waste would continue to consist of materials such as office paper, cardboard, plastic, glass, scrap metal, packaging materials, test debris, and wood. Under the Proposed Action, personnel would generate approximately 62,370 cubic ft of nonhazardous waste (Scharrer 2007). This represents an increase of approximately 58,320 cubic ft, or approximately 1,440 percent compared to the No Action Alternative. These quantities are included in the analysis of the Expanded Operations Alternative in the SWEIS (DOE 1999, 2006). Much of this increase would be recycled, as appropriate. Remaining nonhazardous waste would be removed and taken to the SNL/NM Solid Waste Transfer Facility to be sorted, baled, and transported for disposal in local commercial and municipal landfills.

4.8.2.2. Hazardous Waste

Under the Proposed Action, operations at the 9940 Complex and Thunder Range facilities would generate approximately 150 lb/yr (68 kg/yr) of hazardous waste, an increase of approximately 36 percent over the amount that would be produced under the No Action Alternative. The following hazardous materials would be used and stored:

- Potentially explosive fuels (e.g., nitromethane) would be stored and used. The inventory would be kept to one 50-gallon drum.
- Other fuels would not be stored on site, but would be used for vehicles and generators.
- High concentration (>60 percent) hydrogen peroxide would be stored and used. The inventory would be kept to one 50-gallon drum.
- Small amounts of paints, oils, adhesives, epoxies, solvents, compressed air, cements, cleaning, office, and construction chemicals would be used at the 9940 Complex and Thunder Range.
- Small amounts of hazardous waste would be generated from light bulbs and unused chemicals (e.g., paint, WD-40, glues) (Scharrer 2007).

Hazardous material or waste would be removed and processed through the SNL/NM Hazardous Waste Management Facility to be disposed of in accordance with SNL/NM Hazardous Waste Program policies and procedures.

4.8.2.3. Radioactive Waste

Under the Proposed Action, up to 5 lb/yr (2.3 kg/yr) of radioactive waste could be generated in the form of decontamination waste, personnel protective equipment, and melted components of test articles and sources. This waste would be appropriately characterized, packaged, and disposed of in accordance with the existing SNL/NM waste management process.

4.8.2.4. Construction and Demolition Waste

During facility construction and modification activities, a small amount of construction-related debris would be anticipated. All debris would be removed for disposal at a licensed landfill.

The explosive testing and training typically would require fabricating test structures or venues. These structures, or at least parts of these structures, would usually be destroyed or rendered unusable at the completion of the test or training event. Much of the increases in waste, noted above, would result from these tests and new capabilities at the 9940 Complex and Thunder Range.

4.8.2.5. Explosives Management and Waste

As an explosive testing facility, explosives would constantly be present at the 9940 Complex and Thunder Range. The storage and use of explosives at the site would continue to be regulated by the SNL/NM Environment, Safety, and Health Manual (MN471001), Chapter 9, Explosives Safety; the DOE Explosives Safety Manual (DOE M 440.1-1); and the Conduct of Operations Manual: Explosives Operations (MN471018). All safety decisions on the handling, assembly, disassembly, disposal, or other operations connected with any explosive or explosive device would also continue to be performed in accordance with the SNL/NM Corporate Explosives Program.

The 9940 Complex explosive site plan is in the approval process, and the Thunder Range explosive site plan is being generated by SNL/NM.

Explosives are generally consumed during training and testing events. Minimal explosive waste would be generated under the Proposed Action. Any explosive waste generated would be disposed of in accordance with SNL waste management procedures.

4.8.2.6. Special Waste

New Mexico "special waste" is a type of solid waste that has unique handling, transportation, and disposal requirements. The following are types of special wastes: treated, formerly characteristic hazardous wastes; asbestos waste; a spill of a chemical substance or commercial product; dry chemicals, which, when wetted, become characteristically hazardous; and petroleum contaminated soils.

These waste types have not typically been generated from activities at the 9940 Complex and Thunder Range and are not expected to be generated; however, there is the potential to generate a New Mexico "special waste" from a spill or release of a chemical or petroleum. If generated, the amount would be covered by the estimate of solid waste.

4.9. UTILITIES AND INFRASTRUCTURE

4.9.1. No Action

There would be no impact to the utilities and infrastructure as a result of the No Action Alternative. Operations would continue at the 9940 Complex and Thunder Range as described in the SNL/NM SWEIS and subsequent NEPA documentation (DOE 1999, 2006).

4.9.2. Proposed Action

Under the Proposed Action, there would be no environmental impact on the existing utilities and infrastructure. It is anticipated that no significant additional power, water, sewer, or communication systems would be required. Additional roads would be graded for use; however, an SNL/NM biologist has determined that the proposed roads are in disturbed areas. The areas have been surveyed, and the grading of roads in these areas would have the least environmental impact to wildlife and vegetation. Additionally, previous archaeological surveys show that no cultural resources are located in these proposed road areas.

4.10. CUMULATIVE EFFECTS

No potential cumulative effects have been identified for the following resource areas: land resources; geology, topography, and soils; cultural resources; and utilities and infrastructure.

Air emissions at the 9940 Complex and Thunder Range during site development and operations could combine with air emissions from other sources in the area. Typically, these other emission sources would be transportation-related (exhaust emissions, particulates from driving on unpaved roads) or from explosive events at other facilities in the Coyote Test Field. As these are all short-term activities with localized impacts, it is unlikely that significant cumulative impacts to air quality would result.

Noise produced by explosive events at the 9940 Complex and Thunder Range could combine with other noise sources in the area, particularly aircraft noise from the Albuquerque International Sunport and outdoor tests at other SNL/NM testing facilities and the nearby USAF Chestnut Site. A total of 199 explosive events occurred at the Chestnut Site from August 2006 through July 2007 (Table 4.10-1). Explosive events generally last less than one or two seconds, making simultaneous explosive events unlikely. Large explosive events (500 lb TNT equivalent or greater) would occur infrequently. The number of events that would be audible to offsite residents would increase as a result of Proposed Action implementation and active USAF testing. The audibility of a particular test would vary with the test characteristics and atmospheric conditions. The distance from the project area to the Albuquerque International Sunport would mitigate potential cumulative noise impacts of explosive events and aircraft noise.

TABLE 4.10-1 USAF Explosive Testing at Chestnut Site, August 2006 through July 2007

Explosive Weight (lb net explosive weight)						
>0-1	>1-5	>5-20	>20-50	>50-100	>100-500	>500
8	2	143	9	33	4	0

Sources: KAFB 2007a, 2006

Potential groundwater contamination that could result from transport of explosive residue through the vadose zone could be cumulative with other surficial sources of explosive residue in the area, particularly the U.S. Air Force Chestnut Site and other SNL/NM testing facilities. Post-test cleanup of test debris and periodic soil cleanup at the 9940 Complex and Thunder Range would mitigate the possibility of contaminants reaching groundwater, thus minimizing the potential for cumulative impacts.

Loss of faunal habitat under the Proposed Action would be cumulative with development of Mesa del Sol to the west. However, these developments represent a small percentage of equivalent habitat that continues to exist on KAFB, the Pueblo of Isleta, and within the middle Rio Grande valley.

Additional waste generated under the Proposed Action, combined with waste generated by other activities at SNL/NM and KAFB, could cause cumulative impacts to waste handling facilities or landfills. However, waste generated at the 9940 Complex and Thunder Range would be a small proportion of the total waste generated by SNL/NM and KAFB. Thus, cumulative impacts of waste generation would not be significant.

4.11. LONG-TERM ENVIRONMENTAL STEWARDSHIP

Long-Term Environmental Stewardship (LTES) at SNL/NM involves stewardship activities for past, present, and future activities.

The LTES mission ensures long-term protection of human health and the environment, proactive management toward sustainable use, and protection of natural and cultural resources affected by SNL/NM operation and operational legacies. This mission would be accomplished by working with the line and support organizations in proactively identifying potential environmental impacts and applying environmental processes and guidance through a life-cycle approach.

Section 3.1, Land Resources, discusses the environmental restoration legacy, and Table 3.1-1 lists the ER sites. Part of the LTES mission is to ensure that past operational legacies do not become new operational legacies. Another part of the LTES mission is to ensure minimization of new environmental impacts, which includes the potential for new contamination at the 9940 Complex and Thunder Range. Key components to ensure potential impacts are properly mitigated include life-cycle planning, institutional controls, and monitoring.

New projects planned and conducted at Thunder Range would need to be evaluated through the NEPA process, at which time a project evaluation would occur to determine the life-cycle analysis necessary for that project. This life-cycle analysis would include evaluation of potential new contamination and impact to current or new institutional controls, and any new environmental impacts not previously evaluated, along with associated mitigation actions.

Current institutional controls must be maintained for the proposed activities to continue. Additional institutional controls may be imposed on the site if any additional “past” legacy is identified, or if any new activities require new institutional controls. Proper planning and mitigation should minimize the creation of any new institutional controls. This information is tracked and assessed by the SNL/NM environmental departments.

Based on the nature of the planned activities, a baseline environmental sampling event would need to be conducted prior to the start of the proposed activities and any new activities. This baseline would establish the cleanup criteria associated with site activities, and would be based on residential land use standards and potential contaminant transport. Activities occurring in areas which involve former ER Project sites designated for industrial land use would be baselined against that level. Cleanup would be required to meet the baseline level, since it already exceeds the residential standard. A long-term, ongoing monitoring strategy would need to be produced from this effort. All environmental data collected at Thunder Range would be shared with SNL/NM environmental departments.

4.12. Deliberate Actions

In preparation of this EA, DOE considered measures to minimize the risk and consequences of deliberate, malevolent actions such as a potential terrorist attack or sabotage. This discussion of deliberate actions is limited to training and testing activities under the Proposed Action. Equipment and activities required for site development would not use energetic materials and would therefore present an unattractive target for deliberate actions with minimal consequences to human health or the environment.

The proposed project area offers certain inherent safeguards for training and testing activities: restricted access within a military installation, a relatively remote location within the military installation, and access to a highly-effective, rapid-response security force.

DOE based its analysis of the Proposed Action on conceptual information of safeguard and security measures. If DOE decides to implement the Proposed Action, as part of its detailed design and planning processes, DOE would continue to identify safeguards, security measures, and design features that would further protect facilities and training and testing areas from terrorist attack and other forms of sabotage. DOE believes that the safeguards should involve a dynamic process of enhancement to meet threats, which could change over time. Potential additional measures that DOE could adopt include:

- Reinforcement of building or storage bunker roofs or walls to secure against theft of energetic materials;
- Additional doors, airlocks, and other features to delay unauthorized intrusion;
- Additional site perimeter barriers;
- Active denial systems to disable any adversaries and prevent access to the facility; and
- Increased area coverage, monitoring, and/or capabilities of surveillance systems to detect potential intruders.

Although it is not possible to predict if or how the malevolent acts would occur, DOE examined several deliberate action scenarios, consequences of those actions, and general mitigations.

Theft of energetic materials. The theft of energetic materials could result in transport to another location within or outside KAFB, and detonation with the intent of harming human health or infrastructure. Potential targets within the boundaries of KAFB would include SNL facilities; consequences of various types of accidents at these facilities have been analyzed in the SNL/NM SWEIS, including bounding scenarios of aircraft crashes and earthquakes (DOE 1999). The consequences of detonations at potential targets outside KAFB are highly variable, but could result in loss of life. Because activities of the type described in the Proposed Action already take place at SNL and KAFB, and have been ongoing for decades, there are already extensive safeguards in place to minimize the potential of theft of energetic materials. Multiple layers of protection exist to keep materials inside KAFB boundaries.

In-situ detonation of energetic materials. Energetic materials could be detonated at storage locations within the project area. The consequences of such a detonation could include loss of life. Because storage locations are in a remote area on an access-controlled military reservation, the number of lives lost from a malevolent act would be limited to a relatively small number of nearby workers. Storage locations have barriers against intrusion and are reinforced to reduce the consequences of a potential accident or deliberate act.

Training or testing activity sabotage. Energetic materials could be deliberately detonated prematurely during training or testing activities. The consequences of such a detonation could include loss of life. Because of the remote location of training and testing areas on an access-controlled military reservation, the number of live lost from a malevolent act would be limited to a relatively small number of workers or trainees. In general, those personnel involved in training or testing activities have had background checks as part of their employment. Access from non-involved personnel is strictly controlled.

Theft of sealed radiation sources. Sealed sources, used in training activities, contain small amounts of radioactive material that could pose a contamination hazard if the source material were deliberately dispersed. The consequences of exposure to this radioactive material would vary with the amount of source radioactivity, but could result in a dose to one or more individuals that would raise the risk of cancer. Sealed sources are accountable items that would be secured according to SNL and DOE guidelines. Access to sealed sources would be strictly controlled.

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5.0 LIST OF AGENCIES AND PERSONS CONSULTED

The USAF agreed to cooperating agency status for this EA because of the potential impacts to USAF land and activities resulting from expansion of DOE-permitted land and operations. Members of the 377th Air Base Wing reviewed and provided comments on a draft of this EA. These comments resulted in revisions reflected in the current version of the document.

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APPENDIX A ANIMAL AND PLANT SPECIES DOCUMENTED OR EXPECTED TO OCCUR IN PROJECT AREA

TABLE A-1 Animal Species Documented or Expected to Occur in Project Area

Bird Species	
Common Name	*Scientific Name*
American Crow	*Corvus brachyrhynchos*
American Goldfinch	*Carduelis tristis*
American Kestrel	*Falco sparverius*
American Pipit	*Anthus rubescens*
American Robin	*Turdus migratorius*
Ash-throated Flycatcher	*Myiarchus cinerascens*
Baird’s Sparrow	*Ammodramus bairdii*
Bank Swallow	*Riparia riparia*
Barn Owl	*Tyto alba*
Barn Swallow	*Hirundo rustica*
Bewick’s Wren	*Thryomanes bewickii*
Black-chinned Hummingbird	*Archilochus alexandri*
Black-chinned Sparrow	*Spizella atrogularis*
Black-headed Grosbeak	*Pheucticus melanocephalus*
Black-throated Sparrow	*Amphispiza bilineata*
Blue Grosbeak	*Guiraca caerulea*
Blue-gray Gnatcatcher	*Polioptila caerulea*
Brewer’s Sparrow	*Spizella breweri*
Broad-tailed Hummingbird	*Selasphorus platycercus*
Brown-headed Cowbird	*Molothrus ater*
Bullock’s Oriole	*Icterus bullockii*
Burrowing Owl	*Athene cunicularia*
Bushtit	*Psaltriparus minimus*
Calliope Hummingbird	*Stellula calliope*
Canyon Towhee	*Pipilo fuscus*
Cassin’s Kingbird	*Tyrannus vociferans*
Cassin’s Sparrow	*Aimophila cassinii*
Cassin’s Vireo	*Vireo cassinii*
Cave Swallow	*Petrochelidon fulva*
Chestnut-collared Longspur	*Calcarius ornatus*
Chihuahuan Raven	*Corvus cryptoleucus*

TABLE A-1 Animal Species Documented or Expected to Occur in Project Area (continued)

Common Name	*Scientific Name*
Chipping Sparrow	*Spizella passerina*
Clay-colored Sparrow	*Spizella pallida*
Cliff Swallow	*Petrochelidon pyrrhonota*
Common Nighthawk	*Chordeiles minor*
Common Raven	*Corvus corax*
Cooper's Hawk	*Accipiter cooperii*
Cordilleran Flycatcher	*Empidonax occidentalis*
Crissal Thrasher	*Toxostoma crissale*
Curve-billed Thrasher	*Toxostoma curvirostre*
Dark-eyed Junco	*Junco hyemalis*
Dusky Flycatcher	*Empidonax oberholseri*
Eastern Bluebird	*Sialia sialis*
Eastern Meadowlark	*Sturnella magna*
European Starling	*Sturnus vulgaris*
Ferruginous Hawk	*Buteo regalis*
Golden Eagle	*Aquila chrysaetos*
Grasshopper Sparrow	*Ammodramus savannarum*
Gray Flycatcher	*Empidonax wrightii*
Gray Vireo	*Vireo vicinior*
Great Horned Owl	*Bubo virginianus*
Greater Roadrunner	*Geococcyx californianus*
Great-tailed Grackle	*Quiscalus mexicanus*
Green-tailed Towhee	*Pipilo chlorurus*
Hammond's Flycatcher	*Empidonax hammondii*
Harris's Sparrow	*Zonotrichia querula*
Hermit Thrush	*Catharus guttatus*
Horned Lark	*Eremophila alpestris*
House Finch	*Carpodacus mexicanus*
House Sparrow	*Passer domesticus*
Ladder-backed Woodpecker	*Picoides scalaris*
Lapland Longspur	*Calcarius lapponicus*
Lark Bunting	*Calamospiza melanocorys*
Lark Sparrow	*Chondestes grammacus*
Lazuli Bunting	*Passerina amoena*

TABLE A-1 Animal Species Documented or Expected to Occur in Project Area (continued)

Common Name	*Scientific Name*
Lesser Goldfinch	*Carduelis psaltria*
Lesser Nighthawk	*Chordeiles acutipennis*
Lincoln's Sparrow	*Melospiza lincolnii*
Loggerhead Shrike	*Lanius ludovicianus*
Long-billed Curlew	*Numenius americanus*
MacGillivray's Warbler	*Oporornis tolmiei*
McCown's Longspur	*Calcarius mccownii*
Merlin	*Falco columbarius*
Mountain Bluebird	*Sialia currucoides*
Mountain Plover	*Charadrius montanus*
Mourning Dove	*Zenaida macroura*
Northern Flicker	*Colaptes auratus*
Northern Harrier	*Circus cyaneus*
Northern Mockingbird	*Mimus polyglottos*
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*
Northern Shrike	*Lanius excubitor*
Northern Waterthrush	*Seiurus noveboracensis*
Orange-crowned Warbler	*Vermivora celata*
Peregrine Falcon	*Falco peregrinus*
Pine Siskin	*Carduelis pinus*
Pinyon Jay	*Gymnorhinus cyanocephalus*
Plumbeous Vireo	*Vireo plumbeus*
Prairie Falcon	*Falco mexicanus*
Red-tailed Hawk	*Buteo jamaicensis*
Rock Dove	*Columba livia*
Rock Wren	*Salpinctes obsoletus*
Rough-legged Hawk	*Buteo lagopus*
Ruby-crowned Kinglet	*Regulus calendula*
Rufous Hummingbird	*Selasphorus rufus*
Sage Sparrow	*Amphispiza belli*
Sage Thrasher	*Oreoscoptes montanus*
Savannah Sparrow	*Passerculus sandwichensis*
Say's Phoebe	*Sayornis saya*
Scaled Quail	*Callipepla squamata*

TABLE A-1 Animal Species Documented or Expected to Occur in Project Area (continued)

Common Name	*Scientific Name*
Scott's Oriole	*Icterus parisorum*
Sharp-shinned Hawk	*Accipiter striatus*
Short-eared Owl	*Asio flammeus*
Song Sparrow	*Melospiza melodia*
Spotted Towhee	*Pipilo maculatus*
Sprague's Pipit	*Anthus spragueii*
Swainson's Hawk	*Buteo swainsoni*
Townsend's Warbler	*Dendroica townsendi*
Tree Swallow	*Tachycineta bicolor*
Turkey Vulture	*Cathartes aura*
Vesper Sparrow	*Pooecetes gramineus*
Violet-green Swallow	*Tachycineta thalassina*
Virginia's Warbler	*Vermivora virginiae*
Warbling Vireo	*Vireo gilvus*
Western Bluebird	*Sialia mexicana*
Western Kingbird	*Tyrannus verticalis*
Western Meadowlark	*Sturnella neglecta*
Western Scrub-Jay	*Aphelocoma californica*
Western Tanager	*Piranga ludoviciana*
Western Wood-Pewee	*Contopus sordidulus*
White-crowned Sparrow	*Zonotrichia leucophrys*
White-throated Sparrow	*Zonotrichia albicollis*
Wilson's Warbler	*Wilsonia pusilla*
Yellow Warbler	*Dendroica petechia*
Yellow-rumped Warbler	*Dendroica coronata*
Reptile Species	
Common Name	*Scientific Name*
Black-headed snake	*Tantilla hobartsmithi*
Box turtle	*Terrapene ornata*
Coachwhip	*Masticophis flagellum*
Collared lizard	*Crotaphytus collaris*
Fence lizard	*Scoloporus undulatus*
Gopher snake	*Pituophis melanoleucus*
Great plains skink	*Eumeces obsoletus*

TABLE A-1 Animal Species Documented or Expected to Occur in Project Area (continued)

Common Name	*Scientific Name*
Leopard lizard	*Gambelia wislizenii*
Lesser earless lizard	*Holbrookia maculata*
Little striped whiptail	*Cnemidophorus inornatus*
Massasauga	*Sistrurus catenatus*
New Mexican whiptail	*Cnemidophorus neomexicanus*
Prairie rattlesnake	*Crotalus viridus*
Red-Spotted Toad	*Bufo punctatus*
Short-horned lizard	*Phrynosoma douglasii*
Side-blotched lizard	*Uta stansburiana*
Spiny lizard	*Scoloporus magister*
Western diamondback rattlesnake	*Crotalus atrox*
Mammal Species	
Common Name	*Scientific Name*
Banner-tailed kangaroo rat	*Dipodomys spectabilis*
Black-tailed jackrabbit	*Lepus californicus*
Bobcat	*Felis rufus*
Coyote	*Canus latrans*
Deer mouse	*Peromyscus maniculatus*
Desert cottontail	*Sylvilagus audubonii*
Hoary bat	*Lariusrus cinereus*
Kit fox	*Vulpes macrotis*
Little brown myotis bat	*Myotis lucifugus*
Mexican free-tailed bat	*Tadarida brasiliensis*
Mule deer	*Odocoileus hemionus*
Pallid bat	*Antrozous pallidus*
Porcupine	*Erethizon doratum*
Rock squirrel	*Spermophilus variegatus*
Silky pocket mouse	*Perognathus flavus*
Silver-haired bat	*Lasionycteris noctivagans*
Spotted bat	*Euderma maculatum*
Spotted ground squirrel	*Spermophilus spilosoma*
Townsend's big-eared bat	*Plecotus townsendii*
Western pipistrelle	*Pipistrellus hesperus*

TABLE A-2 Plant Species Documented or Expected to Occur in Project Area

Common Name	*Scientific Name*
Sand verbena	*Abronia fragrans*
Indian ricegrass	*Achnatherum hymenoides*
Dwarf desertpeony	*Acourtia nana*
Umbrellawort	*Allionia incarnata*
Plain's dozedaisy	*Aphanostephus ramosissimus*
Poverty three-awn	*Aristida divaricata*
Purple three-awn	*Aristida purpurea*
Bigelow sage	*Artemisia bigelovii*
Sand sage	*Artemisia filifolia*
Antelope horns	*Asclepias asperula*
Horsetail milkweed	*Asclepias subverticillata*
Santa Fe milkvetch	*Astragalus feensis*
Freckled milkvetch	*Astragalus lentiginosus*
Nuttal's milkvetch	*Astragalus nuttallianus*
Four-wing saltbush	*Atriplex canescens*
Wright's baccharis	*Baccharis wrightii*
Desert marigold	*Baileya multiradiata*
Burningbush	*Bassia scoparia*
Sideoats grama	*Bouteloua curtipendula*
Black grama	*Bouteloua eriopida*
Blue grama	*Bouteloua gracilis*
James' rush pea	*Caesalpinia jamesii*
Hartweg's sundrops	*Calylophus hartwegii*
Twinleaf senna	*Cassia bauhinioides*
Baby aster	*Chaetopappa ericoides*
Fremont's goosefoot	*Chenopodium fremontii*
New Mexico thistle	*Cirsium neomexicanum*
Bindweed	*Convolvulus arvensis*
Golden corydalis	*Corydalis aurea*
Pincushion cactus	*Coryphantha vivipara*
Hidden flower	*Cryptantha crassisepala*
Hidden flower	*Cryptantha fulvocanescens*
James's hidden flower	*Cryptantha jamesii*
Buffalo gourd	*Cucurbita foetidissima*
Dodder	*Cuscuta megalocarpa*

TABLE A-2 Plant Species Documented or Expected to Occur in Project Area (continued)

Common Name	*Scientific Name*
Fendler's springparsley	*Cymopterus fendleri*
Feather indigobush	*Dalea formosa*
Fluff grass	*Dasyochloa pulchella*
Low woollygrass	*Dasyochloa pulchella*
Larkspur	*Delphinium virescens*
Tansy mustard	*Descurainia richardsonii*
Spectacle pod	*Dithyrea wislizenii*
Dogweed	*Dyssodia acerosa*
Hedgehog cactus	*Echinocereus fendleri*
Squirreltail	*Elymus elymoides*
Torrey's jointfir	*Ephedra torreyana*
Mexican lovegrass	*Eragrostis mexicana*
Rabbitbrush	*Ericameria nauseosa*
Fleabane	*Erigeron divergens*
Trailing fleabane	*Erigeron flagellaris*
Hairy woollygrass	*Erioneuron pilosum*
Pincushion cactus	*Escobaria vivipara*
Fendler's spurge	*Euphorbia fendleri*
Thymeleaf spurge	*Euphorbia serpyllifolia*
Blanketflower	*Gaillardia pinnatifida*
Firewheel	*Gaillardia pulchella*
Scarlet Gaura	*Gaura coccinea*
Blue gilia	*Gilia rigidula var. acerosa*
Rosy gilia	*Gilia sinuata*
Broom snakeweed	*Gutierrezia sarothrae*
New Mexico needlegrass	*Hesperostipa neomexicana*
Dwarf ipomopsis	*Ipomopsis pumila*
One-seed juniper	*Juniperus monosperma*
Winterfat	*Krascheninnikovia lanata*
Prickly lettuce	*Lactuca serriola*
Flatspine stickseed	*Lappula occidentalis*
Creosote bush	*Larrea tridentata*
Fendler's bladderpod	*Lesquerella fendleri*
Bristle flax	*Linum aristatum*
Pale wolfberry	*Lycium pallidum*
Lacy tansyaster	*Machaeranthera pinnatifida*

TABLE A-2 Plant Species Documented or Expected to Occur in Project Area (continued)

Common Name	*Scientific Name*
Desert dandelion	*Malacothrix fendleri*
Plains Blackfoot	*Melampodium leucanthum*
Rough Menodora	*Menodora scabra*
Whitestem stickleaf	*Mentzelia albicaulis*
Colorado four o'clock	*Mirabilis multiflora*
Smooth spreading four o'clock	*Mirabilis oxybaphoides*
Ear Muhly	*Muhlenbergia arenacea*
Sand muhly	*Muhlenbergia arenicola*
Brush muhly	*Muhlenbergia porteri*
Ring muhly	*Muhlenbergia torreyi*
Hairy nama	*Nama hispidum*
Whitest evening primrose	*Oenothera albicaulis*
Evening primrose	*Oenothera primiveris*
Club cholla	*Opuntia clavata*
Prickly pear	*Opuntia cymochila*
Tree cholla	*Opuntia imbricata*
Twistspine pricklypear	*Opuntia macrorhiza var. macrorhiza*
Tulip prickly pear	*Opuntia phaeacantha*
Grizzlybear pricklypear	*Opuntia polyacantha var. erinacea*
Whipple's cholla	*Opuntia whipplei*
Louisiana broomrape	*Orobanche ludoviciana*
Manyflower broomrape	*Orobanche ludoviciana ssp. Multiflora*
Scorpionweed	*Phacelia crenulata*
Groundcherry	*Physalis longifolia*
Woolly plaintain	*Plantago patagonica*
Galleta	*Pleuraphis jamesii*
Desert unicorn-plant	*Proboscidea althaeifolia*
Woolly paperflower	*Psilostrophe tagetina*
Slimflower scurfpea	*Psoralidium tenuiflorum*
Canaigre	*Rumex hymenosepalus*
Russian thistle	*Salsola kali*
Prickly ussian thistle	*Salsola tragus*
Grama Grass Cactus	*Sclerocactus papyracanthus*
Paperspine fishhook cactus	*Sclerocactus papyracanthus*
Burrograss	*Scleropogon brevifolius*

TABLE A-2 Plant Species Documented or Expected to Occur in Project Area (continued)

Common Name	*Scientific Name*
Douglas' ragwort	*Senecio flaccidus var. douglasii*
Threadleaf ragwort	*Senecio flaccidus var. flaccidus*
Plains Bristlegrass	*Setaria macrostachya*
Silverleaf nightshade	*Solanum elaeagnifolium*
Narrow-leaf globemallow	*Sphaeralcea angustifolia*
Scarlet globemallow	*Sphaeralcea coccinea*
Fendler's globemallow	*Sphaeralcea fendleri*
Gray globemallow	*Sphaeralcea incana*
Alkali sacaton	*Sporobolus airoides*
Spike dropseed	*Sporobolus contractus*
Sand dropseed	*Sporobolus cryptandrus*
Mesa dropseed	*Sporobolus flexuosus*
Narrowleaf wirelettuce	*Stephanomeria minor*
Brownplume wirelettuce	*Stephanomeria pauciflora*
Common dandelion	*Taraxacum officinale*
Yellow salsify	*Tragopogon dubius*
Siberian elms	*Ulmus pumila*
Bigbract verbena	*Verbena bracteata*
Banana yucca	*Yucca baccata*
Soapweed yucca	*Yucca glauca*
Rocky Mountain zinnia	*Zinnia grandiflora*

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APPENDIX B BUILDINGS WITHIN OR NEAR PROJECT AREA

TABLE B-1 Buildings within or near Project Area

Building Number	*Eligibility*
Within Boundary	
9916A	not determined
9917	not determined
9919	not determined
9920	not determined
9921	not determined
9921B	not determined
9921C	not determined
9921D	not determined
9922	not determined
9923	not determined
9924	not determined
9926A	not determined
9926A2	not determined
9926L	not determined
9926M	not determined
9926N	not determined
9926S	not determined
9926W	not determined
9926Z	not determined
9928	not determined
9929	not determined
9940	not eligible
99401B	not determined
99402B	not determined
9941	not determined
9942	not determined
9950	not determined
9950A	not determined
9951	not determined
9952	not determined
9953	not determined
9954	not determined
9955	not determined
9956	not determined
9956A	not determined
9956D	not determined
9956E	not determined
9956F	not determined
9957	not determined
9964	not eligible
9964A	not eligible

Building Number	*Eligibility*
Within Boundary (continued)	
9965	not eligible
9965A	not eligible
9965B	not eligible
9965C	not eligible
9965E	not eligible
9965H	not eligible
9965I	not eligible
9965J	not eligible
9965K	not eligible
9965M	not eligible
9966	not eligible
S9966A	not eligible
9966C	not eligible
9966D	not eligible
9967	not eligible
9968	not eligible
9969	not eligible
Outside but Near Boundary	
9930	not determined
9930A	not determined
9930B	not determined
9930C	not determined
9931	not determined
9932	not determined
9932A	not determined
9933	not determined
9933A	not determined
9934A	not determined
9958	not determined
9959	not determined
9960	not determined
9960B	not determined
9961	not determined
9961A	not determined
9962	not determined

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APPENDIX C AIR QUALITY

Section 1. Transportation Activities Emissions

Particulate emissions from dirt roads (as PM_{10}) were estimated using the standard equation from EPA AP-42 *Chapter 13.2.2 Unpaved Roads* for light duty vehicles traveling dirt roads. This equation was chosen because the vehicles that would be used in the Proposed Action are predominantly light duty vehicles with a gross vehicle weight less than 3 tons. Variables required for the calculation of the emission factor include the silt content and moisture content of road surface material, vehicle speed, and number of precipitation days per year:

$$E = \frac{k\ (s/12)^{a}\,(S/30)^{d}}{(M/0.5)^{c}} - C$$

where k, a, c, and d are empirical constants, and

E = size-specific emission factor (lb/vehicle mile traveled)
s = surface material silt content (%)
M = surface material moisture content (%)
S = mean vehicle speed
C = emission factor for 1980's vehicle fleet exhaust, brake wear, and tire wear

Below are the constants used in the unpaved road emission factor:

PM-10

Constant	**Description**	**Value**	**Source**
k	particle size specific constant	1.8	AP-42 Table 13.2.2-2
s	surface material silt content (%)	7.0	*
a	silt content exponent	1	AP-42 Table 13.2.2-2
S	mean vehicle speed	25	Speed Limit
d	vehicle speed exponent	0.5	AP-42 Table 13.2.2-2
M	surface moisture content (%)	5.1	AP-42 Table 13.2.2-1
c	moisture content exponent	0.2	AP-42 Table 13.2.2-2
P	number of days/yr with 0.01″ precip	80	AP-42 Fig. 13.2.2-1
C	age correction factor	0.00047	AP-42 Table 13.2.2-4

* Bernalillo County PM-10 Emission Inventory for 2004, Desert Research Institute Division of Atmospheric Science, Las Vegas, Nevada.

Below is the correction factor used for precipitation:

$E_{ext} = E\ ((365-P)/365)$

Where:

E_{ext} = emission factor extrapolated for natural mitigation (lb/vehicle mile traveled)
E = emission factor from equation above
P = number of days in a year with at least 0.01″ of precipitation

The calculated emission factor and the variables used are listed in Table C-1. This emission factor is expressed in pounds of PM_{10} per average vehicle mile traveled.

TABLE C-1 Fugitive Dust Roadway Emission Factor

Parameter (units)	Value
Calculated emission factor (lb/vehicle mile traveled) [a]	0.235
Correction for precipitation (constant)	0.47
Controls – surface treatment	50%
Surface material silt content (%) [s]	7.0
Surface material moisture content (%) [M]	5.1
Mean vehicle speed [S]	25
Emission factor for exhaust, brake wear, and tire Wear (lb/vehicle mile traveled) [*C*]	0.00047
Empirical Constants (unitless) [b]	
k	1.8
a	1.0
c	0.2
d	0.5

[a] Calculation method is detailed in AP-42 *Chapter 13.2.2 Unpaved Roads*
[b] Empirical Constants – Public Roads PM_{10} values

A 50 percent surface treatment control was assumed when calculating the emission factor. Current practices at the 9940 Complex include the use of chemical polymer stabilization on the roadways to reduce the amount of fugitive dust. The use of this substance, or equivalent, would be required for the new roads in the Proposed Action.

Multiplying the emission factor by the average vehicle mile traveled results in the estimated emission rate for PM_{10} from vehicle usage. The current vehicle usage at the existing facilities was doubled to account for potential growth in operations under the Proposed Action. The estimated emission rate of PM_{10} from the unpaved roadways within the project area is 0.0906 grams/second. As per New Mexico Environmental Department modeling guidelines (NMAQB 2007), it was assumed that the emission rate was spread over a 10 meter by 10 meter area which results in 9.06E-04 grams/second-square meter.

This emission rate was used in the EPA screening model (SCREEN) as an area source to determine the potential concentration of PM_{10} in micrograms per cubic meter ($\mu g/m^3$) to the nearest KAFB boundary. The SCREEN result was compared to the EPA significance levels to determine if detailed dispersion modeling would be required. The concentration calculated using SCREEN indicated that no detailed dispersion modeling is required for this site. Table C-2 lists the modeled result along with the comparison to the significance levels.

TABLE C-2 Fugitive Dust Roadway Estimated Emissions

Parameter	Value [a]	Units
Estimated emission rate	9.06E-04	$g/s\text{-}m^2$
Maximum 1-hour concentration at nearest fenceline (SCREEN model result)	26	$\mu g/m^3$
24-hour correction	0.15	-
Maximum 24-hour concentration	3.9	$\mu g/m^3$
Annual correction	0.03	-
Maximum annual concentration	0.78	$\mu g/m^3$
PM_{10} EPA Significance Levels		
24-hour	5	$\mu g/m^3$
Annual	1	$\mu g/m^3$

[a] Values are found in the NMED modeling guidelines.

Section 2. Explosive Detonation Emissions and Screening

Emissions from explosive detonations were estimated for all proposed shot limit amounts listed in Table 2.2-2 (plus a 5- and 20-pound shot) using the U.S. EPA-approved air dispersion model, Open Burn/Open Detonation Model (OBODM). The types of explosives proposed for use were compared to the available selections in the OBODM as listed in Table C-3. Using the three explosives supported by the OBODM, the Criteria Pollutants and Hazardous Air Pollutants (HAPs) were identified for each explosive along with the associated emission factor, listed in Table C-4. The highest emission factor represents the worst case for each pollutant that was modeled and is identified in the table with a yellow highlight.

TABLE C-3 Types of Explosives and OBOD Model Comparison

Type	OBOD Model Explosive
TNT	Yes
RDX	Yes
PBX	No
PETN	No
ANFO	No
Semtex	No
Data Sheet	No
Prima Sheet	No
Comp C4	No
Comp B	Yes
DNT	No
HMX	No
PBXN-5	No
Nitro methane	No

TABLE C-4 Emission Factors for OBODM Pollutants with Criteria and HAP Identification

Pollutant	TNT	RDX	Comp B	Criteria	HAP
1,3 butadiene	0.0000017	---	---	---	Yes
Barium	0.0082	---	---	---	Yes
Benzene	0.0000041	0.000069		---	Yes
Carbon monoxide	0.01	0.031		Yes	---
Cadmium	0.00004	---	---	---	Yes
Carbon tetrachloride	---	---	0.00000036	---	Yes
Chromium	0.000023	---	---	---	Yes
Copper	0.0005	---	---	---	Yes
Ethylbenzene	0.00000047	---	0.000002	---	Yes
Lead	0.000009	---	---	---	Yes
Nitric oxide	0.0097	0.0009	0.0093	Yes	---
Nitrogen dioxide	0.00076	0.0006	0.00019	Yes	---
Methylene chloride	0.00018	---	0.00014	---	Yes
PM_{10}	0.093	---	0.012	Yes	---
Sulfur dioxide	0.00014	---	0.00013	Yes	---
Styrene	0.0000015	---	---	---	Yes
Tetrachloroethylene	---	---	0.000018	---	Yes
Toluene	0.0000051	---	0.000006	---	Yes
n-Hexane	0.00000093	---	0.00000055	---	Yes

HAP Emissions Screening

The hourly (potential to emit) emissions of HAPs from explosive detonations were compared to the Occupational Exposure Limit (OEL) divided by 15, as prescribed in the New Mexico Environment Department air permitting regulation 20 NMAC 2.72 (Table C-5). If the HAP emissions are less than the OEL/15 emission rate, then the emissions are considered to be insignificant. This methodology is based on the *New Mexico Air Quality Bureau Air Dispersion Modeling Guidelines* (NMAQB 2007). If the potential HAPs emissions are greater than the OEL/15 emission rate, then the pollutant was evaluated for impact using the OBODM. The OEL values are from the American Conference of Governmental Industrial Hygienists (2006) documentation if available. The National Institute of Occupational Safety and Health pocket guide to chemical hazards was used for constituents that were not included in American Conference of Governmental Industrial Hygienists documentation. The emissions for the HAPs screening was based on a 2,000-pound detonation assumed to occur over 15 seconds, the modeling time for an instantaneous explosive source.

TABLE C-5 HAPs Emission (lb/hr) and OEL/15

Pollutant	lb/hr [a]	OEL/15 [b]	lb/hr Less then OEL/15 [b]
1,3 Butadine	1.417E-05	0.0667	Yes
Barium	0.0683	0.0330	No
Benzene	3.417E-05	0.2129	Yes
Cadmium	0.000333	0.0003	No
Carbon tetrachloride	0.000003	4.1936	Yes
Chromium	0.0001917	0.0667	Yes
Copper	0.00416	0.0667	Yes
Ethylbenzene	1.667E-05	29.0000	Yes
Lead	0.000075	0.0033	Yes
Methylene chloride	0.002359	5.787	Yes
Styrene	0.0000125	28.4000	Yes
Tetrachloroethylene	0.00015	45.2080	Yes
Toluene	0.00005	50.2247	Yes
n-Hexane	0.00186	120.000	Yes

[a] The detonation emissions are recorded in lb/hr units.
[b] The units of OEL are typically mg/m^3. The *New Mexico Air Quality Bureau Air Dispersion Modeling Guidelines – Revised April 2007* define that when the OEL is divided by 15 a direct comparison can be made with the lb/hr unit to determine if modeling is required.

Section 3. OBODM Parameters and Results

Input Parameters

Default OBODM input parameters were used except for those listed below.

RECEPTOR DATA–GRID SYSTEM

A 100-meter by 100-meter grid out to 5,000 meters from the detonation point was used for the model runs for explosive values of 2,000, 1,100, 500, 350, and 100 lb. A 50-meter by 50-meter grid out to 3,000 meters from the detonation point was used for explosive values of 50, 20, and 5 lb.

METEOROLOGICAL DATA

The following meteorological parameters were used in the modeling:

Surface pressure (mb) [600.0-1100.0]	840.00
Pasquill stability category [A-F]	D
Reference wind speed (m/s) [1.0- 50.0]	2.000
Surface roughness length (cm) [.00-100.00]	15.000

SOURCE DATA

Particulate matter produced by the explosive detonation would have the potential to consist of many constituents (Table C-5). In an attempt to develop a representative composite for particulate matter consisting of a variety of light and heavy metals, potential test objects, and the main organic ingredient of carbon, the following breakdown of a composite particulate was used.

Carbon black (50%)
MW =12.01, D =2.62

Aluminum oxide (25%)
MW =101.96, D= 3.97

Lead oxide (25%)
MW =223.2, D=9.35

Taking a weighted average to get a composite representation of the particulate matter, the following values were used in the OBODM for molecular weight and density of PM_{10}:

Molecular weight (g/g-mol) = 87.29
Density (g/cm^3) = 4.64

Because the metals are most likely coming from small impurities and the explosive container, it is most probable that the actual percentage of metals in the PM_{10} is less than the 50 percent identified in these assumptions. The following is the particle size distribution used:

Upper Bound	Lower Bound	Mass Fraction
2.0	0.1	.25
4.0	2.1	.25
6.0	4.1	.20
8.0	6.1	.15
10.0	8.1	.15

<u>Results</u>

The pollutant concentrations from the OBODM are listed in Table C-6. Note that explosive quantities of 50 pounds and less are not modeled at the KAFB boundary.

TABLE C-6 OBODM-Determined Pollutant Concentrations by Pounds of Explosives, Location, and Timeframe

Constituent	Concentration (ug/m^3)	Deposition (ug/m^2)	Location (x) meters
2,000 pound–T-Range 7 Maximum Concentrations			
CO	117.13	NA	1600
Cadmium	3.2958	379.06	1600
NO	51.863	NA	1600
NO2	4.0635	NA	1600
PM10	453.98	NA	1600
SO2	0.74854	NA	1600
Barium	307.75	25.698	1600
Copper	41.732	4.864	1600
Methylene chloride	0.57655	NA	1600
2,000 pound–T-Range 7 1-hour Peak Concentrations			
CO	5.3054	NA	400
Cadmium	0.065261	NA	300
NO	2.1448	NA	400
NO2	0.16804	NA	400
PM10	22.484	NA	400
SO2	0.030955	NA	400
Barium	8.3393	NA	400
Copper	0.82448	NA	300
Methylene chloride	0.025509	NA	400
2,000 pound–T-Range 7 KAFB Boundary 1-hour Peak Concentrations			
CO	5.28739	NA	1200
Cadmium	0.053427	5.75132*	1200
NO	2.09747	NA	1200
NO2	0.164337	NA	1200
PM10	22.1763	NA	1200
SO2	0.0302728	NA	1200
Barium	4.74882	10,905.5*	1200
Copper	0.0195362	60.7673*	1200
Methylene chloride	0.0253465	NA	1200
* Not 1-hour, peak at boundary			

TABLE C-6 OBODM-Determined Pollutant Concentrations by Pounds of Explosives, Location, and Timeframe (continued)

Constituent	Concentration (ug/m^3)	Deposition (ug/m^2)	Location (x) meters
1,100 pound–T-Range 1A Maximum Concentrations			
CO	100.27	NA	500
Cadmium	2.8792	288.73	300
NO	44.596	NA	500
NO2	3.4941	NA	500
PM10	390.47	1,756	500
SO2	0.64366	NA	500
Barium	274.56	19,881	500
Copper	41.732	4864	400
Methylene chloride	0.57655	NA	600
1,100 pound – T-Range 1A 1-hour Peak Concentrations			
CO	4.0384	NA	1000
Cadmium	0.047818	NA	300
NO	1.6319	NA	900
NO2	0.12786	NA	900
PM10	17.140	NA	900
SO2	0.023553	NA	900
Barium	6.5100	NA	600
Copper	0.82448	NA	600
Methylene chloride	0.02551	NA	1100
1,100 pound – T-Range 1A KAFB Boundary 1-Hr Peak Concentrations			
CO	3.44077	NA	1600
Cadmium	0.564768E-05	0.00992996*	1600
NO	1.27947	NA	1600
NO2	0.100246	NA	1600
PM10	13.8621	NA	1600
SO2	0.0184665	NA	1600
Barium	1.03221	1,731.41*	1600
Copper	0.002488	6.4193*	1600
Methylene chloride	0.023502	NA	1600
* Not 1-hour, peak at boundary			

TABLE C-6 OBODM-Determined Pollutant Concentrations by Pounds of Explosives, Location, and Timeframe (continued)

Constituent	Concentration (ug/m^3)	Deposition (ug/m^2)	Location (x) meters
350 pound–T-Range 4 Maximum Concentrations			
CO	74.994	NA	400
Cadmium	2.1377	166.27	200
NO	33.189	NA	400
NO2	2.6004	NA	400
PM10	290.59	982	400
SO2	0.47902	NA	400
Barium	221.04	12,339	400
Copper	27.639	2,182.7	200
Methylene chloride	0.36912	NA	400
350 pound–T-Range 4 1-hour Peak Concentrations			
CO	2.3994	NA	700
Cadmium	0.027033	NA	200
NO	0.96771	NA	700
NO2	0.07582	NA	700
PM10	10.178	NA	700
SO2	0.013967	NA	700
Barium	4.0123	NA	400
Copper	0.34884	NA	200
Methylene chloride	0.011549	NA	700
350 pound–T-Range 4 KAFB Boundary 1-hour Peak Concentrations			
CO	2.05	NA	1200
Cadmium	.00001	.0297	1200
NO	.7644	NA	1200
NO2	.05989	NA	1200
PM10	8.277	NA	1200
SO2	.011	NA	1200
Barium	.5335	864	1200
Copper	.0001	37.32	1200
Methylene chloride	.0096	NA	1200

TABLE C-6 OBODM-Determined Pollutant Concentrations by Pounds of Explosives, Location, and Timeframe (continued)

Constituent	Concentration (ug/m^3)	Deposition (ug/m^2)	Location (x) meters
100 pound–T-Range 1 Maximum Concentrations			
CO	54.530	NA	300
Cadmium	1.4657	85.633	200
NO	24.106	NA	300
NO2	1.8887	NA	300
PM10	211.25	NA	300
SO2	0.34793	NA	300
Barium	170.81	7,129.3	300
Copper	18.026	1,065.8	200
Methylene chloride	0.26834	NA	300
100 pound–T-Range 1 1-hour Peak Concentrations			
CO	1.3556	NA	500
Cadmium	0.016029	NA	200
NO	0.54917	NA	500
NO2	0.043027	NA	500
PM10	5.7672	NA	500
SO2	0.0079261	NA	500
Barium	2.4016	NA	300
Copper	0.19674	NA	200
Methylene chloride	0.0065319	NA	500
100 pound–T-Range 1 KAFB Boundary 1-Hr Peak Concentrations			
CO	0.648585	NA	1600
Cadmium	0.396856E-07	0.236872E-05*	1600
NO	0.224714	NA	1600
NO2	0.0176063	NA	1600
PM10	2.54143	NA	1600
SO2	0.0032433	NA	1600
Barium	0.0205163	20.1046*	1600
Copper	0.749098E-08	0.116538E-04*	1600
Methylene chloride	0.00300642	NA	1600
50 pound Maximum Concentrations			
CO	45.724	NA	250
Cadmium	1.4084	78.850	150
NO	20.253	NA	250
NO2	1.5868	NA	250
PM10	177.65	371.5	250
SO2	0.29231	NA	250
Barium	149.71	5,275.7	250
Copper	17.567	895.18	150
Methylene chloride	0.22511	NA	250

TABLE C-6 OBODM-Determined Pollutant Concentrations by Pounds of Explosives, Location, and Timeframe (continued)

Constituent	Concentration (ug/m^3)	Deposition (ug/m^2)	Location (x) meters
50 pound 1-hour Peak Concentrations			
CO	0.99257	NA	450
Cadmium	0.012726	NA	150
NO	0.40148	NA	400
NO2	0.031456	NA	400
PM10	4.2056	NA	400
SO2	0.0057946	NA	400
Barium	1.7960	NA	250
Copper	0.15843	NA	150
Methylene chloride	0.0047720	NA	450
20 pound Maximum Concentrations			
CO	36.220	NA	200
Cadmium	1.2164	50.487	100
NO	16.069	NA	200
NO2	1.2590	NA	200
PM10	141.09	233.8	200
SO2	0.23193	NA	200
Barium	123.26	3,496.2	200
Copper	15.474	651.61	200
Methylene chloride	0.17854	NA	200
20 pound 1-hour Peak Concentrations			
CO	0.65457	NA	350
Cadmium	0.0085985	NA	100
NO	0.26415	NA	350
NO2	0.020696	NA	350
PM10	2.7734	NA	350
SO2	0.0038124	NA	350
Barium	1.2161	NA	200
Copper	15.474	NA	100
Methylene chloride	0.00315	NA	350
5 pound Maximum Concentrations			
CO	33.576	NA	150
Cadmium	1.4986	39.326	50
NO	22.060	NA	100
NO2	1.7284	NA	100
PM10	195.16	79.5	100
SO2	0.31839	NA	100
Barium	180.71	3,052.6	100
Copper	19.251	513.75	50
Methylene chloride	0.18183	NA	150

TABLE C-6 OBODM-Determined Pollutant Concentrations by Pounds of Explosives, Location, and Timeframe (continued)

Constituent	Concentration (ug/m^3)	Deposition (ug/m^2)	Location (x) meters
5 pound 1-hour Peak Concentrations			
CO	0.41836	NA	250
Cadmium	0.0065409	NA	50
NO	0.22547	NA	250
NO2	0.017605	NA	250
PM10	2.3643	NA	250
SO2	0.0032542	NA	250
Barium	1.0301	NA	100
Copper	0.083917	NA	50
Methylene chloride	0.002153	NA	250

* Deposition is not time averaged, it is total maximum deposition at the location identified.

Section 4. Soil Accumulation Calculations

Given: Industrial soil screening level for cadmium is 564 mg/kg and barium is 100,000 mg/kg.
Assumption: 1. Soil density is 1.5 g/cm^3
2. Depth of cadmium in soil is 2 inches (soil sample depth) = 0.05m

Cumulative Concentrations from small scale tests at Thunder Range
Data taken from Tables 2.2-3 and 4.3-4.

Cadmium

(1300/yr) x (39.3 µg/m^2) + (100/yr) x (50.5 µg/m^2) + (50/yr) x (78.8 µg/m^2) = 60,080 µg/m^2/yr
(5 lb shots) **(20 lb shots)** **(50 lb shots)**

60,080 µg/m^2/yr = 60.08 mg/m^2/yr

Barium

(1300/yr) x (3.052 mg/m^2) + (100/yr) x (3.496 mg/m^2) + (50/yr) x (5.275 mg/m^2) = 4,580.95 mg/m^2/yr
(5 lb shots) **(20 lb shots)** **(50 lb shots)**

Solution:

Annual increase in cadmium concentration in soil:

$$60.08\frac{mg/yr}{m^2}\times\frac{1}{0.05m}\times\frac{cm^3}{1.5g}\times\frac{m^3}{10^6 cm^3}\times\frac{1000g}{kg} = 0.801 mg/kg/yr$$

Years to reach cadmium screening level:
Cadmium screening level (564 mg/kg) / (0.801 mg/kg/yr) = 704 years

Annual increase in barium concentration in soil:

$$4581\frac{mg/yr}{m^2}\times\frac{1}{0.05m}\times\frac{cm^3}{1.5g}\times\frac{m^3}{10^6 cm^3}\times\frac{1000g}{kg} = 61.07 mg/kg/yr$$

Years to reach barium screening level:

Industrial barium screening level (100,000 mg/kg) / (61.07 mg/kg year) = 1,637 years

APPENDIX D NOISE, VIBRATION, AND OVERPRESSURE

Noise and vibrations are generated from the overpressure produced by explosive detonations. Detonation of explosives can produce dangerously high sound pressure levels from impulse overpressures. The sound pressure level (SPL) is related to a blast pressure using a logarithmic relationship. The SPL is given by:

$$SPL = 10 \log (P/Po)^2$$

where Po is the reference pressure of 20 micro-pascals, which is also defined as 0 decibels.

When the Occupational Safety and Health Administration (OSHA) threshold limit value 140 decibels level is inserted into this equation and the equation is solved for P, the result is 0.2 kilopascal (kPa). This value is used to calculate the safety radii for the OSHA threshold limit value for each explosive quantity.

The noise assessment considered limits for noise exposure provided by SNL/NM based on SNL and OSHA. Table D-1 lists the peak overpressures considered for potential impacts.

TABLE D-1 Peak Overpressure and Sound Pressure Level Thresholds Considered for Potential Impacts

Damage or Threshold Criteria	Peak Overpressure		SPL
	psi	kPa	dB
Impulse noise limit (140 decibels)	0.029	0.20	140
Cracked window (1 in 10,000)	0.029	0.20	140
Broken window	0.10	0.70	151
Light aircraft damage (in-flight)	0.20	1.40	156
Structural damage (building)	1.0	6.90	170
Small mammal injury (open)	2.0	13.8	177
Human eardrum rupture	3.0	20.7	180
Bird in flight injury	5.0	34.5	185
Burrowed small mammal injury	6.5	45.0	187
Lethal to small mammals (open)	8.0	55.2	189

psi = lb per square inch (Source: DOE 2007)
kPa = kilopascal
SPL = sound pressure leve
dB = decibels

The blast overpressure is calculated using a standard cube root, scaled distance equation based on TNT equivalency of the explosive material. Overpressures based on the maximum shot explosive weight are calculated as distance from the test area center point. Maximum shot explosive weights are listed in Table D-2.

TABLE D-2 Explosive Weight for Each Test Area

Site	Per Shot Limit (lb)
Thunder Range—Range 7	2,000
Thunder Range—Range 1A	1,100
Thunder Range—Range 4	350
Thunder Range—Range 6	130
Thunder Range—Range 1	100
9940 Site	50
9940 Training South	50
9940 Training East	50
ATEF	50
Thunder Range—Range 2	50
Site	Per Shot Limit (lb)
Thunder Range—Range 5	50
Thunder Range—Training Site North	50
Thunder Range—Training Site South	50
Thunder Range—Range 3	5
9940 Training West	-

ATEF = Advanced Technology Evolution Facility
lb=pounds

Safety radii for exposure to air overpressure resulting from detonation of explosives are calculated using the following equation

$$R = \left[\frac{105.93 W_a^{\;0.3667} \left(P_{\text{amb}} / P_{\text{standard}} \right)^{0.6333}}{\Delta P} \right]^{\frac{1}{1.1}}$$

Where W_a is the quantity of explosive (kg), P_{amb} is the ambient barometric pressure (85 kPa), and $P_{standard}$ is the sea level pressure (101 kPa). Given the two primary standards of concern, 0.20 kPa for worker safety and 0.7 kPa for structure impact (i.e., window breakage), the safety radii are listed in Table D-3.

TABLE D-3 Scaled Safety Radii for Blast Exposure (meters)

(W) Exp Qty		Pressure (kPa)	
		(140 decibels)	(glass)
(lb)	(kg)	0.2	0.7
1	0.5	208	67
5	2.3	356	114
10	4.5	449	144
20	9.1	566	181
50	22.7	768	246
100	45.4	967	310
130	59.0	1056	338
350	113.4	1469	470
500	226.8	1654	530
1100	499.0	2151	689
2000	907.2	2626	841

As presented in Table D-3, the bounding safety radius from 250 lb explosives for worker safety (i.e., below 140 decibels) is 1,469 meters from the center point of the test site. The bounding safety radius for structures is 470 meters from the center point of the test site. The bounding analysis corresponds to the Thunder Range – Range 7 Test Area. A majority of the tests (i.e., 98 percent) would use 50 pounds of explosives or less. From detonation of 50 lb explosives, the safety radius for worker safety is 768 meters and the safety radius for structures is 246 meters. Table D-4 lists the safety radii for each test area.

TABLE D-4 Noise and Overpressure Safety Radii for Each Test Area

Site	Per Shot Limit (lb)	Safety Radii (meters)	
		Worker	Structure
Thunder Range—Range 7	2000	2626	841
Thunder Range—Range 1A	1100	2151	689
Thunder Range—Range 4	350	1469	470
Thunder Range—Range 6	130	1056	338
Thunder Range—Range 1	100	967	310
9940 Site	50	768	246
9940 Training South	50	768	246
9940 Training East	50	768	246
Thunder Range—Range 10 (ATEF)	50	768	246
Thunder Range—Range 2	50	768	246
Thunder Range—Range 5	50	768	246
Thunder Range—Range 8 (Training Site North)	50	768	246
Thunder Range—Range 9 (Training Site South)	50	768	246
Thunder Range—Range 3	5	356	114
9940 Training West	—	—	—

The primary concern for vibration is the potential impacts on nearby structures. The safety radii for particle velocity can be computed based on the explosive yield using a conservative scaling distance of 50 foot/lb^2. Table D-5 lists the vibration safety radii for each test area.

TABLE D-5 Vibration Safety Radii for Each Test Area

Site	Per Shot Limit (lb)	Radii (meters)
Thunder Range—Range 7	2000	682
Thunder Range—Range 1A	1100	506
Thunder Range—Range 4	350	285
Thunder Range—Range 6	130	174
Thunder Range—Range 1	100	152
9940 Site	50	108
9940 Training South	50	108
9940 Training East	50	108
ATEF	50	108
Thunder Range—Range 2	50	108
Thunder Range—Range 5	50	108
Thunder Range—Training Site North	50	108
Thunder Range—Training Site South	50	108
Thunder Range—Range 3	5	34
9940 Training West	—	—

As listed, the vibration safety radii are within the overpressure radii for each test area and therefore the overpressure radii is bounding. Table D-6 lists a matrix of the impact radii (meters) for the overpressure thresholds listed in Table D-1 varying overpressure thresholds with explosive quantity.

TABLE D-6 Matrix of Impact Radii (distances in meters)

Explosive Quantity (TNT equivalent)		Overpressure (kPa)								
(lb)	(kg)	0.2	0.7	1.4	6.9	13.8	20.7	34.5	45	55.2
1	0.5	208	67	36	8	4	3	2	2	1
5	2.3	356	114	61	14	8	5	3	3	2
10	4.5	449	144	77	18	10	7	4	3	3
20	9.1	566	181	96	23	12	8	5	4	3
50	22.7	768	246	131	31	16	11	7	6	5
100	45.4	967	310	165	39	21	14	9	7	6
350	158.8	1469	470	250	59	31	22	14	11	9

APPENDIX E CORRESPONDENCE

To be developed upon completion of Final Environmental Assessment.

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