4.3 SANDIA NATIONAL LABORATORIES/NEW MEXICO

SNL/NM is located within the Kirtland Air Force Base (KAFB), approximately 11 kilometers (7 miles) southeast of downtown Albuquerque, New Mexico (see **Figure 4–12**). Albuquerque is located in Bernalillo County, in north central New Mexico, and is the state's largest city, with a population of approximately 420,000. The Sandia Mountains rise steeply immediately north and east of the city, with the Manzanita 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, each located about 25 kilometers (15.5 miles) to the northwest. The Pueblo of Sandia and town of Bernalillo are located 34 kilometers (21 miles) and 39 kilometers (24 miles), respectively, to the north. The Pueblo of Isleta and towns of Los Lunas and Belen are located 17 kilometers (10.5 miles), 28 kilometers (17.5 miles), and 45 kilometers (28 miles), respectively, to the southwest.

SNL/NM uses approximately 3,560 hectares (8,800 acres) of Federal land on KAFB which is administered by DOE's NNSA. There are approximately 670 buildings at SNL/NM, plus a number of structures associated with outdoor test areas. DOE missions at SNL/NM are conducted within five TAs, as well as several outdoor test areas. TAs comprise the basic geographic configuration of SNL/NM (see **Figure 4–13**). TA-I is the main administration and site support area and contains several laboratories. TA-II consists primarily of support service facilities along with the new Explosive Components Facility, several active and inactive waste management facilities, and vacated facilities replaced by the Explosive Components Facility. TA-III is devoted primarily to physical testing; TA-IV contains primarily accelerator operations; and TA-V contains primarily reactor facilities. The Coyote Test Field and the Withdrawn Area are used for outdoor testing (DOE 1999d). Unless otherwise referenced, the following descriptions of the affected environment at SNL/NM and TA-V are based all or in part on information provided in the *SNL/NM SWEIS* (DOE 1999d), which is incorporated by reference.

4.3.1 Land Resources

4.3.1.1 Land Use

KAFB is an Air Force Materiel Command Base located southeast of Albuquerque, New Mexico. KAFB shares facilities and infrastructure with several organizations, including DOE. It is comprised of 20,865 hectares (51,559 acres) of land, including portions of Cibola National Forest withdrawn in cooperation with the U.S. Forest Service. KAFB is geographically bounded by the Pueblo of Isleta to the south, the Albuquerque International Sunport and lands held in trust by the State of New Mexico to the west, and the city of Albuquerque to the north (see Figure 4–13). The eastern boundary lies within the Manzanita Mountains. Land owned by the Pueblo of Isleta is a wide expanse of open rangeland. Lands held in trust by the State of New Mexico include the Mesa del Sol area, which is a 5,260-hectare (13,000-acre) parcel of vacant land that has been annexed by the city of Albuquerque and will be developed in the future. The city of Albuquerque has the most influence on land use adjacent to the north-northwestern boundary of KAFB. The city has experienced steady growth in these areas characterized by single-family and multi-family residential dwellings, mixed/minor commercial establishments, and light industrial/wholesale operations. The northeast boundary of KAFB is surrounded almost entirely by Cibola National Forest.

Land ownership on KAFB is divided primarily among the U.S. Air Force (49 percent), the U.S. Forest Service (31 percent), DOE (6 percent), and the Bureau of Land Management (5 percent). The majority of acreage comprising the western half of KAFB is owned by the U.S. Air Force. DOE also owns land in this area, which is occupied almost entirely by SNL/NM facilities. Some land in the southwestern half of the base is owned by the Bureau of Land Management and has been withdrawn by the U.S. Air Force. The eastern portion of KAFB, commonly referred to as the Withdrawn Area, consists of more than 8,288 hectares

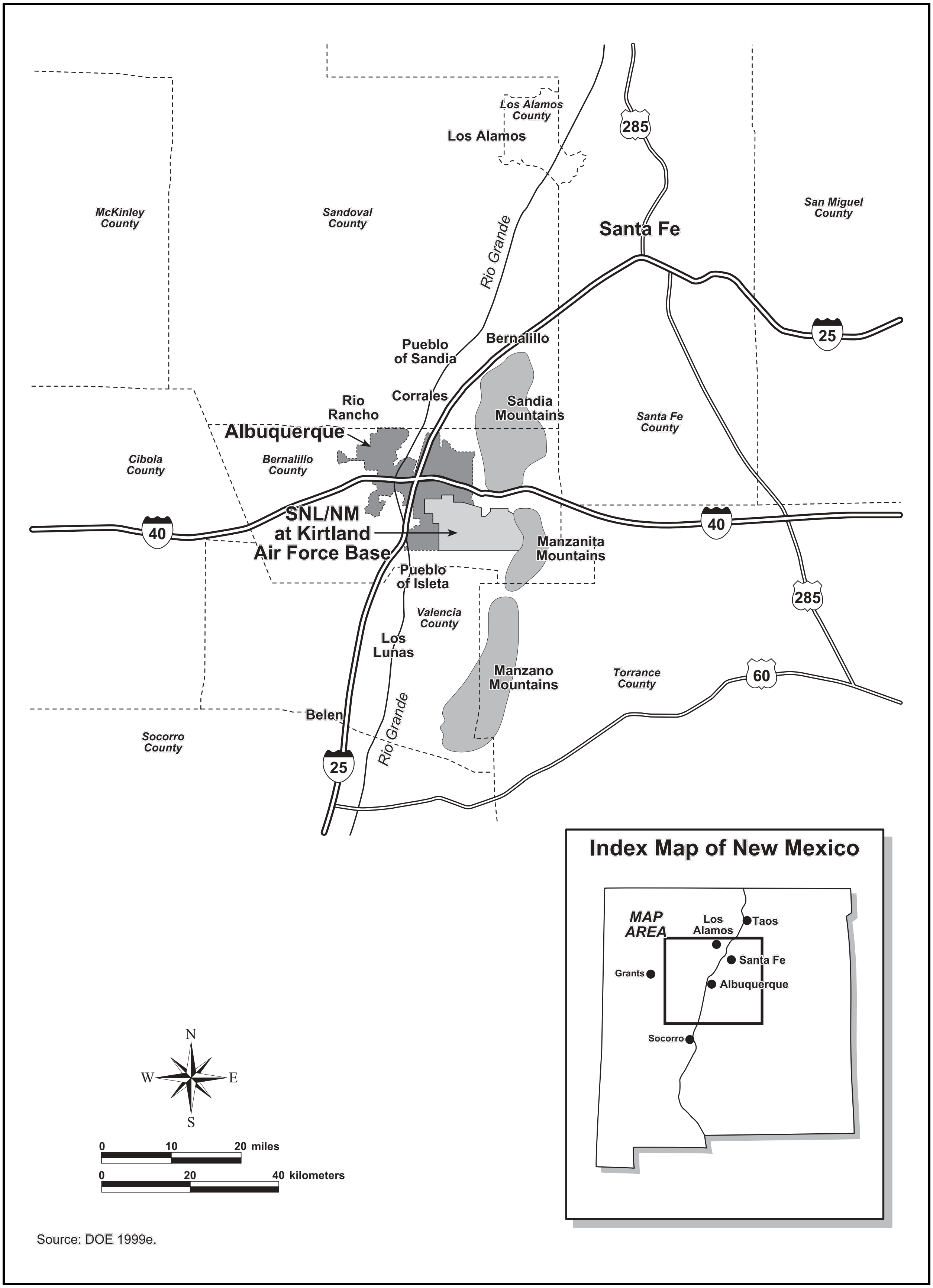
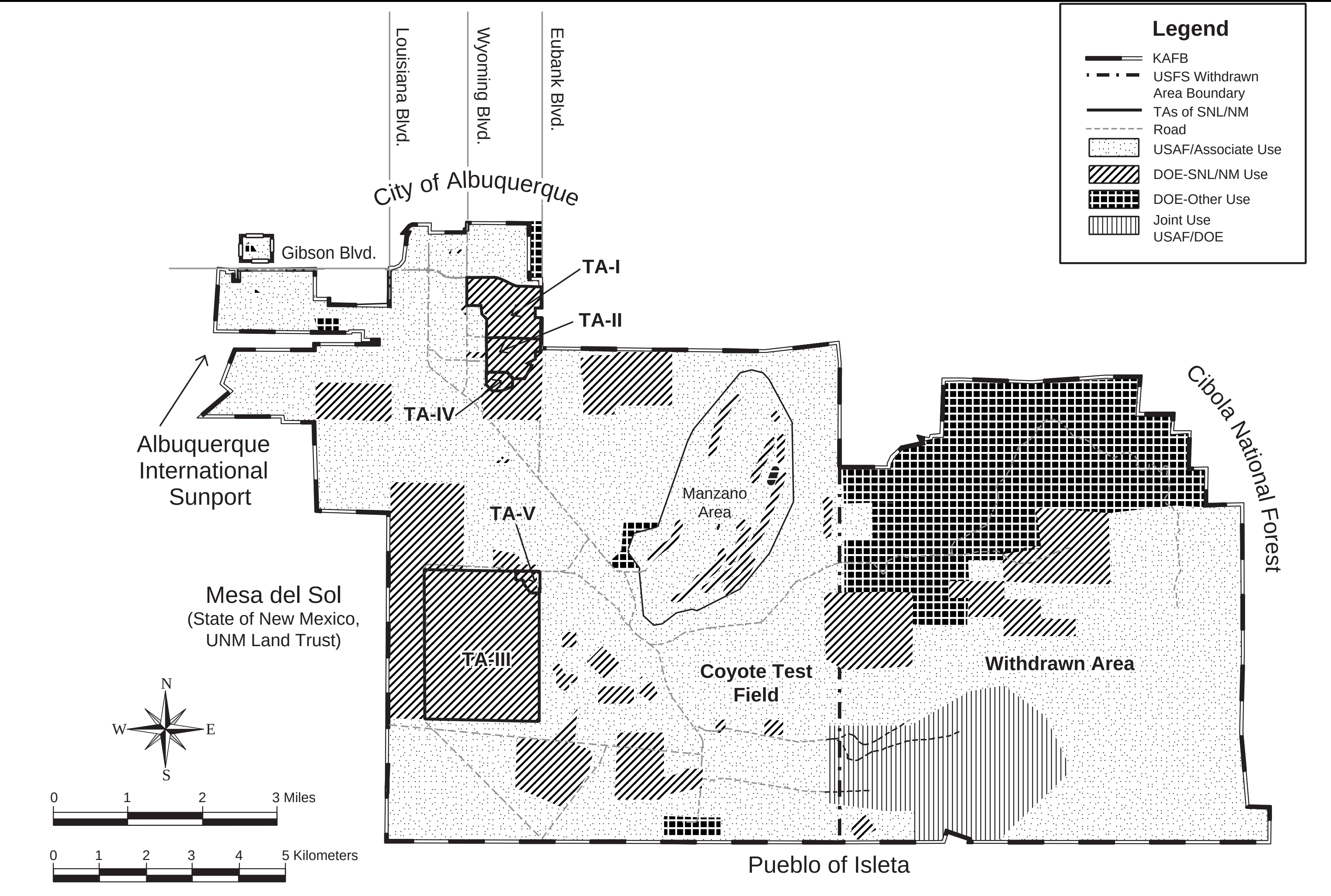


Figure 4–12 Location of SNL/NM



Source: DOE 1999b.

Figure 4–13 Land Use at KAFB

(20,480 acres) of U.S. Forest Service land within the Cibola National Forest that has been withdrawn by the U.S. Air Force and DOE in separate actions.

The U.S. Air Force and DOE are the principal land users within the KAFB. Land use is established through coordination and planning agreements between these agencies. On matters involving the Withdrawn Area, the U.S. Forest Service is also involved. The U.S. Air Force operates on much of its own land, as well as on property within its portion of the Withdrawn Area. DOE owns only a small portion of the land it needs, and is required to conduct many of its activities under permit on land owned or withdrawn by the U.S. Air Force or within its section of the Withdrawn Area. DOE also leases land adjacent to KAFB to support SNL/NM activities. SNL/NM facilities and operations encompass the majority of DOE's land use requirements on KAFB. Other DOE-funded facilities located on KAFB include the Lovelace Respiratory Research Institute; the Nonproliferation and National Security Institute; the Transportation Safeguards Division; Federal Manufacturing and Technology/New Mexico; Ross Aviation, Inc.; the Energy Training Center; and the DOE/Albuquerque Operations Office.

There is no single comprehensive land use plan for KAFB; however, existing land use designations and future planning scenarios are addressed in documents produced by the U.S. Air Force, the U.S. Forest Service, and SNL/NM. As discussed in the *SNL/NM SWEIS*, these documents include the *KAFB Comprehensive Plan*, the *Cibola National Forest Land and Resource Management Plan*, the *SNL Sites Comprehensive Plan*, and *SNL Sites Integrated Master Plan*.

The primary land use at SNL/NM fits into the industrial/research park category. This category coincides with the preliminary future use scenarios presented to the Citizens Advisory Board of the Future Use, Logistics, and Support Working Group. KAFB land used by the U.S. Air Force is also designated for industrial use, but includes a broader range of other uses such as residential, recreational, and medical activities that are associated with day-to-day base operations. Additionally, large areas of land within KAFB, particularly in the Withdrawn Area, do not support specific facilities or programs, but are used as safety zones in association with U.S. Air Force and DOE testing and training activities. The five SNL/NM TAs cover approximately 1,036 hectares (2,560 acres), or 87 percent of DOE-owned land. The land area covered by TAs-I through V is 142 hectares (350 acres), 85 hectares (210 acres), 765 hectares (1,890 acres), 34 hectares (85 acres), and 10 hectares (25 acres), respectively.

TA-V is located adjacent to the northeast corner of TA-III (see Figure 4–13). In addition to DOE-owned lands within the boundaries of TA-V, approximately 2.4 hectares (2 acres) are permitted to DOE by the U.S. Air Force to provide additional security. TA-V is a relatively small research area consisting of about 35 closely grouped structures with little open space (see Figure 3–7). Experimental and engineering nuclear reactors are located within the site. Approximately 159 personnel work in the area.

4.3.1.2 Visual Resources

The surrounding visual characteristics of SNL/NM consist of mostly flat, gently sloping grassland to the west and mountainous terrain to the east. Key landforms that dominate views in the general area include the Four Hills Formation, the Manzanita Mountains, and the Manzano Mountains further south. From areas of Albuquerque nearest KAFB, views to the east and southeast are limited by the Four Hills Formation and surrounding foothills of the Manzano area. Views to the south partially consist of KAFB facilities, the Albuquerque International Sunport, and open rangeland. In general, the terrain features associated with the western portion of KAFB are not particularly distinctive. The eastern half, however, exhibits greater visual variety due to its mountain and canyon topography. Most SNL/NM facilities are well within the KAFB boundary. Because of their location and the surrounding terrain characteristics, most facilities are not visible from roads and areas with public access. Distant views of TA-I are possible from eastbound Interstate 40, but they are brief and show limited detail. Views from Interstate 25 consist of background landscapes only.

Development is the most apparent modern alteration of the natural environment on KAFB affecting visual resources. Much of this activity is striking in nature and characterized by an urban setting with large buildings, extensive roadways, utility structures, parking lots, and other developed areas. The northwestern portion of KAFB, which includes SNL/NM TAs-I, -II and -IV, is the most populated and densely developed area that exemplifies these conditions. Although limited in size, TA-V is also heavily developed. TA-III has a more limited and scattered development pattern, but similarly exhibits a variety of man-made modifications that affect the visual environment. Developed areas of SNL/NM have a Bureau of Land Management Visual Resource Contrast Class IV rating (i.e., management activities dominate the view and are the major focus of viewer attention). SNL/NM has initiated Campus Design Guidelines in an effort to give more consideration to visual impacts. The Coyote Test Field and particularly the Withdrawn Area are more sparsely developed. Undeveloped and sparsely developed lands within KAFB have a Visual Resource Contrast rating of Class II or III. Management activities within these classes may be seen but should not dominate the view.

TA-V, which, as noted above, contains 35 closely grouped structures within a relatively small area, has a Class IV Visual Resource Management Contrast rating.

4.3.2 Site Infrastructure

Site infrastructure characteristics for SNL/NM and KAFB are summarized in **Table 4–19**.

Table 4–19 SNL/NM and KAFB Sitewide Infrastructure Characteristics

Resource	***Site Usage*** [a]	***Site Capacity*** [a]
Transportation		
Roads (kilometers)	72 [b]	Not applicable
Railroads (kilometers)	0	Not applicable
Electricity		
Energy (megawatt-hours per year)	504,000	1,100,000
Peak load (megawatts)	69 [c]	125
Fuel		
Natural gas (cubic meters per year)	35,700,000	65,100,000
Liquid fuels	1,500,000	Not applicable
Coal (metric tons per year)	0	0
Water (liters per year)	4,400,000,000	7,600,000,000

[a] Site usage and capacity values are for all of KAFB, of which SNL/NM is a part, with the exception of liquid fuels usage which is available for SNL/NM only.
[b] Includes paved and unpaved roads.
[c] Peak load estimated from site-wide electrical energy capacity assuming peak load is 120 percent of average demand.
Sources: DOE 1999d.

4.3.2.1 Ground Transportation

The site maintains about 32 kilometers (20 miles) of paved roads and 40 kilometers (25 miles) of unpaved roads (see Table 4–19). There are also approximately 65 hectares (160 acres) of paved service and parking areas. Rail facilities are not available on KAFB. Local and linking transportation systems, including roadways, are detailed in Section 4.3.9.4.

4.3.2.2 Electricity

Electrical service to KAFB and SNL/NM is supplied by Public Service Company of New Mexico. The electrical transmission system is a high-voltage (46-kilovolt) overhead transmission system from the Public Service Company of New Mexico to the various substations within SNL/NM. SNL/NM maintains approximately 185 kilometers (115 miles) of electrical transmission/distribution lines and 26 master unit substations that distribute all its electrical power. The Public Service Company of New Mexico provides power to SNL/NM through the Eubank substation, located east of SNL/NM. A second source of power from the Public Service Company of New Mexico is currently under construction south of TA-IV. South of Tijeras Arroyo, KAFB owns and maintains the transmission lines that support SNL/NM facilities. The system has experienced outages to facilities in TAs-III, -IV, and -V and the Coyote Test Field. Improvements to the system are anticipated pending completion of an upgrade project.

The KAFB electrical capacity is about 1.1 million megawatt-hours per year (see Table 4–19). In 1996, SNL/NM used 197,000 megawatt-hours of electricity. The rest of KAFB used 307,000 megawatt-hours of electricity in 1996. Peak load usage at SNL/NM is 32 megawatts (DOE 1996e). It is estimated that KAFB and SNL/NM have a combined peak load demand of about 69 megawatts. Site-wide peak load capacity is 125 megawatts. Electric power usage at TA-V is estimated to be approximately 5,000 mega-watt-hours annually (SNL/NM 2001b).

4.3.2.3 Fuel

Natural gas supplied by the Public Service Company of New Mexico to SNL/NM and KAFB is the primary heating fuel used at the SNL/NM steam plant. The source of natural gas to KAFB and the SNL/NM central steam plant is a high-pressure line that enters KAFB near the intersection of Pennsylvania Avenue and Gibson Boulevard. SNL/NM also maintains 7.2 kilometers (4.5 miles) of gas line. Natural gas is also supplied to self-contained boilers at SNL/NM facilities in TAs-I, -II, and -IV, which are not on the steam distribution system. Laboratories also use natural gas in many of the buildings for heating and experiments. Diesel fuel is used as an emergency backup during natural gas pressure interruptions.

The KAFB natural gas delivery system has a capacity of about 65 million cubic meters (2.3 billion cubic feet) per year (Table 4–19). In 1996, SNL/NM used approximately 16.4 million cubic meters (580 million cubic feet) of natural gas. Other KAFB users accounted for about 19.3 million cubic meters (680 million cubic feet) of additional natural gas usage. SNL/NM use of propane was about 1.4 million liters (370,000 gallons) and is used in TAs-III and -V and in other remote locations. Diesel fuel use was approximately 57,000 liters (15,000 gallons) in 1996. Annual propane and fuel oil use by other KAFB users is not available. TA-V uses approximately 142,000 cubic meters (5 million cubic feet) of natural gas and about 189,000 liters (50,000 gallons) of propane annually (SNL/NM 2001b).

4.3.2.4 Water

KAFB owns and operates the water supply and distribution system, which includes piping, the main booster pump station, storage reservoirs, and wells. Water is supplied from wells located generally in the northwestern portion of KAFB that withdraw from the Santa Fe Group (see Section 4.3.6.2). Neither the existing water service from KAFB to SNL/NM, nor most major SNL/NM facilities are metered. The system has a capacity of approximately 7.6 billion liters (2 billion gallons) per year (Table 4–19). In 1996, SNL/NM used approximately 1.7 billion liters (440 million gallons) of water. Other KAFB users accounted for about 2.7 billion liters (710 million gallons) of additional water usage. TA-V uses about 6.1 million liters (1.6 million gallons) of water per year (SNL/NM 2001b).

4.3.3 Air Quality

The climate at SNL/NM and in the surrounding region is semiarid. The ambient temperatures in the region are characteristic of high-altitude, dry continental climates. Winter daytime temperatures average approximately 10 °C (50 °F), with nighttime temperatures often dropping into the low teens. Summer daytime temperatures generally do not exceed 32 °C (90 °F), except in July, when average maximum temperatures reach 34 °C (93 °F). The Albuquerque basin is characterized by low precipitation, averaging between 19 and 25 centimeters (7.5 and 10 inches) per year. Most of this precipitation falls from July through September and usually occurs from thunderstorm activities and the intrusion of warm, moist tropical air from the Pacific Ocean. The storms are accompanied by localized heavy wind gusts. Winter months are typically dry, with less than 5 centimeters (2 inches) of precipitation and limited snowfall. The average annual relative humidity is about 43 percent. New Mexico has one of the greatest frequencies of lightning in the United States. Tornadoes are uncommon in the Albuquerque basin.

Temperature, relative humidity, and precipitation do not vary dramatically across the region. Daily and seasonal wind patterns occur near the mountains and plateau. Daytime up-slope flows are usually coupled with downslope flows during the night. Strong springtime, easterly winds occur near canyons, and light north-south flows occur in the Rio Grande Valley. In general, areas closer to the mountains or canyons experience more frequent winds from an easterly direction at night. Daytime wind patterns are not as pronounced, but generally flow toward the mountains or along the Rio Grande Valley. The Rio Grande Valley experiences the most frequent calm conditions and the lowest average wind speed. In most areas, the nighttime wind direction frequency produces the most dominant average annual direction. The average annual wind speed is 4 meters per second (8.9 miles per hour) (WRCC 2001).

4.3.3.1 Nonradiological Releases

SNL/NM is in the Albuquerque Middle Rio Grande Intrastate Air Quality Control Region (#152) (40 CFR 81.83). The EPA has classified this region as better than national standards for sulfur dioxides; unclassifiable/attainment for ozone; unclassifiable for PM_{10}; unclassifiable or better than national standards for nitrogen dioxide; attainment (maintenance area) for carbon monoxide; and not designated for lead (40 CFR 81.332). The nearest Prevention of Significant Deterioration Class I area to SNL/NM is Bandelier National Monument, which is located 80 kilometers (50 miles) to the north-northeast.

The primary stationary sources of criteria pollutants are the steam plant boilers (which represent more than 90 percent of the total emissions of criteria pollutants), Building 862 generators, and the fire testing facilities located at the Lurance Canyon Burn Site. Other sources are spatially separated, thereby contributing minimal impacts. Emissions of hazardous chemical air pollutants include those from facilities that release chemicals to the atmosphere and from operations at the burn site.

The steam plant produces heat for buildings in TA-I and the eastern portion of KAFB. SNL/NM has four standby generators, each with a 600-kilowatt capacity. These diesel-fired generators are in TA-I, Building 862. The generators have a local air quality permit limiting operation to 500 hours per year per generator. They are started monthly for maintenance and testing, as well as during electrical power outages in TA-I. The fire testing facilities (Lurance Canyon Burn Site) include a number of open pools, the Smoke Emission Reduction Facility, and the Small Wind-Shielded Facility. The open pools emit directly to the atmosphere, while the two facilities are closed and emit through exhaust stacks. The fire testing facilities are used to test the response of shipping containers, aerospace components, and other items to high-temperature conditions. These facilities typically average 42 tests per year; each test lasts about 30 minutes, although some can last as long as 4 hours. Mobile sources (motor vehicles) are a major source of criteria pollutant emissions in and around SNL/NM. **Table 4–20** summarizes the emissions associated with these facilities for 1996, as well as volatile organic compound and hazardous air pollutant emissions from the entire site.

Table 4–20 Estimated Air Emissions from Stationary Sources at SNL/NM in 1996

Pollutant	*1996 Emissions (metric tons per year)*
Carbon monoxide	13.8
Nitrogen oxides	140
PM_{10}	3.31
Sulfur dioxide	0.29
Volatile organic compounds	3.69
Hazardous air pollutants	2.2

PM_{10} = Particulate matter less than or equal to 10 microns in aerodynamic diameter.
Source: DOE 1999d.

Volatile organic compound and hazardous air pollutant emissions also come from laboratories, miscellaneous chemical operations, and the fire testing facilities. Chemical uses and the corresponding emissions occur in each TA and in the outlying test areas. In 1996, hazardous air pollutant emissions associated with chemical users were 2.2 metric tons (2.4 tons). Volatile organic compound emissions for 1996 were approximately 3.7 metric tons (4.07 tons).

Few industrial emission sources exist in the region. Primary air pollutant emissions in the region result from using motor vehicles, the seasonal use of wood-burning stoves and fireplaces, and open burning activities.

Air quality for SNL/NM is governed by regulations promulgated locally by the Albuquerque/Bernalillo County Air Quality Control Board and federally by the EPA. The EPA has delegated authority for regulating sources under the Clean Air Act to the State of New Mexico. In turn, the State of New Mexico has delegated authority for regulating sources to the Control Board, located in Bernalillo County.

The Albuquerque/Bernalillo County Air Quality Control Board promulgates regulations in 20 New Mexico Administrative Code 11 for compliance with the Clean Air Act, as well as applicable state and local air quality requirements. The Albuquerque Environmental Health Department Air Quality Division administers the regulations promulgated by the Control Board. The New Mexico Environmental Improvement Board has established ambient air quality standards (20 New Mexico Administrative Code 2.3) that are generally more stringent than the Federal standards and that incorporate additional standards for hydrogen sulfide and total reduced sulfur. In addition to the criteria pollutants provisions, the EPA established in 40 CFR Part 61 the National Emission Standards for Hazardous Air Pollutants (NESHAP) and Title III of the 1990 Clean Air Act Amendments, which define hazardous air pollutants. The primary nonradiological pollutants considered in this EIS are criteria pollutants and hazardous air pollutants. Hazardous air pollutants include the 188 hazardous air pollutants defined by the EPA in Title III of the Clean Air Act. Also included are other potentially toxic chemical air pollutants for which occupational exposure limits have been defined by various organizations, including those chemicals categorized as volatile organic compounds (any organic compound that participates in atmospheric photochemical reactions except those designated by the EPA administrator as having negligible photochemical reactivity). Only those hazardous air pollutants that would be of concern for any alternatives at this site are discussed here.

Monitoring stations throughout the Albuquerque Basin are operated by the Albuquerque Environmental Health Department and the New Mexico Environment Department to measure criteria pollutants, including carbon monoxide, nitrogen dioxide, PM_{10}, and ozone. These monitoring stations do not measure lead or sulfur dioxide. An additional station, the Criteria Pollutant Monitoring Station located in TA-I, measures lead and sulfur dioxide.

In addition to regional ambient air quality monitoring for criteria pollutants, SNL/NM operates six onsite monitoring stations for PM_{10}. Monitoring results indicate that sampling locations closer to the most populated areas of SNL/NM generally reveal higher PM_{10} concentrations. In addition, PM_{10} concentrations generally increase during the windy season due to blowing soil particles. Additional information on criteria pollutant concentrations at monitoring stations in TA-I is presented in the *SNL/NM SWEIS* and the *1999 Annual Site Environmental Report, Sandia National Laboratories, New Mexico* (SNL/NM 2001a). Measurements at these stations include contributions of criteria pollutants from the nearby SNL/NM emission sources. **Table 4–21** compares air pollutant concentrations which are considered to be representative of background conditions near SNL/NM to applicable Federal (40 CFR Part 50) and state (20 New Mexico Administrative Code 2.3) standards for each pollutant. These values include monitoring data in the Albuquerque Basin during 1999 and particulate matter values recommended by the state agency. Monitoring data in the Albuquerque Basin and at monitors within the SNL/NM in some cases show higher values. Air quality standards were not exceeded in 1999 in the Albuquerque Basin, except the PM_{10} standards were exceeded at one onsite monitor where values of 50.6 micrograms per cubic meter, annual average, and 188 micrograms per cubic meter, 24-hour average were reported. Onsite concentrations were all below threshold standards. Maximum onsite PM_{10} concentrations were 16.6 and 66 micrograms per cubic meter for annual and 24-hour averaging at the KUPM monitor northwest of TA-V (SNL/NM 2001a, EPA 2001).

Table 4–21 Comparison of Background Ambient Air Concentrations With Applicable National and New Mexico Ambient Air Quality Standards [a]

Pollutant	*Averaging Period*	*Most Stringent Standard [b] (micrograms per cubic meter)*	*Maximum Ambient Air Concentration (micrograms per cubic meter)*
Carbon monoxide	8 hours 1 hour	8,280 12,500	4,660 [c] 5,520 [c]
Lead	Quarterly	1.5	0.002 [d]
Nitrogen dioxide	Annual 24 hours	78.1 156	26.1 [e] 46 [e]
Ozone	1 hour	196	145 [f]
PM_{10}	Annual 24 hours	50 150	30 [g] 30 [g]
Sulfur dioxide	Annual 24 hours 3 hours	43.5 217 1,090	0.12 [h] 1.7 [h] 13.5 [h]
Total suspended particulates	Annual 24 hours	60 150	30 30

PM_{10} = particulate matter less than or equal to 10 microns in aerodynamic diameter.

[a] New Mexico also has ambient standards for total reduced sulfur and hydrogen sulfide. There is no monitoring data for these compounds and they are not pollutants of concern at SNL/NM.

[b] The more stringent of NAAQS and the state standard. The annual standards are not to be exceeded. Short-term standards may be exceeded, generally once, before a violation must be reported. The preamble of the state regulation (Section 108) allows excesses over short periods of time due to unusual meteorological conditions. Standards and monitored values for pollutants other than particulate matter are stated in parts per million (ppm). These values have been converted to micrograms per cubic meter ($\mu g/m^3$) with appropriate corrections for temperature (21 °C [70 °F]) and pressure (elevation 5,400 feet) following New Mexico dispersion modeling guidelines (revised 1998) (NMAQB 1998).

[c] 1999 maximum background concentrations from monitoring stations 350011003-1 or 350010023-1.

[d] 1999 maximum background concentration at onsite criteria pollutant monitoring station.

[e] 1999 annual concentration at Albuquerque monitor (350010023-1) 25 micrograms per cubic meter plus contribution from the Cobisa Power Plant (1.1 micrograms per cubic meter) (DOE 1999d).

[f] Highest 1-hour ozone monitoring value at the criteria pollutant monitoring station site in 1999.

[g] Background PM_{10} values for 24-hour and annual PM_{10} cumulative impacts from New Mexico Air Pollution Control Board (DOE 1999d).

[h] Background concentrations resulting from operation of the Cobisa Power Plant (DOE 1999d).

Source: DOE 1999d, EPA 2001, SNL/NM 2001a.

The ambient air concentrations attributable to sources at SNL/NM are presented in **Table 4–22**. These concentrations are based on the No Action concentrations presented in the *SNL/NM SWEIS* and include the contribution from the Cobisa Power Plant and the various small sources expected to be operational by 2008. These concentrations are used as the baseline concentration from SNL/NM activities in the cumulative analysis (Section 5.3.14). These concentrations, when combined with background concentrations, (Section 5.3.14) are below the ambient air quality standards. Concentrations of hazardous and toxic compounds are below regulatory standards and human health guidelines as described in the *SNL/NM SWEIS*.

Table 4–22 Modeled Ambient Air Concentrations from SNL/NM Sources

Pollutant	*Averaging Period*	*Most Stringent Standard* [a] *(micrograms per cubic meter)*	*Concentration* [b] *(micrograms per cubic meter)*
Carbon monoxide	8 hours 1 hour	8,280 [c] 12,500 [c]	78.4 119
Nitrogen dioxide	Annual 24 hours	78.1 [c] 156 [d]	10 103.7
Ozone	1 hour	196 [e]	(f)
PM_{10}	Annual 24 hours	50 [c] 150 [c]	11.4 114.2
Sulfur dioxide	Annual 24 hours 3 hours	43.5 [c] 217 [c] 1,090 [c]	1.7 12.2 21.1
Total suspended particulates	Annual 24 hours	60 [c] 150 [c]	11.4 114

[a] The more stringent of the Federal and state standards is presented if both exist for the averaging period. NAAQS (40 CFR Part 50), other than those for ozone, particulate matter, lead, and those based on annual averages, are not to be exceeded more than once per year. The annual arithmetic PM_{10} mean standard is attained when the expected annual arithmetic mean concentration is less than or equal to the standard.
[b] Concentrations are based on No Action modeled concentrations presented in the *SNL/NM SWEIS* (DOE 1999d), which occur at a receptor at the National Atomic Museum outside the SNL/NM fence line.
[c] Federal and state standard.
[d] State standard.
[e] Federal 8-hour standard is currently under litigation.
[f] Not directly emitted or monitored by the site.
PM_{10} = Particulate matter less than or equal to 10 microns in aerodynamic diameter.
Note: NAAQS also include standards for lead. No sources of lead emissions have been identified for any alternative evaluated. Emissions of hazardous air pollutants not listed here have been identified at SNL/NM, but are not associated with any of the alternatives evaluated. The EPA revised the ambient air quality standards for particulate matter and ozone in 1997 (62 FR 38856, 62 FR 38652); however, these standards are currently under litigation, but could become enforceable during the life of this project.
Sources: 40 CFR Part 50; DOE 1999d.

4.3.3.2 Radiological Releases

In 1999, the highest activities found in SNL/NM's atmospheric emissions were primarily the result of argon and tritium. These radionuclides generally have been the most significant releases over the past 10 years. The major radionuclide species and curies released from SNL/NM are listed in **Table 4–23**. There was a total of 17 point sources and 3 diffuse sources (landfills) listed in the 1999 NESHAP report; 4 of 20 facilities reported zero emissions.

There are three NESHAP sources in TA-V. Two facilities had reportable NESHAP emissions in 1999. One, the Annular Core Research Reactor, is used to perform in-pile experiments for severe reactor accident research projects. In 1997, the configuration was converted to support the Medical Isotope Production Project, which will produce radiopharmaceuticals. Argon-41, an air activation product, was the only radionuclide released from this source in 1999. The second source is the Sandia Pulsed Reactor, which is used to produce intense neutron bursts for effects testing on materials and electronics. This reactor also emitted only argon-41 in 1999. There were no releases from the Hot Cell Facility (the third source) in 1999. This facility provides full capability to remotely handle and analyze radioactive materials such as irradiated targets.

Table 4–23 Radiological Airborne Releases to the Environment at SNL/NM in 1999[a]

Source	*Technical Area*	*Radionuclide*	*Release (curies)*
Sandia Pulsed Reactor, Building 6590	TA-V	Argon-41	2.30
Annular Core Research Reactor, Building 6588	TA-V	Argon-41	2.99
High-Energy Radioactive Megavolt Electron Source, Building 970	TA-IV	Nitrogen-13	4.08×10^{-4}
Mixed Waste Landfill (diffuse emissions)	TA-III	Tritium (Hydrogen-3)	0.294
Radioactive and Mixed Waste Management Facility, Building 6920	TA-III	Tritium	0.6
Chemical Waste Landfill (diffuse emissions)	TA-III, South	Uranium-238	2.52×10^{-6}
Explosives Components Facility, Building 905	TA-II	Tritium	5.05×10^{-4}
Cleaning and Contamination Central Laboratory, Building 897	TA-I	Carbon-14	3.5×10^{-5}
Neutron Generator Facility, Building 870 - East Annex - North Wing Tritium Envelope	TA-I	 Tritium Tritium	 0.08 2.7
TANDEM Accelerator, Building 884	TA-I	Tritium Nitrogen-13 Fluorine-18	1×10^{-6} 1.85×10^{-5} 1.69×10^{-6}
Radiation Laboratory, Building 827	TA-I	Tritium	1×10^{-5}
Calibration Laboratory, Building 869	TA-I	Tritium	2.6×10^{-5}

[a] Radionuclides with half-lives less than about 10 minutes are not included in the table. Also not included are radionuclides for which less than 10^{-6} curies are released per year. Refer to SNL/NM 2001a for the complete list of airborne releases.

Source: SNL/NM 2001a.

4.3.4 Noise

Baseline sounds at SNL/NM consist of noise generated in and around the surrounding area, mainly from transportation and stationary sources. Activities at and around SNL/NM affect ambient (background) sound. These include aircraft associated with the Albuquerque International Sunport and KAFB, vehicular traffic at KAFB, and industrial sources. SNL/NM test programs, including tests of high explosives, rocket motors, and large-caliber weapons and tests producing sonic booms, contribute to the noise baseline. Other noise sources at SNL/NM include industrial and construction activities.

Noise effects to the community depend on the loudness of the sound, the intensity of vibrations, the frequency of the events, and the atmospheric conditions transmitting sound during the event. In most cases, the impulse sound heard outside KAFB resembles a dull thud or a short burst (less than three seconds). The noise baseline (aircraft, traffic, and industrial sources) would mask the sounds produced by most SNL/NM activities.

SNL/NM's ambient background sounds will be relatively consistent. Background sounds produced by generators, air conditioning, ventilation systems, vehicles, and employee activities constitute a substantial sound source during the morning, midday, and evening. The range of background noise levels associated with these sources is from 50 to 70 dBA (day-night average sound level).

SNL/NM testing produces the most perceptible impulse sound levels at TA-III, Coyote Test Field, and other outdoor test facilities. The 1996 baseline frequency of impulse noise events is 1,059 events. Only a small fraction of these events are loud enough to be heard or felt beyond the site boundary. No residential areas on KAFB or in the city of Albuquerque are affected by vibrations expected to be damaging or annoying.

SNL/NM is subject to aircraft noise from the Albuquerque International Sunport and KAFB and from vehicular traffic on KAFB. Aircraft noise is the most prevalent sound because Runway 8-26 is the primary runway for the Albuquerque International Sunport. Aircraft take off and land in an easterly direction on this runway about 75 to 80 percent of the time. Aircraft using this runway fly directly over SNL/NM. Noise abatement procedures to decrease aircraft noise in nearby neighborhoods, such as Ridgecrest and Four Hills, affect SNL/NM. These procedures direct pilots to avoid these neighborhoods by flying over SNL/NM.

Based on Federal Aviation Administration land use compatibility guidelines, adverse effects on people are most likely to occur within the 75-dBA day-night average noise-level area. At the Albuquerque International Sunport, the 65- and 70-dBA noise levels extend beyond the Sunport boundary with KAFB, but not the 75-dBA noise level.

The Air Force Research Laboratory, U.S. Air Force/Explosive Ordnance Disposal, and the Defense Special Weapons Agency detonate explosives on KAFB, and non-SNL/NM agencies perform noise-producing activities at SNL/NM. These activities and the potential for conflicts with land uses are discussed in the *SNL/NM SWEIS*. Motor vehicle noise is prevalent in the more congested areas of KAFB.

The adjoining city of Albuquerque limits sound levels as specified in its Noise Control Ordinance, although this ordinance is not applicable to KAFB. The limitation on noise levels at a residential property line is 55 dBA during the day and 50 dBA at night. Limits are also specified for commercial and industrial properties (City of Albuquerque 2001).

4.3.5 Geology and Soils

SNL/NM is located on the east-central boundary of the 48- by 145-kilometers long (30- by 90-miles long), north-south trending Albuquerque-Belen Basin (SNL/NM 1993). This basin lies within the extensive Rio Grande rift zone (as further described in Section 4.2.5) and the Basin and Range Physiographic Province. KAFB is bordered to the east by the Manzanita Mountains and to the northeast by the Sandia Mountains. The strata beneath the western most portion of KAFB, where the SNL/NM TAs are located, consists primarily of gravels, sands, silts, and clays ranging in age from Quaternary to Miocene (recent to 24 million years old). These consist of alluvium deposited by the ancestral Rio Grande that overlie alluvial fan deposits derived from erosion of the mountains to the east. Immediately overlying the Sante Fe Group across portions of SNL/NM, south of Tijeras Arroyo, is the Ortiz Gravel which is a discontinuous unit with a thickness ranging from 0 to 46 meters (0 to 150 feet) (SNL/NM 1993). The Santa Fe Group is the primary basin-fill material and mainly is composed of unconsolidated sediments (e.g., gravel, sand, silt, clay, and caliche) in the Albuquerque-Belen Basin. The basin-fill deposits and the Santa Fe Group are in turn underlain by Precambrian age (more than 570 million years old) crystalline and Paleozoic age (245 to 570 million years old) marine carbonate bedrock, which also compose the mountains to the east of KAFB (SNL/NM 1993). Additional details about SNL/NM site geology are presented in the *SNL/NM SWEIS*.

Extensive nonmetallic mineral deposits exist in the area in the form of aggregate rock, sand, silt, and clay as components of the basin-fill deposits which underlie KAFB. The potential for metallic mineral deposits also exists within the older bedrock located to the west of the site, as well as placer deposits within the alluvial and colluvial sediments. Evidence of historic placer mining has been identified throughout KAFB as a result of cultural resource surveys.

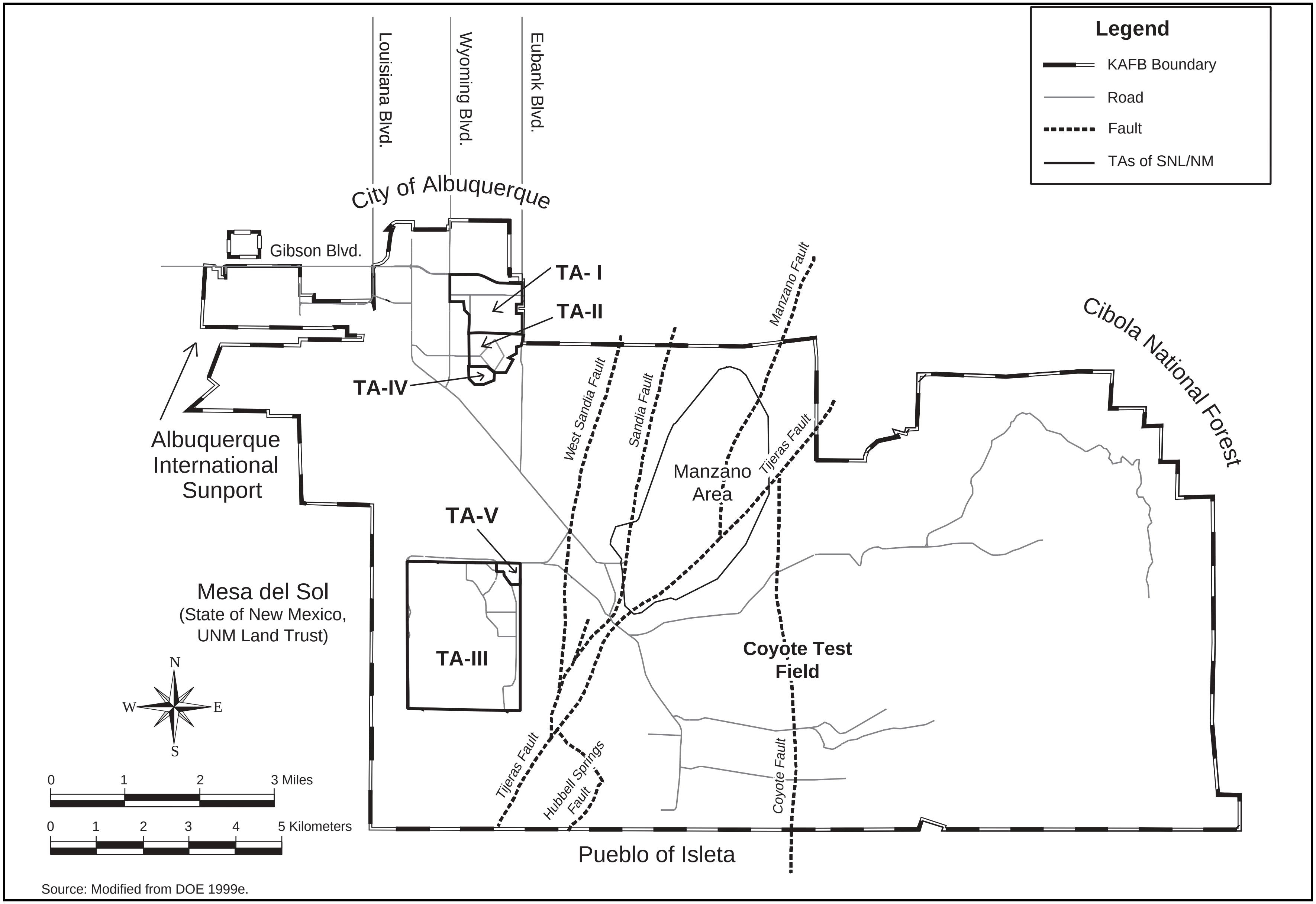
A number of regional faults cross KAFB just to the east of SNL/NM (Sandia, West Sandia, Manzano, Hubbell Springs, Tijeras, and Coyote Faults) (see **Figure 4–14**). There is no evidence of movement along these faults over the last 10,000 years. Although not active, a determination has not been made as to whether any of these faults should be considered "capable." A capable fault is one that has had movement at or near the ground surface at least once within the past 35,000 years or recurrent movement within the past 50,000 years (10 CFR 100, Appendix A).

KAFB and SNL/NM are located in a region with relatively moderate to high seismicity. Modified Mercalli Intensities of up to VII have been reported (DOE 1996e). Over the last 100 years, only three earthquakes have reportedly caused damage in Albuquerque (DOE 1996e). Since 1966, New Mexico has experienced four moderate earthquakes, all approximately magnitude 5 on the Richter scale. Two of these were in Dulce (near the Colorado border in north-central New Mexico), one was in Gallup (near the Arizona border in west-central New Mexico), and one was in Eunice (extreme southeast corner of New Mexico, near the Texas border). The closest of these (Dulce and Gallup earthquakes) were epicentered about 200 kilometers (125 miles) from the site. The largest earthquake experienced in the Albuquerque area occurred on January 4, 1971, and measured magnitude 4.7. There was no appreciable damage to SNL/NM buildings, although some cracks were noted that could have predated the earthquake. This event had a reported Modified Mercalli Intensity of VI at its epicenter, which was located some 12 kilometers (7.4 miles) north-northwest of SNL/NM, as measured from TA-V. Within a radius of 100 kilometers (62 miles) of SNL/NM, a total of 14 significant earthquakes (i.e., having a magnitude of at least 4.5 or a Modified Mercalli Intensity of VI or larger) have been documented, with none centered closer than the January 1971 event (USGS 2001c). Since 1973, 37 earthquakes have been recorded within 100 kilometers (62 miles) of SNL/NM ranging in magnitude from 1.6 to a magnitude 4.8 event in January 1990. The closest of these minor-to-light earthquakes was a July 1985 1.6-magnitude event that was reportedly felt and centered about 6 kilometers (3.7 miles) north of TA-V within KAFB boundaries. All but a few of the remaining 37 earthquakes had epicenters greater than 60 kilometers (37 miles) away. The most recent was a Richter magnitude 4 earthquake that occurred in January 1998 at a distance of 58 kilometers (36 miles) from the site (USGS 2001d).

A nondamaging earthquake producing a Modified Mercalli Intensity of less than III is predicted to have an annual probability of occurrence of 1 in 2 (i.e., once every 2 years) and a damaging event has a probability of 1 in 100 (i.e., once every 100 years) (DOE 1996e). For reference, a comparison of Modified Mercalli Intensity (the observed effects of earthquakes) with measures of earthquake magnitude and ground acceleration is provided in Section F.5.2 (see Appendix F).

As discussed in more detail in Section 4.2.5, the U.S. Geological Survey has developed new earthquake hazard maps that are based on spectral response acceleration. These maps have been adapted for use in the new International Building Code (ICC 2000) and depict maximum considered earthquake ground motion of 0.2- and 1-second spectral response acceleration, respectively, based on a 2 percent probability of exceedance in 50 years (i.e., 1 in 2,500). SNL/NM is calculated to lie within the 0.61g to 0.62g mapping contours for a 0.2-second spectral response acceleration and the 0.17g to 0.18g contours for a 1-second spectral response acceleration. For comparison, the calculated peak ground acceleration for the given probability of exceedance is approximately 0.27g (USGS 2001e).

The potential for future damaging volcanic activity at SNL/NM and the vicinity is considered to be low (DOE 1996e). As for other geologic hazards, slope instability is a concern on steeper slopes such as along water-cut drainages and on mountain slopes to the east of the SNL/NM TAs in the Manzanita Mountains. However, most SNL/NM facilities are constructed on level ground or on the gentle slopes of alluvial fan sediments.



Source: Modified from DOE 1999e.

Figure 4–14 Regional Faults at KAFB and SNL/NM

Several soil associations occur across KAFB and are derived primarily from materials eroded from the nearby mountains and deposited as alluvial fans. These include the Bluepoint-Kokan, Madurez-Wink, Tijeras-Embudo, Kolob-Rock outcrop, and Seis-Orthids associations, with the Kolob-Rock outcrop confined to the eastern portion of the site. These soils are moderately to very steep, well-drained, loamy, and stony soils and include basalt, sandstone, and limestone outcrops. The remainder of the soils are generally well drained to excessively drained and loamy, cobbly, or stony. Wind erosion hazard is severe on terraces and on mountain and hill slopes, and the hazard for water erosion is generally moderate on alluvial fans, foothills, and highlands. The soils are suitable for standard construction techniques. No soils are classified as prime farmland (DOE 1996e).

There are no known capable faults on KAFB. The closest mapped fault to TA-V is the West Sandia Fault, which is located about 1 kilometer (1.6 miles) to the east of the area. Surficial stratigraphy in the southern portion of SNL/NM is dominated primarily by unconsolidated sediments of the Santa Fe Group deposited by the Tijeras Arroyo that attain a thickness of up to 90 meters (300 feet). Soils encompassing TA-V are mapped as Tijeras gravelly fine sandy loam. This unit has a moderate water erosion hazard, but is otherwise suitable for development (SNL/NM 1993).

4.3.6 Water Resources

4.3.6.1 Surface Water

KAFB and SNL/NM are located on the East Albuquerque Mesa, which slopes southwest toward the Rio Grande, the major water drainage in the area. This river flows north to south in the vicinity of KAFB and is located approximately 10 kilometers (6 miles) to the west of the KAFB boundary and SNL/NM facilities (DOE 1996e). Surface water features are depicted in **Figure 4–15**. Surface water from KAFB and SNL/NM, primarily runoff, flows through several major and many small, unnamed arroyos. These rather steep-walled, intermittent stream channels flow primarily only in response to runoff from summer thunderstorms, as runoff from snowmelt in the Manzanita Mountains to the east rarely reaches the lower portions of the arroyos or the Rio Grande. Tijeras Arroyo is the primary drainage feature on KAFB. Tijeras Arroyo enters KAFB just northeast of TAs II and IV and runs southwest before being joined by Arroyo del Coyote at a point about 3.2 kilometers (2 miles) upstream of where Tijeras Arroyo leaves KAFB, and south of TA-IV. Tijeras Arroyo then joins with the Rio Grande at a point approximately 8 kilometers (5 miles) west of the KAFB boundary (DOE 1996e). With the exception of flow from two springs (Coyote Springs and Sol Se Mete), there are no perennial streams or other natural surface water bodies at KAFB. Most runoff and spring seepage infiltrates into the ground and either does not reach a drainage or travels only a relatively short distance down the arroyos and is therefore not conveyed off site.

Onsite arroyos at KAFB and SNL/NM are not classified and, therefore, are protected by default under State of New Mexico surface water quality standards for the uses of livestock watering and wildlife habitat (New Mexico Administrative Code 20.6.4.10). New Mexico standards also apply to the Rio Grande with designated uses for irrigation, limited warm water fishery, livestock watering, wildlife habitat, and secondary contact. Additionally, a stretch of the Rio Grande through Pueblo of Isleta beginning approximately 10 kilometers (6 miles) downstream of the Tijeras Arroyo has additional water quality standards associated with the added designated protected uses for primary contact and primary contact-ceremonial. Due to the ephemeral nature of surface water on KAFB and SNL/NM, it is not a source of municipal, industrial, or irrigation water.

SNL/NM wastewater discharge to arroyos is limited to stormwater runoff. Runoff from TAs-I, -II, and -IV is collected in storm sewer systems that discharge to Tijeras Arroyo. There is no discharge from TAs-III and -V. Storm-water runoff from TAs-I, -II, and -IV is monitored for NPDES permit compliance under the

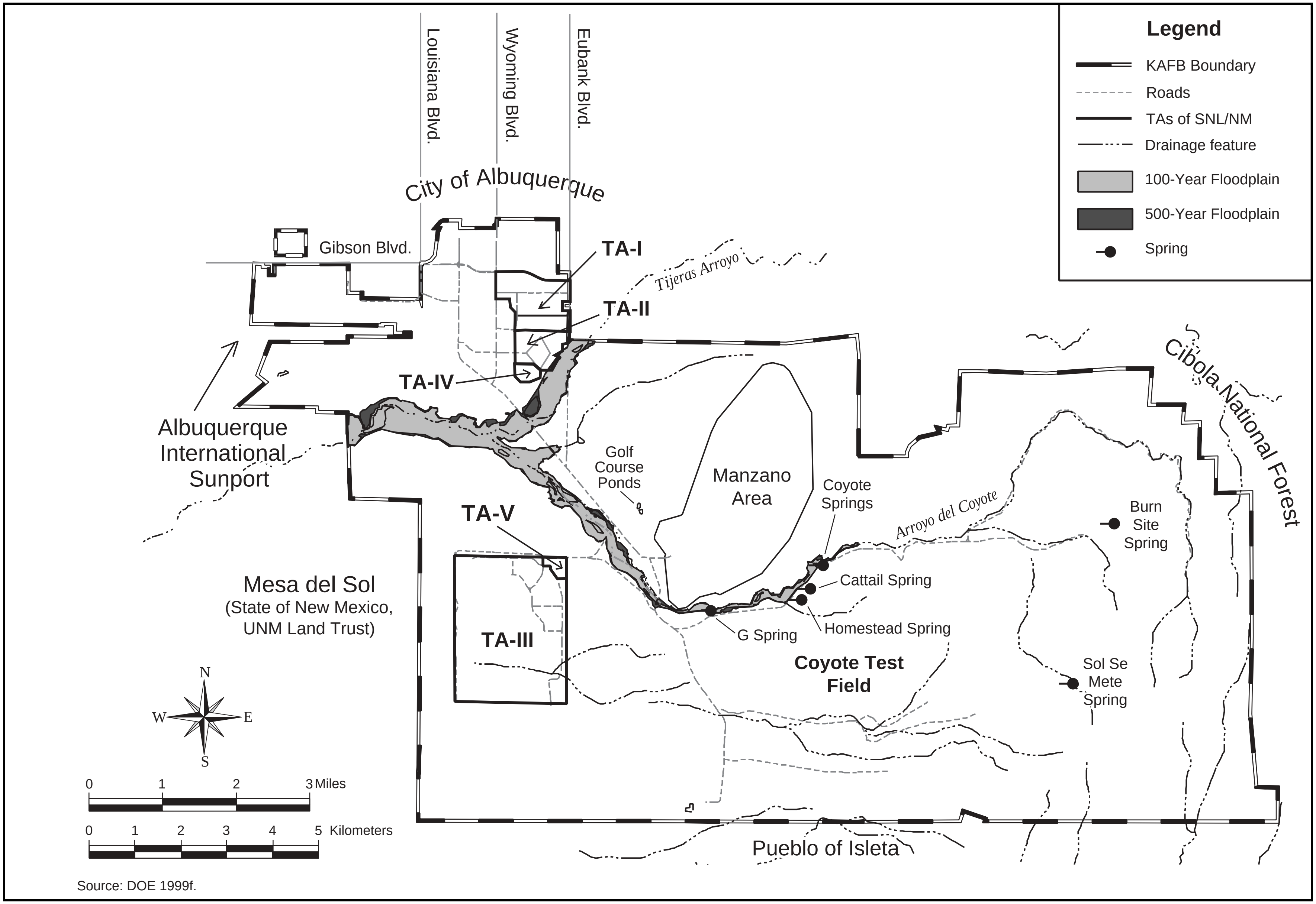


Figure 4–15 Surface Water Features at KAFB

EPA's NPDES Stormwater Multi-Sector General Permit (Permit Number NMR05A181). Monitoring results are reported in the annual site environmental report (SNL/NM 2001a). Industrial and sanitary effluent is collected and discharged to the city of Albuquerque sanitary sewer system in accordance with city permit requirements. As several research reactors in TA-V have the potential to produce radiologically contaminated wastewater, reactor process wastewater from responsible facilities is sent to the Liquid Effluent Control System for screening. This system consists of three 18,900-liter (5,000-gallon) holding tanks, an ion-exchange and filter system, and an automatic alarm to alert personnel to the presence of radionuclides. The collected effluent is sampled and analyzed for tritium, gross alpha, gross beta, and gamma activity to ensure that it meets permit limits before being discharged to the sanitary sewer system. SNL/NM discharges about 3 million liters (800,000 gallons) per day of wastewater to the sewer system (SNL/NM 2001a). This wastewater is treated at the Albuquerque sewage treatment plant and ultimately discharged to the Rio Grande at a point about 1.1 kilometers (0.7 miles) north of Tijeras Arroyo. SNL/NM also has three septic systems that service remote locations and are periodically serviced by a licensed contractor (SNL/NM 2001a). Industrial and sanitary effluent management is further discussed in Section 4.3.12.

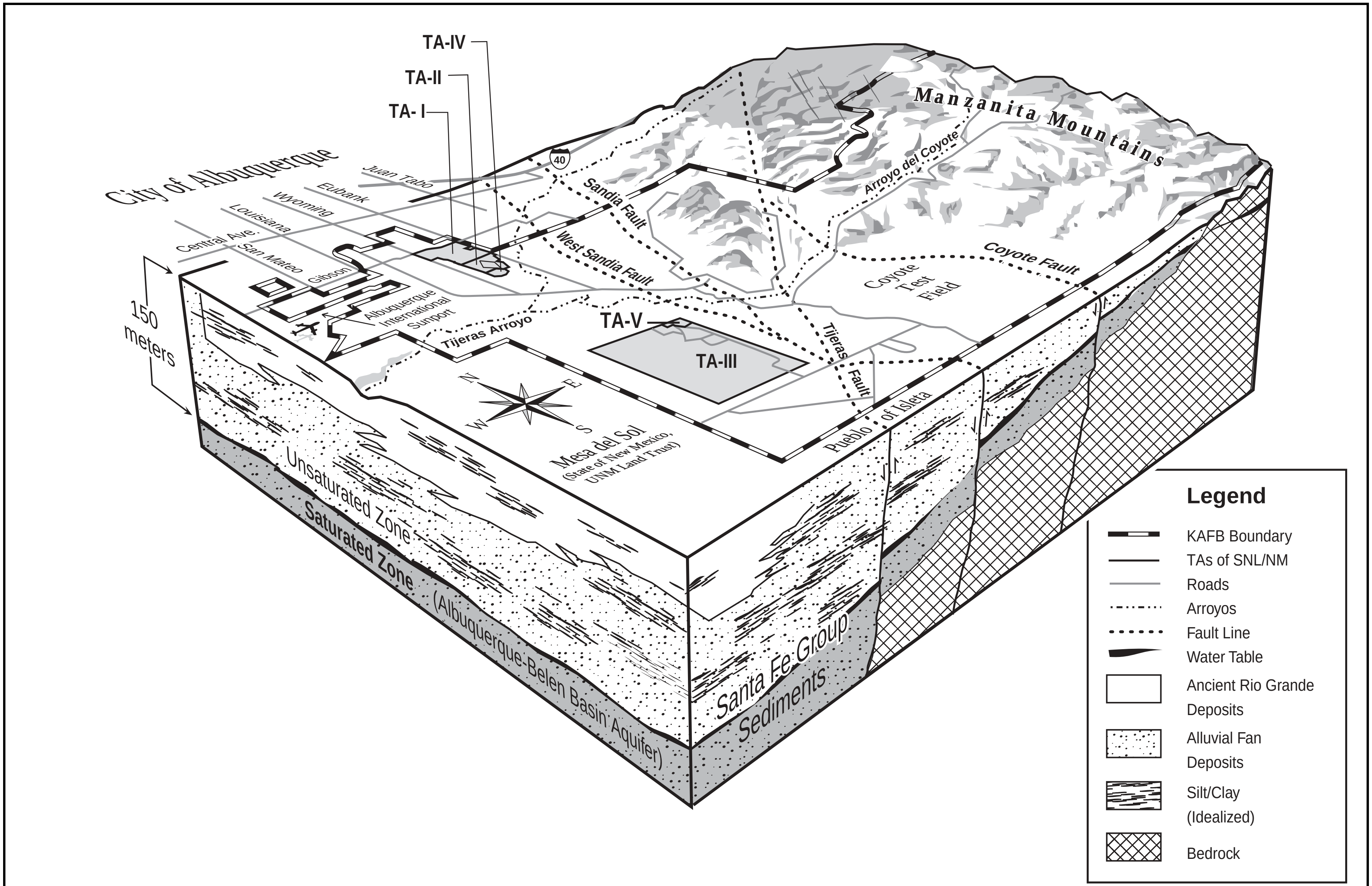
Floodplains on KAFB are generally confined to the major arroyos as shown in Figure 4–15. Although not shown in Figure 4–15, there are narrow 100-year floodplains that are confined to existing drainage channels and low-lying streets and vacant areas in TA-I. Otherwise, no SNL/NM facilities are built in a 100- or 500-year floodplain.

TA-V contains no permanent, natural surface water bodies and is not located within a delineated floodplain. A drainage ditch located on the northern border of the area conveys stormwater runoff to Arroyo del Coyote to the east.

4.3.6.2 Groundwater

Groundwater beneath the western portion of KAFB encompassing SNL/NM exists within an interconnected series of water-bearing geologic units, principally the Santa Fe Group, which comprise the Albuquerque-Belen Basin aquifer (**Figure 4–16**). This is the major source of groundwater within the Albuquerque Basin. Thus, the Albuquerque-Belen Basin aquifer (i.e., a valley-fill aquifer) is considered a Class II aquifer (i.e., currently used or potentially available for drinking water or other beneficial use) (DOE 1996e). The local hydrostratigraphy and associated water table elevations within the Albuquerque-Belen Basin aquifer beneath the western and central portions of KAFB are influenced by the Sandia/Tijeras/Hubbell Springs Fault system which transects KAFB, creating distinct hydrogeologic regions. As result, depth to the regional water table decreases appreciably to the east within blocks of downfaulted strata and ranges from approximately 150 meters (500 feet) near the western boundary of KAFB to about 45 meters (150 feet) near the Hubbell Springs Fault just southeast of TA-III. Shallow groundwater may be found near the surface in shallow alluvium along portions of Arroyo del Coyote northeast of TA-III. In contrast, groundwater beneath the far eastern portion of KAFB primarily occurs in limited quantities in the fractured bedrock, with the depth to groundwater thought to exceed 45 meters (150 feet). Groundwater flow is generally north to northwest in the northwestern portion of KAFB where TAs-I, -II, and -IV are located and generally to the west in the eastern portion of KAFB and within the central, faulted hydrogeologic region of KAFB (DOE 1996e). Locally, the direction of groundwater flows is to the northeast in the northern corner of KAFB towards the cone of depression created by base and city wells (SNL/NM 2001a). Perched groundwater bodies have also been identified at a depth of some 90 meters (300 feet) beneath TAs-I, -II, and -IV.

Sources of recharge to the basin, and to the Albuquerque-Belen Basin aquifer in particular, include precipitation runoff and snowmelt along the basin margins, underflow from interconnections with aquifers in adjacent basins, and surface recharge from irrigation and other artificial sources (DOE 1996e). Locally, recharge is in the form of infiltration of runoff through arroyos. However, the rate of groundwater



Source: DOE 1999e.

Figure 4–16 Conceptual Diagram of Groundwater System Underlying KAFB

withdrawal in the region, particularly by city of Albuquerque and KAFB supply wells, exceeds the relatively low recharge rate of 0.01 to 0.25 centimeters (0.004 to 0.1 inches) per year, a condition called overdraft. As a result, the regional water table just beneath the western portion of KAFB has been declining at a rate of 0.06 to 0.9 meters (0.2 to 3 feet) per year, while water levels farther to the east of the Sandia/Tijeras/Hubbell Springs Fault system have been much less affected. During the 12-year period from 1985 through 1996, water levels declined by more than 11 meters (35 feet) in the extreme northwestern portion of KAFB.

A network of monitoring wells is used to collect samples for characterizing baseline water chemistry and groundwater contamination, which is part of the site's environmental monitoring program. Groundwater quality at SNL/NM has been impacted by past activities at SNL/NM sites, with the sources of contamination under investigation. Sites with potential or known groundwater contamination at SNL/NM are Sandia North, which includes TA-I and TA-II; the Mixed Waste Landfill within the TA-III complex; locations in TA-V; the Lurance Canyon Burn Site, located in the eastern portion of KAFB; and the Chemical Waste Landfill, also within TA-III. The primary contamination at TA-V is trichloroethene which has been detected at levels of about three to four times the maximum contaminant level and attributed to the disposal of wastewater released to the Liquid Waste Disposal System site from 1963 to 1967. Sources of previously high levels of nitrate, including septic tanks and leachfields, have since been closed. Nitrate levels exceeding the maximum contaminant level have also been detected in groundwater at the Lurance Canyon Burn Site. Detailed information on groundwater monitoring including analytical results is presented in the annual site environmental report (SNL/NM 2001a).

The groundwater beneath SNL/NM and adjacent areas is the source of drinking water for SNL/NM, KAFB, and adjacent portions of the city of Albuquerque and the Pueblo of Isleta. The local groundwater is also used for irrigation and industry. Water use is detailed in Section 4.3.2.4.

Groundwater beneath TA-V occurs within the Albuquerque-Belen Basin aquifer. The depth to groundwater is inferred as approximately 100 meters (330 feet) and the direction of flow is generally to the northwest. As previously discussed, trichloroethene and nitrate are contaminants present in the groundwater beneath TA-V. In FY99, trichlorethene was again detected in one monitoring well in excess of the EPA Maximum Contaminant Level of 10 micrograms per liter at a maximum concentration of 23 micrograms per liter. The only inorganic chemical detected in excess of applicable regulatory criteria was nitrate (Maximum Contaminant Level of 10 milligrams per liter) at a maximum concentration of 16.3 milligrams per liter (SNL/NM 2001a).

4.3.7 Ecological Resources

4.3.7.1 Terrestrial Resources

KAFB is located at the juncture of four major North American biological provinces: Great Basin, Rocky Mountains, Great Plains, and Chihuahuan Desert. Each province influences the existing biological communities. KAFB contains a diversity of biological resources due, in part, to these influences and an elevation change from a low point of approximately 1,585 meters (5,200 feet) in Tijeras Arroyo to a high point of 2,352 meters (7,715 feet) at Mount Washington in the Manzanita Mountains.

The four major vegetation associations at KAFB, grassland, woodland, riparian, and altered, are distinct in the form and composition of their vegetation (see **Figure 4–17**). The grassland association occupies the lower alluvial slopes and terrace surfaces of the Rio Grande valley near the city of Albuquerque. It is the dominant vegetation association on KAFB, west of the Withdrawn Area. Important species of this association include galleta, sand dropseed, ring muhly, black grama, and little bluestem (SNL/NM 1993). Woodland vegetation occurs primarily on the upper alluvial slopes and mountainous areas of the Withdrawn

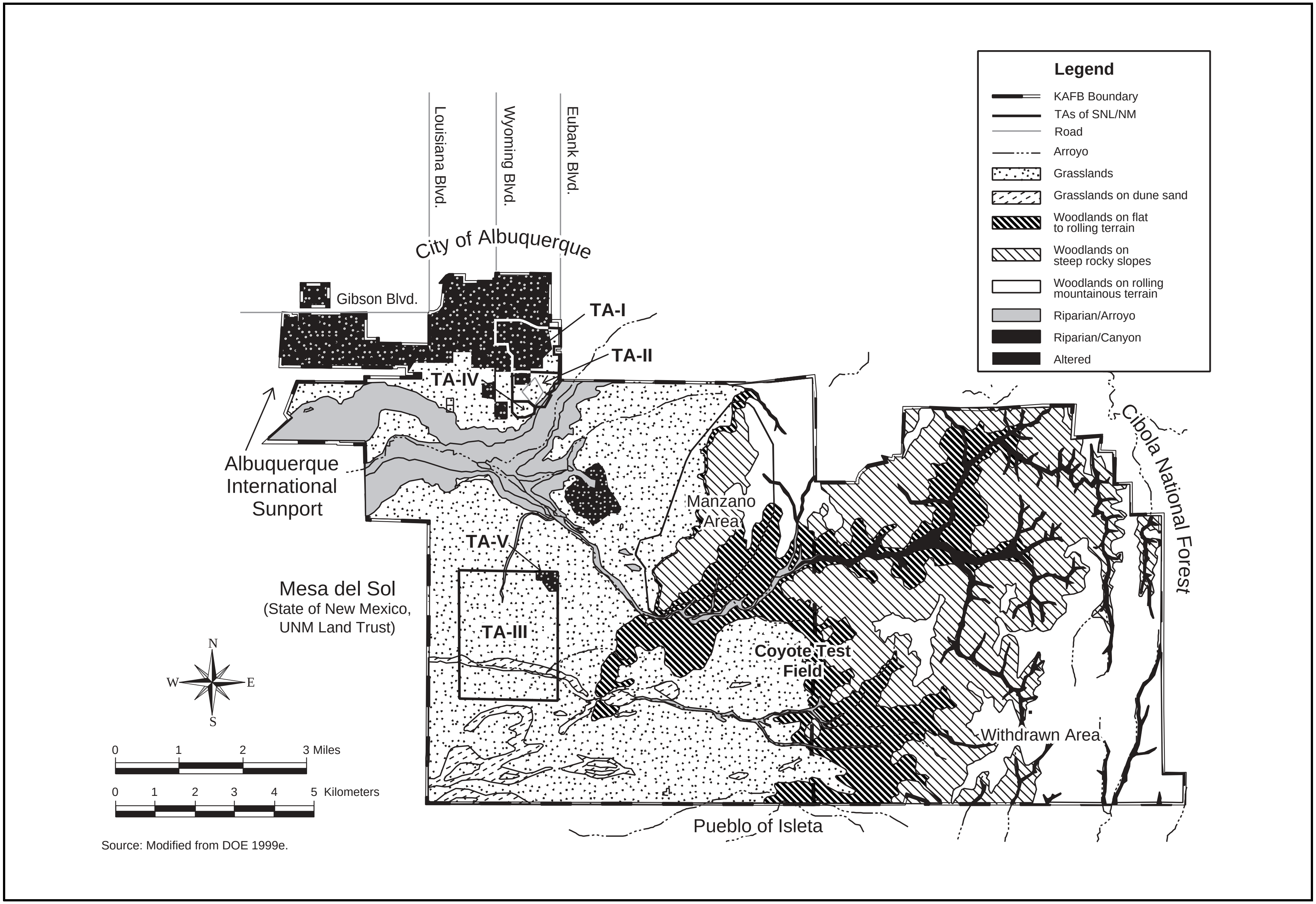


Figure 4–17 Vegetation Associations at KAFB

Area. Species present within woodland areas change with altitude. For example, one-seed juniper is present between 1,829 to 1,890 meters (6,000 to 6,200 feet), while an even mix of pinyon pine and one-seed juniper are found between 1,890 to 1,981 meters (6,200 to 6,500 feet). Many areas of the woodlands are becoming progressively choked with deadwood and dense thickets of young trees. Isolated, narrow bands of riparian vegetation occur along the surface drainages of KAFB. These drainages are predominantly ephemeral and contain flow only after large rainfall events. Riparian vegetation constitutes less than 5 percent of the area of KAFB and is limited primarily to the upper reaches of Arroyo del Coyote and associated drainages. The riparian woodland vegetation is dominated by exotic species, principally salt-cedar, which is widespread in the arroyos on KAFB. Human development and activities have created altered vegetation associations at KAFB. This vegetation ranges from no vegetative cover to manicured landscapes, such as the golf course. Most of this vegetation consists of nonnative species. At least 267 plant species occur on KAFB.

At least 195 species of amphibians, reptiles, birds, and mammals occur on KAFB. This diversity is due, in part, to the variety of habitats, which include cliff faces, caves, abandoned mines, and drainages, in addition to the four major vegetation associations. Although an altered habitat, the grass, ponds, and variety of trees at the KAFB golf course provide a particularly rich haven for animals, including waterfowl and shorebirds. The most important ecological factor that controls wildlife communities on KAFB is the limited availability of surface water. Common animals on KAFB include the whiptail lizard, red-spotted toad, American kestrel, ash-throated flycatcher, coyote, and deer mouse. Game animals which occur on the site, primarily within woodland and canyon habitats, include the mountain lion, black bear, and mule deer; however, hunting is not permitted on site. Raptors, such as the American kestrel and Cooper's hawk, and carnivores, such as the coyote and mountain lion, are two ecologically important groups on the KAFB. A variety of migrating birds have been recorded at the site. Migratory birds are protected under the Migratory Bird Treaty Act.

TA-V is located within the grassland vegetative association; however, the site has been altered by development and little natural habitat is present. Grasses present within undeveloped portions of the area would include those typical of the grassland association on the site as a whole. Animal species common to the grassland vegetative association, such as the coyote and red-tailed hawk, would be expected to be found in the general vicinity of TA-V.

4.3.7.2 Wetlands

Natural spring-fed wetlands form a minor component of the riparian habitat on KAFB and are cumulatively less than 0.4 hectares (1 acre) in size. KAFB has six wetlands, all associated with springs (see Figure 4–15). These wetlands are designated as jurisdictional wetlands under Section 4.04 of the Clean Water Act, because they have the soils, hydrology, and vegetation that meet standard criteria. The largest wetland is Coyote Springs in Arroyo del Coyote. Two of the wetlands, Sol se Mete and Burn Site Springs, are in the canyons of the Withdrawn Area. Species characteristic of these wetlands include wire rush, three-square, Torrey rush, and cattail. Only the Burn Site Spring is on land used by SNL/NM. The U.S. Forest Service manages a tank that collects water for wildlife at this spring and the Sol se Mete Spring. There are no wetlands located within TA-V.

4.3.7.3 Aquatic Resources

There is no permanent natural aquatic habitat on KAFB. Drainages found on the site are predominantly ephemeral and contain flow only after large rainfall events. The U.S. Air Force administers constructed ponds on the KAFB golf course and a constructed lake, Christian Lake, in the southern part of KAFB. There are no aquatic resources located within TA-V.

4.3.7.4 Threatened and Endangered Species

There are four agencies that have authority to designate threatened, endangered, and sensitive species in New Mexico. The agencies are the USFWS, the New Mexico Game and Fish Department, the New Mexico Forestry and Resource Conservation Division, and the U.S. Forest Service. The State of New Mexico separates the regulatory authority for plants and animals between the Forestry and Resource Conservation Division and the Game and Fish Department, respectively. The U.S. Forest Service lists species for special management consideration on lands under their jurisdiction and protects these species under the authority of the Endangered Species Act of 1973.

Table 4–24 lists the threatened, endangered, and sensitive plant species on KAFB. One state-listed sensitive plant species, the Santa Fe milkvetch, occurs on the low hills in the southwestern part of KAFB. The Strong prickly pear, found near the northern boundary of KAFB, is on the State of New Mexico Rare Plant Review List.

Table 4–24 Listed Threatened and Endangered Species, Species of Concern, and Other Unique Species that Occur or May Occur at SNL/NM

Species	*Federal Classification*	*State Classification*	*Occurrence on Sandia*
Mammals			
Gunnison's prairie dog	Unlisted	Special Concern	Resident
Pale Townsend's big-eared bat	Special Concern	Special Concern	Occasional
Small-footed myotis	Special Concern	Special Concern	Occasional
Western spotted skunk	Unlisted	Special Concern	Low probability of occurrence
Birds			
American peregrine falcon	Special Concern	Threatened	Not documented
Baird's sparrow	Special Concern	Threatened	Winter visitor
Bell's vireo	Special Concern	Threatened	Winter visitor
Black swift	Unlisted	Special Concern	Occasional in summer and as a migrant
Ferruginous hawk	Special Concern	Special Concern	Transient
Gray vireo	Special Concern	Threatened	Occasional
Loggerhead shrike	Special Concern	Special Concern	Resident
Mountain plover	Endangered	Special Concern	Not documented
Swainson's hawk	Special Concern	Special Concern	Occasional
Western burrowing owl	Special Concern	Special Concern	Occasional
White-faced ibis	Special Concern	Special Concern	Casual
Reptiles			
Desert massasuaga	Special Concern	Unlisted	Low probability of occurrence
Texas horned lizard	Special Concern	Special Concern	Resident
Texas longnose snake	Special Concern	Special Concern	Moderate probability of occurrence
Plants			
Grama grass cactus	Special Concern	Unlisted	Resident
Sante Fe milkvetch	Special Concern	NML2	Resident
Strong prickly pear	Unlisted	NML3	Not documented

NML2 = New Mexico List 2: Official listing of plant species that are vulnerable to extinction or extirpation within the state due to rarity or restricted distribution, but are not protected under the New Mexico Endangered Plant Species Act.

NML3 = New Mexico List 3: Official listing of plant species that are on the New Mexico Rare Plant Review List as species for which more information is needed, but are not protected under the New Mexico Endangered Plant Species Act.

Source: DOE 1999d.

The peregrine falcon was the only federally listed threatened or endangered animal species that may frequent KAFB. A probable sighting near Mount Washington was likely a migrant. No nesting activity of this species has been observed, and KAFB contains only marginal nesting habitat. In 1997, the U.S. Air Force conducted a raptor survey of KAFB and did not observe any listed raptor species. On August 25, 1999, the USFWS delisted the American peregrine falcon from the Federal list of endangered and threatened wildlife. The USFWS has determined that this species has recovered following restrictions on the use of organochlorine pesticides (such as dichloro-diphenyl-trichloroethane) in the United States and Canada, following the implementation of successful management activities (64 FR 46541). On February 16, 1999, the USFWS designated the mountain plover as a proposed threatened species. Although KAFB could contain potential habitat for the mountain plover, numerous avian surveys of the Withdrawn Area and KAFB in general have not documented its presence. No federally proposed or candidate species occur on KAFB. In 1993, a colony of state-listed threatened gray vireos was discovered in the western foothills of the Withdrawn Area on land controlled by the U.S. Air Force. This is the largest known concentration of gray vireos in the State of New Mexico. Eight species of concern have been observed on KAFB, in addition to 13 migratory nongame birds of management concern for the USFWS Region 2. These species are protected under the Migratory Bird Treaty Act. Four state-listed threatened animal species occur on KAFB. One state-listed sensitive species, Pale Towsend's big-eared bat, has been observed hibernating in two caves. No critical habitat for threatened or endangered species has been identified on KAFB.

No federally listed threatened and endangered species utilize TA-V. However, since TA-V is located in the grassland plant association sensitive species could frequent the area. No designated critical habitat is present on TA-V.

4.3.8 Cultural and Paleontological Resources

Cultural resources are human imprints on the landscape and are defined and protected by a series of Federal laws, regulation, and guidelines. A draft *Cultural Resource Management Plan for Kirtland Air Force Base New Mexico* addressing resources across the entire base is summarized in the *SNL/NM SWEIS*. Due to the paucity of identified cultural resources under DOE jurisdiction, DOE has not prepared a cultural resource management plan. Since the first documented survey in 1936, both KAFB and the DOE buffer zones (land bordering the site to the southwest) have been the subject of cultural resource studies. Over 160 cultural resource investigations, reports, and studies have been conducted, most in the last 10 years. Approximately 75 percent of the area has been studied. Within the boundaries of KAFB and the DOE buffer zone, 284 prehistoric and historic archaeological sites have been recorded, of which 192 have been recommended as eligible or potentially eligible for the National Register of Historic Places.

Cultural sites are often occupied continuously or intermittently over substantial time spans. For this reason, a single location may contain evidence of use during both historic and prehistoric periods. In the discussions that follow, the numbers of prehistoric and historic resources are presented. However, the sum of these resources may be greater than the total number of sites reported due to this dual-use history at sites. Therefore, where the total number of sites reported is less than the sum of prehistoric and historic sites, certain locations were used during both periods.

4.3.8.1 Prehistoric Resources

Predominant among the prehistoric sites on KAFB are scatters of artifacts. Some artifact scatters consist of only stone debris from tool making and some tools themselves, while others have only ceramic shards or have both stone and ceramic artifacts. Some sites have just the artifact scatter, while others have features associated with the scatter. These features are often thermal features (such as hearths or ash pits) or structural features (such as remnants of walls or other forms of structures). A total of 181 sites have evidence of prehistoric use, of which 141 are eligible or potentially eligible for listing on the National Register of Historic Places. Because not all of the sites have been inventoried and buried sites would likely not have been identified during many past surveys, the potential for the presence of more sites is high. TA-V has been completely inventoried for prehistoric sites and no sites have been identified.

4.3.8.2 Historic Resources

As with prehistoric sites, historic sites on KAFB consist of artifact scatters, except that the artifacts present are things such as fragments of metal, pieces of ceramic or porcelain dishes, household items such as kitchen utensils, and other items one might find associated with a habitation. These scatters are often associated with features such as historic fences, roads, mining features (e.g., placer mining pits), or remnants of habitations. Of the historic sites, mining sites are the most common, followed by habitations, then sites related to agriculture and ranching, then small, isolated trash scatters. A total of 153 sites have evidence of historic use, of which 88 are eligible or potentially eligible for listing on the National Register of Historic Places.

Within KAFB, 579 architectural properties have been recorded and assessed for National Register of Historic Places eligibility, of which 9 individual properties have been recommended as eligible or potentially eligible for the National Register of Historic Places. Most sites were recorded by the 377th Air Base Wing of KAFB, under the auspices of the U.S. Department of Defense Legacy Program, and are on KAFB lands. Few of these properties predate World War II, and most were constructed during the 1940s and 1950s. Recent studies identified 21 buildings in TA-I that are of historic interest, and further study by DOE, in consultation with the New Mexico State Historic Preservation Office, will determine if these buildings are eligible for the National Register (SNL/NM 2001a). The architectural properties in TA-II, as a group, are eligible for National Register of Historic Places listing as a district.

TA-V has been completely inventoried for historic sites and no sites have been identified. Assessments of buildings in TA-V for inclusion in the National Register of Historic Places have not been made since structures located there are less than 50 years old. As the buildings at the site attain the 50-year mark, DOE will assess them for eligibility for inclusion in the National Register.

4.3.8.3 Native American Resources

Consultations to identify traditional cultural properties were conducted in connection with the preparation of the *SNL/NM SWEIS*. A traditional cultural property is a place or object that is significant to a particular living community. Fifteen Native American tribes with cultural interest in the area were contacted and no specific traditional cultural property locations were identified. However, some tribes have stated that they have cultural affinity to archaeological and natural sites on KAFB and expressed concerns for cultural sites that are important to them. Areas of concern to some of the tribes included the well-being and protection of natural and cultural sites; access to any traditional cultural properties identified in the future; concerns for the treatment of human remains that might be discovered; a desire to be consulted on Native American Graves Protection and Repatriation Act issues; claims of traditional use of the area before restricted access became effective; and use of the area for hunting and gathering of resources.

As noted above, TA-V has been completely inventoried for prehistoric sites and historic sites and no such sites have been identified. No traditional cultural properties have been identified on KAFB, including TA-V.

4.3.8.4 Paleontological Resources

Few paleontological resources have been discovered in the vicinity of KAFB, although fossil vertebrate remains have been found approximately 5 to 6 kilometers (3.1 to 3.7 miles) northwest of TA-V. These include an anklebone from a camel, a skull and teeth from a horse, and teeth from a hare. These fossils were excavated on the south side of Tijeras Arroyo and may have been transported varying distances from their original source. It is possible that fossils are present on KAFB, but are buried by the alluvial fan deposits from the Sandia Mountains (SNL/NM 1993). No fossils have been identified at TA-V.

4.3.9 Socioeconomics

Statistics for population, housing, community services, and local transportation are presented for the region of influence, a four-county area in New Mexico (**Figure 4–18**) that includes the city of Albuquerque, which is where approximately 97.5 percent of all SNL/NM employees reside (see **Table 4–25**). In 1997, SNL/NM employed 6,824 persons.

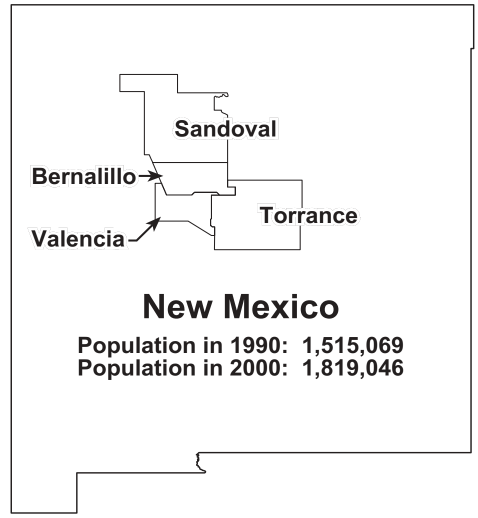


Figure 4–18 Counties in the SNL/NM Region of Influence

4.3.9.1 Regional Economic Characteristics

Between 1990 and 1999, the civilian labor force in the region of influence increased 18.8 percent to the 1999 level of 360,924. In 1999, the annual unemployment average in the region of influence was 4.0 percent, which was slightly less than the annual unemployment average for New Mexico (5.6 percent) (DOL 2000).

In 1997, service activities represented the largest sector of employment in the four-county area (33.3 percent). This was followed by retail trade (24.4 percent), and government (19.4 percent). The totals for these employment sectors in New Mexico were 27.5 percent, 23.7 percent, and 25.1 percent, respectively (NMDL 1998). SNL/NM is the fifth largest employer in New Mexico and the third largest in the four-county area.

Table 4–25 Distribution of Employees by Place of Residence in the SNL/NM Region of Influence in 1997

County	*Number of Employees*	*Total Site Employment (percent)*
Bernalillo	5,846	85.7
Sandoval	311	4.6
Torrance	160	2.3
Valencia	336	4.9
Region of influence total	6,653	97.5

Source: DOE 1999d.

4.3.9.2 Demographic Characteristics

The 2000 demographic profile of the region of influence population is included in **Table 4–26**. The 2000 population in the region of influence was 729,649 people, of whom about 76 percent lived in Bernalillo County. Persons self-designated as minority individuals comprise 52 percent of the total population. This minority population is composed largely of Hispanic or Latino and American Indian residents. The Pueblos of Cochiti, Isleta, Jemez, San Felipe, Sandia, Santa Ana, Santo Domingo, and Zia, and the Canoncito Navajo Reservation are important centers of these American Indian populations.

Income information for the SNL/NM region of influence is included in **Table 4–27**. Bernalillo, Sandoval, and Valencia Counties each had median household incomes near or above the New Mexico state average ($30,836). The median household income for Torrance County ($26,334) was below the state average. Torrance County had 24.6 percent of the population living below the poverty line compared to the New Mexico state average of 19.3 percent.

Table 4–26 Demographic Profile of the Population in the SNL/NM Region of Influence

	County				*Region of Influence*
	Bernalillo	***Sandoval***	***Torrance***	***Valencia***	
Population					
2000 population	556,678	89,908	16,911	66,152	729,649
1990 population	480,577	63,319	10,285	45,235	599,416
Percent change from 1990 to 2000	15.8	42.0	64.4	46.2	21.7
Race (2000) (Percent of Total Population)					
White	70.8	65.1	73.9	66.5	69.7
Black or African American	2.8	1.7	1.7	1.3	2.5
American Indian and Alaska Native	4.2	16.3	2.1	3.3	5.5
Asian	1.9	1.0	0.3	0.4	1.6
Native Hawaiian & Other Pacific Islander	0.1	0.1	0.1	0.1	0.1
Some other race	16.1	12.4	17.9	23.9	16.4
Two or more races	4.2	3.5	4.0	4.6	4.1
Percent Minority	51.7	49.7	42.8	60.6	52.0
Ethnicity (2000)					
Hispanic or Latino	233,565	26,437	6,283	36,371	302,656
Percent of total population	42.0	29.4	37.2	55.0	41.5

Source: DOC 2001.

Table 4–27 Income Information for the SNL/NM Region of Influence

	Bernalillo	***Sandoval***	***Torrance***	***Valencia***	***New Mexico***
Median household income 1997 ($)	36,853	40,139	26,334	30,092	30,836
Percent of persons below poverty line (1997)	14.6	12.9	24.6	18.3	19.3

Source: DOC 2000.

4.3.9.3 Housing and Community Services

Table 4–28 lists the total number of occupied housing units and vacancy rates in the region of influence. In 1990, the four-county area contained 246,561 housing units, of which 225,289 were occupied. The median value of owner-occupied units was $85,300 in Bernalillo County, which is higher than the other three counties and nearly twice the median value of units in Torrance County. Coincidentally, the vacancy rate was lowest in Bernalillo County (7.8 percent) and highest in Torrance County (24.8 percent).

Community services include public education and healthcare (i.e., hospitals, hospital beds, and doctors). In 1998, student enrollment in the region of influence totaled 120,159 and the average student-to-teacher ratio was 16.4:1 (Department of Education 2000). Community health services and facilities are concentrated in Bernalillo County.

Table 4–28 Housing and Community Services in the SNL/NM Region of Influence

	County				
	Bernalillo	***Sandoval***	***Torrance***	***Valencia***	***Region of Influence***
Housing (1990) [a]					
Total units	201,235	23,667	4,878	16,781	246,561
Occupied housing units	185,582	20,867	3,670	15,170	225,289
Vacant units	15,653	2,800	1,208	1,611	21,272
Vacancy rate (percent)	7.8	11.8	24.8	9.6	8.6
Median value ($)	85,300	69,600	46,500	72,100	Not available
Public Education (1998) [b]					
Total enrollment	85,847	14,700	6,171	13,441	120,159
Student-to-teacher ratio	16.3:1	16.4:1	17.2:1	17.1:1	16.4:1
Community Healthcare (1998) [c]					
Hospitals	8	0	0	0	8
Hospital beds per 1,000 persons	3.1	0	0	0	2.3
Physicians per 1,000 persons	3.7	0.9	0.3	0.5	3

[a] DOE 1999d.
[b] Department of Education 2000.
[c] Gaquin and DeBrandt 2000.

4.3.9.4 Local Transportation

Key roads in the vicinity of KAFB include Interstates 25 and 40 (see Figure 4–12). Interstate 25 runs north-south and is approximately 1.5 miles west of the KAFB boundary at its nearest approach. Interstate 40 runs east-west through Albuquerque and is approximately 1.6 kilometers (1 mile) north of the KAFB boundary at its nearest approach. Access to KAFB and SNL/NM consists of an urban road network maintained by the city of Albuquerque, the gates and roadways of KAFB, and SNL/NM-maintained roads. Traffic enters SNL/NM through three principal gates: Wyoming, Gibson, and Eubank. Most commercial traffic enters through the Eubank gate because it provides direct access to the SNL/NM shipping and receiving facilities located in TA-II. An additional entrance to KAFB, the Truman gate, serves KAFB's western areas. The roads near SNL/NM experience heavy traffic in the early morning and late afternoon. The principal contributors are SNL/NM staff and other civilian and military personnel commuting to and from KAFB.

The Santa Fe Railroad (now Burlington Northern & Santa Fe Railroad) discontinued its spur into KAFB in 1994. Land within KAFB, permitted to DOE for the railroad right-of-way, has been returned to the U.S. Air Force and demolition of the spur has begun. Primary air service is provided for the entire region by the Albuquerque International Sunport, located immediately northwest of KAFB. Runways and other flight facilities are shared with KAFB.

4.3.10 Environmental Justice

Under Executive Order 12898, DOE is responsible for identifying and addressing disproportionately high and adverse impacts on minority or low-income populations. As discussed in Appendix E, minority persons are those who identify themselves as Hispanic or Latino, Asian, Black or African American, American Indian or Alaska Native, Native Hawaiian or Other Pacific Islander, or multiracial. Persons whose income is below the Federal poverty threshold are designated as low-income.

TA-V is located at latitude 34° 59' 46.13" north, longitude 106° 31' 49.85" west. **Figure 4–19** shows the location of TA-V and the region of potential radiological impacts. As shown in the figure, the region surrounding TA-V includes the Albuquerque Metropolitan Area and Indian Reservations in the Albuquerque-Santa Fe areas.

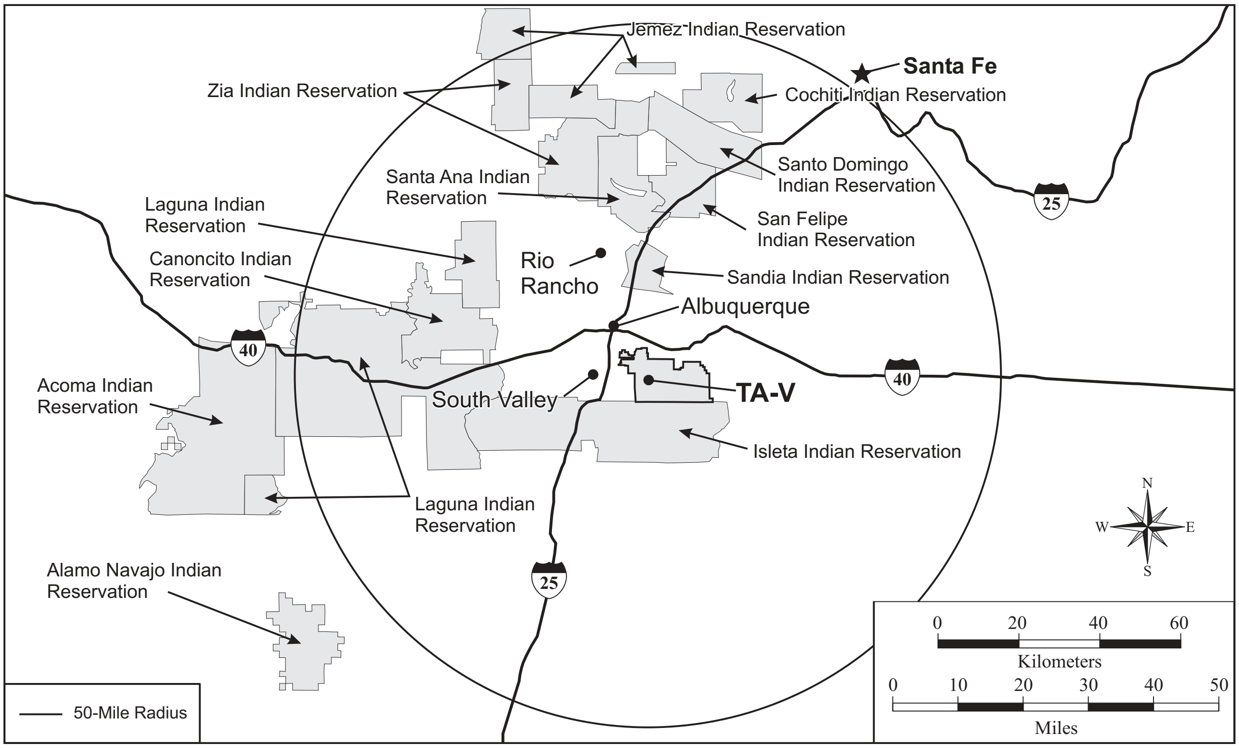


Figure 4–19 Location of TA-V and Indian Reservations Surrounding SNL/NM

Nine counties are included or partially included in the potentially affected area (see **Figure 4–20**): Bernalillo, Cibola, McKinley, Sandoval, San Miguel, Santa Fe, Socorro, Torrance, and Valencia. **Table 4–29** provides the racial and Hispanic composition for these counties using data obtained from the decennial census conducted in 2000. In the year 2000, a majority of these county residents designated themselves as members of a minority. Hispanics and American Indians/Alaska Natives comprised over 90 percent of the minority population. As a percentage of the total resident population in 2000, New Mexico had the largest percentage minority population (55 percent) among the contiguous states and the second largest percentage minority population among all of the states—only Hawaii had a larger percentage minority population (77 percent).

Figure 4–21 compares the growth in the minority populations in potentially affected counties between 1990 and 2000. As discussed in Section E.5.1 of Appendix E, data concerning race and Hispanic origin from the 2000 Census cannot be directly compared with that for the 1990 Census because the racial categories used in the two enumerations were different. Bearing this change in mind, the minority population in potentially affected counties increased from approximately 51 percent to 57 percent in the decade from 1990 to 2000. Hispanics and American Indians/Alaska Natives accounted for approximately 84 percent of the increase in minority population during the decade. For comparison, minorities composed approximately one-quarter of the total population of the United States in 1990 and nearly one-third of the total population in 2000.

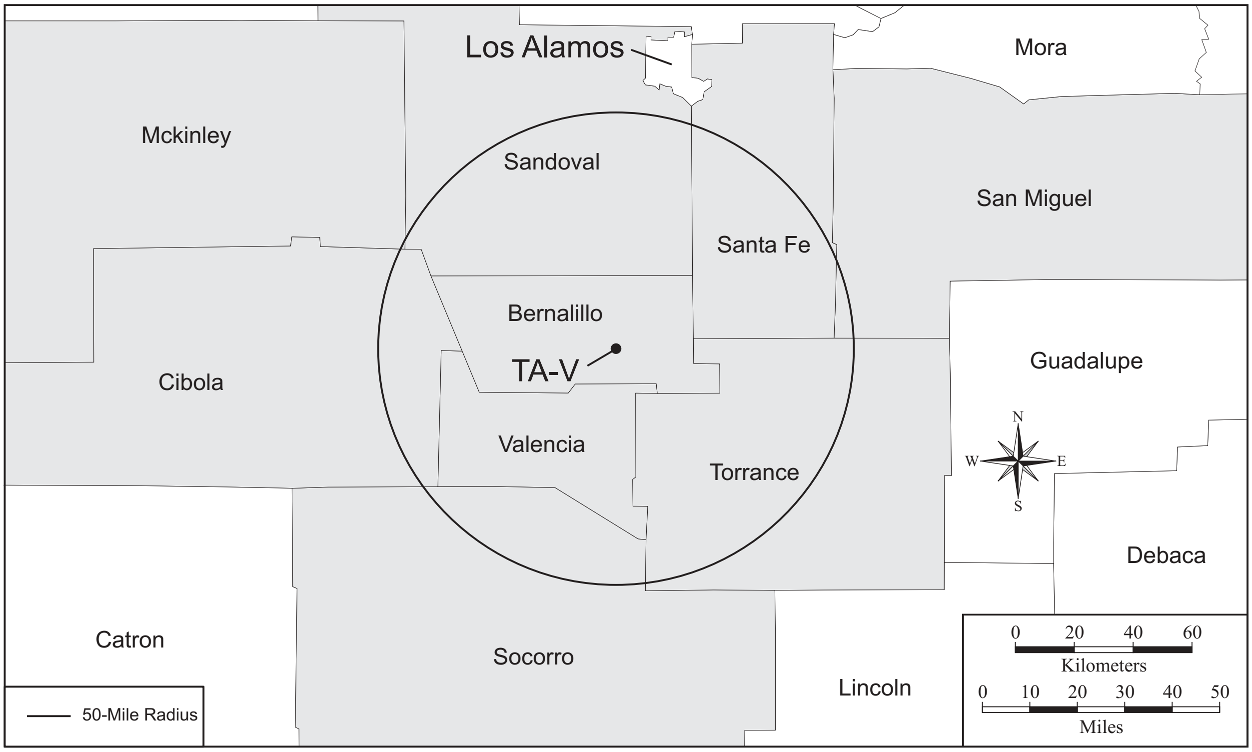


Figure 4–20 Potentially Affected Counties Surrounding TA-V at SNL/NM

Table 4–29 Populations in Potentially Affected Counties Surrounding TA-V in 2000

Population Group	Population	Percentage of Total
Minority	569,428	56.5
Hispanic	416,189	41.3
Black/African American	17,533	1.7
American Indian/Alaska Native	106,093	10.5
Asian	13,213	1.3
Native Hawaiian/Pacific Islander	647	0.1
Two or more races	15,753	1.6
Some other race	1,644	0.2
White	436,466	43.3
Total	1,007,538	100.0

Source: DOC 2001.

The percentage of low-income population at risk in potentially affected counties surrounding TA-V in 1990 was approximately 15 percent. In 1990, nearly 13 percent of the total population of the continental United States reported incomes less than the poverty threshold. In terms of percentages, minority populations at risk are relatively large in comparison with the national percentage, while the percentage low-income population at risk is commensurate with the corresponding national percentage. Complete census data with block group resolution for minority and low-income populations obtained from the decennial census of 2000 are scheduled for publication in 2002.

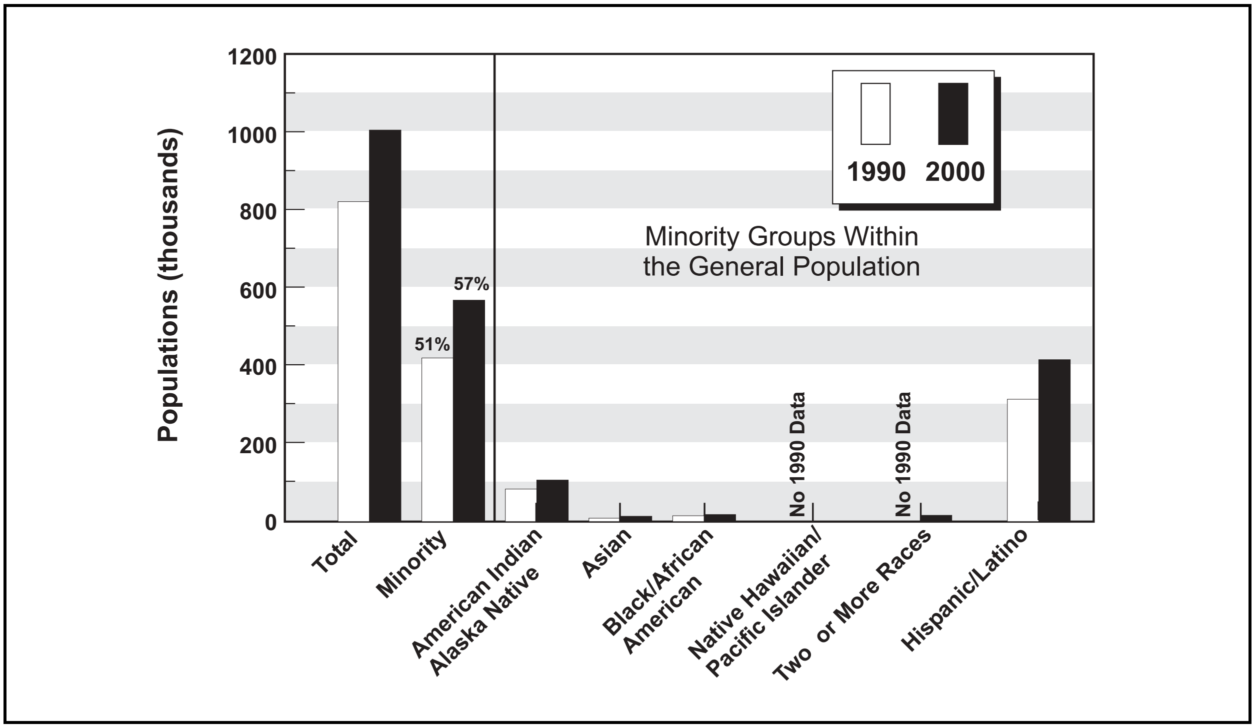


Figure 4–21 Comparison of Populations in Potentially Affected Counties Surrounding TA-V in 1990 and 2000

4.3.11 Existing Human Health Risk

Public and occupational health and safety issues include the determination of potentially adverse effects on human health that result from acute and chronic exposures to ionizing radiation and hazardous chemicals.

4.3.11.1 Radiation Exposure and Risk

Major sources and levels of background radiation exposure to individuals in the vicinity of SNL/NM are shown in **Table 4–30**. Annual background radiation doses to individuals are expected to remain constant over time. The total dose to the population, in terms of person-rem, changes as the population size changes. Background radiation doses are unrelated to SNL/NM operations.

Releases of radionuclides to the environment from SNL/NM operations provide another source of radiation exposure to individuals near the site. Types and quantities of radionuclides released from SNL/NM operations in 1999 are listed in the *1999 Annual Site Environmental Report, Sandia National Laboratories, Albuquerque, New Mexico* (SNL/NM 2001a). The releases are summarized in Section 4.3.3.2 of this EIS. The doses to the public resulting from these releases are presented in **Table 4–31.** These doses fall within the radiological limits given in DOE Order 5400.5, *Radiation Protection of the Public and the Environment*, and are much lower than those of background radiation.

Table 4–30 Sources of Radiation Exposure to Individuals in the SNL/NM Vicinity Unrelated to SNL/NM Operations

Source	*Effective Dose Equivalent (millirem per year)*
Natural Background Radiation	
Total external (cosmic and terrestrial) [a]	92
Internal terrestrial and global cosmogenic [b]	40
Radon in homes (inhaled)	200 [b, c]
Other Background Radiation [b]	
Diagnostic x rays and nuclear medicine	53
Weapons test fallout	less than 1
Air travel	1
Consumer and industrial products	10
Total	397

[a] SNL/NM 1999, SNL/NM 2001a.
[b] NCRP 1987.
[c] An average for the United States.

Table 4–31 Radiation Doses to the Offsite Public from Normal SNL/NM Operations in 1999 (total effective dose equivalent)

Members of the Public	*Atmospheric Releases*		*Liquid Releases*		*Total*	
	Standard [a]	*Actual*	*Standard* [a]	*Actual*	*Standard* [a]	*Actual*
Maximally exposed offsite individual (millirem)	10	0.00021	4	0	100	0.00021
Population within 80 kilometers (50 miles) (person-rem) [b]	None	0.0221	None	0	100	0.0221
Average individual within 80 kilometers (50 miles) (millirem) [c]	None	3.2×10^{-5}	None	0	None	3.2×10^{-5}

[a] The standards for individuals are given in DOE Order 5400.5. As discussed in that order, the 10-millirem-per-year limit from airborne emissions is required by the Clean Air Act (40 CFR 61) and the 4-millirem-per-year limit is required by the Safe Drinking Water Act (40 CFR 141). The total dose of 100 millirem per year is the limit from all pathways combined. The 100-person-rem value for the population is given in proposed 10 CFR 834, *Radiation Protection of the Public and Environment: Proposed Rule*, as published in 58 FR 16268. If the potential total dose exceeds the 100-person-rem value, the contractor operating the facility is required to notify DOE.
[b] Based on an estimated population of 695,400 in 1999.
[c] Obtained by dividing the population dose by the number of people living within 80 kilometers (50 miles) of the site.
Source: SNL/NM 2001a.

Using a risk estimator of 1 latent cancer death per 2,000 person-rem to the public (see Appendix B), the fatal cancer risk to the maximally exposed member of the public due to radiological releases from SNL/NM operations in 1999 is estimated to be 1.1×10^{-10}. That is, the estimated probability of this hypothetical person dying of cancer at some point in the future from radiation exposure associated with one year of SNL/NM operations is about 1 in 10 billion (it takes several to many years from the time of radiation exposure for a cancer to manifest itself).

According to the same risk estimator, 1.1×10^{-5} excess fatal cancers are projected in the population living within 80 kilometers (50 miles) of SNL/NM from normal operations in 1999. To place this number in perspective, it may be compared with the number of fatal cancers expected in the same population from all causes. The mortality rate associated with cancer for the entire U.S. population is 0.2 percent per year. Based on this mortality rate, the number of fatal cancers expected during 1999 from all causes in the population living within 80 kilometers (50 miles) of SNL/NM was 1,390. This expected number of fatal cancers is much higher than the 1.1×10^{-5} fatal cancers estimated from SNL/NM operations in 1999.

Members of the public living on site at KAFB receive the same dose as the offsite public from background radiation, but they also receive an additional dose from SNL/NM facilities with nuclear materials. The maximum exposed individual on site would be a hypothetical member of the public (onsite public housing resident) located near the Kirtland Underground Munitions Storage Complex. The maximum dose to the onsite person and the cumulative dose to all onsite residents from operations in 1999 are presented in **Table 4–32.** According to a risk estimator of one latent fatal cancer per 2,000 person-rem (see Appendix B), the number of projected fatal cancers among onsite residents from normal operations in 1999 is 2.6×10^{-7}.

Table 4–32 Radiation Doses to the Onsite Public in 1999 and to Workers in 1998 Due to Normal SNL/NM Operations (total effective dose equivalent)

Onsite Receptor	*Onsite Releases and Direct Radiation*	
	Standard	*Actual*
Maximally exposed onsite public receptor (millirem per year)	Refer to Table 4–31	8.5×10^{-4}
Collective KAFB resident population (person-rem per year) [a]	None	5.1×10^{-4}
Average badged worker (millirem per year) [b]	None [c]	52
Collective badged worker population (person-rem per year) [b]	None	9.5

a Based on a population of 5,670 people estimated to be living in permanent on-base housing.
b Based on a badged worker population of 181 receiving a measured total effective dose equivalent over 10 millirem.
c No standard is specified for an average radiation worker; however, the radiological limit for an individual worker is 5,000 millirem per year (10 CFR 835). DOE's goal is to maintain radiological exposure as low as is reasonably achievable. Therefore, DOE has recommended an administrative control level of 500 millirem per year (DOE 1999c); the site must make reasonable attempts to maintain individual worker doses as low as reasonably achievable below this level.
Sources: DOE 1998b, SNL/NM 2001a.

The average dose to a badged worker and the collective dose to the badged worker population, both of whom have a measured total effective dose equivalent greater than 10 millirems, are also shown in Table 4–32. According to a risk estimator of one latent fatal cancer per 2,500 person-rem among workers (see Appendix B), the number of projected fatal cancers in the badged worker population of 181 from normal operations in 1998 is 0.0038. The risk estimator for workers is lower than the estimator for the public because of the absence from the workforce of the more radiosensitive infant and child age groups.

A more detailed presentation of the radiation environment, including background exposures and radiological releases and doses, is presented in the *1999 Annual Site Environmental Report, Sandia National Laboratories, Albuquerque, New Mexico* (SNL/NM 2001a). The concentrations of radioactivity in various environmental media (including air, water, and soil) in the site region (on and off the site) also are presented.

External radiation doses have been measured on the SNL/NM site that may contain radiological sources for comparison with offsite natural background radiation levels. Measurements taken in 1999 showed an average onsite dose on the SNL/NM site of 109 millirem compared to an offsite dose of 99 millirem (SNL/NM 2001a).

External concentrations of gross alpha and beta radiation in air are measured at SNL/NM. The concentrations in air of gross alpha and beta radiation in the general vicinity of TA-V in 1999 were 3.9×10^{-15} curies per cubic meter and 1.12×10^{-14} curies per cubic meter, respectively. These concentrations were about the same as measured at other onsite locations (SNL/NM 2001a).

4.3.11.2 Chemical Environment

The background chemical environment important to human health consists of the atmosphere, which may contain hazardous chemicals that can be inhaled; drinking water, which may contain hazardous chemicals that can be ingested; and other environmental media with which people may come in contact (e.g., soil through direct contact or via the food pathway).

Adverse health impacts to the public are minimized through administrative and design controls to decrease hazardous chemical releases to the environment and to achieve compliance with permit requirements. The effectiveness of these controls is verified through the use of monitoring information and inspection of mitigation measures. Health impacts to the public may occur during normal operations at SNL/NM via inhalation of air containing hazardous chemicals released to the atmosphere by SNL/NM operations. Risks to public health from ingestion of contaminated drinking water or direct exposure to hazardous chemicals are also potential pathways.

Baseline air emission concentrations for air pollutants and their applicable standards are presented in Section 4.3.3.1. These concentrations are estimates of the highest existing offsite concentrations and represent the highest concentrations to which members of the public could be exposed. These concentrations are compared with applicable guidelines and regulations.

Chemical exposure pathways to SNL/NM workers during normal operation may include inhaling the workplace atmosphere, drinking SNL/NM potable water, and other possible contacts with hazardous materials associated with work assignments. Workers are protected from hazardous materials specific to the workplace through appropriate training, protective equipment, monitoring, and management controls. SNL/NM workers are also protected by adherence to OSHA and EPA occupational standards that limit atmospheric and drinking water concentrations of potentially hazardous chemicals. Appropriate monitoring, which reflects the frequency and amounts of chemicals utilized in the operation process, ensures that these standards are not exceeded. Additionally, DOE requirements ensure that conditions in the workplace are as free as possible from recognized hazards that cause or are likely to cause illness or physical harm. Therefore, worker health conditions at SNL/NM are substantially better than are required by standards.

4.3.11.3 Health Effects Studies

There are no known epidemiological studies that examine the impact of SNL/NM on the health of the surrounding communities. The Office of Epidemiologic Studies Epidemiologic Surveillance Program has been implemented at SNL/NM to monitor the health of current workers at the Albuquerque site. This program monitors and evaluates the occurrence of illness and injury in the workforce on a continuing basis and issues annual reports. Epidemiologic surveillance makes use of routinely collected health data including reasons for illness absence, disabilities, and the OSHA recordable injuries and illnesses. These health event data, coupled with demographic data about the active workforce, are analyzed to evaluate whether particular occupational groups are at increased risk of disease or injury when compared with other workers at SNL/NM. A summary of epidemiological surveillance at SNL/NM can be found in Volume II, Appendix E, Section E.4.8 of the *Final Programmatic Environmental Impact Statement for Stockpile Stewardship and Management* (DOE 1996e).

4.3.11.4 Accident History

A review of the SNL/NM annual environmental and accidental reports indicates that there have been no significant adverse impacts to workers, the public, or the environment. This review was performed to examine the site's accident history. The period of review, from 1986 to 1990, was a time during which plant operations were much higher than in previous years and the years following the review period (DOE 1996e). There have been no criticality accidents at SNL/NM.

4.3.11.5 Emergency Preparedness

Each DOE site has an established emergency management program that would be activated in the event of an accident. This program has been developed and is maintained to ensure adequate response to most accident conditions and to provide response efforts for accidents not specifically considered. The emergency management program incorporates activities associated with planning, preparedness, and response (DOE 1996e). In addition, DOE has specified actions to be taken at all DOE sites to implement lessons learned from the emergency response to an accidental explosion at Hanford in May 1997.

4.3.12 Waste Management

Waste management includes minimization, characterization, treatment, storage, transportation, and disposal of waste generated from ongoing DOE activities. The waste is managed using appropriate treatment, storage, and disposal technologies, and in compliance with all applicable Federal and state statutes and DOE orders.

4.3.12.1 Waste Inventories and Activities

SNL/NM manages the following types of waste: transuranic, mixed transuranic, low-level radioactive, mixed low-level radioactive, hazardous, and nonhazardous. Because there is no transuranic or mixed transuranic waste associated with TA-18 operations, these waste types are not discussed in this EIS. Waste generation rates and the inventory of stored waste from activities at SNL/NM are provided in **Table 4–33**. The SNL/NM waste management capabilities are summarized in **Table 4–34**.

Although not listed on the National Priorities List, SNL/NM adheres to the CERCLA guidelines for environmental restoration projects that involve certain hazardous substances not covered under RCRA. The initial remedial assessment of SNL/NM potential release sites was conducted under CERCLA beginning in 1984 and ending in 1987. The assessment identified 117 potential release sites. By 1993, the number had increased to 219 potential release sites, including offsite locations. Remediation field activities conducted under the Environmental Restoration Project are scheduled for completion in FY02, with permit modification by FY04 to remove remediated release sites from further action. As of August 1998, 60 release sites remained on the list for restoration or additional assessment. SNL/NM has proposed to the appropriate regulatory authority no further action for 122 of the 182 release sites. There are 11 environmental restoration sites within TA-V. Only two of these sites are classified as potential release sites. One is an oil release near Building 6597 (soil contamination) and the other is trichloroethylene contamination (potential groundwater contamination) near the guard gate on the north side of the TA. Both of these sites are under investigation (SNL/NM 2001b). More information on regulatory requirements for waste disposal is provided in Chapter 6.

4.3.12.2 Low-Level Radioactive Waste

SNL/NM generates low-level radioactive waste as a result of research and development activities. Small quantities of low-level radioactive waste can be received periodically from remote test facilities including Kauai, Hawaii; White Sands Missile Range, New Mexico; and Tonopah Test Range, Nevada. Most of the low-level radioactive waste consists of contaminated equipment and combustible decontamination materials and cleanup debris. The Radioactive and Mixed Waste Management Facility in TA-III processes low-level radioactive waste to meet the waste acceptance criteria of designated DOE disposal sites (DOE 1996e).

Table 4–33 Waste Generation Rates and Inventories at SNL/NM

Waste Type	*Generation Rate (cubic meters per year)*	*Inventory (cubic meters)*
Low-level radioactive	577	336
Mixed low-level radioactive	143	152
Hazardous (in kilograms)		
Resource Conservation and Recovery Act	36,965	Not applicable [a]
Toxic Substance Control Act	122,000	Not applicable [a]
Nonhazardous		
Liquid	1,060,000	Not applicable [a]
Solid	2,100	Not applicable [a]

[a] Generally, hazardous and nonhazardous wastes are not held in long-term storage.
Source: DOE 1999d.

Table 4–34 Waste Management Capabilities at SNL/NM[a]

Facility Name/Description	*Capacity*	*Status*	*Applicable Waste Type*		
			Low-Level Radioactive Waste	*Mixed Low-Level Radioactive Waste*	*Hazardous*
Treatment Facility (cubic meters per year)					
RMWMF [b]	61,326	Online		X	
HBWSF [b]	61,326	Online		X	
Thermal Treatment Facility (in kilograms)	136	Online			X [c]
Storage Facility (cubic meters)					
RMWMF in TA-III	8,000	Online	X	X	
High bay (6596) in TA-I	1,800	Online	X	X	
Interim storage site in TA-III	510	Online	X	X	
Manzano bunkers [d]	1,556	Online	X	X	
HWMF Waste Packaging Building 959	22	Online			X
HWMF Waste Packaging Building 958	227	Online			X
HWMF Modular Storage Buildings	38	Online			X

RMWMF = Radioactive and Mixed Waste Management Facility; HBWSF = High Bay Mixed Waste Storage Facility; HWMF = Hazardous Waste Management Facility

[a] There are no treatment, storage or disposal facilities for nonhazardous wastes located at SNL/NM. Off site facilities are used.

[b] Treatment options are discussed in the SNL/NM Site Treatment Plan. Final approval of treatment options is not expected prior to renewal of the existing hazardous waste permit sometime after 2000. DOE has paid annual operating fees associated with the treatment units since 1996.

[c] Treatment of explosive waste.

[d] Includes Manzano Bunkers 37034, 37045, 37055, 37057, 37063, 37078, 37118.

Source: DOE 1999d.

4.3.12.3 Mixed Low-Level Radioactive Waste

In general, mixed low-level radioactive waste is generated during laboratory experiments and components testing. Mixed low-level radioactive waste generated at SNL/California has also been shipped to SNL/NM for management in accordance with a New Mexico Environment Department compliance order issued under the Federal Facility Compliance Act.

SNL/NM has the capability to treat some mixed wastes on site at the Radioactive and Mixed Waste Management Facility and the High Bay Mixed Waste Storage Facility. Treatment options include thermal treatment, neutralization, chemical treatment, centrifugation, encapsulation, flocculation, physical treatment, reverse osmosis, and mechanical processing.

Processing includes activities required to comply with the waste acceptance criteria and Federal regulations. Pursuant to the Federal Facility Compliance Act, SNL/NM developed a site treatment plan for mixed wastes. The site treatment plan is intended to bring SNL/NM into compliance with land disposal restrictions (storage prohibitions) under the New Mexico Hazardous Waste Act and RCRA. DOE submitted a proposed site treatment plan, and on October 6, 1995, a Compliance Order was issued by the State of New Mexico requiring SNL/NM to comply with the site treatment plan for the treatment of mixed wastes at SNL/NM (DOE 1996e).

4.3.12.4 Hazardous Waste

The Hazardous Waste Management Facility, located in TA-II, performs safe handling, packaging, short-term storage, and shipping of all RCRA-regulated, Toxic Substances Control Act-regulated, and other hazardous and toxic waste categories, except explosives. The hazardous waste generated at SNL/NM predominantly results from experiments, testing, research and development activities, and infrastructure fabrication and maintenance. Environmental restoration and decontamination and decommissioning also generate hazardous waste. In addition, SNL/NM manages small amounts of waste from other operations such as SNL/NM's Advanced Materials Laboratory on the University of New Mexico campus in Albuquerque or DOE's Albuquerque Operations Office.

Hazardous waste generated by SNL/NM is collected and transported to the Hazardous Waste Management Facility for packaging and short-term (less than one year) storage prior to offsite transportation for recycling, treatment, or disposal at a licensed facility.

The Thermal Treatment Facility, located in the northeast corner of TA-III, is used to thermally treat small quantities of waste explosive substances, waste liquids contaminated with explosive substances, and waste items (e.g., rags, wipes, and swabs) contaminated with explosive substances. No radioactive waste is treated at the Thermal Treatment Facility.

4.3.12.5 Nonhazardous Waste

Solid waste consists predominantly of office and nonhazardous laboratory trash. It does not include food waste from cafeteria operations, which is managed under a separate contract with the U.S. Air Force. Nonhazardous building debris generated from decontamination and decommissioning activities may also be considered solid waste; however, it is currently managed at KAFB. After nonhazardous solid waste is transferred to the Solid Waste Transfer Facility, it is screened for improperly disposed of, potentially hazardous materials, which are removed from the trash and disposed of through appropriate processes. All solid waste is currently disposed of at the Rio Rancho Sanitary Landfill in Rio Rancho, New Mexico.

In 1996, the SNL/NM sewer system consisted of a 64-kilometer (40-mile) underground pipe network that discharged approximately 1 million liters (280 million gallons) of industrial and domestic wastewater. Wastewater has leaked from underground sewer lines. Possible soil contamination associated with these leaks is being investigated and cleaned up as part of the Environmental Restoration Project.

4.3.12.6 Waste Minimization

SNL/NM has an active waste minimization and pollution prevention program to reduce the total amount of waste generated and disposed of at the site. This is accomplished by eliminating waste through source reduction or material substitution; by recycling potential waste materials that cannot be minimized or eliminated; and by treating all of the waste that is generated to reduce its volume, toxicity, or mobility prior to storage or disposal. Achievements and progress in this area have been updated at least annually. Implementing pollution prevention projects reduced the total amount of waste generated at SNL/NM in 1999 by approximately 8 cubic meters (10.5 cubic yards). Examples of pollution prevention projects completed in 1999 at SNL/NM include the reduction of sanitary waste by 5,895 metric tons (6,496 tons) by crushing concrete and asphalt material for reuse, thereby eliminating the need to purchase new materials (DOE 2000h).

4.3.12.7 Waste Management PEIS Records of Decision

The *Waste Management PEIS* Records of Decision affecting SNL/NM are shown in **Table 4–35**. Decisions on the various waste types were announced in a series of Records of Decisions published after publication of the *Waste Management PEIS* (DOE 1997a). The hazardous waste Record of Decision was published on August 5, 1998 (63 FR 41810), and the low-level radioactive and mixed low-level radioactive waste Record of Decision was published on February 18, 2000 (65 FR 10061). The hazardous waste Record of Decision states that most DOE sites will continue to use offsite facilities for the treatment and disposal of major portions of nonwastewater hazardous waste. The Oak Ridge Reservation and the Savannah River Site will continue treating some of their own nonwastewater hazardous waste on site in existing facilities, where this is economically feasible. The low-level radioactive waste and mixed low-level radioactive waste Record of Decision states that, for the management of low-level radioactive waste, minimal treatment will be performed at all sites and onsite disposal will continue, to the extent practicable, at INEEL, LANL, the Oak Ridge Reservation, and the Savannah River Site. In addition, Hanford and NTS will be available to all DOE sites for low-level radioactive waste disposal. Mixed low-level radioactive waste will be treated at Hanford, INEEL, the Oak Ridge Reservation, and the Savannah River Site, and will be disposed of at Hanford and NTS. More detailed information concerning DOE's decisions for the future configuration of waste management facilities at SNL/NM is presented in the hazardous waste and low-level radioactive waste and mixed low-level radioactive waste Records of Decision.

Table 4–35 Waste Management PEIS Records of Decision Affecting SNL/NM

Waste Type	*Preferred Action*
Low-level radioactive	DOE has decided to treat SNL/NM's low-level radioactive waste on site and to ship the waste to either the Hanford Site or NTS for disposal. [a]
Mixed low-level radioactive	DOE has decided to regionalize treatment of mixed low-level radioactive waste at the Hanford Site, INEEL, the Oak Ridge Reservation, and the Savannah River Site. DOE has decided to ship SNL/NM's mixed low-level radioactive waste to either the Hanford Site or NTS for disposal. [a]
Hazardous	DOE has decided to continue to use commercial facilities for treatment of SNL/NM's nonwastewater hazardous waste. [b]

[a] From the Record of Decision for low-level radioactive and mixed low-level radioactive waste (65 FR 10061).
[b] From the Record of Decision for hazardous waste (63 FR 41810).
Sources: 65 FR 10061, 63 FR 41810.

4.4 NEVADA TEST SITE

NTS is located on approximately 365,100 hectares (880,000 acres) in southern Nye County, Nevada. The site is located 105 kilometers (65 miles) to the northwest of Las Vegas and 16 kilometers (10 miles) northeast of the California State line (see **Figure 4–22**). All of the land within NTS is owned by the Federal Government and is administered, managed, and controlled by DOE's NNSA. NTS contains approximately 900 buildings that provide approximately 259,300 square meters (2,790,600 square feet) of space. Many of these facilities have been either mothballed or abandoned because of the reduction of program activities at the site (DOE 1998a).

NTS (originally the Nevada Proving Grounds) was established in 1950 as an on-continent proving ground and has seen more than four decades of nuclear weapons testing. Since the nuclear weapons testing moratorium in 1992 and under the direction of DOE, test site use has diversified into many other programs. Programs currently conducted at NTS include those related to defense, waste management, environmental restoration, nondefense research and development, and work for others (DOE 1996d).

The Device Assembly Facility (DAF) is located in Area 6, which is situated within the east-central portion of NTS. This area occupies about 21,200 hectares (52,500 acres) between Yucca Flat and Frenchman Flat, straddling Frenchman Mountain. The area was used for one atmospheric and five underground nuclear tests between 1957 and mid-1990 (DOE 1996d). Unless otherwise referenced, the following descriptions of the affected environment at NTS and DAF are based all or in part on information provided in the *NTS SWEIS* (DOE 1996d), which is incorporated by reference.

4.4.1 Land Resources

4.4.1.1 Land Use

Federal lands surround NTS, with the Nellis Air Force Range Complex located on the north, east, and west, and U.S. Bureau of Land Management lands on the south and southwest. Beyond the Federal lands surrounding NTS, principal land uses in Nye County in the vicinity of the site include mining, grazing, agriculture, and recreation. Of the total land area within the county, only a small number of isolated areas are under private ownership and, therefore, are subject to general planning guidelines. Rural communities located within the vicinity of NTS include Alamo, 69 kilometers (43 miles) to the northeast; Pahrump, 42 kilometers (26 miles) to the south; Beatty, 26 kilometers (16 miles) to the west; and Amargosa Valley, 5 kilometers (3 miles) to the south.

Clark County, Nevada, lies immediately to the east of NTS. The Federal Government owns 95 percent of the county. Primary land uses on these Federal lands include open grazing, mining, and recreation. Outdoor recreational areas located in the vicinity of NTS include Lake Mead National Recreation Area, 121 kilometers (75 miles) to the east; Red Rock National Conservation Area, 64 kilometers (40 miles) to the southwest; Death Valley National Monument, 19 kilometers (12 miles) to the west-southwest; and Desert National Wildlife Range, 5 kilometers (3 miles) to the east. Several state parks are also located within 80 kilometers (50 miles) of NTS.

Land use zone categories at NTS include the Nuclear Test Zone, Nuclear and High Explosives Test Zone, Research Test and Experiment Zone, Radioactive Waste Management Zone, Solar Enterprise Zone, Defense Industrial Zone, and Reserved Zone (**Figure 4–23**). In most cases, an area is assigned to a use category based on the environmental characteristics it exhibits. Environmental characteristics, especially geography and geology, generally determine how suitable an area is for a particular use. Technical and experimental areas cluster in those sectors of NTS where geography and geology are most favorable to testing (DOE 1998a).

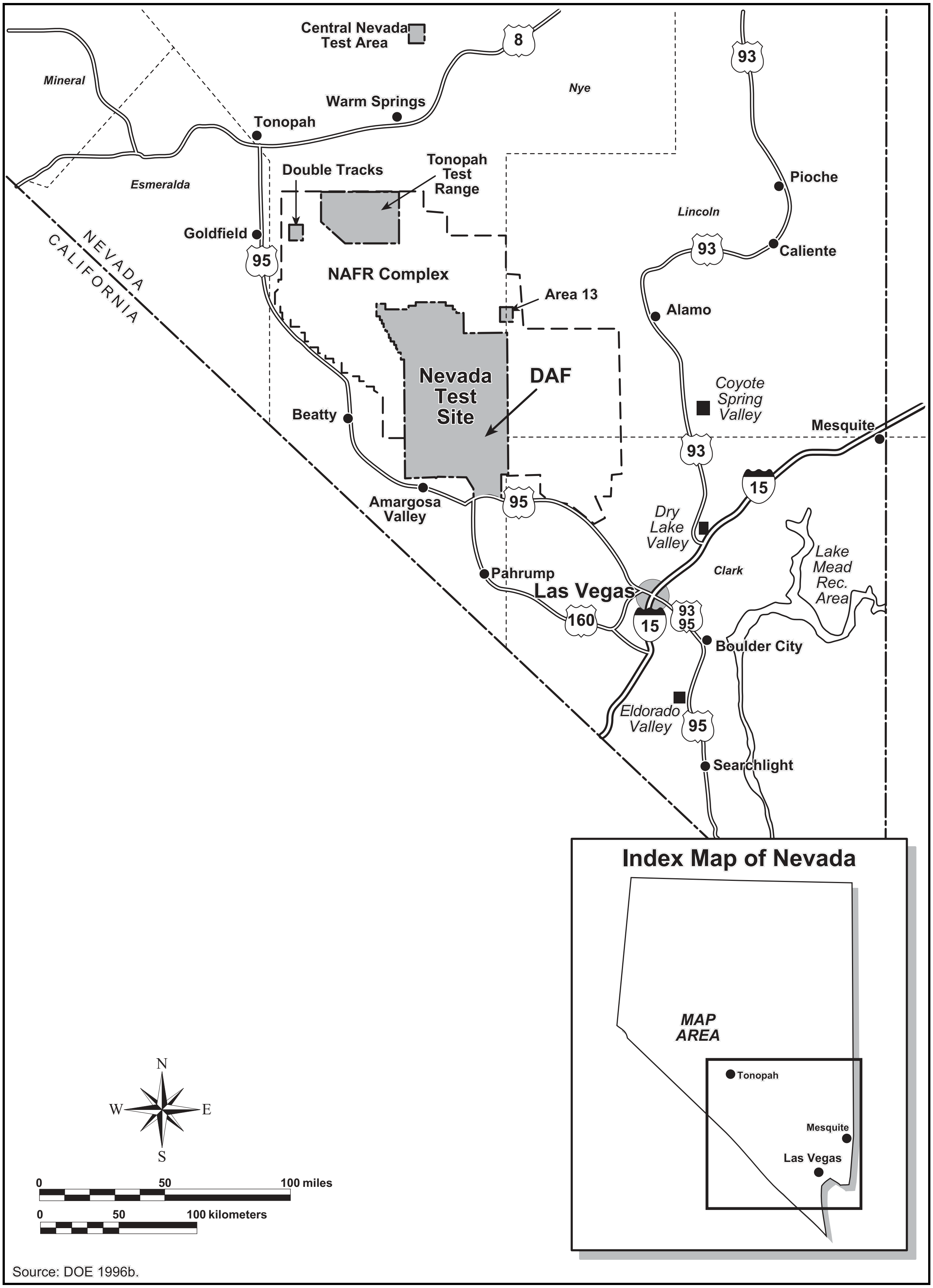


Figure 4–22 Location of NTS

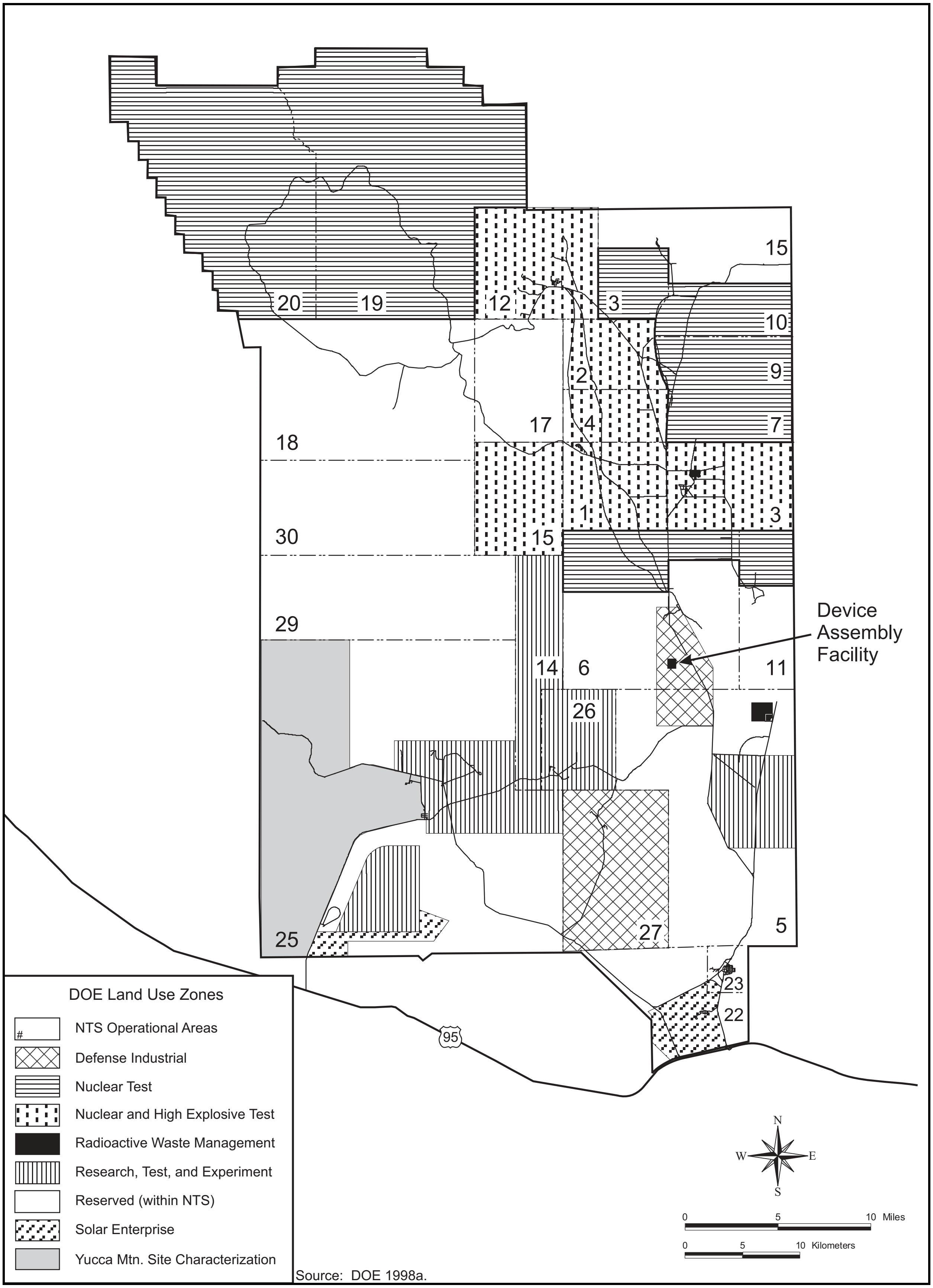


Figure 4–23 Land Use at the Nevada Test Site

Approximately 45 percent of NTS is currently unused or provides buffer zones for ongoing programs or projects, while about 7 to 10 percent (24,300-35,000 hectares [60,000-86,500 acres]) of the site has been disturbed. The following information describes the land use zones.

Nuclear Test Zone—This area is reserved for dynamic experiments, hydrodynamic tests, and underground nuclear weapons and weapons effects tests. This zone includes compatible defense and nondefense research, development, and testing activities.

Nuclear and High Explosives Test Zone—This area is designated within the Nuclear Test Zone for additional underground nuclear weapons tests and outdoor high explosive tests. This zone includes compatible defense and nondefense research, development, and testing activities.

Research Test and Experiment Zone—This area is designated for small-scale research and development projects and demonstrations; pilot projects; outdoor tests; and experiments related to the development, quality assurance, or reliability of material and equipment under controlled conditions. This zone includes compatible defense and nondefense research, development, and testing projects and activities.

Radioactive Waste Management Zone—This area is designated for the management of radioactive wastes.

Solar Enterprise Zone—The area is designated for the development of a solar power generation facility, as well as light industrial equipment and commercial manufacturing capabilities.

Defense Industrial Zone—This area is designated for stockpile management of weapons, including production, assembly, disassembly or modification, staging, repair, retrofit, and surveillance. Also included in this zone are permanent facilities for stockpile stewardship operations involving equipment and activities such as radiography, lasers, material processing, and pulsed power.

Reserved Zone—This area includes land and facilities that provide widespread flexible support for diverse short-term testing and experimentation. The reserved zone is also used for short-duration exercises and training such as nuclear emergency response and Federal Radiological Monitoring and Assessment Center training and Department of Defense (DoD) land-navigation exercises and training.

NTS is part of the National Environmental Research Park network, although certain areas of the site are excluded from this designation because of operations or other activities related to the primary mission of the site. The National Environmental Research Park designation provides for research into biological diversity, plant and community development in disturbed and undisturbed landscapes, regional climate trends, soil formation differences, and other factors that control environmental conditions. Additionally, the compatibility of the environment with energy technology options can be studied (DOE 1998a).

Land-use planning does not occur at the state level in Nevada; however, counties and other municipalities may plan if they so choose. The recently adopted Nye County comprehensive plan is a policy document that permits the county to begin a process of establishing a comprehensive land-use plan and zoning ordinance. No municipalities within Nye County have adopted land-use plans, policies, or controls (DOE 1996f).

Three land use zones occur in Area 6 (Figure 4–23). The northern quarter of the area is designated as the Nuclear Test Zone, the south central portion is categorized as the Defense Industrial Zone, and the remaining area is designated as the Reserved Zone. DAF, which occupies 12 hectares (29 acres) of land, is located within the Defense Industrial Zone (DOE 1995d). The facility is isolated from other structures and is surrounded by desert (Figure 3–9).

4.4.1.2 Visual Resources

NTS is located in a transition area between the Mojave Desert and the Great Basin. Vegetation characteristic of both deserts is found on the site. The topography of the site consists of a series of north-south-oriented mountain ranges separated by broad, low-lying valleys and flats. Site topography is also characterized by the presence of numerous subsidence craters resulting from past nuclear testing. The southwestern Nevada volcanic field, which includes portions of NTS, is a nested, multicaldera volcanic field. The facilities of NTS are widely distributed across this desert setting.

The area surrounding NTS is unpopulated to sparsely populated desert and rural land. Access to areas that would have views of the site is controlled by NTS or the U.S. Air Force; therefore, few viewpoints are accessible to the general public. Public viewpoints of NTS along U.S. Route 95, the principal highway between Tonopah and Las Vegas, are limited to Mercury Valley due to the various mountain ranges surrounding the southern boundary of the site. The primary viewpoint in Mercury Valley is a roadside turnoff containing Nevada Historical Marker No. 165 of the Nevada State Park System, entitled "Nevada Test Site." NTS facilities within 8 kilometers (5 miles) are visible from this viewpoint. The main base camp at Mercury, located in Area 23, is well defined at night by facility lighting. Lands within NTS have a Visual Resource Contrast rating of Class II or III. Management activities within these classes may be seen, but should not dominate the view. Developed areas within the site are consistent with a Visual Resource Contrast Class IV rating in which management activities dominate the view and are the focus of viewer attention.

DAF is located in Area 6, which covers about 21,200 hectares (53,500 acres) between Yucca Flat and Frenchman Flat, straddling Frenchman Mountain. Developed areas are widespread. DAF is a 9,290-square-meter (100,000-square-foot) facility that has a low profile and is covered with a minimum of 1.5 meters (5 feet) of earth. Several small building and parking lots surround DAF itself. Areas within and immediately adjacent to the facility are bare ground; the site is surrounded by desert. As is the case for NTS as a whole, undeveloped portions of the Area 6 have a Visual Resource Contrast Class II or III, while developed portions, including DAF, have a Visual Resource Contrast Class IV rating.

4.4.2 Site Infrastructure

Site infrastructure characteristics for NTS are summarized in **Table 4–36**.

Table 4–36 NTS Sitewide Infrastructure Characteristics

Resource	*Site Usage*	*Site Capacity*
Transportation		
Roads (kilometers)	1,127 [a]	Not applicable
Railroads (kilometers)	0	Not applicable
Electricity		
Energy consumption (megawatt-hours per year)	101,377	176,844
Peak load (megawatts)	27	45
Fuel		
Natural gas (cubic meters per year)	0	Not applicable
Liquid Fuels (liters per year)	4,201,805	Not limited
Coal (metric tons per year)	0	Not applicable
Water (liters per year)	832,000,000	5,150,000,000 [b]

[a] Includes paved and unpaved roads.
[b] Sustainable water production capacity of all site wells.
Sources: DOE 1996d, DOE 1998a, DOE 2000i.

4.4.2.1 Ground Transportation

About 644 kilometers (400 miles) of paved roads have been developed out of the 1,127 kilometers (700 miles) of roads on the site (Table 4–36). There is no railway service connection to NTS. Local and linking transportation systems, including roadways, are detailed in Section 4.4.9.4.

4.4.2.2 Electricity

Electric power is delivered to NTS at the Mercury switching center in Area 22 by a primary 138-kilovolt supply line from the Nevada Power Company system near Las Vegas. A second Nevada Power Company-owned 138-kilovolt line connects the Mercury switching center to the Jackass Flats substation in Area 25. Valley Electric Cooperative, serving the Pahrump, Nevada, area, also has a transmission connection to the Jackass Flats substation. The dual transmission and station connections provide NTS with the ability to receive service from either transmission source depending on contractual arrangements. A DOE-owned 138-kilovolt loop extends this primary power supply into NTS forward areas where smaller, lower-voltage distribution lines feed power to individual facilities. During the last several years, NTS has been provided power under contracts with Nevada Power Company and the Western Area Power Administration. Additionally, DOE has periodically operated oil-fired diesel generators at Area 25 for peak and back-up power supply purposes. Electric power at NTS is carried over 426 kilometers (265 miles) of transmission and subtransmission lines.

NTS electrical capacity is about 177,000 million megawatt-hours per year. In 2000, NTS electrical usage was about 101,000 megawatt-hours (Table 4–36). Peak load usage is 27 megawatts with a site peak load capacity of 45 megawatts (DOE 1996f).

4.4.2.3 Fuel

Liquid fuels are the principal fuel resources used at NTS (DOE 1996f). No coal or natural gas is used. Unleaded gasoline and diesel fuel are available at NTS. The fuel capacity in Mercury is 45,424 liters (12,000 gallons) of unleaded gasoline and 37,853 liters (10,000 gallons) of diesel fuel. The bulk fuel storage capacity in Mercury is 1,589,826 liters (420,000 gallons) of both unleaded gasoline and diesel fuel. The fuel capacity in Area 6 is 75,706 liters (20,000 gallons) for both unleaded gasoline and diesel fuel. The bulk fuel storage capacity in Area 6 is 158,983 liters (42,000 gallons) of unleaded gasoline and 397,457 liters (105,000 gallons) of diesel fuel. The fuel capacity in Area 12 is 75,706 liters (20,000 gallons) of unleaded gasoline (DOE 1998a).

NTS used approximately 4.2 million liters (1.1 million gallons) of liquid fuels in 2000. In 2000, DAF used about 83,000 liters (22,000 gallons) of liquid fuels.

4.4.2.4 Water

NTS is presently served by a water system divided into four service areas consisting of 11 wells for potable water, two wells for nonpotable water, some 30 usable storage tanks, 13 usable construction water sumps, and 6 water transmission systems (with 4 permitted water distribution systems and 3 permitted water trucks in 1999). One potable well (Well C) was inactive again in 1998 due to a failed pump (DOE 2000i). The wells are not being used to their full capacity and are capable of producing much more water if needed. Additional inactive wells are available, or wells may be drilled and developed if increased water production is required. Wells, sumps, and storage tanks are used, as required, to support construction or operational activities. Domestic, construction, and fire protection water are supplied by this system through over 161 kilometers (100 miles) of supply line. Potable water is trucked to support facilities that are not connected to the potable water system. The maximum production capacity of the site potable supply wells is approximately 8.0 billion liters (2.1 billion gallons) per year. The sustainable site production capacity has been estimated at a level of approximately 5.15 billion liters (1.36 billion gallons) annually which equates to the historical maximum production level without measurable impact on the regional groundwater system. NTS has adopted this production level and hydrographic basin-specific levels for planning purposes in accordance with sound resource management principals (DOE 1998a). Water rights appropriated under the Federal Reserve Water Rights Doctrine essentially grants an unquantified water right to support NTS missions. However, downgradient groundwater users have challenged DOE's water rights under the states water appropriations process (DOE 1998a). NTS used approximately 832 million liters (219.8 million gallons) of water in 1999 (DOE 2000i).

Area 6 of NTS is in water service area C which also encompasses Areas 1, 3, 5, 11, 22, 23, 26, and 27. Supply wells 4, 4a, C, and C1 provide potable water service to facilities in these areas including DAF. Combined, these wells have a maximum production capacity of approximately 2.55 billion liters (672 million gallons) per year (DOE 1998a).

4.4.3 Air Quality

The climate at NTS is characterized by limited precipitation, low humidity, and large diurnal temperature ranges. The lower elevations are characterized by hot summers and mild winters, which are typical of other Great Basin areas. As elevation increases, precipitation increases and temperatures decrease.

Annual precipitation at higher NTS elevations is about 23 centimeters (9 inches), including snow accumulations. The lower elevations receive approximately 15 centimeters (6 inches) of precipitation annually, with occasional snow accumulations lasting only a few days.

Precipitation in the summer falls in isolated showers, which cause large variations among local precipitation amounts. Summer precipitation occurs mainly in July and August, when intense heating of the ground beneath moist air masses triggers thunderstorm development and associated lightning. A tropical storm occasionally will move northeastward from the coast of Mexico, bringing heavy precipitation during September and October.

Elevation influences temperatures at NTS. At an elevation of 2,000 meters (6,560 feet) on Pahute Mesa, the average daily maximum and minimum temperatures are 4 °C to -2 °C (40 °F to 28 °F) in January and 27 °C to 17 °C (80 °F to 62 °F) in July. In the Yucca Flat weapons test basin, at an elevation of 1,195 meters (3,920 feet), the average daily maximum and minimum temperatures are 11 °C to -6 °C (51 °F to 21 °F) in January, and 36 °C to 14 °C (96 °F to 57 °F) in July. Elevation at Mercury is 1,314 meters (4,310 feet), and the extreme temperatures are 21 °C to -11 °C (69 °F to 12 °F) in January and 43 °C to 15 °C (109 °F to 59 °F) in July.

The annual average temperature in the NTS area is 19 °C (66 °F). Monthly average temperatures range from 7 °C (44 °F) in January to 32 °C (90 °F) in July. Relative humidity readings (taken four times per day) range from 11 percent in June to 55 percent in January and December.

Average annual wind speeds and direction vary with location. At higher elevations on Pahute Mesa, the average annual wind speed is 4.5 meters per second (10 miles per hour). The prevailing wind direction during winter months is north-northeasterly, and during summer months winds are southerly.

In the Yucca Flat weapons test basin, the average annual wind speed is 3 meters per second (7 miles per hour). The prevailing wind direction during winter months is north-northwesterly, and during summer months is south-southwesterly. At Mercury, the average annual wind speed is 4 meters per second (8 miles per hour) with northwesterly prevailing winds during winter months, and southwesterly prevailing winds during summer months.

Wind speeds in excess of 27 meters per second (60 miles per hour), with gusts up to 48 meters per second (107 miles per hour), may be expected to occur once every 100 years. Additional severe weather in the region includes occasional thunderstorms, lightning, tornadoes, and sandstorms. Severe thunderstorms may produce high precipitation that continues for approximately one hour and may create a potential for flash flooding. Few tornadoes have been observed in the region, and they are not considered a significant event. The estimated probability of a tornado striking a point at NTS is extremely low (3 in 10 million years).

4.4.3.1 Nonradiological Releases

NTS is located in Nevada Intrastate Air Quality Control Region (#147). The region has been designated as attainment with respect to the National Ambient Air Quality Standards (NAAQS). The nearest nonattainment area is the Las Vegas area, located 105 kilometers (65 miles) southeast of NTS. Las Vegas Valley Hydrographic Area 212, located in Clark County, is classified as moderate nonattainment for carbon monoxide and serious nonattainment for fugitive dust (PM_{10}). The remaining portion of Clark County is designated as unclassifiable/attainment for these pollutants (40 CFR Part 81.329).

The nearest Prevention of Significant Deterioration Class I areas to NTS are the Grand Canyon National Park, 208 kilometers (130 miles) to the southeast, and the Sequoia National Park, 169 kilometers (105 miles) to the southwest. NTS has no sources subject to Prevention of Significant Deterioration requirements.

The criteria air pollutants emitted at NTS include particulates from construction, aggregate production, surface disturbances, and fugitive dust from vehicles traveling on unpaved roads; various pollutants from fuel-burning equipment, incineration, and open burning; and volatile organics from fuel storage facilities. A summary of emission estimates for sources at NTS is presented in **Table 4–37**. Emissions of hazardous air pollutants from current NTS sources are below regulatory requirements.

Table 4–37 NTS Source Emission Inventory in 1993

Pollutant	*Source*	*Emissions (kilograms per hour)*
PM_{10}	Area 12 boiler	1.3
	Area 23 boiler	1.6
	Area 23 boiler	1.3
	Area 23 incinerator	0.34
	Area 6 boiler	1.3
	Area 1 rotary dryer	3.2
Sulfur dioxide	Area 12 boiler	1.3
	Area 23 boiler	1.4
	Area 23 boiler	1.3
	Area 23 incinerator	1.4
	Area 6 boiler	1.1

PM_{10} = particulate matter less than or equal to 10 microns in aerodynamic diameter.
Source: DOE 1996d.

Ambient air quality at NTS is not currently monitored for criteria pollutants or hazardous air pollutants, with the exception of radionuclides. Elevated levels of ozone or particulate matter may occasionally occur because of pollutants transported into the area or because of local sources of fugitive particulates. Ambient concentrations of other criteria pollutants (sulfur dioxide, nitrogen oxides, carbon monoxide, and lead) are probably low because there are no large sources of these pollutants nearby. The nearest area with air pollutant sources of concern is the Las Vegas area. Ambient air quality data for NTS is summarized in **Table 4–38**. These measurements were recorded during the period from August 15 through September 15, 1990. Monitoring stations were located in Area 23 at Building 525; Area 6 at Building 170; and Area 12 at the sanitation department office trailer. DAF is located in Area 6. Based on the data collected during this study, NTS is well within all applicable Federal and state ambient air quality standards.

Table 4–38 Ambient Air Quality Data for NTS [a]

Pollutant	*Averaging Period*	*Most Stringent Standard [b] (micrograms per cubic meter)*	*Monitored Concentration (micrograms per cubic meter)*		
			Area 23	*Area 6*	*Area 12*
Carbon monoxide					
less than 5,000 feet above mean sea level	8 hours	10,000	1,370	1,150	2,290
at any elevation	1 hour	40,000	1,370	1,950	2,750
Lead	Quarterly	1.5	(d)	(d)	(d)
Nitrogen dioxide	Annual	100	(d)	(d)	(d)
Ozone [c]	1 hour	235	(d)	(d)	(d)
PM_{10}	Annual	50	(d)	(d)	(d)
	24 hours	150	78.3	20.2	45.4
Sulfur dioxide	Annual	80	(d)	(d)	(d)
	24 hours	365	39.3	(d)	15.7
	3 hours	1,300	65.4	(d)	52.4

PM_{10} = particulate matter less than or equal to 10 microns in aerodynamic diameter

[a] Nevada also has ambient standards for visibility and hydrogen sulfide. Measurements recorded from August 15 to September 15, 1990.

[b] The more stringent of the Federal and state standards is presented if both exist for the averaging period. The NAAQS (40 CFR Part 50), other than those for ozone, particulate matter, lead, and those based on annual averages, are not to be exceeded more than once per year. The annual arithmetic PM_{10} mean standard is attained when the expected annual arithmetic mean concentration is less than or equal to the standard.

[c] Another standard applies at Lake Tahoe Basin.

[d] Not measured.

Sources: Nevada Administrative Code 445B.391, DOE 1996d.

The existing ambient air concentrations attributable to sources at NTS are expected to represent a small percentage of the ambient air quality standards. No modeled concentrations are available showing the site contributions to ambient concentrations at the site boundary.

4.4.3.2 Radiological Releases

During 1998, an estimated 363 curies of tritium and 0.24 curies of plutonium-239/240 were released to the atmosphere at NTS. These releases were attributed to: (1) diffusion of tritiated water vapor from evaporation from tunnel and characterization well containment ponds, (2) diffuse emissions calculated from the results of environmental surveillance activities, and (3) resuspension of plutonium as measured with air sampling equipment or calculated by use of resuspension equations. The releases and their sources are presented in **Table 4–39**. None of the releases were from Area 6, where DAF is located.

Table 4–39 Radiological Airborne Releases to the Environment at NTS in 1999

Radionuclide	Source	Release (curies)
Tritium (Hydrogen-3)	Containment ponds	24.7 [a]
	Laboratories	5.7
	SCHOONER	65
	Sedan Crater, Area 10	260
	Area 5, Radioactive Waste Management Site	7.1
Plutonium-239/240	Areas 3 and 9	0.04
	Other Areas [b]	0.20

[a] Evaporation from the containment ponds.
[b] There were no radioactive releases from Area 6 in 1999.
Source: DOE 2000i.

4.4.4 Noise

The major noise sources at NTS include equipment and machines (e.g., cooling towers, transformers, engines, pumps, boilers, steam vents, paging systems, construction and material-handling equipment, and vehicles), blasting and explosives testing, and aircraft operations. No NTS environmental noise survey data are available. At the NTS boundary, away from most facilities, noise from most sources is barely distinguishable above background noise levels.

The acoustic environment in areas adjacent to NTS can be classified as either uninhabited desert or small rural communities. In the uninhabited desert, the major sources of noise are natural physical phenomena such as wind, rain, and wildlife activities, and an occasional airplane. The wind is the predominant noise source. Desert noise levels as a function of wind have been measured at an upper limit of 22 decibels A-weighted (dBA) for a still desert and 38 dBA for a windy desert.

A background sound level of 30 dBA is a reasonable estimate. This is consistent with other estimates of sound levels for rural areas. The rural communities day-night average sound level has been estimated in the range of 35 to 50 decibels (dB) (EPA 1974). A background sound level of 50 dB is a reasonable estimate for Mercury.

Except for the prohibition of nuisance noise, neither the State of Nevada nor local governments have established specific numerical environmental noise standards.

4.4.5 Geology and Soils

NTS and surrounding areas are in the southern part of the Great Basin, the northern most subprovince of the Basin and Range Physiographic Province. This region is generally characterized by more or less regularly spaced, generally north-south trending mountain ranges separated by alluvial basins that were formed by faulting. The Great Basin subprovince is a closed drainage basin, i.e., precipitation that falls over the basin has no outlet to the Pacific Ocean. The relief of NTS is considerable, ranging from less than 1,000 meters (3,280 feet) above sea level in Frenchman Flat and Jackass Flats to about 2,339 meters (7,675 feet) on Rainier Mesa. There are three primary valleys at NTS: Yucca Flat, Frenchman Flat, and Jackass Flats. Both Yucca Flat and Frenchman Flat are topographically closed, with playas in the lowest portions of each basin. Jackass Flats is topographically open with drainage via the Fortymile Wash off NTS.

The topography of NTS has been altered by historic DOE actions, particularly underground nuclear testing. The principal effect of testing has been the creation of numerous craters in Yucca Flat basin and a lesser number of craters on Pahute and Rainier Mesas.

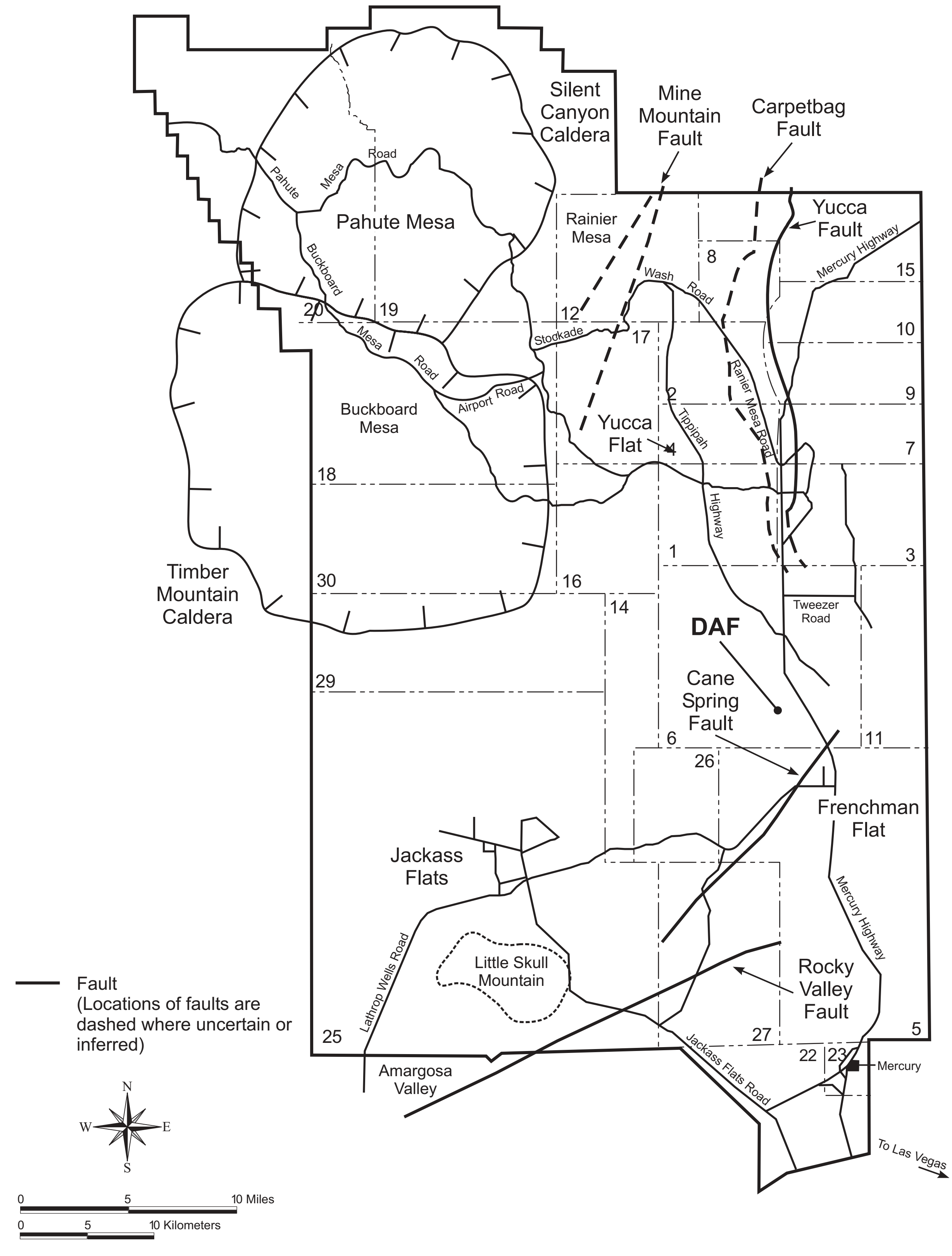
NTS is underlain by a thick section (more than 10,597 meters [34,768 feet]) of Paleozoic (Permian to Cambrian) age (245 to 570 million years old) and older sedimentary rocks, locally intrusive Cretaceous age (66 to 145 million years old) granitic rocks, a variable assemblage of middle to late Tertiary (Miocene) age (5 to 24 million years old) volcanic rocks, and locally thick deposits of postvolcanic sands and gravels that fill the present day valleys. Additional details about NTS site geology are presented in the *NTS SWEIS*.

Extensive rock and mineral resources are present in the NTS region. A number of mines were developed into districts within the region from the early 1900s to the late 1970s. Significant gold and silver deposits may be present east of Goldfield in the northwestern Nellis Air Force Range Complex located north of NTS. Small amounts of tungsten were produced from the Oak Spring mining district at the north end of Yucca Flat, and silver, copper, lead, zinc, molybdenum sulfides are also known to be present. Economic quantities of silver, copper, lead, and zinc have been recovered from the Groom mine in this area. The Calico Hills and Mine Mountain mining districts within NTS exhibit copper, silver, lead, zinc, and mercury sulfides in fractured carbonate and clastic rocks. Free gold with silver sulfides occurs at the surface associated with mine workings developed within the Wahmonie mining district located east of Jackass Flats and north of Skull Mountain. Industrial minerals such as uranium may be present in the northwestern part of the Nellis Air Force Range Complex. Other potential industrial mineral resources include barite and possibly fluorite. Most of the alluvial valleys in the region have aggregate resources at least along the flanks of adjacent mountains. NTS is considered a valuable source of these resources to meet future demand. Hot springs are common in the province and, if water temperatures near Yucca Mountain are representative, water temperatures in the region may be insufficient for commercial geothermal power development (DOE 1998a).

NTS is also crossed by numerous faults (**Figure 4–24**). Three major fault zones in the region may be currently active (Mine Mountain, Cane Spring, and Rock Valley) and thus are deemed capable per the U.S. Nuclear Regulatory Commission definition (10 CFR 100, Appendix A). Small earthquakes recently occurred at or near the Cane Spring Fault zone and the Rock Valley Fault zone, although no surface displacement was associated with either of these earthquakes. The Cane Spring fault is thought to have been the source of a magnitude 4.3 earthquake in August 1971. In February 1973, an earthquake of magnitude 4.5 occurred along the Rock Valley Fault System (DOE 1998a). A fault near Little Skull Mountain in the southwest part of NTS was the location of a magnitude 5.6 (Richter magnitude 5.7) earthquake on June 28, 1992. This is the largest earthquake recorded within the boundaries of NTS and may have resulted from a magnitude 7.5 earthquake near Landers, California, that occurred less than 24 hours earlier. Although there was no surface rupture, the Little Skull Mountain earthquake was the first to cause significant damage to facilities at NTS. These facilities, however, were built prior to the more stringent building codes presently followed at NTS. Nevertheless, another earthquake was epicentered below Little Skull Mountain on September 13, 1992 and registered Richter magnitude 4.1 to 4.4, but caused no damage. It had a Mercalli Intensity of IV (DOE 1998a, USGS 2001f).

Additionally, Yucca Fault in the Yucca Flat weapons test basin has been active in the recent geologic past (Figure 4–24). This fault displaces surface alluvium by as much as 18 meters (60 feet). Displacement of this young surface alluvium indicates that movement on Yucca Fault has occurred within the last few thousand to tens of thousands of years; subsurface displacement along this fault is 213 meters (700 feet).

Seismic waves from nuclear explosions are believed to relieve tectonic stress, as manifested by earthquakes deeper than 3 kilometers (1.2 miles), aftershocks, and reactivation of nearby faults in the areas designated for nuclear device testing. Studies of nuclear-explosive tests show that these events can generate vertical and horizontal displacements on nearby existing faults. As much as 102 centimeters (40 inches) of vertical displacement and 15 centimeters (6 inches) of horizontal displacement have been observed. Parts of both the Yucca Fault and the Carpetbagger Fault have been reactivated from nearby testing of nuclear devices.



Sources: DOE 1996d, DOE 1996e.

Figure 4–24 Major Faults at NTS

NTS lies in a region with relatively high seismicity and, as referenced above, the site is tectonically active. Within a radius of 100 kilometers (62 miles) of NTS (as measured from Area 6), a total of 7 significant earthquakes (i.e., having a magnitude of at least 4.5 or a Modified Mercalli Intensity of VI or larger) of natural origin have been documented. The largest of these was a Richter magnitude 5.13 earthquake in May 1967 centered 93 kilometers (58 miles) east-northeast of the site. None have been centered closer than 66 kilometers (41 miles) away (USGS 2001f). Since 1973, about 280 earthquakes in total (excluding those attributed to nontectonic sources) have been recorded within 100 kilometers (62 miles) of NTS, with the majority ranging in magnitude from 3 to 4 (USGS 2001g). Most notably, the June 29, 1992, magnitude 5.6 event located in the southwest portion of the site near Skull Mountain produced a maximum acceleration of 0.21g at Amargosa Valley (DOE 1996f). A Modified Mercalli Intensity was not attributed to this event (USGS 2001g). Also note that this earthquake is not listed among the significant earthquakes in the region despite its magnitude (USGS 2001f). Nevertheless, the region has remained seismically active. In calendar year 2000, there were four earthquakes recorded within 100 kilometers (62 miles) of the site. The closest of these was a September 9, 2000, Richter magnitude 3.0 event centered 27 kilometers (17 miles) southwest of Area 6 again near Little Skull Mountain (USGS 2001g). For reference, a comparison of Modified Mercalli Intensity (the observed effects of earthquakes) with measures of earthquake magnitude and ground acceleration is provided in Section F.5.2 (see Appendix F).

As discussed in more detail in Section 4.2.5, the U.S. Geological Survey has developed new earthquake hazard maps that are based on spectral response acceleration. These maps have been adapted for use in the new International Building Code (ICC 2000) and depict maximum considered earthquake ground motion of 0.2- and 1.0-second spectral response acceleration, respectively, based on a 2 percent probability of exceedance in 50 years (i.e., 1 in 2,500). NTS is calculated to lie within the 0.58g to 0.59g mapping contours for a 0.2-second spectral response acceleration and the 0.18g to 0.19g contours for a 1.0-second spectral response acceleration. For comparison, the calculated peak ground acceleration for the given probability of exceedance is approximately 0.26g (USGS 2001e).

Eruptions of the southwest Nevada volcanic field occurred primarily in the Middle Tertiary Period (around 24 million years ago). Successive eruptions produced no less than seven large and partially overlapping calderas, which were filled with lava flows and blanketed by vast deposits of volcanic tuff. As silicic volcanism that produced the large-volume ash flows of the Nevada volcanic field ended, basaltic volcanism began in the region about 11 million years ago. The episodes of basaltic volcanism were relatively low-volume and less explosive as compared to the earlier silicic eruptions. The basaltic eruptions produced small volcanoes and cinder cones that can be found in Crater Flat to the west of NTS. The youngest of these features is the Lathrop Wells volcano that could be as little as 75,000 years old. Expert analyses performed for the Yucca Mountain Project estimate that the probability of basaltic lava activity impacting the Yucca Mountain Repository located near the southwest boundary of NTS is about 1 in 7,000 over the first 10,000 years of repository operations (DOE 2002). NTS lies about 240 kilometers (150 miles) southeast of the Long Valley area of California that has the potential for a volcanic eruption of the Mt. St. Helens type (DOE 1996f).

Soil studies to characterize site conditions have been limited at NTS. Soil loss through wind and water erosion is a common occurrence throughout NTS and surrounding areas. Limited areas of soils can be irrigated on NTS, and these occur only in the lower elevations of the Yucca Flat weapons test basin, Frenchman Flat, and Jackass Flats. Elsewhere on NTS, the soils are generally very limited in both thickness and areal extent. In general, soils across NTS have low available water-holding capacities and soil textures that are gradational from coarse-grained soils near the mountain fronts to fine-grained soils in the playa areas of the Yucca Flat weapons test basin and Frenchman Flat. Most soils are underlain by a hardpan of caliche in the lower elevations. Soil salinity generally increases dramatically in the direction of the playa areas, with the highest level of soluble salts accumulating in the deeper soil profile horizons in Frenchman Flat. The potential for soil erosion and shrink-swell also increases into the playas and basins, with the potential for water erosion increasing with slope. There is no prime farmland at NTS (DOE 1996f).

Soils on portions of NTS have been contaminated during the conduct of various testing and ancillary operations. The largest areas of surficial contamination are in the Yucca Flat weapons test basin, Frenchman Flat, Plutonium Valley, and in scattered locations in the western and northwestern parts of the facility. A comprehensive investigation is underway to determine the risks associated with this soil contamination, and actions will be taken as part of the environmental restoration program to reduce these risks, as appropriate.

DAF in NTS Area 6 is located on the northern boundary of Frenchman Flat. The nearest capable fault to DAF is the Cane Spring Fault, which is located about 5 kilometers (3 miles) southeast of the facility site (Figure 4–23). Surficial stratigraphy is dominated primarily by alluvial sediments that attain a thickness of approximately 332 meters (1,090 feet) near the DAF (NTS 2001).

4.4.6 Water Resources

4.4.6.1 Surface Water

NTS is located within the Great Basin, a closed hydrographic basin from which no surface water leaves except by evaporation. The Great Basin includes much of Nevada. There are no perennial streams or other naturally-occurring surface water bodies at NTS. Streams (arroyos) in the region are ephemeral. Runoff results from snowmelt and from precipitation during storms that occur most commonly in winter and occasionally in fall and spring, as well as during localized thunderstorms that occur primarily in the summer. Much of the runoff quickly infiltrates into rock fractures or into the surface soils before being lost by evapotranspiration. Some is carried down alluvial fans in arroyos, and some drains onto playas where it may stand for weeks as a lake. Runoff in the eastern half of the site ultimately collects in the playas (Yucca and Frenchman Lakes) of Yucca Flat and Frenchman Flat, respectively (**Figure 4–25**). In the northeastern portion, runoff drains off the site and onto the Nellis Air Force Range Complex. In the western half and southernmost part of NTS, runoff is carried toward the Amargosa Desert (DOE 1996f). There are a number of springs on NTS, but seepage from springs travels only a short distance from the source before evaporating or infiltrating into the ground. In addition, there are a number of engineered waste disposal ponds and open reservoirs for industrial water on the site.

Intermittent streams within NTS are not classified, but are protected by the State of Nevada for specified uses in accordance with NAC 445A.199-445A.225. Surface water within NTS boundaries is not used. In fact, no public water supplies are drawn from springs in Amargosa Valley, which is located downgradient from NTS along the primary pathway for surface water flow. The closest surface water supply that is used for public consumption is Lake Mead, which supplies a large portion of the water demand of metropolitan Las Vegas. There are no NPDES permits for NTS because there are no wastewater discharges directly to onsite or offsite surface waters (DOE 2000i). However, discharges to sewage lagoons and ponds are regulated by the State of Nevada. Specifically, ten usable sewage treatment facilities on NTS operate under a state general permit (GNEV93001) issued by the Nevada Division of Environmental Protection. This permit was renewed for five years on December 7, 1999. NTS maintains compliance with required permits. Due to the reduced treatment efficiency noted in some sewage treatment lagoons, DOE plans to install septic systems in the affected areas which would be permitted under state operating permits (DOE 2000i).

The potential exists for sheet flow and channelized flow through arroyos to cause localized flooding throughout NTS. However, because of the size of NTS, no comprehensive floodplain analysis has been conducted to delineate the 100- and 500-year floodplains. Nevertheless, a rise in the surface elevation of any standing water on a playa creates a potential flood hazard. Playas in the Yucca Flat weapons test basin

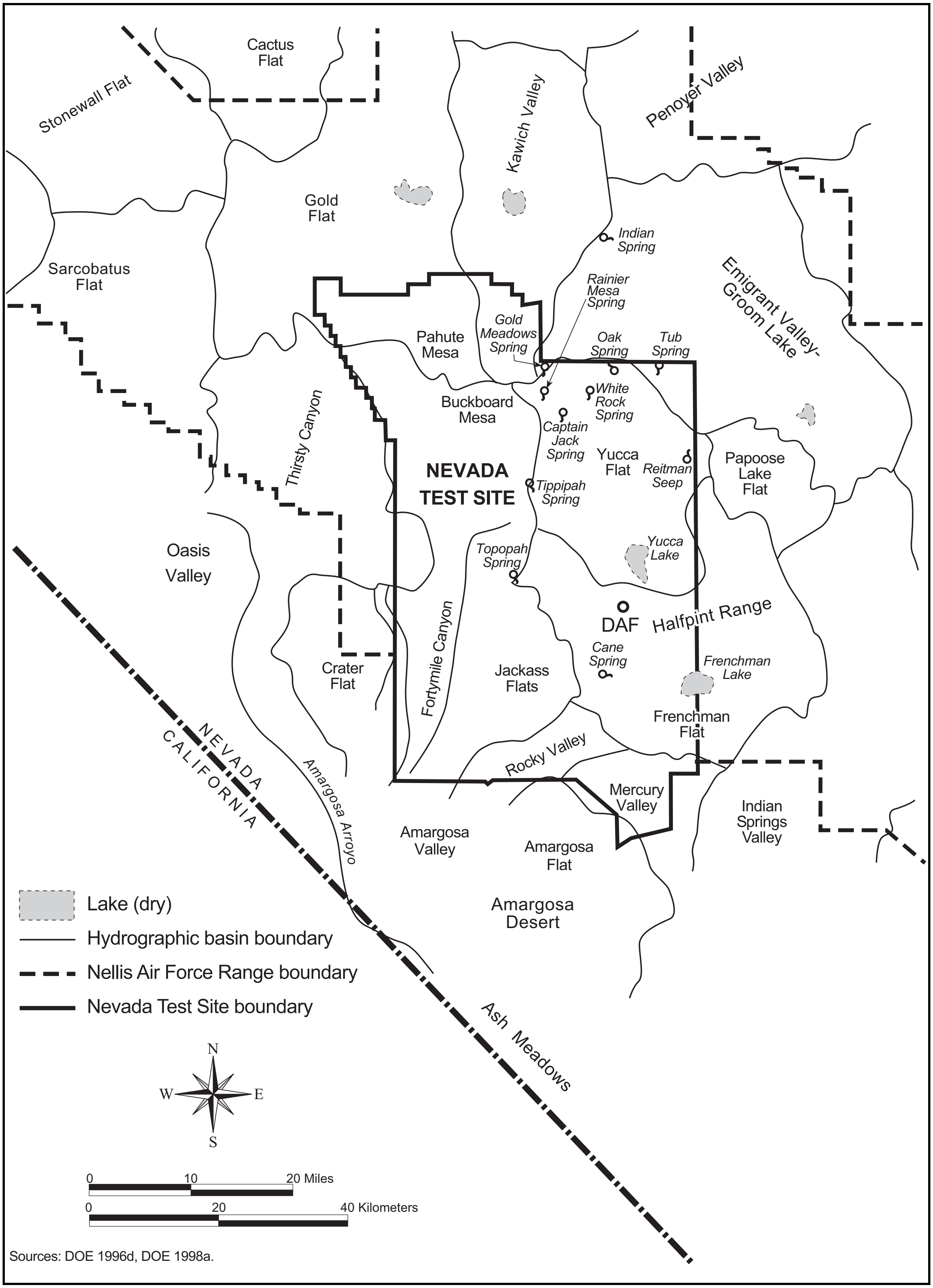


Figure 4–25 Surface Water Features at the Nevada Test Site

and Frenchman Flat in the northeastern and eastern parts of NTS, respectively, collect and dissipate runoff from their respective hydrographic basins. Several arroyos in the Yucca Flat weapons test basin pose a potential flood hazard to existing facilities as do arroyos on Frenchman Flat. Ground-surface disturbance and craters associated with underground nuclear tests have rerouted parts of natural drainage paths in areas of nuclear device testing. Some craters have captured nearby drainage, and headward erosion of drainage channels is occurring. However, this is considered to be negligible. In some areas of NTS, the natural drainage system has been all but obliterated by the craters. The western half and southernmost parts of NTS have arroyos that carry runoff beyond NTS boundaries during intense storms. Fortymile Canyon, the largest of these arroyos, originates on Pahute Mesa and intersects the Amargosa arroyo in the Amargosa Desert about 32 kilometers (20 miles) southwest of NTS. The Amargosa arroyo continues to Death Valley, California. Areas prone to flooding surround Fortymile Wash, a major tributary of Fortymile Canyon (Figure 4–24). Tonopah Wash, which runs southwesterly across Jackass Flats from Jackass Divide in the south-central part of NTS, is a major tributary to the Amargosa arroyo.

There are no named streams within the DAF area and no permanent, natural, surface water features near the area. An evaporation/percolation basin is located near the facility. Runoff from the site is conveyed via the natural topography east and southeast toward Frenchman Lake. This playa only retains standing water during the winter months. A storm water conveyance and diversion structure protects the facility and supporting structures from flooding and is designed for the probable maximum flood (DOE 1995d).

4.4.6.2 Groundwater

Groundwater beneath NTS exists within three groundwater subbasins of the Death Valley Basin flow system. This flow system encompasses about 41,000 square kilometers (16,000 square miles) of the Great Basin. In particular, the eastern half of NTS is located within the Ash Meadows Subbasin, and the western half of the site lies largely within the Alkali Flat Furnace Creek Ranch Subbasin. In addition, a small section of the northwest corner of the site is located within the Pahute Mesa Oasis Valley Subbasin (DOE 2002) (**Figure 4–26**). The groundwater section boundaries delineated in Figure 4B26 roughly correspond to the hydrographic areas mapped in Figure 4B25. Hydrographic areas are mapped on the basis of topographic divides and are the geographic unit used by the State of Nevada for the purposes of water appropriation and management. NTS lies within at least part of 10 of these areas (i.e., Gold Flat, Buckboard Mesa, Kawich Valley, Emigrant Valley, Oasis Valley, Yucca Flat, Jackass Flats, Frenchman Flat, Rock Valley, and Mercury Valley) (DOE 2002).

The hydrogeology of the NTS region is rather complex. Nevertheless, three principal hydrogeologic systems are recognized. The first is the valley-fill alluvium that mostly consists of gravel, sand, silt, and clay alluvium and playa lake deposits of Quaternary to Late Tertiary age (i.e., recent to about 5 million years old). These deposits comprise the valley-fill aquifer. Volcanic rocks including rhyolite lava flow and welded and nonwelded ash flow tuff deposits of mainly middle to late Tertiary age (i.e., about 5 to 24 million years old) characterize the second system. This system encompasses the lava flow and welded-tuff aquifers. The last major system consists of sedimentary rocks ranging in age from Permian/Pennsylvania to Cambrian (i.e., 245 to 570 million years old) that include the limestones and dolostones comprising the upper and lower carbonate aquifers. Within these systems, six major aquifers and four major aquitards in the region have been defined. Groundwater quality within aquifers at NTS not affected by nuclear testing is generally acceptable for drinking water and industrial and agricultural uses. All hydrologic units that supply drinking water to NTS are classified as Class II groundwater (i.e., those that are currently used or are potentially available for drinking water or other beneficial uses) (DOE 1998a). The lower carbonate aquifer primarily represents the regional aquifer and is composed of 4,000 to 5,000 meters (13,120 to 16,400 feet) of relatively thick, permeable limestones and dolostones with thinner, less permeable siltstones, shales, and quartzites. However, the lower carbonate aquifer is not present in all areas, and rarely is the entire thickness of the unit

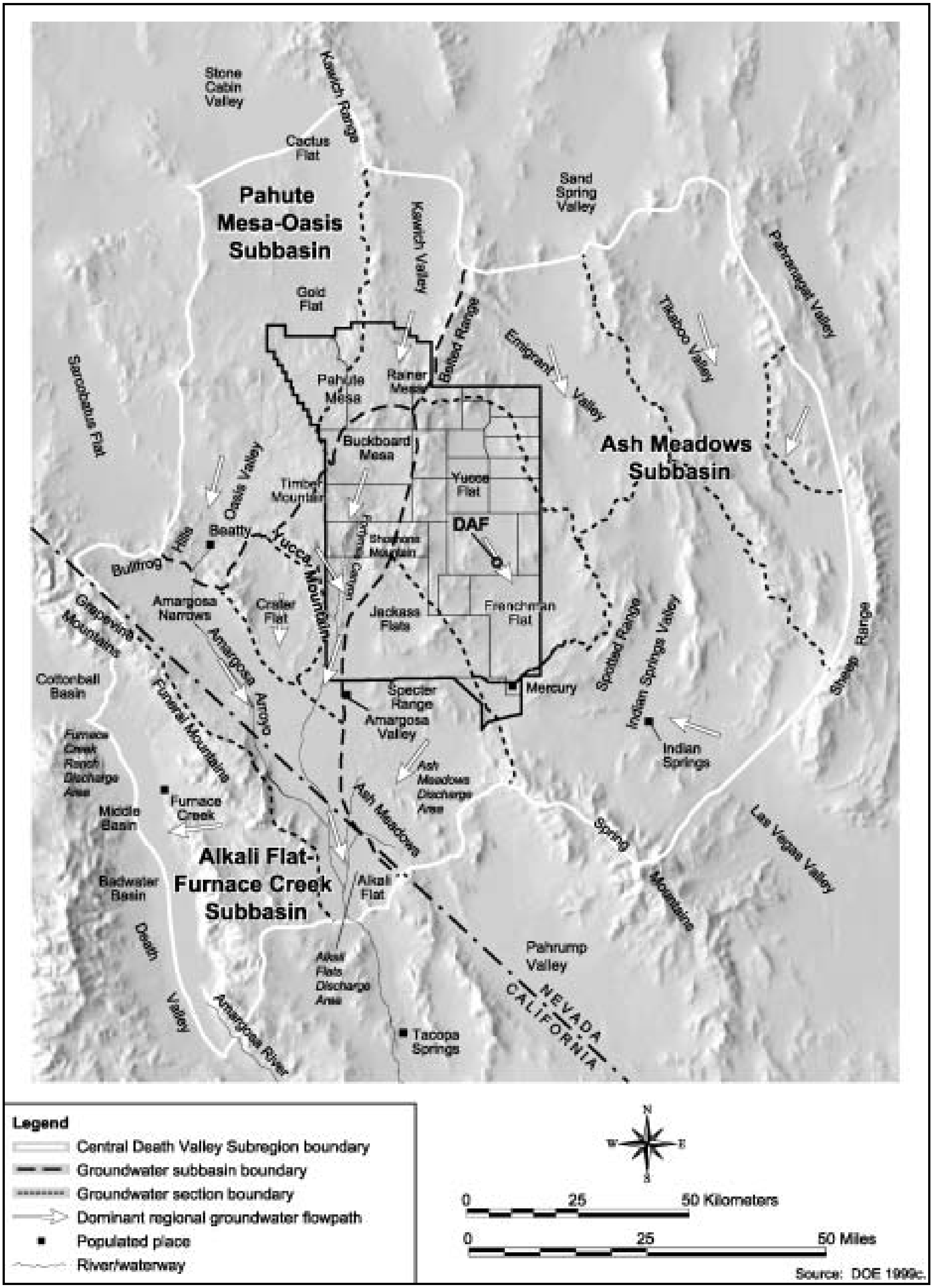


Figure 4–26 Groundwater Hydrologic Regions of the Nevada Test Site and Vicinity

present under NTS or adjacent areas. Generally, in the eastern half of the site, the water table occurs in the valley-fill alluvium and Tertiary volcanic rocks overlying the regional aquifer and predominantly in the volcanic aquifers across the western half of the site (DOE 2000i). Thinner sequences of these volcanic rocks overlie the upper carbonate aquifer and clastic confining units within some areas of the Yucca and Frenchman Flats.

The depth to groundwater in wells at NTS varies from about 79 meters (260 feet) below land surface in the extreme northwest part of the site and about 160 meters (525 feet) below land surface in portions of Frenchman Flat and the Yucca Flat weapons test basin to more than 610 meters (2,000 feet) under the upland portions of Pahute Mesa. Perched groundwater is known to occur in some parts of NTS, mainly in the volcanic rocks of the Pahute Mesa area. Groundwater flows generally south and southwest. The flow system extends from the water table to a depth that may exceed 1,494 meters (4,900 feet). The rates of flow are quite variable, with average flow rates over broad areas estimated to range from 2 to 201 meters per year (7 to 660 feet per year).

Recharge of the groundwater beneath NTS is primarily derived from underflow from basins upgradient from the site and from the infiltration of precipitation over upland areas on and upgradient from the site. Within the groundwater subbasins (Figure 4–26) of the Death Valley flow system, groundwater generally flows downgradient in a south-to-southwesterly direction with discharge occurring in the low-lying valleys as small springs or via evapotranspiration. These discharge locations are dictated by the presence of rocks of lower permeability and lower elevations. Two examples are the Ash Meadows and Alkali Flat discharge areas located south of NTS (Figure 4–26). The groundwater discharge from the Ash Meadows area is estimated at 21 million cubic meters (742 million cubic feet) per year. In contrast, groundwater discharge on NTS is more limited and occurs only as a few small springs from perched zones primarily located in the northern, upland areas of the site and from several wells.

Onsite water wells and select offsite wells are monitored in accordance with the Federal Safe Drinking Water Act and state regulations. Concurrently, DOE monitors onsite wells and select offsite wells for specific radionuclides. Approximately 30 monitoring wells and 10 springs are also sampled. Analytical results for all monitoring activities are published in the annual site environmental report (DOE 2000i).

The locations of 862 underground nuclear tests have been confirmed at NTS that correspond to areas of potential groundwater contamination (**Figure 4–27**). About one-third of these tests were at or below the water table and produced heavy metal and a wide range of radionuclide by-products. Detonations conducted near the water table have contaminated locally groundwater with over 60 radionuclides, with tritium being the most prevalent radionuclide. Additional information on activities being conducted under the site environmental restoration program to address contamination from underground nuclear testing is discussed in the annual site environmental report (DOE 2000i).

Drinking water at NTS is currently provided by 11 potable wells and is supplemented by bottled water in remote areas. Construction and fire-control water are supplied by two other wells in addition to the potable water supply wells. Springs and seeps are not used for water-supply purposes. DOE’s water withdrawals have lowered water levels in the vicinity of water supply wells and have resulted in localized changes in groundwater flow direction. In general, the effects of pumping NTS water supply wells are concentrated within a distance of a few thousand feet of the operating wells. Water use is detailed in Section 4.4.2.4.

All water used at DAF in Area 6 is groundwater from four supply wells (C, C1, 4, and 4a). Wells 4 and 4a withdraw from volcanic aquifers at a depth of about 387 meters (1,270 feet), and wells C and C1 withdraw from the carbonate aquifers (upper and lower carbonate aquifers) from depths of 473 and 485 meters (1,552 and 1,591 meters), respectively. The depth to groundwater near the margins of Frenchman Flat in the

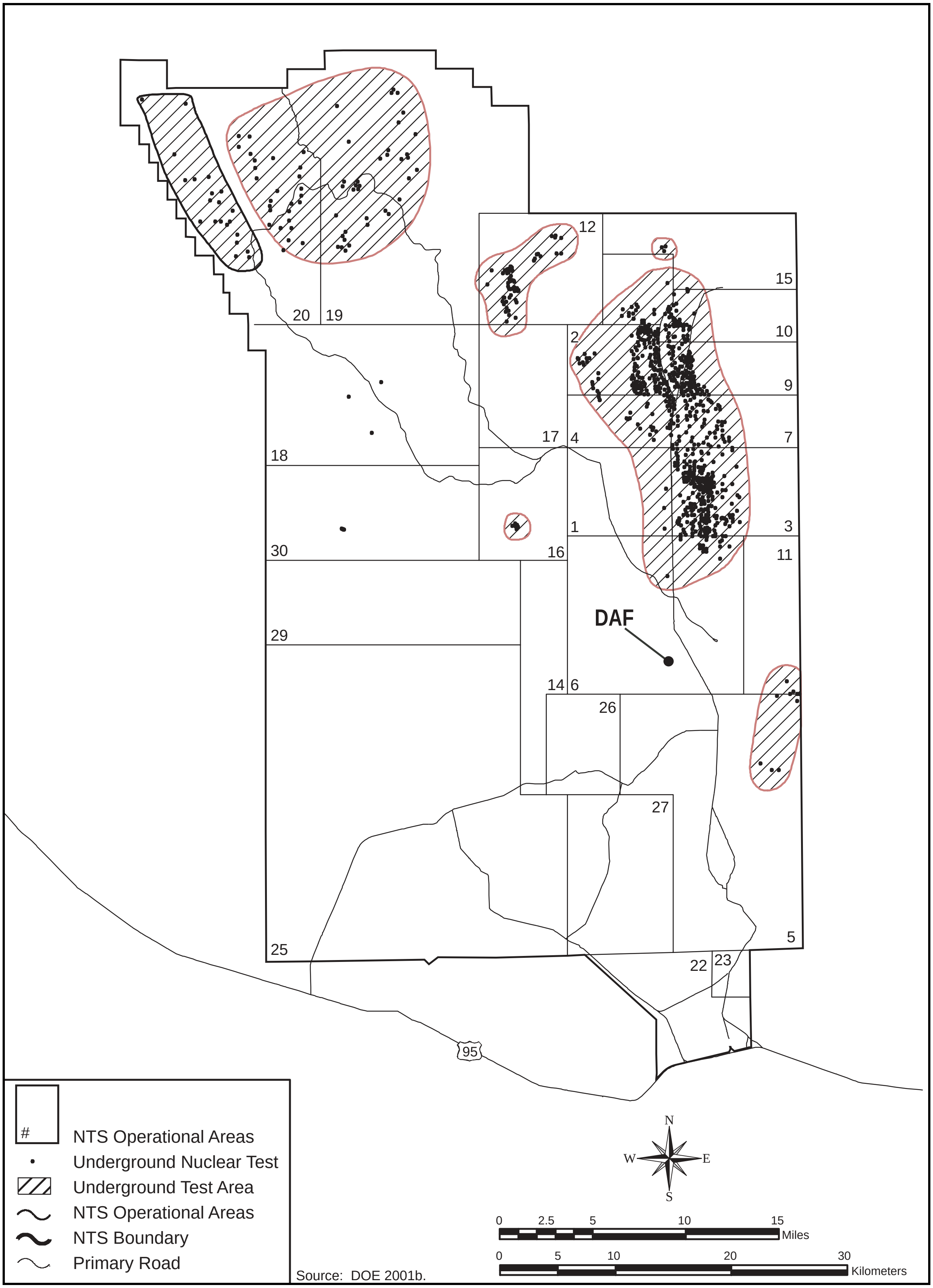


Figure 4–27 Areas of Potential Groundwater Contamination on NTS

vicinity of DAF is approximately 360 meters (1,180 feet) (DOE 1995d, DOE 2000i). The depth of the water table beneath DAF is approximately 280 meters (920 feet) (NTS 2001). The flow is generally to the southwest, but is locally variable.

4.4.7 Ecological Resources

4.4.7.1 Terrestrial Resources

NTS is located along the transition zone between the Mojave and Great Basin deserts. As a result, it has a diverse and complex mosaic of plant and animal communities representative of both deserts, as well as some communities common only in the transition zone between these deserts (**Figure 4–28**). This transition zone extends to the east and west far beyond the boundaries of NTS. Thus, the range of almost all species found on the site also extends beyond the site, and there are few rare or endemic species present.

Mojave Desert plant communities are found at elevations below approximately 1,219 meters (4,000 feet) in Jackass Flats, Rock and Mercury Valleys, and Frenchman Flat. Creosote bush is the visually dominant shrub, and it is associated with a variety of other shrubs, depending on soil type and elevation. Two plant communities are unique to the transition zone. The first, which occurs at elevations from 1,219 to 1,524 meters (4,000 to 5,000 feet), is dominated by blackbrush. The second occurs in the bottom of enclosed Frenchman and Yucca Flat weapons test basins, where trapped winter air is too cold for typical Mojave Desert plants. The most abundant shrubs in these areas include three species of wolfberry. Little or no vegetation grows on the playas in these basins. Plant communities typical of the Great Basin Desert occur at elevations generally above 1,524 meters (5,000 feet). Communities dominated by saltbush, rabbitbrush, sagebrush, and pinyon pine/sagebrush occur with increasing elevation. Over 700 plant taxa have been found at NTS.

Two hundred seventy-nine species of terrestrial vertebrates have been recorded at NTS, including 54 species of mammals, 190 species of birds, and 33 species of reptiles. Typical Mojave Desert species found at the site include kit fox, Merriam's kangaroo rat, desert tortoise, chuckwalla, western shovelnose snake, and sidewinder snake. Typical Great Basin Desert species include cliff chipmunk, Great Basin pocket mouse, mule deer, northern flicker, scrub jay, Brewer's sparrow, western fence lizard, and striped whipsnake. About 60 wild horses live on the northern part of NTS. Water holes, both natural and manmade, are important to many species of wildlife, including game animals such as pronghorn and mule deer. Hunting is not permitted anywhere on NTS. Raptors such as the turkey vulture and rough-legged hawk and carnivores such as the long-tailed weasel and bobcat are two ecologically important groups on the site. A variety of migratory birds have been found at NTS (DOE 1996f). Migratory birds are protected under the Migratory Bird Treaty Act.

Vegetative communities that are found within Area 6 include those of both the Mojave Desert and transition zone. DAF is located within habitat most like that of the Mojave Desert. Gentle slopes cut by shallow arroyos 1 to 3 meters (3 to 10 feet) deep with shallow soils characterize the area. Facilities associated with DAF include a paved access road, a water storage tank, a diversion ditch uphill of the buildings, and sewage evaporation ponds. Whereas cleared areas have removed habitat for most animals of the site, the sewage evaporation ponds have provided unlimited water to birds of the region. Baseline biological studies associated with the facility, conducted in 1993 and 1994, identified 117 species of plants, 11 mammals, 71 birds, and 16 reptiles in the vicinity of DAF (DOE 1995a, DOE 1995b). Dominant plants were the Joshua tree and creosote bush. Common animals included the Merrian's kangaroo rat, long-tailed pocket mouse, mourning dove, house finch, black-throated sparrow, zebra-tailed lizard, and side-blotched lizard.

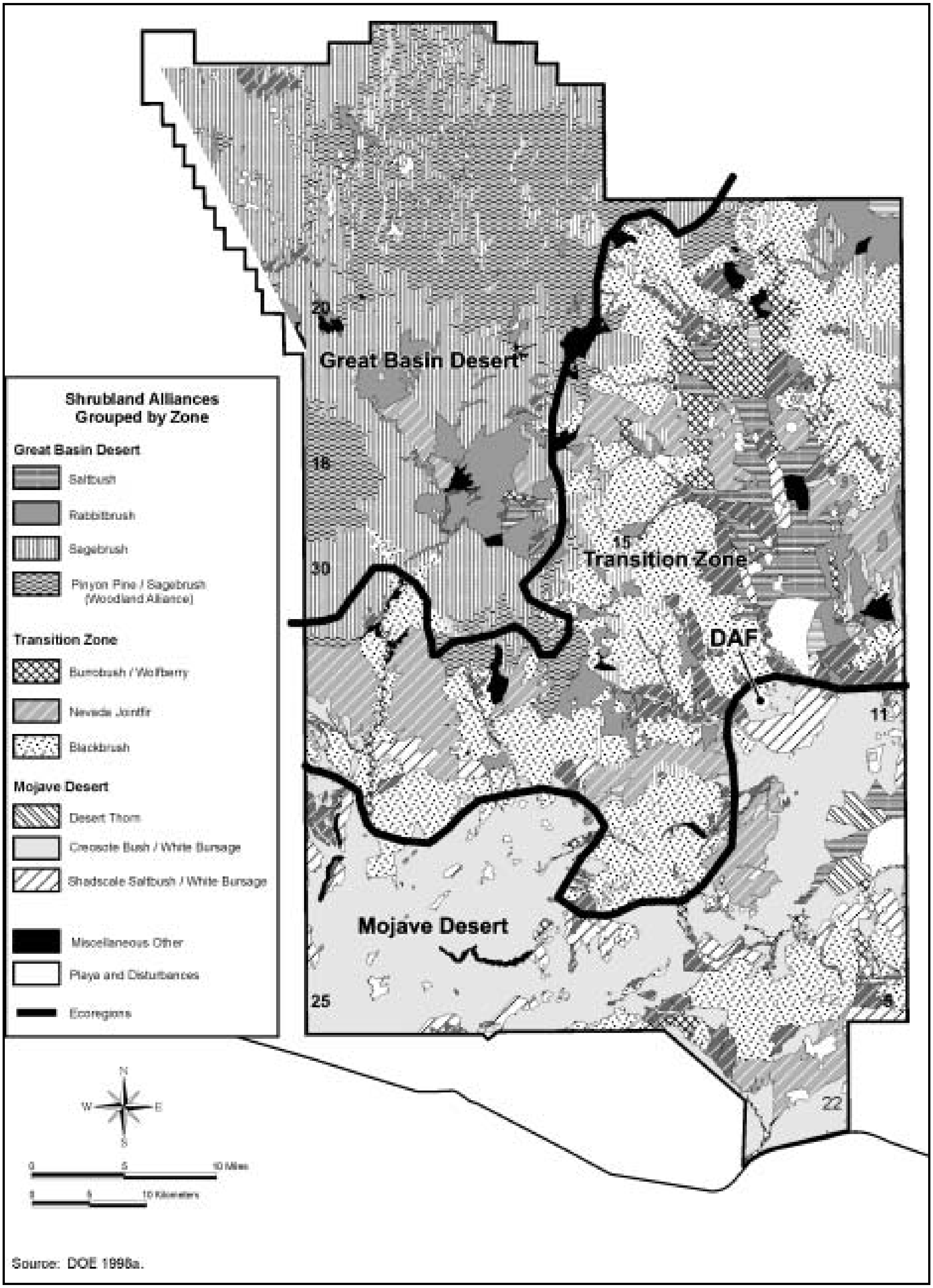


Figure 4–28 Vegetation Association at NTS

4.4.7.2 Wetlands

There are at least 20 springs and seeps found at NTS, most of which support wetland vegetation such as cattail, sedges, and rushes. It is likely that these would constitute wetlands as defined under Section 4.04 of the Clean Water Act. One newly identified wetland, an historic borrow pit that catches water in large enough quantities and for long enough periods of time to sustain wetland vegetation, has been identified (DOE 1999e).

There is one natural water body found within Area 6 (DOE 1998a). It is located about 6.5 kilometers (4 miles) north of DAF. There are no wetlands located within the vicinity of DAF.

4.4.7.3 Aquatic Resources

Known natural water sources on NTS consist of 24 springs and seeps, four tanks (natural rock depressions that catch and hold surface runoff), and one intermittent playa pond. Manmade impoundments on NTS, which are scattered throughout the eastern half of the site, support three introduced species of fish: bluegill, goldfish, and golden shiners. Eighty-one species of plants and 138 species of animals (not all of which are aquatic species) have been documented at or near aquatic sites on NTS (DOE 1999e).

There is one natural water body located in Area 6 about 6.5 kilometers (4 miles) north of DAF. However, sewage evaporation ponds are located at the DAF site (DOE 1995a). As noted above, these ponds are important to birds of the region.

4.4.7.4 Threatened and Endangered Species

There are three agencies that have authority to designate threatened, endangered, and sensitive species in Nevada. The agencies are the USFWS, the Nevada Division of Wildlife, and the U.S. Forest Service. The U.S. Forest Service lists species for special management consideration on lands under their jurisdiction and protects these species under the authority of the Endangered Species Act of 1973.

The only Federally threatened species found at NTS is the Mojave Desert population of the desert tortoise (**Table 4–40**). Desert tortoises are found throughout the southern half of the site. The abundance of tortoises at NTS is low to very low compared to other areas within the range of this species. NTS contains less than 1 percent of the total desert tortoise habitat of the Mojave Desert population (DOE 1998a).

Area 6 is located within that part of the Mojave Desert which makes up the northernmost territory for the desert tortoise. No other threatened or endangered species have been found in the area around the DAF. In addition, no critical habitat has been identified in the area.

4.4.8 Cultural and Paleontological Resources

The current knowledge of cultural resources at NTS is the result of over 20 years of surveys and data recovery, most conducted prior to specific NTS activities taking place. In addition to preactivity surveys and studies, in 1990 DOE entered into a Programmatic Agreement with the State Historic Preservation Office and the Advisory Council for Historic Preservation, which implemented the *Long-Range Study Plan for Negating Potential Adverse Effects to Historic Properties on Pahute and Rainier Mesas*. As a result of these programs, 4.7 percent of the site (16,386 hectares [40,491 acres]) has been surveyed for cultural resources. Due to the restricted status of NTS over the past 50 years, site cultural resources have not been subjected to illegal collecting and/or damage from indiscriminate land uses of public lands. Most archaeological sites are in good condition. Based on current knowledge, all areas of NTS have the potential to contain archaeological sites that are considered significant because they meet the eligibility criteria for the National Register of Historic Places.

Table 4–40 Listed Threatened and Endangered Species, Species of Concern, and Other Unique Species that Occur or May Occur at NTS

Species	*Federal Classification*	*State Classification*	*Occurrence at NTS*
Mammals			
Fringed-myotis	Special Concern	Unlisted	Occasional
Long-eared myotis	Special Concern	Unlisted	Occasional
Long-legged myotis	Special Concern	Unlisted	Occasional
Pale Townsend's big-eared bat	Special Concern	Unlisted	Occasional
Pygmy rabbit	Special Concern	Unlisted	Potential habitat
Spotted bat	Special Concern	Protected by State of Nevada	Occasional
Small-footed myotis	Special Concern	Special Concern	Potential habitat
Birds			
American peregrine falcon	Special Concern	Unlisted	Occasional
Black tern	Special Concern	Special Concern	Potential habitat
Ferruginous hawk	Special Concern	Unlisted	Rare transient
Gray flycatcher	Special Concern	Unlisted	Potential habitat
Least bittern	Special Concern	Special Concern	Potential habitat
Lucy's warbler	Special Concern	Unlisted	Potential habitat
Phainopepla	Special Concern	Special Concern	Potential habitat
Western burrowing owl	Special Concern	Protected by State of Nevada	Resident
White-faced ibis	Special Concern	Protected by State of Nevada	Migrant
Reptiles			
Bandelier Gila monster	Special Concern	Special Concern	Potential habitat
Chuckwalla	Special Concern	Unlisted	Resident
Desert tortoise	Threatened	Protected by State of Nevada	Resident
Plants			
Beatley mild vetch	Special Concern	Endangered	Potential habitat
Beatley phacelia	Special Concern	Unlisted	Potential habitat
Black woolypod	Special Concern	Unlisted	Potential habitat
Cane Spring evening primrose	Special Concern	Unlisted	Potential habitat
Clokey's egg-vetch	Special Concern	Unlisted	Potential habitat
Death Valley beard tongue	Special Concern	Unlisted	Potential habitat
Delicate rock daisy	Special Concern	Special Concern	Potential habitat
Eastwood milkweed	Special Concern	Special Concern	Potential habitat
Kingston bedstraw	Special Concern	Unlisted	Potential habitat
Pahute Mesa beardtongue	Special Concern	Unlisted	Potential habitat
Pahute Mesa green gentian	Special Concern	Unlisted	Potential habitat
Parish's phacelia	Special Concern	Unlisted	Potential habitat
Sanicle biscuitroot	Special Concern	Unlisted	Potential habitat
White bearpoppy	Special Concern	Unlisted	Potential habitat
White-margined beardtongue	Special Concern	Unlisted	Potential habitat

Source: DOE 1998a.

4.4.8.1 Prehistoric Resources

Prehistoric sites found on NTS include habitation sites with wood and brush structures, windbreaks, rock rings, and cleared areas; rock shelters; petroglyphs (rock art); hunting blinds; rock alignments; quarries; temporary camps; milling stations; roasting ovens or pits; water caches; and limited activity locations (DOE 1996f). Approximately 1,615 prehistoric sites have been identified on NTS, of which about one-half are eligible for listing on the National Register of Historic Places. Most of the known prehistoric cultural resources are concentrated in the northern third of the site on Pahute and Rainier Mesas, and in the southwestern portion of the site in the Forty-Mile Canyon and Cat Canyon areas (DOE 1998a).

By 1998, 42 archaeological reconnaissance surveys covering approximately 1,228 hectares (3,305 acres) had been conducted within the Frenchman Flat hydrologic basin. This is the area within which the DAF is located. Ninety-five prehistoric sites were recorded as a result of these surveys. Of these sites, 2 are temporary camps, 2 are extractive localities, 38 are processing localities, 52 are localities, and 1 is a residential base. More recently, 1,089 hectares (2,690 acres) in Frenchman Flat in Area 6 were surveyed for cultural resources. No sites eligible for the National Register of Historic Places were found (DOE 2000a).

4.4.8.2 Historic Resources

Historic site types on NTS include mines and prospects, trash dumps, settlements, campsites, ranches, homesteads, developed spring heads, roads, trails, and nuclear weapons developments sites. Sixty-five historic sites have been identified on NTS (DOE 1998a). One site, Sedan Crater, is listed on the National Register of Historic Places. Sedan Crater was created in 1962 as part of the Plowshare Program, whose aim was to identify peaceful uses for nuclear explosions. It is located in Yucca Flats. At least 600 buildings, structures, and objects dating to the Cold War era have been identified on NTS, but these have not been systematically recorded or evaluated for significance. Frenchman Flat and Yucca Flat are rich in significant structures of the atmospheric testing and Cold War eras, while the remaining portions of the site are less important with respect to historic sites from this period. One site considered eligible for listing is the Emigrant Trail, which traverses the southwest corner of NTS and was used by westward-bound pioneers of the nineteenth century. Additional historic sites may occur in unsurveyed portions of the site (DOE 1996f).

The DAF is located within the northern portion of Frenchman Flat. Four historic sites have been identified in the Frenchman Flat area. Two are of an unspecified historic nature and two are related to nuclear testing and research. The most recent archaeological survey of the Frenchman Flat area of Area 6, which covered 1,089 hectares (2,690 acres), did not identify any additional historic resources (DOE 2000a).

4.4.8.3 Native American Resources

The Consolidated Group of Tribes and Organizations has had a long-standing relationship with DOE since 1987. The group is comprised of 16 Tribes and 3 official Native American organizations, representing the Southern Paiutes, Western Shoshones, and Owens Valley Paiutes. Each of these internal groups substantiated cultural and historic ties to NTS and the surrounding areas. The primary focus of the Consolidated Group of Tribes and Organizations has been the protection of traditional cultural resources. The organization has identified several sites at NTS that are important to Native American people, including storied rocks, rock shelters, wooden lodges, rock rings, springs, and certain archaeological sites. In addition, 107 plant and more than 20 animal species resident on NTS have been identified by Native American elders as part of their traditional resources. Due to the restricted access status of NTS for over 50 years, most of the site has not been impacted by grazing, mining, offroad vehicle travel, or other public uses. This has contributed significantly to the preservation of many cultural and biological resources that are important to Native Americans (DOE 1998a).

The Consolidated Group of Tribes and Organizations has stated that Frenchman Flat, where DAF is located, contains a wide variety of plants, animals, and archaeological sites of cultural importance to Native American people. A total of 20 plant species was identified at two plant study locations within the west-central portion of this area.

4.4.8.4 Paleontological Resources

Alluvium-filled valleys surrounded by ranges composed of Precambrian and Paleozoic sedimentary rocks and Tertiary volcanic tuffs and lavas characterize the surface geology of NTS. Although the Precambrian sedimentary deposits contain no fossils or only a few poorly preserved fossils, the Paleozoic marine limestones are moderately to abundantly fossiliferous. Marine fossils found in the same Paleozoic formation on Nellis Air Force Range, adjacent to NTS to the north, include trilobites, conodonts, ostracods, solitary and colonial corals, brachiopods, cephalopods, algae, gastropods, and archaic fish. These fossils, however, are relatively common and have low research potential. Tertiary volcanic deposits are not expected to contain fossils (DOE 1996f).

Late Pleistocene terrestrial vertebrate fossils could be expected in Quaternary deposits. The possibility of finding mammoth, horse, camel, and bison remains might be expected because such fossils have been found at Tule Springs, 56 kilometers (35 miles) from the southern edge of NTS, as well as in Nye Canyon. Fossils found at Tule Springs include bison, deer, a small donkey-like horse, camel, Columbia mammoth, ground sloth, giant jaguar, bobcat, coyote, muskrat, and a variety of rabbits, rodents, and birds. Although no known fossil localities have been recorded to date on NTS, Quaternary deposits with paleontological materials may occur on the site (DOE 1996f).

As noted above, no known pleistocene fossil localities have been recorded to date on NTS, including the DAF area. Also, no fossils were discovered during construction of DAF. However, since paleontological surveys of the site have not been conducted, the possibility exists that Ice Age fossils could be found in Quaternary alluvium within the area.

4.4.9 Socioeconomics

Statistics for population, housing, community services, and local transportation are presented for the region of influence, a two-county area in Nevada (**Figure 4–29**) in which 97 percent of all NTS employees reside (**Table 4–41**). Within Clark County, most NTS employees reside in the Las Vegas area.

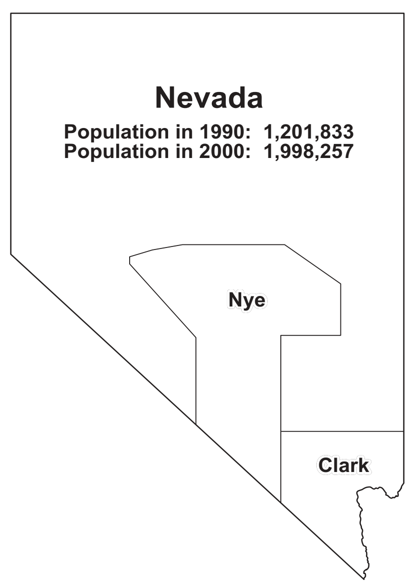


Figure 4–29 Counties in the NTS Region of Influence

4.4.9.1 Regional Economic Characteristics

Between 1990 and 1999, the civilian labor force in the NTS region of influence increased 57.3 percent to the 1999 level of 664,889. In 1999, the annual unemployment average in the two-county area was 4.4 percent, which was the same as the annual unemployment average for Nevada (4.4 percent) (DOL 2000).

In 1998, service activities represented the largest sector of employment in the region of influence (45.1 percent). This was followed by retail trade (20.4 percent), and government

(10.4 percent). The totals for these employment sectors in Nevada were 42.4 percent, 20.5 percent, and 11.8 percent, respectively (NDETR 1999).

Table 4–41 Distribution of Employees by Place of Residence in the NTS Region of Influence in 1994

County	*Number of Employees*	*Total Site Employment (percent)*
Clark	Not available	90
Nye	Not available	7
Region of influence total	Not available	97

Source: DOE 1996d.

4.4.9.2 Demographic Characteristics

The 2000 demographic profile of the region of influence population is included in **Table 4–42**. Between 1990 and 2000, the region of influence population increased by 85.5 percent. The 2000 population was 1,408,250 people, of whom about 97.6 percent lived in Clark County. Persons self-designated as minority individuals comprised a 39.2 percent of the total population.

Income information for the NTS region of influence is included in **Table 4–43.** In 1997, the median household income in Clark County ($39,486) was higher than the Nye County median income ($36,580) and the Nevada state average of $39,280. Both counties had a larger percentage of persons living below the poverty lined compared to the state average.

Table 4–42 Demographic Profile of the Population in the NTS Region of Influence

	Clark County	*Nye County*	*Region of Influence*
Population			
2000 Population	1,375,765	32,485	1,408,250
1990 Population	741,368	17,781	759,149
Percent Change from 1990 to 2000	85.6	82.7	85.5
Race (2000) (Percent of total population)			
White	71.6	89.6	72.0
Black or African American	9.1	1.2	8.9
American Indian and Alaska Native	0.8	2.0	0.8
Asian	5.3	0.8	5.2
Native Hawaiian and Other Pacific Islander	0.5	0.3	0.5
Some other race	8.6	3.0	8.5
Two or more races	4.2	3.1	4.2
Percent minority	39.8	15.3	39.2
Ethnicity (2000)			
Hispanic or Latino	301,143	2,713	304,856
Percent of total population	22.3	8.4	21.6

Source: DOC 2001.

Table 4–43 Income Information for the NTS Region of Influence

	Clark County	*Nye*	*Nevada*
Median household income 1997 ($)	39,486	36,580	39,280
Percent of persons below poverty line (1997)	11.1	12.7	10.7

Source: DOC 2000.

4.4.9.3 Housing and Community Services

Table 4–44 lists the total number of occupied housing units and vacancy rates in the NTS region of influence. In 1990, the region of influence contained 325,261 housing units, of which 293,689 were occupied. The median values of owner-occupied units were $93,300 in Clark County and $70,800 in Nye County. The vacancy rate in Clark County was 9.5 percent, and the vacancy rate in Nye County was 17.5 percent (DOC 1998).

Community services include public education and health care (i.e., hospitals, hospital beds, and doctors). In 1998, student enrollment in the region of influence totaled 209,042, with a student-to-teacher ratio of 20:1 (Department of Education 2000). Community health services and facilities are concentrated in Clark County (Gaquin and DeBrandt 2000).

Table 4–44 Housing and Community Services in the NTS Region of Influence

	Clark County	*Nye County*	*Region of Influence*
Housing (1990) [a]			
Total units	317,188	8,073	325,261
Occupied housing units	287,025	6,664	293,689
Vacant units	30,163	1,409	31,572
Vacancy rate (percent)	9.5	17.5	9.7
Median value ($)	93,300	70,800	–
Public Education (1998) [b]			
Total enrollment	203,777	5,265	209,042
Student-to-teacher ratio	20:1	15.6:1	20:1
Community Health Care (1998) [c]			
Hospitals	8	1	9
Hospital beds per 1,000 persons	1.9	1.6	1.9
Physicians per 1,000 persons	1.7	0.5	1.7

[a] DOC 1998.
[b] Department of Education 2000.
[c] Gaquin and DeBrandt 2000.

4.4.9.4 Local Transportation

The main access to NTS is Mercury Highway, which originates at U.S. Highway 95, 105 kilometers (65 miles) northwest of Las Vegas, Nevada, and accesses the main gate in Mercury (see Figure 4–22). U.S. Highway 95 is the most frequented direct access to NTS and is used by over 95 percent of the employees working on site. It is the closest and most direct route to the site for hauling materials and waste, whether hauled directly by trucks or by rail. Another entrance located 8 kilometers (5 miles) to the west of Mercury is a turnoff to Jackass Flats Road; however, this entrance is presently barricaded. NTS has a restricted access into Area 25 from U.S. Highway 95 at Lathrop Wells Road, which is located about 32 kilometers (20 miles) west of Mercury. A seldom-used fourth entrance is located in the northeast corner of the site and can be reached from State Route 375. This route requires crossing the Nellis Air Force Range Complex. Other existing roadways, although unpaved, could provide entrance or exit routes in case of an emergency. Access to NTS is restricted, and guard stations are located at all entrances, as well as throughout the site. Background traffic on key roads in the vicinity of the site has grown rapidly in the last 10 years. For example, average annual growth ranging from 2 to 5 percent has been experienced on U.S. Highway 95, while less than 2 percent growth is common elsewhere on rural highways. While background traffic has increased in Nevada, traffic volumes at the Mercury interchange have decreased by approximately 2 percent per year during the last 10 years because of reductions in the NTS workforce.

Commuter buses provide daily passenger service to NTS from Las Vegas and Pahrump by way of U.S. Highway 95. The number of buses entering the site varies daily depending on the onsite activities in progress. Currently, there are 54 buses serving Las Vegas and 5 buses serving Pahrump. The commuter bus service provides dedicated routes to the forward areas, and paved parking areas for the buses are located at the support facilities within Areas 6, 23 (Mercury), and 25. Limited bus parking is also available at other NTS support facilities. Parking for government and private commuter vehicles is available at most buildings at the site.

The closest rail line to NTS is the Union Pacific line, which passes through Las Vegas approximately 80 kilometers (50 miles) east of Mercury. This line connects Los Angeles with Salt Lake City. There is no direct railway link to the site. Commercial air service to and from the area is available through McCarran International Airport, which is located in Las Vegas, 120 kilometers (75 miles) southeast of NTS. Aside from three small airports in the region, air transport service is also possible through two U.S. Air Force bases in the area: Nellis Air Force Base in North Las Vegas and the Indian Springs Auxiliary Airfield. Two serviceable airstrips are also located on NTS (Desert Rock Airport in Area 22 and Yucca Lake airstrip in Area 6) in addition to 10 helipads.

4.4.10 Environmental Justice

Under Executive Order 12898, DOE is responsible for identifying and addressing disproportionately high and adverse impacts on minority or low-income populations. As discussed in Appendix E, minority persons are those who identify themselves as Hispanic or Latino, Asian, Black or African American, American Indian or Alaska Native, Native Hawaiian or Other Pacific Islander, or multiracial. Persons whose incomes are below the Federal poverty threshold are designated low-income.

DAF is located at latitude 36° 53' 37.824" north, longitude 116° 2' 54.794" west. No Indian reservations lie within or partially within the region of potential radiological impacts centered on the DAF.

Three counties in Nevada are partially included in the potentially affected area (**Figure 4–30**): Clark, Lincoln, and Nye. In addition, Inyo County, California, is partially contained in the region of potential radiological impacts. **Table 4–45** provides the racial and Hispanic composition for these counties using data obtained from the decennial census conducted in 2000. In the year 2000, approximately 4 of 10 county residents identified themselves as a member of a minority group. Hispanics or Latinos and Blacks or African Americans comprised approximately three-quarters of the resident minority population.

Figure 4–31 compares the growth in minority populations in the potentially affected counties between 1990 and 2000. As discussed in Section E.5.1 of Appendix E, data concerning race and Hispanic origin from the 2000 Census cannot be directly compared with that from the 1990 Census because the racial categories used in the two enumerations were different. Bearing this change in mind, the minority populations in potentially affected counties increased from approximately 24 percent to 39 percent in the decade from 1990 to 2000. During that decade, Nevada's population increase was the largest among all of the states in the U.S. The Hispanic or Latino population more than tripled, and the Asian population of potentially affected counties nearly tripled during the past decade. Over 70 percent of the increase in minority populations occurred in the Las Vegas metropolitan area of Clark County. For comparison, minorities composed approximately one-quarter of the total population of the United States in 1990 and nearly one-third of the total population in 2000.

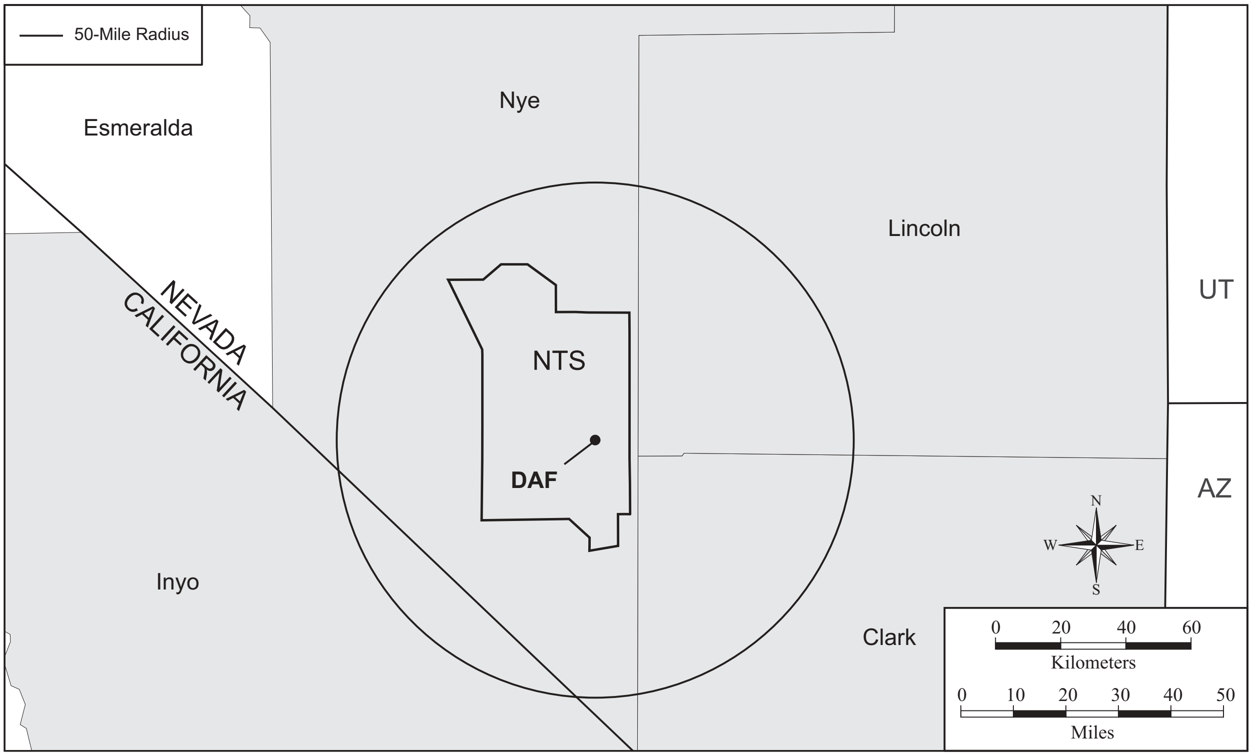


Figure 4–30 Potentially Affected Counties Surrounding DAF at NTS

Table 4–45 Populations in Potentially Affected Counties Surrounding DAF in 2000

Population Group	*Population*	*Percentage of Total*
Minority	554,986	38.8
Hispanic	307,334	21.5
Black/African American	121,865	8.5
American Indian/Alaska Native	10,092	0.7
Asian	71,639	5.0
Native Hawaiian/Pacific Islander	5,980	0.4
Two or more races	38,076	2.7
Some other race	2,133	0.1
White	873,241	61.1
Total	1,430,360	100.0

Source: DOC 2001.

The percentage of low-income population at risk in potentially affected counties surrounding DAF in 1990 was approximately 14 percent. In 1990, nearly 13 percent of the total population of the continental United States reported incomes less than the poverty threshold. In terms of percentages, minority populations in potentially impacted counties are relatively large in comparison with the national percentage, largely due to the population explosion in the Las Vegas metropolitan area during the last decade. The percentage low-income population at risk in 1990 is commensurate with the corresponding national percentage. Complete census data with block group resolution for minority and low-income populations obtained from the decennial census of 2000 are scheduled for publication in 2002.

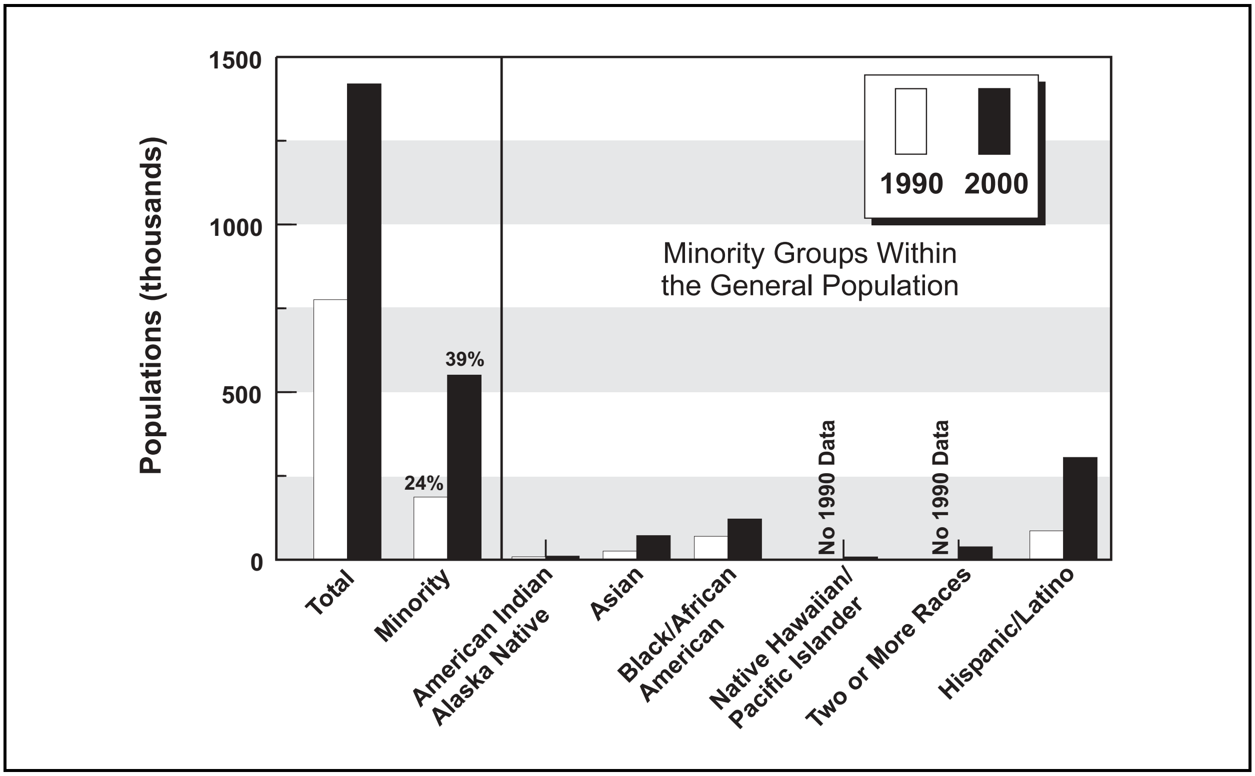


Figure 4–31 Comparison of Populations in Potentially Affected Counties Surrounding DAF in 1990 and 2000

4.4.11 Existing Human Health Risk

Public and occupational health and safety issues include the determination of potentially adverse effects on human health resulting from acute and chronic exposures to ionizing radiation and hazardous chemicals.

4.4.11.1 Radiation Exposure and Risk

Major sources and levels of background radiation exposure to individuals in the vicinity of NTS are shown in **Table 4–46**. Annual background radiation doses to individuals are expected to remain constant over time. The total dose to the population, in terms of person-rem, changes as the population size changes. Background radiation doses are unrelated to NTS operations.

Releases of radionuclides to the environment from NTS operations provide another source of radiation exposure to individuals in the vicinity of NTS. Types and quantities of radionuclides released from NTS operations in 1999 are listed in the *Nevada Test Site Annual Site Environmental Report for Calendar Year 1999* (DOE 2000i). The releases are summarized in Section 4.4.3.2 of this EIS. The doses to the public resulting from these releases are presented in **Table 4–47**. These doses fall within the radiological limits given in DOE Order 5400.5, *Radiation Protection of the Public and the Environment*, and are much lower than those of background radiation.

Table 4–46 Sources of Radiation Exposure to Individuals in the NTS Vicinity Unrelated to NTS Operations

Source	*Effective Dose Equivalent (millirem per year)*
Natural Background Radiation	
Total external (cosmic and terrestrial) [a]	74
Internal terrestrial and global cosmogenic [b]	40
Radon in homes (inhaled)	200 [b, c]
Other Background Radiation [b]	
Diagnostic x rays and nuclear medicine	53
Weapons test fallout	less than 1
Air travel	1
Consumer and industrial products	10
Total	379

[a] Derived from information on cosmic and terrestrial radiation given in EPA 1981.
[b] NCRP 1987.
[c] This is an average for the United States.

Table 4–47 Radiation Doses to the Public From Normal NTS Operations in 1998 (total effective dose equivalent)

Members of the Public	*Atmospheric Releases*		*Liquid Releases*		*Total*	
	Standard [a]	*Actual*	*Standard* [a]	*Actual*	*Standard* [a]	*Actual*
Maximally exposed offsite individual (millirem)	10	0.63 [b]	4	0	100	0.63
Population within 80 kilometers (50 miles) (person-rem) [c]	None	0.38	None	0	100	0.38
Average individual within 80 kilometers (50 miles) (millirem) [d]	None	0.01	None	0	None	0.01

[a] The standards for individuals are given in DOE Order 5400.5. As discussed in that Order, the 10-millirem per year limit from airborne emissions is required by the Clean Air Act (40 CFR 61) and the 4-millirem per year limit is required by the Safe Drinking Water Act (40 CFR 141). The total dose of 100 millirem per year is the limit from all pathways combined. The 100-person-rem value for the population is given in the proposed 10 CFR 834, *Radiation Protection of the Public and Environment; Proposed Rule,* published in 58 FR 16268. If the potential total dose exceeds the 100 person-rem value, the contractor operating the facility would be required to notify DOE.
[b] Includes the air, milk, and wildlife dose pathways.
[c] Based on a population of 36,517 in 1999.
[d] Obtained by dividing the population dose by the number of people living within 80 kilometers (50 miles) of the site.
Source: DOE 2000i.

Using a risk estimator of 1 latent cancer death per 2,000 person-rem to the public (see Appendix B), the fatal cancer risk to the maximally exposed member of the public due to radiological releases from NTS operations in 1999 is estimated to be 3.2×10^{-7}. That is, the estimated probability of this person dying of cancer at some point in the future from radiation exposure associated with one year of NTS operations is about 3 in 10 million (it takes several to many years from the time of radiation exposure for a cancer to manifest itself).

According to the same risk estimator, 1.9×10^{-4} excess fatal cancers are projected in the population living within 80 kilometers (50 miles) of NTS from normal operations in 1999. To place this number in perspective, it may be compared with the number of fatal cancers expected in the same population from all causes. The mortality rate associated with cancer for the entire U.S. population is 0.2 percent per year. Based on this mortality rate, the number of fatal cancers expected during 1999 from all causes in the population living within 80 kilometers (50 miles) of NTS was 73. This expected number of fatal cancers is much higher than the 1.9×10^{-4} fatal cancers estimated from NTS operations in 1998.

NTS workers receive the same dose as the general public from background radiation, but they also receive an additional dose from working in facilities with nuclear materials. The average dose to the individual worker and the cumulative dose to all workers at NTS from operations in 1998 are presented in **Table 4–48**. These doses fall within the radiological regulatory limits of 10 CFR 835. According to a risk estimator of 1 latent fatal cancer per 2,500 person-rem among workers (see Appendix B), the number of projected fatal cancers among NTS workers from normal operations in 1998 is 4.0×10^{-4}. The risk estimator for workers is lower than the estimator for the public because of the absence from the work force of the more radiosensitive infant and child age groups.

Table 4–48 Radiation Doses to Workers From Normal NTS Operations in 1998 (total effective dose equivalent)

Occupational Personnel	*Onsite Releases and Direct Radiation*	
	Standard [a]	*Actual*
Average radiation worker (millirem)	None [b]	77
Total workers [c] (person-rem)	None	1

[a] The radiological limit for an individual worker is 5,000 millirem per year (10 CFR 835). However, DOE's goal is to maintain radiological exposure as low as is reasonably achievable. Therefore, DOE has recommended an administrative control level of 500 millirem per year (DOE 1999c); the site must make reasonable attempts to maintain individual worker doses below this level.
[b] No standard is specified for an average radiation worker; however, the maximum dose that this worker may receive is limited to that given in footnote a.
[c] There were 13 workers with measurable doses in 1998.
Sources: DOE 1998b.

External radiation doses have been measured in the vicinity of the NTS DAF site that may contain radiological sources for comparison with offsite natural background radiation levels. Measurements taken in 1999 showed an average onsite dose in the vicinity of the DAF site of 91 millirem, compared to an offsite dose of 101 millirem (DOE 2000i).

External concentrations of plutonium in air are measured in the vicinity of DAF. The concentrations of plutonium-239/240 in the vicinity of DAF in 1999 was 2.1×10^{-17} curies per cubic meter. This value is about three times higher than that measured at offsite control locations. Finally, concentrations in air of gross alpha and beta radiation in the vicinity of DAF in 1999 were 2.2×10^{-15} curies per cubic meter and 2.2×10^{-14} curies per cubic meter, respectively. These alpha and beta radiation concentrations are about the same as those measured at offsite locations (DOE 2000i).

4.4.11.2 Chemical Environment

The background chemical environment important to human health consists of the atmosphere, which may contain hazardous chemicals that can be inhaled; drinking water, which may contain hazardous chemicals that can be ingested; and other environmental media with which people may come in contact (e.g., soil through direct contact or via the food pathway).

Adverse health impacts to the public are minimized through administrative and design controls to decrease hazardous chemical releases to the environment and to achieve compliance with permit requirements. The effectiveness of these controls is verified through the use of monitoring information and inspection of mitigation measures. Health impacts to the public may occur during normal operations at NTS via inhalation of air containing hazardous chemicals released to the atmosphere by NTS operations. Risks to public health from ingestion of contaminated drinking water or direct exposure are also potential pathways.

Baseline air emission concentrations for air pollutants and their applicable standards are presented in Section 4.4.3.1. These concentrations are estimates of the highest existing offsite concentrations and represent the highest concentrations to which members of the public could be exposed. These concentrations are compared with applicable guidelines and regulations.

Chemical exposure pathways to NTS workers during normal operation may include inhaling the workplace atmosphere, drinking NTS potable water, and other possible contacts with hazardous materials associated with work assignments. Workers are protected from hazards specific to the workplace through appropriate training, protective equipment, monitoring, and management controls. NTS workers are also protected by adherence to OSHA and EPA occupational standards that limit atmospheric and drinking water concentrations of potentially hazardous chemicals. Appropriate monitoring, which reflects the frequency and amounts of chemicals utilized in the operation processes, ensures that these standards are not exceeded. Additionally, DOE requirements ensure that conditions in the workplace are as free as possible from recognized hazards that cause or are likely to cause illness or physical harm. Therefore, worker health conditions at NTS are expected to be substantially better than required by standards.

4.4.11.3 Health Effects Studies

Several epidemiological studies have been conducted to investigate possible adverse health effects of low-level radioactive fallout on residents of Nevada and Utah. These studies have been summarized in the *Final Programmatic Environmental Impact Statement for Stockpile Stewardship and Management (SSM PEIS)* (DOE 1996e). A mortality study of Utah children under 15 years old investigated the relationship between childhood leukemia and radioactive fallout and found a significant excess of leukemia among children who died during the high fallout period (between 1951 and 1958) compared to those who died during the low fallout periods (between 1944 and 1950 and between 1959 and 1975). A follow-up study found that bone doses of southern Utah residents were too low to account for the excess leukemia deaths.

A nonstatistically significant excess of thyroid neoplasm was reported among children living near the nuclear testing sites (Utah/Nevada) compared to a group living in Arizona.

An excess number of leukemia cases were observed among men who participated in military maneuvers in August 1957. No excess in “total cancers” was observed, but four cases of polycythemia vera were reported where 0.2 were expected. For a more detailed description of the studies and the findings, refer to Appendix Section E.4.9 of the *SSM PEIS* (DOE 1996e).

Occupational health studies on NTS workers are being conducted; however, no completed studies on the health of current or past NTS workers are available (DOE and HHS 2000). In one study, accessible information is being reviewed to determine whether former NTS workers might develop health problems due to their employment at the site. The review is focused on construction workers in underground and excavation work and re-entry workers who were employed there from 1951-1992. About 15,000 workers were identified for the cohort study. Exposure information and health data are being collected, and former workers are being contacted. A determination of which workers might possibly be at significant risk for health problems will be made. Those workers will be offered an opportunity to participate in a free medical screening program.

4.4.11.4 Accident History

NTS has been used for nuclear testing since 1951. There were some 100 atmospheric nuclear explosions before the Limited Test Ban Treaty was implemented in 1963. Since then, all nuclear tests have been conducted underground. There have been no criticality accidents at NTS.

4.4.11.5 Emergency Preparedness

Each DOE site has established an emergency management program that would be activated in the event of an accident. This program has been developed and is maintained to ensure adequate response for most accident conditions and to provide response efforts for accidents not specifically considered. The emergency management program incorporates activities associated with emergency planning, preparedness, and response. The NTS Emergency Preparedness Plan is designed to minimize or mitigate the impact of any emergency upon the health and safety of employees and the public. The plan integrates all emergency planning into a single entity to minimize overlap and duplication and to ensure proper responses to emergencies not covered by a plan or directive. The manager of the Nevada Operations Office has the responsibility to manage, counter, and recover from an emergency occurring at NTS.

The NTS Emergency Preparedness Plan provides for identification and notification of personnel regarding any emergency that may develop during operational and nonoperational hours. The Nevada Operations Office receives warnings, weather advisories, and any other communications that could provide advance warning of a possible emergency. The plan is based upon current Nevada Operations Office vulnerability assessments, resources, and capabilities regarding emergency preparedness.

DOE has also specified actions to be taken at all DOE sites to implement lessons learned from the emergency response to an accidental explosion at Hanford in May 1997.

4.4.12 Waste Management

Waste management includes minimization, characterization, treatment, storage, transportation, and disposal of waste generated from ongoing DOE activities. The waste is managed using appropriate treatment, storage, and disposal technologies, and in compliance with all applicable Federal and state statutes and DOE orders.

4.4.12.1 Waste Inventories and Activities

NTS manages the following types of waste: transuranic, mixed transuranics, low-level radioactive, mixed low-level radioactive, hazardous, and nonhazardous. Because there is no transuranic or mixed transuranic waste associated with TA-18 operations, these waste types are not discussed in this EIS. Waste generation rates and the inventory of stored waste from activities at NTS are provided in **Table 4–49**. The NTS waste management capabilities are summarized in **Table 4–50**.

Table 4–49 Waste Generation Rates and Inventories at NTS

Waste Type	*Generation Rate (cubic meters per year)*	*Inventory (cubic meters)*
Low-level radioactive	178	Not available
Mixed low-level radioactive	0	Not available
Hazardous	34.6	Not applicable [a]
Nonhazardous (liquid and solid)	7,170	Not applicable [a]

[a] Generally, hazardous and nonhazardous wastes are not held in long-term storage.
Source: DOE 1996e.

Table 4–50 Waste Management Facilities at NTS

Facility	*Capacity*	*Status*	*Applicable Waste Type*			
			Low-Level Radioactive Waste	*Mixed Low-Level Radioactive Waste*	*Hazardous*	*Non-hazardous*
Treatment Facility						
Explosive Ordnance Disposal Unit (kilograms per year)	1,873	Online			X [a]	
Storage Facility						
Transuranic Waste Storage Pad (cubic meters)	1,150	Online		X		
Hazardous Waste Storage Unit (liters)	61,625	Online			X	
Disposal Facility						
Areas 3 and 5 Radioactive Waste Management Site (cubic meters)	500,000	Online	X			
Area 5 Pit 3 Mixed Waste Disposal Unit (cubic meters)	118,908	Online		X		
Area 6 Hydrocarbon Disposal Site (cubic meters)	42,000	Online				X
Area 9 U-10c Solid Waste Disposal Site (cubic meters)	990,000	Online				X
Area 23 Solid Waste Disposal Site (cubic meters)	450,000	Online				X

[a] Treatment of waste explosives, including damaged or expired conventional explosives, by detonation.
Sources: DOE 1996d, DOE 1996f.

Other than reporting requirements, there is no formal CERCLA program at NTS. The Federal Facilities Agreement and Consent Order with the state may preclude NTS from being placed on the National Priority List. More of a RCRA approach in remediating environmental problems will be taken under the Federal Facilities Agreement and Consent Order (DOE 1999e). More information on regulatory requirements for waste disposal is provided in Chapter 6.

4.4.12.2 Low-Level Radioactive Waste

NTS has a formal storage facility for NTS-generated low-level radioactive waste. This facility is located in the Area 5 Radioactive Waste Management Site. NTS-generated waste is stored at this facility while characterization and certification activities are being completed prior to disposal.

NTS currently operates the Area 3 and 5 Radioactive Waste Management Sites for the disposal of low-level radioactive waste generated at NTS and at offsite DOE and DOD facilities. Low-level radioactive waste is accepted for disposal from generators that have received approval from DOE Headquarters and DOE Nevada Operations Office (DOE 1999e).

The Area 5 Radioactive Waste Management Site uses pits and trenches for shallow land burial of standard-packaged low-level waste. Included in this category of low-level waste is classified waste. Classified waste is low-level radioactive waste that is “classified” because of the physical shape or specific composition of the material contained in the waste. Classification creates a need for the use of separate disposal units which are controlled with additional security measures. Area 3 uses subsidence craters generated during underground nuclear weapons testing for disposal of bulk low-level radioactive waste. Waste disposed of at Area 3 tends to have a lower activity concentration than waste disposed of at Area 5 because bulk waste tends to be generated during environmental restoration projects (DOE 1999e).

4.4.12.3 Mixed Low-Level Radioactive Waste

On January 5, 1994, the State of Nevada and NNSA Nevada Operations Office entered into a Mutual Consent Agreement that allowed mixed low-level radioactive wastes generated at NTS to be moved into storage at the Area 5 Transuranic Waste Storage Pad. This was amended in June 1994 to include mixed low-level radioactive waste generated in Nevada via environmental restoration work. Waste at this facility will continue to be held in storage until a final determination of the proper treatment and disposal technology is established by the EPA. A Federal Facilities Agreement and Consent Order was signed, effective March 27, 1996, requiring compliance with a site treatment plan, which was also finalized in March 1996. Compliance with the Federal Facilities Agreement and Consent Order exempts NTS from potential enforcement action resulting from the mixed waste storage prohibition under RCRA (DOE 1999e).

A single disposal unit, Pit 3 in Radioactive Waste Management Site Area 5, has interim status as a mixed waste disposal unit for NTS-generated wastes that meet the RCRA land disposal restrictions. Mixed low-level radioactive waste is stored on the Transuranic Waste Storage Pad until characterization is complete. If the waste meets or has been treated to meet the land disposal restrictions requirements, it may be disposed of in Pit 3 (DOE 1999e).

4.4.12.4 Hazardous Waste

Hazardous wastes result from ongoing operations that utilize solvents, lubricants, fuel, lead, metals, motor oil, and acids. Hazardous wastes are accumulated at satellite areas, stored at the Area 5 RCRA-permitted Hazardous Waste Storage Unit for up to one year and shipped offsite by truck using Department of Transportation-approved transporters to a commercial RCRA-permitted facility. The Area 11 Explosive Ordnance Disposal Unit is a thermal treatment unit where explosive wastes are detonated or treated.

4.4.12.5 Nonhazardous Waste

Solid waste landfills located in Areas 6, 9, and 23 are in use for the disposal of solid nonhazardous wastes. The Area 6 Hydrocarbon Disposal Site accepts hydrocarbon-burdened soil and debris. The Area 9 U-10c Solid Waste Disposal Site is a construction and demolition landfill. The Area 23 Solid Waste Disposal Site receives all types of nonhazardous solid waste with non pathogenic hospital waste, dead animals, and asbestos-containing materials buried in separate cells that are identified by concrete markers. Liquid nonhazardous wastes are disposed of in septic tanks, sumps, or ponds (DOE 1996f).

4.4.12.6 Waste Minimization

The NNSA Nevada Operations Office has an active waste minimization and pollution prevention program to reduce the total amount of waste generated and disposed of at NTS. This is accomplished by eliminating waste through source reduction or material substitution; by recycling potential waste materials that cannot be minimized or eliminated; and by treating all waste that is generated to reduce its volume, toxicity, or mobility prior to storage or disposal. The Nevada Operations Office published its first Waste Minimization Plan in 1991, which defined specific goals, methodologies, responsibilities, and achievements of various programs and organizations. The achievements and progress are updated at least annually. Implementing pollution prevention projects reduced the total amount of waste generated at NTS in 1999 by approximately 1,223 cubic meters (1,600 cubic yards). Examples of pollution prevention projects completed in 1999 at NTS include: reduction of sanitary waste by approximately 716 metric tons (789 tons) by selling ferrous, nonferrous, and light steel scrap metals for recycling; and reduction of sanitary waste by less than 1 metric ton (1.1 tons) by collecting and redistributing unneeded copier machine supplies within the Nevada Operations Office and the Nevada Environmental Protection Agency, and returning the remaining supplies to the vendor for credit (DOE 2000h).

4.4.12.7 Waste Management PEIS Records of Decision

The *Waste Management PEIS* Records of Decision affecting NTS are shown in **Table 4–51**. Decisions on the various waste types were announced in a series of Records of Decision that have been published as a result of analyses documented in the *Waste Management PEIS* (DOE 1997a). The hazardous waste Record of Decision was published on August 5, 1998 (63 FR 41810), and the low-level radioactive and mixed low-level radioactive waste Record of Decision was published on February 18, 2000 (65 FR 10061). The hazardous waste Record of Decision states that most DOE sites will continue using offsite facilities to treat and dispose of major portions of nonwastewater hazardous waste, except the Oak Ridge Reservation and the Savannah River Site, which will continue treating some of their own nonwastewater hazardous waste on site in existing facilities where this is economically feasible. The low-level radioactive waste and mixed low-level radioactive waste Record of Decision states that, for the management of low-level radioactive waste, minimal treatment will be performed at all sites, and disposal will continue on site to the extent practicable at INEEL, LANL, the Oak Ridge Reservation, and the Savannah River Site. In addition, Hanford and on site NTS will be available to all DOE sites for low-level radioactive waste disposal. Mixed low-level radioactive waste will be treated at Hanford, INEEL, the Oak Ridge Reservation, and the Savannah River Site, and will be disposed of at Hanford and NTS. More detailed information concerning DOE's decisions for the future configuration of waste management facilities at NTS is presented in the hazardous waste and low-level radioactive waste and mixed low-level radioactive waste Records of Decision.

Table 4–51 Waste Management PEIS Records of Decision Affecting NTS

Waste Type	*Preferred Action*
Low-level radioactive	DOE has decided to continue to treat and dispose of NTS low-level radioactive waste on site. In addition, NTS is available to all DOE sites for low-level radioactive waste disposal. [a]
Mixed low-level radioactive	DOE has decided to regionalize treatment of mixed low-level radioactive waste at the Hanford Site, INEEL, the Oak Ridge Reservation, and the Savannah River Site. NTS will continue to dispose of its own mixed low-level radioactive waste on site and will receive and dispose of mixed low-level radioactive waste generated and shipped by other sites, consistent with permit conditions and other applicable requirements. [a]
Hazardous	DOE has decided to continue to use commercial facilities for treatment of NTS nonwastewater hazardous waste. [b]

[a] From the Record of Decision for low-level radioactive and mixed low-level radioactive waste (65 FR 10061).
[b] From the Record of Decision for hazardous waste (63 FR 41810).
Source: 65 FR 10061, 63 FR 41810.

4.5 ANL-W

ANL-W is located within the boundaries of INEEL. Because of this, the general site description presented in this section is that of INEEL. INEEL is located on approximately 230,700 hectares (570,000 acres) in southeastern Idaho and is 55 kilometers (34 miles) west of Idaho Falls; 61 kilometers (38 miles) northwest of Blackfoot; and 35 kilometers (22 miles) east of Arco (see **Figure 4–32**). INEEL is owned by the Federal Government and administered, managed, and controlled by DOE. It is primarily within Butte County, but portions of the site are also in Bingham, Jefferson, Bonneville, and Clark Counties. The site is roughly equidistant from Salt Lake City, Utah, and Boise, Idaho (DOE 2000j).