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Final Site-Wide Environmental Impact Statement for the Continued Operation of the Department of Energy/National Nuclear Security Administration Nevada National Security Site and Off-Site Locations in the State of Nevada

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(Chapters 1 through 4)

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Location: Nye and Clark Counties, Nevada

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Abstract: This *Final Site-Wide Environmental Impact Statement for the Continued Operation of the Department of Energy/National Nuclear Security Administration Nevada National Security Site and Off-Site Locations in the State of Nevada (NNSS SWEIS)* analyzes the potential environmental impacts of proposed alternatives for continued management and operation of the Nevada National Security Site (NNSS) (formerly known as the Nevada Test Site) and other U.S. Department of Energy/National Nuclear Security Administration (DOE/NNSA)-managed sites in Nevada, including the Remote Sensing Laboratory (RSL) on Nellis Air Force Base in North Las Vegas, the North Las Vegas Facility (NLVF), the Tonopah Test Range (TTR), and environmental restoration areas on the U.S. Air Force Nevada Test and Training Range. The purpose and need for agency action is to provide support for meeting NNSA's core missions established by Congress and the President and to satisfy the requirements of Executive Orders and comply with Congressional mandates to promote, expedite, and advance the production of environmentally sound energy resources, including renewable energy resources such as solar and geothermal energy systems.

The NNSS has a long history of supporting national security objectives by conducting underground nuclear tests and other nuclear and nonnuclear activities. Since the October 1992 moratorium on nuclear testing, NNSA's mission at the NNSS has evolved from one that focuses on active nuclear weapons tests to one that maintains readiness and the capability to conduct underground nuclear weapons tests; such a test would be conducted only if so directed by the President in the interest of national security. Resources have been reallocated to introduce and expand other mission activities/programs at the NNSS, RSL, NLVF, and TTR to support three DOE/NNSA core missions: National Security/Defense, Environmental Management, and Nondefense. The National Security/Defense Mission includes the Stockpile Stewardship and Management,

Nuclear Emergency Response, Nonproliferation and Counterterrorism, and Work for Others Programs. The Work for Others Program supports other DOE programs and Federal agencies such as the U.S. Department of Defense, U.S. Department of Justice, and U.S. Department of Homeland Security. The Environmental Management Mission includes the Waste Management and Environmental Restoration Programs. The Nondefense Mission includes the General Site Support and Infrastructure, Conservation and Renewable Energy, and Other Research and Development Programs.

The NNSS, RSL, NLVF, and TTR support DOE/NNSA's core missions by providing the capabilities to process and dispose of a damaged nuclear weapon or improvised nuclear device and to conduct high-hazard experiments involving special nuclear material and high explosives, nonnuclear experiments, and hydrodynamic testing. Nuclear stockpile stewardship activities at the NNSS include dynamic plutonium experiments that provide technical information to maintain the safety and reliability of the U.S. nuclear weapons stockpile and research and training in areas such as nuclear safeguards, criticality safety, and emergency response. Special nuclear materials are also stored at the NNSS. In addition, in accordance with the amended Record of Decision (ROD) (DOE/EIS-0243) for the *Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada (1996 NTS EIS*), DOE/NNSA receives low-level and mixed low-level radioactive waste for disposal at the NNSS.

This *NNSS SWEIS* analyzes the potential environmental impacts of three reasonable alternatives for continued operations at the NNSS, RSL, NLVF, and TTR. These alternatives include a No Action Alternative and two action alternatives: Expanded Operations and Reduced Operations. The No Action Alternative, which is analyzed as a baseline for evaluating the two action alternatives, would continue implementation of the *1996 NTS EIS* ROD (DOE/EIS-0243) and subsequent amendments (61 FR 65551and 65 FR 10061), as well as other decisions supported by separate NEPA analyses completed since issuance of the final *1996 NTS EIS*. The No Action Alternative reflects activity levels consistent with those seen since 1996. The Expanded Operations Alternative considers adding new work at the NNSS in the areas of nonproliferation and counterterrorism, high-hazard and other experiments, research and development, and testing. Such expanded operations could include developing test beds for concept testing of sensors, mitigation strategies, and weapons effectiveness. The Reduced Operations Alternative would reduce the overall level of operations and close specific buildings and structures. NNSA would also consider allowing the development of solar power generation facilities under each alternative.

Public Comments: In preparing this *Final NNSS SWEIS*, NNSA considered comments received during the scoping period (July 24, 2009, to October 16, 2009) and during the public comment period on the *Draft NNSS SWEIS* (July 29, 2011, to December 2, 2011), as well as those received after the close of the public comment period on the *Draft NNSS SWEIS*. Five public hearings on the *Draft NNSS SWEIS* were held to provide interested members of the public with opportunities to learn more about NNSA missions, programs, and activities and the content of the *Draft NNSS SWEIS* from exhibits, factsheets, and discussion with NNSA subject matter experts. From September 20 through 28, 2011, public hearings were held in Las Vegas, Pahrump, Tonopah, and Carson City, Nevada, and St. George, Utah. An additional hearing was conducted for the Consolidated Group of Tribes and Organizations on October 6, 2011. All comments received were considered during preparation of this *Final NNSS SWEIS*.

This *Final NNSS SWEIS* contains revisions and new information based in part on comments received on the *Draft NNSS SWEIS*. Vertical change bars in the margins indicate the locations of these revisions and new information. Volume 3 contains the comments received on the *Draft NNSS SWEIS* and DOE/NNSA's responses to those comments. DOE/NNSA will use the analysis presented in this *Final NNSS SWEIS*, as well as other information, in preparing a ROD regarding the continued operation of the NNSS and offsite locations in Nevada. DOE/NNSA will issue a ROD no sooner than 30 days after the U.S. Environmental Protection Agency publishes a Notice of Availability of this *Final NNSS SWEIS* in the *Federal Register*.

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ACRONYMS, ABBREVIATIONS, AND CONVERSION CHARTS

ACRONYMS, ABBREVIATIONS, AND CONVERSION CHARTS

ACEC	Area of Critical Environmental Concern
AEA	Atomic Energy Act
AFVs	Alternate Fuel Vehicles
AIWS	American Indian Writers Subgroup
ALARA	as low as is reasonably achievable
ALOHA	Areal Locations of Hazardous Atmospheres
AMS	Aerial Measuring System
ARG	Accident Response Group
ASSESS	Analytical System and Software for Evaluating Safeguards and Security
ATLAS	Adversary Time-Line Analysis System
BEEF	Big Explosives Experimental Facility
BLM	Bureau of Land Management
BMP	best management practice
CAA	Clean Air Act
CAPP	Chemical Accident Prevention Program
CARE	Communities Against a Radioactive Environment
CAS	corrective action sites
CAU	corrective action unit
CEMP	Community Environmental Monitoring Program
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CEQ	Council on Environmental Quality
CERT	Community Emergency Response Team
CFR	*Code of Federal Regulations*
CGTO	Consolidated Group of Tribes and Organizations
CSP	Concentrated Solar Power
CY	calendar year
D&D	decontamination and decommissioning
DAF	Device Assembly Facility
DAQEM	Department of Air Quality and Environmental Management
DARE	Drug Abuse Resistance Education
DART	days away, restricted, or transferred
dBA	decibels A-weighted
DHS	U.S. Department of Homeland Security
DoD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOE/NNSA	U.S. Department of Energy/National Nuclear Security Administration
DOT	U.S. Department of Transportation
DTRA	Defense Threat Reduction Agency
DU	depleted uranium
EA	Environmental Assessment
EIS	environmental impact statement
EMAC	Ecological Monitoring and Compliance

E-MAD	Engine Maintenance, Assembly, and Disassembly
EMS	Environmental Management System
EPA	U.S. Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act
ERPG	Emergency Response Planning Guideline
ETDS	E-Tunnel Waste Water Disposal System
FAA	Federal Aviation Administration
FACE	Free-Air Carbon Dioxide Enrichment
FBI	Federal Bureau of Investigation
FFACO	Federal Facility Agreement and Consent Order
FLPMA	Federal Land Policy and Management Act
FONSI	Finding of No Significant Impact
FR	*Federal Register*
FRMAC	Federal Radiological Monitoring and Assessment Center
FTE	full-time equivalent
FY	fiscal year
GBUAPCD	Great Basin Unified Air Pollution Control District
GCD	greater confinement disposal
GHG	greenhouse gas
gpd	gallons per day
GTCC	greater-than-Class C [waste]
GWP	global warming potential
HABS	Historic American Buildings Survey
HAER	Historic American Engineering Record
HAP	hazardous air pollutant
HAZMAT	hazardous materials
HLW	high-level radioactive waste
INL	Idaho National Laboratory
ISO	International Organization for Standardization
JASPER	Joint Actinide Shock Physics Experimental Research
JCATS	Joint Conflict and Tactical Simulations
KLF	Kistler Launch Facility
LANL	Los Alamos National Laboratory
LLNL	Lawrence Livermore National Laboratory
LCF	latent cancer fatality
LLW	low-level radioactive waste
LOS	level of service
MCL	maximum contaminant level
MEI	maximally exposed individual
MGCF	Mojave Global Change Facility
MGD	million gallons per day
MLLW	mixed low-level radioactive waste
MSHCP	Multi-Species Habitat Conservation Plan
NAAQS	National Ambient Air Quality Standards

NAC	*Nevada Administrative Code*
NAGPRA	Native American Graves Protection and Repatriation Act
NASA	National Aeronautics and Space Administration
NDEP	Nevada Division of Environmental Protection
NEPA	National Environmental Policy Act of 1969
NESHAPs	National Emission Standards for Hazardous Air Pollutants
NEST	nuclear emergency support team
NHPA	National Historic Preservation Act
NLVF	North Las Vegas Facility
NSO	Nevada Site Office
NNSS	Nevada National Security Site
NOI	Notice of Intent
NPDES	National Pollutant discharge Elimination System
NPS	National Park Service
NPTEC	Nonproliferation Test and Evaluation Complex
NRC	U.S. Nuclear Regulatory Commission
NRHP	National Register of Historic Places
NRS	Nevada Revised Statute
NSO	Nevada Site Office
NSTec	National Security Technologies, LLC
NTS	Nevada Test Site
NUREG	U.S. Nuclear Regulatory Commission Regulation
OSHA	Occupational Safety and Health Act
OST	Office of Secure Transportation
P.L.	Public Law
PCB	polychlorinated biphenyl
PEIS	Programmatic Environmental Impact Statement
pH	a measure of acidity or basicity
PM_n	particulate matter with an aerodynamic diameter less than or equal to $_n$ micrometers
PSD	Prevention of Significant Deterioration
PWS	public water system
QAPP	Quality Assurance Program Plan
rad	radiation absorbed dose
RADTRAN	Radioactive Material Transportation Risk Assessment Code 6
RAP	Radiological Assistance Program
RCRA	Resource Conservation and Recovery Act
rem	roentgen equivalent man
RIMS II	Regional Input-Output Modeling System II
RISKIND	Risks and Consequences of Radioactive Material Transport computer code
RNCTEC	Radiological/Nuclear Countermeasures Test and Evaluation Complex
ROD	Record of Decision
ROI	region of influence
RREM	Routine Radiological Environmental Monitoring
RSL	Remote Sensing Laboratory
RTG	radioisotope thermoelectric generator

RWAP	Radioactive Waste Acceptance Program
RWMC	Radioactive Waste Management Complex
RWMS	Radioactive Waste Management Site
SA	Supplement Analysis
SARA	Superfund Amendments and Reauthorization Act
SEZ	solar energy zones
SNM	special nuclear materials
SNWA	Southern Nevada Water Authority
SPA	Specific Planning Area
SSO	Sandia Site Office
SWAT	special weapons and tactics
SWEIS	site-wide environmental impact statement
TCE	tetrachloroethene
TNT	2,4,6-trinitrotoluene
TPH	total petroleum hydrocarbons
TRAGIS	Transportation Routing Analysis Geographic Information System
TRC	total recordable cases
TRU	transuranic waste
TSCA	Toxic Substances Control Act
TSD	treatment, storage, and disposal
TTR	Tonopah Test Range
TRUPACT	Transuranic Package Transporter
TYSP	Ten-Year Site Plan
UGTA	Underground Test Area
USAF	United States Air Force
U.S.C.	*United States Code*
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UXO	unexploded ordnance
VOC	volatile organic compound
WAC	waste acceptance criteria
WIPP	Waste Isolation Pilot Plant
ZPPR	zero power plutonium reactor
ºC	degrees Centigrade
ºF	degrees Fahrenheit
μS	microsiemens

CONVERSIONS

METRIC TO ENGLISH			ENGLISH TO METRIC		
Multiply	**by**	**To get**	**Multiply**	**by**	**To get**
Area					
Square meters	10.764	Square feet	Square feet	0.092903	Square meters
Square kilometers	247.1	Acres	Acres	0.0040469	Square kilometers
Square kilometers	0.3861	Square miles	Square miles	2.59	Square kilometers
Hectares	2.471	Acres	Acres	0.40469	Hectares
Concentration					
Kilograms/square meter	0.16667	Tons/acre	Tons/acre	0.5999	Kilograms/square meter
Milligrams/liter	1 [a]	Parts/million	Parts/million	1 [a]	Milligrams/liter
Micrograms/liter	1 [a]	Parts/billion	Parts/billion	1 [a]	Micrograms/liter
Micrograms/cubic meter	1 [a]	Parts/trillion	Parts/trillion	1 [a]	Micrograms/cubic meter
Density					
Grams/cubic centimeter	62.428	Pounds/cubic feet	Pounds/cubic feet	0.016018	Grams/cubic centimeter
Grams/cubic meter	0.0000624	Pounds/cubic feet	Pounds/cubic feet	16,025.6	Grams/cubic meter
Length					
Centimeters	0.3937	Inches	Inches	2.54	Centimeters
Meters	3.2808	Feet	Feet	0.3048	Meters
Kilometers	0.62137	Miles	Miles	1.6093	Kilometers
Temperature					
Absolute					
Degrees C + 17.78	1.8	Degrees F	Degrees F - 32	0.55556	Degrees C
Relative					
Degrees C	1.8	Degrees F	Degrees F	0.55556	Degrees C
Velocity/Rate					
Cubic meters/second	2118.9	Cubic feet/minute	Cubic feet/minute	0.00047195	Cubic meters/second
Grams/second	7.9366	Pounds/hour	Pounds/hour	0.126	Grams/second
Meters/second	2.237	Miles/hour	Miles/hour	0.44704	Meters/second
Volume					
Liters	0.26418	Gallons	Gallons	3.78533	Liters
Liters	0.035316	Cubic feet	Cubic feet	28.316	Liters
Liters	0.001308	Cubic yards	Cubic yards	764.54	Liters
Cubic meters	264.17	Gallons	Gallons	0.0037854	Cubic meters
Cubic meters	35.315	Cubic feet	Cubic feet	0.028317	Cubic meters
Cubic meters	1.3079	Cubic yards	Cubic yards	0.76456	Cubic meters
Cubic meters	0.0008107	Acre-feet	Acre-feet	1233.49	Cubic meters
Weight/Mass					
Grams	0.035274	Ounces	Ounces	28.35	Grams
Kilograms	2.2046	Pounds	Pounds	0.45359	Kilograms
Kilograms	0.0011023	Tons (short)	Tons (short)	907.18	Kilograms
Metric tons	1.1023	Tons (short)	Tons (short)	0.90718	Metric tons
ENGLISH TO ENGLISH					
Acre-feet	325,850.7	Gallons	Gallons	0.000003046	Acre-feet
Acres	43,560	Square feet	Square feet	0.000022957	Acres
Square miles	640	Acres	Acres	0.0015625	Square miles

a. This conversion is only valid for concentrations of contaminants (or other materials) in water.

METRIC PREFIXES

Prefix	Symbol	Multiplication factor
exa-	E	1,000,000,000,000,000,000 = 10^{18}
peta-	P	1,000,000,000,000,000 = 10^{15}
tera-	T	1,000,000,000,000 = 10^{12}
giga-	G	1,000,000,000 = 10^{9}
mega-	M	1,000,000 = 10^{6}
kilo-	k	1,000 = 10^{3}
deca-	D	10 = 10^{1}
deci-	d	0.1 = 10^{-1}
centi-	c	0.01 = 10^{-2}
milli-	m	0.001 = 10^{-3}
micro-	µ	0.000 001 = 10^{-6}
nano-	n	0.000 000 001 = 10^{-9}
pico-	p	0.000 000 000 001 = 10^{-12}

CHAPTER 1
INTRODUCTION AND PURPOSE AND NEED FOR AGENCY ACTION

1.0 INTRODUCTION AND PURPOSE AND NEED FOR AGENCY ACTION

1.1 Introduction

This *Site-Wide Environmental Impact Statement for the Continued Operation of the Department of Energy/National Nuclear Security Administration Nevada National Security Site and Off-Site Locations in the State of Nevada (NNSS SWEIS)* analyzes potential environmental impacts of continued management and operation of the Nevada National Security Site (NNSS) (formerly known as the Nevada Test Site) and other sites managed by the U.S. Department of Energy/National Nuclear Security Administration (DOE/NNSA) in Nevada. The primary purpose of continuing operation of the NNSS is to provide support for DOE/NNSA's nuclear weapons stockpile stewardship missions. DOE/NNSA also supports other DOE programs and Federal agencies such as the U.S. Department of Defense (DoD), U.S. Department of Justice, and U.S. Department of Homeland Security. This site-wide environmental impact statement (SWEIS) analyzes the potential environmental impacts of reasonable alternatives for current and reasonably foreseeable missions, programs, capabilities, and projects at the NNSS and offsite locations in Nevada during a 10-year period.

Established by Congress through the National Nuclear Security Administration Act (Title XXXII of the National Defense Authorization Act for Fiscal Year 2000, Public Law [P.L.] 106-65), DOE/NNSA is a separately organized, semiautonomous agency within DOE. The DOE/NNSA Nevada Site Office (NSO) operates programs at the NNSS and at offsite locations in Nevada, including the North Las Vegas Facility (NLVF), the Remote Sensing Laboratory (RSL) on Nellis Air Force Base in North Las Vegas, the Tonopah Test Range (TTR), and environmental remediation areas on the U.S. Air Force Nevada Test and Training Range (formerly the Nellis Air Force Range). These facilities and sites are shown in **Figure 1–1**. The NNSS and the TTR are located in Nye County; NLVF and RSL are located in Clark County; and the Nevada Test and Training Range is located in Nye, Lincoln, and Clark Counties in southern Nevada.

DOE's "National Environmental Policy Act Implementing Procedures" (10 *Code of Federal Regulations* [CFR] Part 1021) require preparation of a SWEIS, a broad-scope document that identifies and assesses the individual and cumulative impacts of ongoing and reasonably foreseeable future actions for certain large multiple-facility DOE sites such as the NNSS (10 CFR 1021.330c). In accordance with 10 CFR Part 1021, an evaluation of a SWEIS is required every 5 years. DOE/NNSA determines whether an existing SWEIS remains adequate or a new SWEIS or supplement to the existing SWEIS is needed. DOE/NNSA prepared this SWEIS to comply with National Environmental Policy Act (NEPA) and Council on Environmental Quality (CEQ) regulations (40 CFR Parts 1500–1508) and DOE NEPA Implementing Procedures (10 CFR Part 1021).

In 1996, DOE issued the *Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada (1996 NTS EIS)* (DOE 1996c) and an associated Record of Decision (ROD) (61 *Federal Register* [FR] 65551). DOE selected the *1996 NTS EIS* Expanded Use Alternative for most activities, but decided to manage low-level radioactive waste (LLW) and mixed low-level radioactive waste (MLLW) at levels described under the No Action Alternative, pending decisions on the *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste (WM PEIS)* (DOE 1997). In the February 2000 *WM PEIS* ROD (65 FR 10061), DOE announced that the NNSS would be one of two regional sites to be used for LLW and MLLW disposal. At the same time, DOE amended the *1996 NTS EIS* ROD to select the Expanded Use Alternative for waste management activities at the NNSS (65 FR 10061).

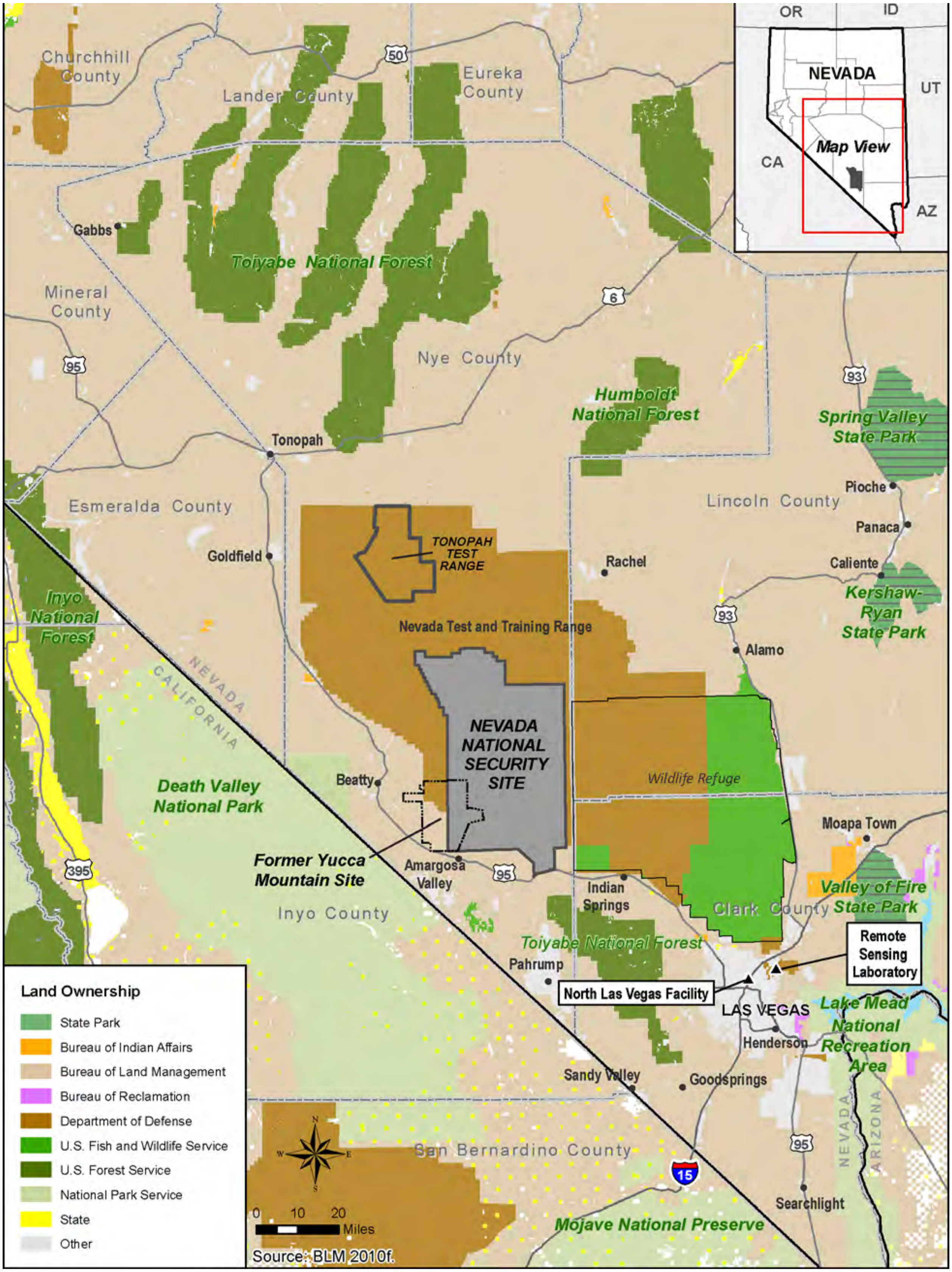

Figure 1–1 Location of the Nevada National Security Site and Offsite Locations

Subsequently, as required by DOE regulations (10 CFR 1021.330(d)), DOE/NNSA conducted the first 5-year review of the *1996 NTS EIS*, as documented in the 2002 *Supplement Analysis for the Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada (2002 NTS SA)* (DOE 2002g). The review found that there were no substantial changes to the actions proposed in the *1996 NTS EIS* and no significant new circumstances or information relevant to environmental concerns. Thus, DOE/NNSA determined that no further NEPA analysis was required (i.e., the existing *1996 NTS EIS* remained adequate based on the supplement analysis [SA], in accordance with 10 CFR 1021.330(d)).

In 2007, DOE/NNSA initiated its second 5-year review of the *1996 NTS EIS* and, in April 2008, issued the *Draft Supplement Analysis for the Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada (2008 Draft NTS SA)* (DOE 2008f). Based on consideration of comments received on the *2008 Draft NTS SA*, potential changes to the NNSS program work scope, and changes to the environmental baseline, DOE/NNSA decided to prepare this SWEIS to update its analysis of the NNSS and offsite location operations in Nevada.

This chapter provides information on the purpose and need for agency action and introduces the alternatives analyzed for DOE/NNSA operations in Nevada and potential decisions to be supported by this SWEIS. This chapter also includes descriptions of related NEPA reviews and a summary of the public involvement process and stakeholder scoping comments, as well as American Indian perspectives prepared by the American Indian Writers Subgroup (AIWS). The AIWS input is in text boxes identified with a Consolidated Group of Tribes and Organizations (CGTO) feather icon.

Introduction—American Indian Perspective

Information provided by the Consolidated Group of Tribes and Organizations (CGTO) for inclusion in the chapters of this site-wide environmental impact statement (SWEIS) is presented in text boxes such as this to distinguish it from U.S. Department of Energy (DOE) text. The full text of American Indian perspective and concerns related to the resources and alternatives evaluated in this SWEIS is presented in Appendix C.

Since the beginning of time, the area encompassing the Nevada National Security Site (NNSS) and the offsite locations has been essential to the lives of American Indian tribes. These lands contain traditional gathering, ceremonial, and recreational areas for the American Indian people. They contain ecological resources and power places that are crucial for the continuation of American Indian culture, religion, and society.

In consideration of our ties to these lands and their resources, and to comply with DOE Order 144.1 and Executive Order 13127, DOE invited the CGTO to contribute to the development of this SWEIS. Specifically, DOE provided the CGTO with the opportunity to develop text summarizing our perspective and concerns regarding the resources and alternatives presented in this SWEIS.

The CGTO has had a long-standing relationship with DOE since 1987. We are comprised of 17 tribes and organizations, representing the Southern Paiute, Western Shoshone, and Owens Valley Paiute and Shoshone people. Each of these groups has substantiated cultural and historic ties to the NNSS and the surrounding areas.

1.2 Purpose and Need for Agency Action

The purpose and need for agency action is to support DOE/NNSA's core missions established by Congress and the President. These include meeting its obligations to ensure a safe and reliable nuclear weapons stockpile, support other national security programs, characterize and/or remediate areas of the NNSS and offsite locations previously contaminated as a result of the Nation's nuclear weapons testing program, and provide for the disposal of LLW and MLLW from across the DOE complex.

DOE/NNSA also must meet the mandates of Executive Orders 13212, *Actions to Expedite Energy-Related Projects*, and 13514, *Federal Leadership in Environmental, Energy, and Economic Performance*, as well as the Energy Independence and Security Act of 2007 (P.L. 109-58). Accordingly, DOE/NNSA's purpose and need also is to satisfy the requirements of these Executive Orders and comply with congressional mandates to promote, expedite, and advance the production of environmentally sound energy resources, including renewable energy resources such as solar and geothermal energy systems.

The NNSS has a long history of supporting national security objectives by conducting underground nuclear tests and other nuclear and nonnuclear activities. Since October 1992, there has been a moratorium on underground nuclear testing (a brief description of underground nuclear testing is provided in Appendix H). Thus, NNSS's role has evolved from an active nuclear testing program to maintaining readiness and the capability to conduct underground nuclear weapons tests; such a test would be conducted only if so directed by the President in the interest of national security. DOE/NNSA's primary mission at the NNSS is supporting nuclear weapons stockpile reliability through subcritical experiments. Changes in national security priorities have resulted in resource reallocation and the introduction and expansion of other national security missions, programs, and activities at the NNSS and offsite locations in Nevada. In addition, the NNSS supports DOE/NNSA waste management activities, including disposal; environmental restoration activities; and research, development, and testing programs related to national security. The NNSS also provides opportunities for various environmental research projects and the development of commercial-scale solar energy projects, as well as development of innovative solar and other renewable energy technologies.

Purpose and Need for Agency Action—American Indian Perspective

The Consolidated Group of Tribes and Organizations (CGTO) knows American Indian people are charged by the Creator to interact with the environment and its resources in culturally appropriate ways to maintain balance, regardless of the U.S. Department of Energy's (DOE's) stated purpose and need for agency action. American Indians further believe these lands and their resources contain life-sustaining characteristics that must be properly respected and cared for to ensure harmony.

The CGTO does not support harmful land-disturbing activities currently conducted and proposed within the Nevada National Security Site (NNSS) area and offsite locations. These lands are part of the traditional holy lands of the Southern Paiute, Western Shoshone, and Owens Valley Paiute and Shoshone people. Harmful land disturbing activities threaten the health and welfare of Indian people through possible contamination and resource destruction.

As Indian people, we are obligated to manage the land and its resources for seven generations. This means we evaluate and guide our actions in terms of what they could do for or to the next seven generations. The CGTO takes this obligation very seriously and has provided information throughout the site-wide environmental impact statement (SWEIS) so we can continue to fulfill our purpose and need to care for these lands.

See Appendix C for more details.

1.3 Alternatives Analyzed

The proposed action in this SWEIS is the continued operation of the NNSS, other DOE/NNSA sites in Nevada, and environmental restoration sites in Nevada. The alternatives in this SWEIS are structured to provide information regarding current and future use of DOE/NNSA facilities in Nevada. The following three alternatives are analyzed: (1) No Action, (2) Expanded Operations, and (3) Reduced Operations. These alternatives were developed to reflect current operations and reasonably foreseeable future operations and to allow DOE/NNSA to analyze and compare the potential environmental effects of a wide range of use options. Chapter 3, Table 3–1, provides a summary of the alternatives analyzed in this SWEIS. In addition, in this *Final NNSS SWEIS*, DOE/NNSA has identified a Preferred Alternative. The Preferred Alternative is discussed briefly in Section 1.3.4 and is fully presented in Chapter 3, Section 3.6, of this SWEIS.

DOE NEPA Implementing Procedures (10 CFR Part 1021) define site-wide NEPA documents as broad-scope environmental impact statements (EISs) or environmental assessments (EAs) that are programmatic in nature and identify and assess the individual and cumulative impacts of ongoing and reasonably foreseeable future actions at a DOE site. This SWEIS considers ongoing and proposed programs, capabilities, and projects (i.e., activities) at DOE/NNSA facilities in Nevada over the next 10 years.

The nature of ongoing activities and their relationship to associated environmental impacts are well-understood. In contrast, however, the nature of some proposed activities is less well known. In the interest of disclosing potential environmental impacts that could occur at the NNSS and offsite locations over the next 10 years, this SWEIS includes ongoing activities as well as activities that are more conceptual in nature. Some examples are commercial solar power development, etc.

To assess potential environmental impacts from all such activities, it was necessary for DOE/NNSA to estimate at a programmatic level certain aspects of the more conceptual proposed activities, such as potential area of land disturbance or amount of groundwater that may be required. DOE/NNSA incorporated these programmatic-level estimates along with more detailed information on ongoing and better-understood proposed activities into the analysis of impacts. For instance, estimated areas of land disturbance, for both potential future activities and well-defined activities, were used in estimating impacts on resources such as soils (area of disturbance and erosion), cultural resources (number of sites potentially affected), and biology (vegetation/habitat loss, number of desert tortoises affected).

DOE/NNSA understands that the level of NEPA analysis conducted for some proposed future activities may not be sufficient to permit implementation, and such activities could require additional NEPA analysis. These activities are identified in Chapter 3. DOE/NNSA will conduct NEPA review for these activities, as appropriate, in the future. DOE/NNSA'S NEPA review procedures are described in Section 9.1.1.

The alternative descriptions are organized under the three NNSS missions. Each mission includes two or more associated programs. The missions and associated programs are (1) the National Security/Defense Mission, which includes the Stockpile Stewardship and Management, Nuclear Emergency Response, Nonproliferation, Counterterrorism, and Work for Others Programs; (2) the Environmental Management Mission, which includes the Waste Management and Environmental Restoration Programs; and (3) the Nondefense Mission, which includes the General Site Support and Infrastructure, Conservation and Renewable Energy, and Other Research and Development Programs. More information about the NNSS missions and programs; their associated capabilities, projects, and facilities; and the levels of operations under each alternative can be found in Chapter 3 of this SWEIS.

Terminology Used in this *NNSS SWEIS*

Missions. In this site-wide environmental impact statement (SWEIS), the term "missions" refers to the major responsibilities assigned to the U.S. Department of Energy/National Nuclear Security Administration (DOE/NNSA) (described in Section 1.1). DOE/NNSA accomplishes these major responsibilities by assigning groups or types of activities to DOE's system of security laboratories, production facilities, and other sites.

Programs. DOE and NNSA are organized into program offices, each of which has primary responsibilities within the set of DOE and NNSA missions. Funding and direction for activities at DOE/NNSA facilities are provided through these program offices, and similarly coordinated sets of activities to meet program office responsibilities are often referred to as "programs." Programs are usually long-term efforts with broad goals or requirements.

Capabilities. This term refers to the combination of facilities, equipment, infrastructure, and expertise necessary to undertake types or groups of activities and implement mission assignments. Capabilities at the Nevada National Security Site (NNSS) have been established over time, principally through mission assignments and activities directed by program offices.

Projects. This term is used to describe activities with a clear beginning and end that are undertaken to meet a specific goal or need. Projects can vary in scale from very small (such as a project to undertake one experiment or a series of small experiments) to major (such as a project to construct and start up a new nuclear facility). Projects are usually relatively short-term efforts and can cross multiple programs and missions, although they are usually "sponsored" by a primary program office. In this SWEIS, "project" is usually used more narrowly to describe construction activities, including facility modifications (such as a project to build a new office building or to establish and demonstrate a new capability). Construction projects considered reasonably foreseeable at the NNSS over about a 10-year period are discussed and analyzed in this SWEIS.

Activities. In this SWEIS, activities are those physical actions used to implement missions, programs, capabilities, or projects.

1.3.1 No Action Alternative

As defined in this *NNSS SWEIS*, the No Action Alternative reflects the use of existing facilities and ongoing projects to maintain operations consistent with those experienced in recent years at the NNSS and offsite locations in Nevada. For each of the three mission areas and their supporting programs, the level of operation for associated capabilities, projects, and activities is determined by operational levels actually realized since 1996. Examples include the number of experiments performed at the Joint Actinide Shock Physics Experimental Research Facility (JASPER) or the U1a Complex; reasonable expectations for recently implemented projects, such as the number of shots for the Large-Bore Powder Gun; or the nature and number of activities, such as training undertaken for the Office of Secure Transportation.

Accordingly, under the No Action Alternative, Stockpile Stewardship and Management Program activities would continue at DOE/NNSA facilities in Nevada under the conditions of the ongoing nuclear testing moratorium. These activities would emphasize U.S. science-based stockpile stewardship tests, experiments, and projects to maintain the safety and reliability of the Nation's nuclear weapons stockpile without underground nuclear testing. By Presidential Decision Directive 15 (November 1993), DOE/NNSA must be able to resume underground nuclear weapons tests within 24 to 36 months if so directed by the President. This capability is maintained at the NNSS. However, conducting such a test is not included or analyzed under any of the alternatives in this SWEIS. A brief description of underground nuclear test phenomenology is included for informational purposes in Appendix H.

In support of the Nuclear Emergency Response, Nonproliferation, and Counterterrorism Programs, under the No Action Alternative, DOE/NNSA would continue its responsibilities regarding (1) support for the Nuclear Emergency Support Team, the Federal Radiological Monitoring and Assessment Center, the Accident Response Group, and the Radiological Assistance Program; (2) Aerial Measuring System activities; (3) weapons of mass destruction emergency responder training; (4) disposition of improvised nuclear devices and radiological dispersion devices; (5) support for DOE/NNSA's Emergency Communications Network; and (6) integration of existing activities and facilities to support U.S. efforts to control the spread of weapons of mass destruction.

Under the No Action Alternative, the Work for Others Program, which is hosted by DOE/NNSA, would entail the shared use of certain facilities, such as the Big Explosives Experimental Facility (BEEF), the Nonproliferation Test and Evaluation Complex, and the T-1 Training Area, with other agencies, such as DoD, as well as the shared use of resources at the NNSS, RSL, NLVF, and the TTR. DOE/NNSA would continue to host the projects of other Federal agencies, such as DoD and the U.S. Department of Homeland Security, as well as state and local government agencies and some nongovernmental organizations.

Under the No Action Alternative, in support of the Environmental Management Mission and Waste Management Program, the NNSS would continue accepting and disposing LLW and MLLW from approved generators as long as such wastes meet the NNSS waste acceptance criteria (WAC). The projected LLW volume analyzed is based on the average annual disposal of LLW from 1997 to 2010. The volume of MLLW analyzed is the permitted capacity of the Mixed Waste Disposal Unit (Cell 18) at the Area 5 Radioactive Waste Management Complex. The Environmental Restoration Program would continue to ensure compliance with the Federal Facility Agreement and Consent Order (FFACO) to characterize, monitor, and, if necessary, remediate locations that have sustained adverse environmental impacts from past DOE/NNSA activities. These impacts include hazardous material and radioactively contaminated areas, facilities, soils, and groundwater.

Under the No Action Alternative, the Nondefense Mission includes those activities that are necessary to support mission-related programs, such as construction and maintenance of facilities, provision of supplies and services, and warehousing. Activities related to supply and conservation of energy, including renewable energy and other research and development projects, are also conducted under the Nondefense Mission. DOE/NNSA would continue to identify and implement energy conservation measures and projects related to energy efficiency, renewable energy, water conservation, transportation/fleet management, and high-performance and sustainable buildings.

Federal Facility Agreement and Consent Order

The Nevada National Security Site Environmental Restoration Program includes activities to comply with the Federal Facility Agreement and Consent Order, which was entered into in 1996 by the U.S. Department of Energy, the U.S. Department of Defense, and the State of Nevada. The Federal Facility Agreement and Consent Order provides a process for identifying sites having potential historic contamination, implementing state-approved corrective actions, and instituting closure actions for remediated sites.

1.3.2 Expanded Operations Alternative

The Expanded Operations Alternative includes the level of operations under the No Action Alternative, plus the level of operations associated with additional capabilities at the NNSS and offsite locations in Nevada. The additional level of operations would include modification and/or expansion of existing facilities and construction of new facilities. An example of an additional level of operations would be the increased number of experiments that would be conducted at the NNSS with conventional high explosives (100 experiments within limited areas of the NNSS) compared with the number that would be conducted under the No Action Alternative (20 experiments in the same areas). An example of facility expansion would be adding a new firing table at BEEF. As with the No Action Alternative, the Expanded Operations Alternative reflects continued implementation of previous NEPA decisions (see Section 1.5) and retains the necessary capabilities from those decisions. The key differences from the No Action Alternative are shown in Chapter 3, Table 3–1, of this SWEIS, and a detailed description of the Expanded Operations Alternative is provided in Chapter 3, Section 3.2.

1.3.3 Reduced Operations Alternative

The Reduced Operations Alternative analyzed in this SWEIS reflects diminished activity levels, as well as decommissioned facilities and areas at the NNSS and other offsite locations in Nevada. The Reduced Operations Alternative includes continued implementation of previous NEPA decisions (see Section 1.5), but may not retain all capabilities from those decisions. Operational levels would be reduced relative to the No Action Alternative, and geographical and organizational constraints would be placed upon some activities under the Reduced Operations Alternative. Using the same example used for the Expanded Operations Alternative, the number of conventional high-explosives experiments under the Reduced Operations Alternative would be 10 experiments compared with the 20 experiments proposed under the No Action Alternative. A geographical constraint example would be the cessation of most activities in the northwest portion of the NNSS (although activities such as security, monitoring, environmental restoration, and military exercises would continue). The key differences from the No Action Alternative are shown in Chapter 3, Table 3–1, of this SWEIS, and a detailed description of the Reduced Operations Alternative is provided in Chapter 3, Section 3.3.

1.3.4 Preferred Alternative

CEQ regulations for implementing NEPA (40 CFR 1502.14(e)) require an agency to identify its preferred alternative or alternatives, if one or more exists, in the draft EIS. At the time the *Draft NNSS SWEIS* was published, DOE/NNSA had not selected a preferred alternative. Since publication of the *Draft NNSS SWEIS*, DOE/NNSA evaluated the agency's and other users' needs over the next 10 years, the information presented in this *NNSS SWEIS*, and the comments received on the draft SWEIS and has identified its Preferred Alternative.

DOE/NNSA's Preferred Alternative is based on the preferences expressed by commentors, the needs of DOE/NNSA and other users as reflected by contemporary priorities given anticipated funding, and a goal of minimizing potential environmental impacts to the extent practicable. DOE/NNSA's Preferred Alternative is a "hybrid" alternative comprising various programs, capabilities, projects, and activities selected from among the three alternatives. Section 3.4 and Table 3–3 describe the Preferred Alternative in greater detail and provide a comparison of mission-based program activities under the three alternatives and the Preferred Alternative.

1.3.5 Relationship to *1996 NTS EIS*

In 1996, DOE issued the final *NTS EIS* and its associated ROD. The *1996 NTS EIS* (DOE 1996c) evaluated four alternatives: (1) Continue Current Operations (No Action Alternative), (2) Discontinue Operations, (3) Expanded Use, and (4) Alternate Use of Withdrawn Lands. These alternatives are described below.

- Alternative 1, Continue Current Operations (No Action) – DOE and interagency programs, activities, and operations at the NNSS associated with five program areas would continue in the same manner and to the same degree (level of operations) as during the 3 to 5 years previous to 1996. For example, at the NNSS, DOE would continue nuclear weapons stockpile and stewardship experiments and operations; environmental restoration would continue in the form of characterization and remediation of contaminated areas and facilities; and waste would be disposed at then-current yearly rates or levels.

- Alternative 2, Discontinue Operations – DOE and interagency programs, activities, and operations at the NNSS would be terminated. Facilities would be placed in cold standby after operations cease. Only those environmental monitoring and security functions necessary for human health, safety, and security would be maintained at the NNSS.

- Alternative 3, Expanded Use – DOE and interagency programs, activities, and operations at the NNSS associated with the five program areas would be maintained, but in a manner and at a level above that of the 3 to 5 years previous to 1996. Defense Program activities associated with stockpile stewardship would increase, as would waste management and environmental restoration activities.

- Alternative 4, Alternate Use of Withdrawn Lands – All defense-related activities and most interagency programs would discontinue at the NNSS.

In its 1996 ROD, DOE selected the Expanded Use Alternative, which provided for increasing the level of operations of most programs, activities, and operations, but decided to manage LLW and MLLW at levels described under the No Action Alternative. However, in a 2000 amendment to the 1996 ROD, DOE selected the Expanded Use Alternative for waste management activities at the NNSS.

For the most part, the level of operations envisioned and analyzed in the *1996 NTS EIS* (DOE 1996c) has not been realized. **Table 1–1** provides a comparison of the *1996 NTS EIS* Expanded Use Alternative and the current *NNSS SWEIS* No Action Alternative. As shown in Table 1–1, under the Expanded Use Alternative, DOE proposed undertaking approximately 110 dynamic experiments (i.e., experiments designed to improve knowledge of plutonium properties and assess performance and safety of nuclear weapons) each year. Since then, however, fewer than 10 such experiments have occurred each year. Also, the Expanded Use Alternative analyzed the transport and disposal of about 37 million cubic feet of LLW and 11 million cubic feet of MLLW at the NNSS. At the end of 2010, however, almost 22 million cubic feet of LLW and 370,000 cubic feet of MLLW had been disposed.

This *NNSS SWEIS* includes three alternatives: (1) No Action, (2) Expanded Operations, and (3) Reduced Operations. The No Action Alternative reflects the DOE/NNSA and interagency programs, activities, and operations in the program areas addressed in the *1996 NTS EIS* Expanded Use Alternative, but at the historic or baseline level of operations experienced since 1996. For example, under the No Action Alternative in this *NNSS SWEIS*, DOE/NNSA analyzed 10 dynamic experiments per year and the transport and disposal of 15 million cubic feet of LLW and 900,000 cubic feet of MLLW.

The No Action Alternative also includes the level of operations associated with missions, programs, capabilities, and projects analyzed in other NEPA documents. For example, DOE/NNSA completed the *Final Environmental Impact Statement for the Proposed Relocation of Technical Area 18 Capabilities and Materials at the Los Alamos National Laboratory* (DOE 2002h; DOE/EIS-319) and its ROD (67 FR 79906) and then relocated materials and equipment associated with criticality experiments to the NNSS. Consistent with the baseline level of operations, under the No Action Alternative, the National Criticality Experiments Research Center is expected to conduct up to 500 criticality operations for training, experiments, and other purposes each year.

As described in Section 1.3.2, the Expanded Operations Alternative includes a higher level of operations than under the No Action Alternative, plus operations associated with proposed additional capabilities, which is a similar concept to the Expanded Use Alternative considered in the *1996 NTS EIS*. The Reduced Operations Alternative reflects diminished levels of operation, as well as geographic restrictions on some activities at the NNSS. There is no clear equivalent to the Reduced Operations Alternative in the *1996 NTS EIS.*

Table 1–1 Comparison of the *1996 NTS EIS* Expanded Use Alternative and the *NNSS SWEIS* No Action Alternative

Mission, Program, Project, or Activity Analyzed	*Analyzed in the* 1996 NTS EIS [a]	*Analyzed in this* NNSS SWEIS [a]
General		
Mission/program	Five program areas: Defense, Waste Management, Environmental Restoration, Nondefense Research and Development, and Work for Others	Three mission areas: National Security/Defense Mission, Environmental Management Mission, and Nondefense Mission
NATIONAL SECURITY/DEFENSE MISSION		
Stockpile Stewardship and Management Program		
Maintain readiness to conduct an underground nuclear test	Addressed as overarching mission	Addressed as overarching mission
Conduct dynamic experiments	110 per year	10 per year
Conduct high-explosives tests and experiments	100 per year at BEEF, up to 70,000 pounds of high explosives per detonation, including limited use of certain hazardous materials; no SNM would be used in any experiment	To support Stockpile Stewardship and Management Program: 20 per year at BEEF (70,000 pounds TNT-equivalent maximum per event) and 10 per year at other locations within the Nuclear Test Zone and Nuclear and High Explosives Test Zone; explosives experiments at BEEF may include limited use of certain hazardous materials To support Work for Others Program: 40 experiments using up to 2,000 pounds TNT-equivalent of explosives at various locations on the NNSS No SNM would be used in any experiment
Disposition damaged U.S. nuclear weapon(s) on an as-needed basis	Disposition damaged U.S. nuclear weapon(s) on an as-needed basis	Disposition damaged U.S. nuclear weapon(s) on an as-needed basis
Reserve land and infrastructure for a large, heavy-industrial facility and/or next generation nuclear weapons simulators	Consistent with analyses in other NEPA documents that considered the NNSS as an alternative location, such as the *Pantex Plant Site-Wide EIS* and the National Ignition Facility in the *Stockpile Stewardship and Management PEIS*	Not analyzed
Conduct underground nuclear test, if so directed by the President of the United States	Yes	Not analyzed
Reserve land and infrastructure for nuclear weapons assembly/disassembly operations and/or long-term storage and disposition of weapons-usable fissile material	Yes	Not analyzed
Shock physics experiments	Not analyzed [b]	12 per year at JASPER and 10 per year at the U1a Complex
Criticality experiments at DAF	Not analyzed [b]	500 operations per year
Pulsed-power experiments at the Atlas Facility	Not analyzed [b]	Facility maintained on standby with capability to conduct up to 12 experiments per year
Plasma physics and fusion experiments	Not analyzed [b]	Conduct up to 600 per year at NLVF and 50 per year at Area 11 of the NNSS
Conduct drillback operations	Yes, as part of maintaining readiness to conduct or as part of actual conduct of an underground nuclear test	Up to five over the next 10 years as part of maintaining readiness to test

Mission, Program, Project, or Activity Analyzed	***Analyzed in the* 1996 NTS EIS** [a]	***Analyzed in this* NNSS SWEIS** [a]
Stage SNM, including nuclear weapons pits	Yes	Yes
Training for the Office of Secure Transportation	Yes, as part of conducting unspecified exercises and training	Yes, up to six times per year
Conduct stockpile stewardship activities at the TTR, including experiments using SNM, where containment is assured	Yes	Yes, but SNM use not expected
Nuclear Emergency Response, Nonproliferation, and Counterterrorism Programs		
Support various DOE/NNSA nuclear emergency response activities, including FRMAC, NEST, ARG, RAP, and AMS	Yes	Yes
Disposition improvised nuclear devices	Not analyzed [a]	Yes
Support U.S. efforts to control the spread of WMDs, including arms control, nonproliferation activities, nuclear forensics, and counterterrorism capabilities	Partial; counterproliferation and nonproliferation activities, treaty verification, and training and exercises were addressed	Yes; counterterrorism activities [b] are also included
Work for Others Program		
Support U.S. Department of Homeland Security testing and evaluation of detection devices for use in transportation-related applications at RNCTEC and other locations on the NNSS	Not analyzed [b]	Yes
Experiments using releases of chemicals and/or biological simulants	Partial; chemical releases at NPTEC (Liquefied Gaseous Fuels Spill Test Facility in the *1996 NTS EIS*) were addressed	Yes; an unspecified number of release experiments at NPTEC and up to 20 experiments using releases of low concentrations of chemicals and biological simulants per year NNSS-wide [a]
Support development of capabilities to detect and defeat assets in deeply buried/hardened targets	Yes	Yes
Host the use of various aerial platforms for tests, experiments, training, and exercise	Yes	Yes
ENVIRONMENTAL MANAGEMENT MISSION		
Waste Management Program		
LLW disposal MLLW disposal	Almost 36,800,000 cubic feet About 10,600,000 cubic feet	15,000,000 cubic feet 900,000 cubic feet [c]
Manage onsite-generated TRU and TRU mixed wastes pending shipment to offsite treatment and disposal facilities	Yes	About 9,600 cubic feet over the next 10 years
Generate and temporarily store hazardous waste pending shipment to a permitted treatment, storage, and disposal facility	Yes	About 190,400 cubic feet over the next 10 years
Operate the Area 11 Explosives Ordnance Disposal Unit	Yes	Yes
Operate the Area 6 hydrocarbon landfill	Yes	Yes
Operate the Area 23 and the U10c Solid Waste Disposal Sites	Yes	About 3,810,000 cubic feet of sanitary solid waste and construction/ decontamination and demolition debris
Environmental Restoration Program		
Underground Test Area Project to characterize, monitor, and remediate, as necessary, groundwater contaminated by underground nuclear testing	Yes	Yes, in accordance with the FFACO; analyze up to 50 additional characterization and/or monitoring wells over the next 10 years

Mission, Program, Project, or Activity Analyzed	***Analyzed in the* 1996 NTS EIS [a]**	***Analyzed in this* NNSS SWEIS [a]**
Soils Project to investigate and characterize soil contamination at non-industrial sites on the NNSS, TTR, and Nevada Test and Training Range and perform corrective actions, as necessary	Yes	Yes, in accordance with the FFACO
Industrial Sites Project to identify, characterize, and remediate, as necessary, industrial sites at the NNSS and TTR	Yes	Yes, in accordance with the FFACO
Conduct environmental restoration activities at Defense Threat Reduction Agency sites on the NNSS	Yes	Yes
Conduct environmental characterization and monitoring at two former offsite underground nuclear weapons test sites: Central Nevada Test Area and Project Shoal	Yes	No; stewardship of both sites has been assumed by the DOE Office of Legacy Management
NONDEFENSE MISSION		
General Site Support and Infrastructure Program		
Infrastructure	Upgrade, renovate, replace, and construct new common site support facilities to support ongoing and additional activities	Maintain, repair, and replace current infrastructure; the only new "infrastructure" would be LLW cells, as needed, and construction of the Underground Test Area Project wells, in consultation with the Nevada Division of Environmental Protection
Conservation and Renewable Energy Program		
Energy conservation	Not addressed	Reduce energy consumption and improve efficiency of energy use
Renewable energy	Up to 1,000 megawatts of solar power generation in one of two Solar Enterprise Zones on the NNSS: Area 22/23 and Area 25 Also considered solar power generation facilities at three non-DOE sites outside of the NNSS	"Solar Enterprise Zone" renamed "Renewable Energy Zone" Allow commercial entity to construct and operate up to 240 megawatts of solar power generation in the Renewable Energy Zone in Area 25
Other Research and Development Program		
Support nondefense research and development	Yes	Yes

AMS = Aerial Measuring System; ARG = Accident Response Group; BEEF = Big Explosives Experimental Facility; DAF = Device Assembly Facility; EIS = environmental impact statement; FFACO = Federal Facility Agreement and Consent Order; FRMAC = Federal Radiological Monitoring and Assessment Center; JASPER = Joint Actinide Shock Physics Experimental Research Facility; LLW = low-level radioactive waste; MLLW = mixed low-level radioactive waste; NEPA = National Environmental Policy Act; NEST = Nuclear Emergency Support Team; NLVF = North Las Vegas Facility; NNSS = Nevada National Security Site; NPTEC = Nonproliferation Test and Evaluation Complex; NTS = Nevada Test Site; PEIS = Programmatic Environmental Impact Statement; RAP = Radiological Assistance Program; RNCTEC = Radiological/Nuclear Countermeasures Test and Evaluation Complex: SNM = special nuclear material; SWEIS = site-wide environmental impact statement; TNT = 2,4,6 trinitrotoluene; TRU = transuranic; TTR = Tonopah Test Range; WMD = weapon of mass destruction.

[a] Quantitative bases for analyses used in this table were derived from the published *1996 NTS EIS* and assumptions used in this *NNSS SWEIS*. For some activities, such as training and exercises, the bases for impact assessment were not derived from the number of events but from the potential to disturb previously undisturbed land.

[b] Addressed in other NEPA documentation.

[c] Actual permitted capacity of the Mixed Waste Disposal Unit (Cell 18) is 899,996 cubic feet.

1.4 Potential Decisions Supported by this Site-Wide Environmental Impact Statement

This SWEIS analyzes and evaluates the potential impacts of existing and proposed capabilities and projects. The results documented in this SWEIS will provide the basis for DOE/NNSA to determine the nature of these capabilities, projects, and activities, as well as their associated level of operations, over about a 10-year period at the NNSS and offsite locations in Nevada. Where information is insufficient to support an implementing decision for more conceptual activities, implementation would require an appropriate level of new or additional NEPA analysis.

DOE/NNSA may choose to implement any alternative in its entirety or to select a hybrid that incorporates parts of the different proposed alternatives. DOE/NNSA may make the following decisions regarding its operations:

- *Implement the No Action Alternative, either wholly or in part.* Under the No Action Alternative, DOE/NNSA operations in Nevada would continue in accordance with previous decisions made pursuant to NEPA reviews.
- *Implement the Expanded Operations Alternative, either wholly or in part.* The Expanded Operations Alternative includes planned and proposed capabilities and projects and an overall increase in the level of operations, relative to the No Action Alternative, that could be implemented over about a 10-year period.
- *Implement the Reduced Operations Alternative, either wholly or in part.* The Reduced Operations Alternative involves reductions of operations. Choosing to implement this alternative in whole or in part would result in reductions of affected capabilities and projects.

DOE/NNSA capabilities and projects at the NNSS are located in seven land use zones that were developed and designated following decisions made in the *1996 NTS EIS* ROD. Implementation of any of the alternatives analyzed in this SWEIS, either in whole or in part, could result in changes to the name, size, or location of these land use zones, or in the location of proposed capabilities and projects within these zones.

Although an analysis of environmental restoration activities' impacts is included in this SWEIS, environmental restoration activities at the NNSS, the TTR, and sites on the Nevada Test and Training Range are driven by the FFACO. The State of Nevada, through the Nevada Division of Environmental Protection (NDEP), oversees FFACO compliance and enforces its provisions. Therefore, DOE/NNSA would not make any decisions regarding environmental restoration activities that are inconsistent with the FFACO without consultation with NDEP.

Although an analysis of LLW/MLLW shipping routes is included in this SWEIS, decisions on routing would not be made as part of this NEPA process. DOE/NNSA sought to understand the differences in potential environmental effects between different routing options, which incorporated changes to local transportation infrastructure since the *1996 NTS EIS*; communicate those differences to the public; and seek stakeholder comments on the range of transportation routes. The analysis of a Constrained (current routing protocol) and an Unconstrained Case (utilizing all routes within the Las Vegas Valley), as well as increased use of rail transport and rail-to-truck transfer stations, was undertaken to develop a greater understanding of the potential environmental consequences of shipping such waste through metropolitan Las Vegas. Any changes to existing routing would be made through revisions to the NNSS WAC. Revisions to the WAC are undertaken in coordination with NDEP, pursuant to the Agreement in Principle between the State of Nevada and DOE/NNSA NSO (State of Nevada 2011). While DOE/NNSA's environmental analyses showed no meaningful differences in potential environmental effects between the Constrained and Unconstrained Cases, the preponderance of stakeholder comments recommended that DOE/NNSA retain highway routing restrictions to avoid shipments of LLW/MLLW through greater metropolitan Las Vegas (Constrained Case). In consideration of the environmental analyses and stakeholder comments, and after consultation with NDEP as part of the WAC revision process, DOE/NNSA determined that it would retain the highway routing restrictions for shipments of LLW/MLLW in the greater Las Vegas metropolitan area and, therefore, there would be no need to revise the WAC in this regard (DOE 2012). DOE/NNSA is not proposing to construct or cause to be constructed any new rail-to-truck transfer facilities to accommodate shipments of radioactive waste or materials under any of the alternatives considered in this SWEIS.

1.5 Relationship Between this Site-Wide Environmental Impact Statement and Other National Environmental Policy Act Analyses

Decisions made in the *1996 NTS EIS* ROD (61 FR 65551) and various subsequent NEPA documents have defined implementation of projects at the NNSS. This section summarizes past and ongoing NEPA compliance reviews and associated decisions (i.e., RODs and Findings of No Significant Impact [FONSIs]) that are germane to the estimation of direct, indirect, and cumulative environmental impacts resulting from the implementation of the projects and activities under each of the three alternatives.

Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada (1996 NTS EIS) **(DOE/EIS-0243) (DOE 1996c) –** As discussed in Section 1.3.4, the *1996 NTS EIS* evaluated four alternatives for the continued operation of the Nevada Test Site (now called the NNSS): (1) Continue Current Operations (No Action Alternative), (2) Discontinue Operations, (3) Expanded Use, and (4) Alternate Use of Withdrawn Lands. Included in the *1996 NTS EIS* was an assessment of reasonable alternatives for flight testing for gravity weapons (bombs) at the TTR. DOE published a ROD on December 13, 1996 (61 FR 65551), selecting the Expanded Use Alternative plus the public education activities from the Alternate Use of Withdrawn Lands Alternative. Under that decision, DOE/NNSA continued the multipurpose, multiprogram use of the NNSS and a continuation and diversification of the DOE Nevada Operations Office (the predecessor of the DOE/NNSA NSO) and interagency programs and operations at the NNSS. The Expanded Use Alternative included support for ongoing DOE Nevada Operations Office program categories defined under the Continue Current Operations (No Action) Alternative and increased the use of the NNSS and its related resources and capabilities. The Expanded Use Alternative also made the NNSS more available to both public and private institutions for demonstration of new technologies.

A subsequent amendment to the *1996 NTS EIS* was included in a February 2000 ROD (65 FR 10061) for the *WM PEIS* (discussed below). This ROD announced DOE's decision to implement LLW and MLLW activities in accordance with the *1996 NTS EIS* Expanded Use Alternative.

Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste (WM PEIS) **(DOE/EIS-0200) (DOE 1997) –** The *WM PEIS* examined the potential environmental impacts of strategic alternatives for managing five types of radioactive and hazardous wastes resulting from nuclear defense and research activities at DOE sites around the United States. When the *1996 NTS EIS* (DOE 1996c) was issued, the NNSS was under consideration in the *Draft WM PEIS* as a site for centralized or regional management of certain DOE wastes. In its 1996 ROD for the *1996 NTS EIS*, DOE selected the Expanded Use Alternative, but decided to manage LLW and MLLW at levels described under the No Action Alternative. However, in a 2000 amendment to the 1996 ROD (as a result of the third amended ROD for the *WM PEIS*), DOE selected the Expanded Use Alternative for waste management activities at the NNSS.

DOE published four RODs associated with the *WM PEIS*, three of which are relevant to the NNSS. In its ROD for the treatment and management of transuranic waste, published January 23, 1998 (63 FR 3629), and subsequent revisions to this ROD, published December 9, 2000, July 25, 2001, and September 6, 2002 (65 FR 82985, 66 FR 38646, and 67 FR 56989, respectively), DOE decided (with one exception) that each DOE site that either had or might generate transuranic waste would prepare the waste for disposal and store it on site until it could be shipped to the Waste Isolation Pilot Plant near Carlsbad, New Mexico, for disposal. In the second ROD, published August 5, 1998 (63 FR 41810), DOE decided to continue using offsite facilities for the treatment of major portions of nonwastewater hazardous wastes generated at DOE sites.

In the third ROD, which addressed the management and disposal of LLW and MLLW and was published February 25, 2000 (65 FR 10061), DOE decided to perform minimal treatment of LLW at all sites and to continue, to the extent practicable, onsite disposal of LLW at Idaho National Laboratory, Los Alamos National Laboratory, Oak Ridge Reservation, and the Savannah River Site. DOE decided to establish regional disposal capacity at the Hanford Site and the NNSS. Specifically, in addition to disposing their own LLW, the Hanford Site and the NNSS would dispose LLW generated at other DOE sites, provided the waste met their respective WAC. DOE decided to treat MLLW at the Hanford Site, Idaho National Laboratory, Oak Ridge Reservation, and the Savannah River Site, with disposal at either the Hanford Site or the NNSS.[1]

Final Environmental Impact Statement for Construction and Operation of a Depleted Uranium Hexafluoride Conversion Facility at the Paducah, Kentucky, Site **(DOE/EIS-0359) (DOE 2004d) –** This EIS, tiered from the *Final Programmatic Environmental Impact Statement for Alternative Strategies for the Long-Term Management and Use of Depleted Uranium Hexafluoride* (DOE/EIS-0269) (DOE 1999c), considered the potential environmental impacts of construction, operation, maintenance, and decontamination and decommissioning of a proposed facility for converting depleted uranium hexafluoride to a more stable chemical form at alternative locations within the Paducah Site. DOE evaluated transportation of the depleted uranium conversion product to a commercial facility or the NNSS for disposal as LLW. The July 27, 2004, ROD (69 FR 44654) stated that DOE planned to decide the specific disposal location(s) after further NEPA review.

Final Environmental Impact Statement for Construction and Operation of a Depleted Uranium Hexafluoride Conversion Facility at the Portsmouth, Ohio, Site **(DOE/EIS-0360) (DOE 2004e) –** This EIS, tiered from the *Final Programmatic Environmental Impact Statement for Alternative Strategies for the Long-Term Management and Use of Depleted Uranium Hexafluoride* (DOE/EIS-0269) (DOE 1999c), considered the potential environmental impacts of construction, operation, maintenance, and decontamination and decommissioning of a proposed facility for converting depleted uranium hexafluoride to a more stable chemical form at alternative locations within the Portsmouth Site. DOE evaluated transportation of the depleted uranium conversion product to a commercial facility or the NNSS for disposal as LLW. The July 27, 2004, ROD (69 FR 44649) stated that DOE planned to decide the specific disposal location(s) after further NEPA review.

Draft Supplement Analysis for Location(s) to Dispose of Depleted Uranium Oxide Conversion Product Generated from DOE's Inventory of Depleted Uranium Hexafluoride **(DOE 2007d) (DOE/EIS-0359-SA1 and DOE/EIS-0360-SA1) –** DOE issued a Notice of Availability for this draft SA on April 3, 2007 (72 FR 15869). DOE is proposing to amend the two site-specific RODs (69 FR 44649 and 69 FR 44654) for depleted uranium hexafluoride conversion to decide whether the depleted uranium conversion product would be disposed at the NNSS or at the EnergySolutions (formerly Envirocare of Utah, Inc.) LLW disposal facilities.

[1] DOE has established a moratorium on the receipt of offsite waste at the Hanford Site until 2022 or until the Waste Treatment Plant at the Hanford Site is operational. This facility is currently under construction and is designed to treat radioactive waste from the Hanford Site's underground storage tanks.

***Final Environmental Assessment for the Site Launch, Reentry and Recovery Operations at the Kistler Launch Facility, Nevada Test Site (NTS)* (FAA 2000) –** The Federal Aviation Administration (FAA) prepared an EA and issued a FONSI on May 3, 2002 (67 FR 22479), for the Kistler Launch Facility (KLF) which included proposed space launch and reentry activities. This EA analyzed preflight processing activities, launch/flight operations, and reentry and recovery operations. To conduct operations, Kistler Aerospace Corporation proposed to construct a base of operations consisting of a private launch site (including a vehicle processing facility); a vehicle reentry, landing, and recovery area; and a payload processing facility. KLF operations and activities were to occur in Area 18 and at an adjacent location in Area 19. The proposed launch site was on the southern slopes of Pahute Mesa, south of Rattlesnake Ridge and north of Stockade Wash, at an elevation of about 5,800 feet. FAA proposed to license Kistler's proposed space launch and reentry activities. FAA issued a FONSI, but the KLF project was subsequently cancelled.

***The Nevada Test Site Development Corporation's Desert Rock Sky Park at the Nevada Test Site Environmental Assessment* (DOE/EA-1300) (DOE 2000) –** This EA analyzed the potential environmental effects of developing, operating, and maintaining a commercial/industrial park in Area 22 of the NNSS, between Mercury and U.S. Route 95, east of Desert Rock Airport. DOE issued a FONSI in March 2000, but the project was not implemented.

***Aerial Operations Facility, Nevada Test Site Environmental Assessment* (DOE/EA-1334) (DOE 2001a) –** This EA analyzed the potential environmental effects of developing, operating, and maintaining an aerial operations facility for testing and operating aerial vehicles at an existing facility located at the southern end of Yucca Lake in Area 6 of the NNSS. DOE issued a FONSI based on this EA in 2001. The facility is in operation.

***Final Environmental Assessment for Aerial Operations Facility Modifications, Nevada Test Site* (DOE/EA-1512) (DOE 2004g) –** This EA evaluated the potential impacts of constructing a new runway, hangars, and operations buildings and performing infrastructure upgrades to accommodate an increase in Aerial Operations Facility operations and personnel. DOE/NNSA issued a FONSI based on this EA in October 2004. The facility is in operation.

***Atlas Relocation and Operation at the Nevada Test Site Final Environmental Assessment* (DOE/EA-1381) (DOE 2001b) –** This EA analyzed the relocation of the Atlas pulsed-power machine from Los Alamos National Laboratory to the NNSS. DOE/NNSA issued a FONSI based on this EA in May 2001. At the NNSS, the Atlas Facility was reassembled in a newly constructed building within a designated industrial, research, and support site in Area 6. The facility is currently in a standby status.

***Supplement Analysis for the Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada (2002 NTS SA)* (DOE/EIS-0243-SA-01) (DOE 2002g) –** In 2002, DOE/NNSA completed the first of three SA reviews of the *1996 NTS EIS* (DOE 1996c). The *2002 NTS SA* provided a 5-year review of the *1996 NTS EIS* to determine whether there were sufficient changes to either the NNSS operations or environmental impacts to warrant a new SWEIS, a supplemental EIS, or whether no further NEPA action was warranted. DOE/NNSA found that there were no substantial changes to the actions proposed in the *1996 NTS EIS* and no significant new circumstances or information relevant to environmental concerns; thus, no further NEPA documentation was required (i.e., the existing *1996 NTS EIS* remained adequate based on the SA, in accordance with 10 CFR 1021.332(d)).

***Final Environmental Impact Statement for the Proposed Relocation of Technical Area 18 Capabilities and Materials at the Los Alamos National Laboratory* (DOE/EIS-0319) (DOE 2002h) –** This EIS addressed the potential impacts of relocating criticality missions and materials from Technical Area 18 at Los Alamos National Laboratory to several sites, including the NNSS. In a December 31, 2002, ROD

(67 FR 79906), DOE/NNSA made the decision to relocate Security Category I/II missions and materials to the Device Assembly Facility at the NNSS. The relocation has been completed.

***Hazardous Materials Testing at the Hazardous Materials Spill Center, Nevada Test Site Environmental Assessment* (DOE/EA-0864) (DOE 2002i) –** This EA established potential environmental impacts from planned releases of hazardous and toxic materials at the Hazardous Materials Spill Center (formerly the Liquefied Gaseous Fuels Spill Test Facility and now the Nonproliferation Test and Evaluation Complex). DOE/NNSA issued a FONSI based on this EA in September 2002. The facility is in operation.

***Final Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada (Yucca Mountain EIS)* (DOE/EIS-0250-F) (DOE 2002e) –** Published in 2002, the *Yucca Mountain EIS* analyzed a proposed action to construct, operate, monitor, and eventually close a geologic repository for the disposal of spent nuclear fuel and high-level radioactive waste at Yucca Mountain in Nye County, Nevada. Following issuance of the *Yucca Mountain EIS* in 2002, DOE modified its approach to repository design and operational plans. In 2008, DOE published the *Final Supplemental Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada* (DOE/EIS-0250F-S1) (DOE 2008g). This supplemental EIS evaluated the potential environmental impacts of DOE's modified repository design and operational plans. As reflected in the Administration's fiscal year 2010, 2011, and 2012 budget requests, however, the Administration has determined that a repository at Yucca Mountain is not a workable option and has called for all funding and activities related to development of a repository at Yucca Mountain to be eliminated.

***Supplement Analysis for the Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada to Address the Increase in Activities Associated with the National Center for Combating Terrorism and Counterterrorism Training and Related Activities* (DOE/EIS-0243-SA-02) (DOE 2003e) –** This second SA to the *1996 NTS EIS* was prepared to determine whether impacts of DOE/NNSA operations, which include activities and potential facility and infrastructure improvements proposed for the NNSS related to combating terrorism and performing counterterrorism training, would be within the limits of impacts identified in the *1996 NTS EIS.* DOE/NNSA determined that there were no significant new circumstances or information relevant to environmental concerns that would require preparation of a supplemental EIS or a new EIS (i.e., the existing *1996 NTS EIS* remained adequate based on the SA, in accordance with 10 CFR 1021.332(d)).

***Final Environmental Assessment for Activities Using Biological Simulants and Releases of Chemicals at the Nevada Test Site* (DOE/EA-1494) (DOE 2004c) –** This EA analyzed the potential environmental effects of conducting experiments, training, and other similar activities involving controlled releases of biological simulants (noninfectious bacteria, fungi, killed viruses, and similar materials) and low concentrations of various chemicals at the NNSS. DOE/NNSA issued a FONSI based on this EA in June 2004. These activities are ongoing at the NNSS.

***Radiological/Nuclear Countermeasures Test and Evaluation Complex, Nevada Test Site Final Environmental Assessment* (DOE/EA-1499) (DOE 2004f) –** This EA evaluated the potential effects of constructing and operating a Radiological/Nuclear Countermeasures Test and Evaluation Complex at the NNSS for post-bench-scale testing and evaluation of radiological and nuclear detection devices that may be used in transportation-related facilities. The new facility would be used by the U.S. Department of Homeland Security. DOE/NNSA issued a FONSI based on this EA in September 2004. The facility was constructed and is operational.

Final West Valley Demonstration Project Waste Management Environmental Impact Statement, West Valley Area Office, West Valley, NY (DOE/EIS-0337F) (DOE 2003) – This EIS evaluated the potential effects of the Department of Energy's proposed action to ship radioactive wastes that are either in storage, or that will be generated from operations over the specified 10-year period, to offsite disposal locations, and to continue its ongoing onsite waste management activities. The June 16, 2005, ROD (70 FR 35073) stated that DOE has decided to ship LLW and MLLW off site for disposal in accordance with all applicable regulatory requirements, including permit requirements, WAC, and applicable DOE Orders. DOE will dispose of LLW and MLLW at commercial sites (such as Envirocare, a commercial radioactive waste disposal site in Clive, Utah), one or both of two DOE sites (the Nevada Test Site [NTS] in Mercury, Nevada; or the Hanford Site in Richland, Washington), or a combination of commercial and DOE sites, consistent with DOE's February 2000 decision regarding LLW and MLLW disposal.

Draft Revised Environmental Assessment, Large-Scale, Open-Air Explosive Detonation, DIVINE STRAKE, at the Nevada Test Site **(DOE/EA-1550) (DOE 2006e) –** This draft revised EA was published in December 2006 to document an analysis of the potential impacts of a proposal by the Defense Threat Reduction Agency, a DOE/NNSA customer, to conduct a single large-scale, open-air explosive detonation of up to 700 tons of an ammonium nitrate and fuel oil mixture above an existing tunnel complex in Area 16 at the NNSS. This draft revised EA modified an earlier 2006 EA to include additional data and analyses. The proposed experiment was known as DIVINE STRAKE. The Defense Threat Reduction Agency cancelled the project.

Draft Environmental Impact Statement for the Disposal of Greater-Than-Class C (GTCC) Low-Level Radioactive Waste and GTCC-Like Waste (GTCC EIS) **(DOE/EIS-0375-D) –** On February 25, 2011, the U.S. Environmental Protection Agency issued a Notice of Availability (76 FR 10583) for this *Draft GTCC EIS* that addressed disposal of LLW generated by activities licensed by the U.S. Nuclear Regulatory Commission or an Agreement State that contains radionuclides in concentrations exceeding Class C limits, as defined in 10 CFR Part 61 (referred to as "greater-than-Class C [GTCC] LLW"), as well as disposal of DOE's GTCC-like waste. Currently, there is no location for disposal of GTCC LLW, although the Federal Government is responsible for such disposal under the Low-Level Radioactive Waste Policy Amendments Act (P.L. 99-240). The NNSS is being considered as one of seven candidate disposal sites in the *Draft GTCC EIS*. DOE is evaluating several disposal technologies in the *Draft GTCC EIS*, including above-grade vaults, intermediate-depth boreholes, and enhanced near-surface disposal facilities.

Draft Supplement Analysis for the Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada (2008 Draft NTS SA) **(DOE/EIS-0243-SA-03) (DOE 2008f) –** The *2008 Draft NTS SA* is the third SA and 5-year comprehensive review of the *1996 NTS EIS* (DOE 1996c). In preparation of the *2008 Draft NTS SA*, a systematic environmental impacts review was conducted to determine whether there were substantial changes in the actions considered in the *1996 NTS EIS* or significant new circumstances or information relevant to environmental concerns. Projects and activities introduced since the *1996 NTS EIS* ROD or proposed for the next 5 years were screened. The *2008 Draft NTS SA* was not finalized; instead, DOE/NNSA elected to proceed with a new SWEIS (this *NNSS SWEIS*) to provide an updated analysis of DOE/NNSA operations in Nevada. All comments from the *2008 Draft NTS SA* were considered in the scoping of this SWEIS.

Complex Transformation Supplemental Programmatic Environmental Impact Statement (Complex Transformation SPEIS) **(DOE/EIS-0236-S4) (DOE 2008l) –** In the *Complex Transformation SPEIS*, alternatives were analyzed for the potential environmental impacts of transforming the nuclear weapons complex into a smaller, more-efficient enterprise that can respond to changing national security challenges and ensure the long-term safety, security, and reliability of the nuclear weapons stockpile. The

NNSS was evaluated, but not selected, as a potential location for a consolidated plutonium center or a consolidated nuclear production center, both of which would entail consolidation of Category I/II special nuclear material. The NNSS was also evaluated, but not selected, as a potential site for consolidated hydrotesting, high-explosives research and development, and environmental testing.[2] In addition, existing DoD and DOE/NNSA test ranges (such as White Sands Missile Range in New Mexico and the NNSS) were considered as alternatives to continued use of the TTR for DOE/NNSA flight test operations. Two RODs were issued on December 19, 2008. In the ROD for Tritium Research and Development, Flight Test Operations, and Major Environmental Test Facilities (December 19, 2008, 73 FR 77656), DOE/NNSA decided to continue to conduct flight testing at the TTR in Nevada under a reduced footprint (i.e., 1 square mile) permit using a campaign mode of operations. The "campaign mode of operations" would continue operations at the TTR but reduce permanent staff and conduct tests and experiments by deploying DOE/NNSA and national laboratory personnel from other locations, as needed. In the ROD for Operations Involving Plutonium, Uranium, and the Assembly and Disassembly of Nuclear Weapons (December 19, 2008, 73 FR 77644), DOE/NNSA decided to transform the plutonium and uranium aspects of the complex into smaller and more-efficient operations while maintaining the capabilities DOE/NNSA needs to perform its national security missions.

***Environmental Assessment for a Solar Demonstration Project at the Nevada National Security Site* (DOE/EA-1842) –** DOE's Office of Energy Efficiency and Renewable Energy was preparing this EA in 2011 on its proposal to support the demonstration of concentrating solar power (CSP) technologies in Area 25 of the NNSS. The intent was to demonstrate technology advancements that are proven at a prototype level, but have not yet been demonstrated at a scale or for a sufficient period for deployment in a commercial setting. This proposed action has been indefinitely postponed and is no longer being addressed as a reasonably foreseeable action in this SWEIS.

1.6 Cooperating Agencies/Tribal Involvement

DOE/NNSA is the lead agency for this SWEIS. Under CEQ NEPA regulations, other Federal agencies, as well as state and local agencies and American Indian tribes, may request designation as cooperating agencies in the preparation of an EIS if they can offer special, relevant expertise or have legal jurisdiction over one of the affected areas being studied (40 CFR 1501.6 and 1508.5). Three government agencies requested cooperating agency status for this SWEIS: the U.S. Bureau of Land Management; the U.S. Air Force; and Nye County, Nevada. DOE/NNSA, as the lead agency, has designated these three organizations as cooperating agencies.

As mentioned in Section 1.1, American Indian groups were invited to participate in the preparation of this SWEIS, in accordance with DOE Order 144.1, *Department of Energy American Indian Tribal Government Interactions and Policy*. As a result of consultation with the CGTO, the AIWS prepared the summary assessments and recommendations that appear in text boxes placed throughout this SWEIS. The text boxes are shaded light brown and have a CGTO feather logo. The AIWS also prepared the text provided in Appendix C, "The American Indian Assessment of Resources and Alternatives Presented in the SWEIS." Appendix C summarizes the beliefs expressed by the CGTO regarding this SWEIS and contains (a) general concerns regarding long-term impacts of DOE/NNSA operations on the NNSS and (b) a synopsis of specific comments made by the AIWS for various chapters of this SWEIS. Although the consultation focused specifically on the three alternatives analyzed in this *NNSS SWEIS*, the CGTO responses in the text boxes and Appendix C also integrate relevant recommendations made by American Indian people regarding previous DOE/NNSA projects in which American Indians participated.

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[2]In this context, "environmental testing" refers to subjecting a test unit to specified, controlled environments such as vibration, shock, or static acceleration.

1.7 Public Involvement Process in this *NNSS SWEIS*

During development of an EIS, the two main opportunities for public involvement occur during scoping and after issuance of the draft EIS (see **Figure 1–2**). This section describes the public involvement processes during scoping and after the *Draft NNSS SWEIS* was issued, as well as how the comments received from the public were incorporated into the development of this *Final NNSS SWEIS*.

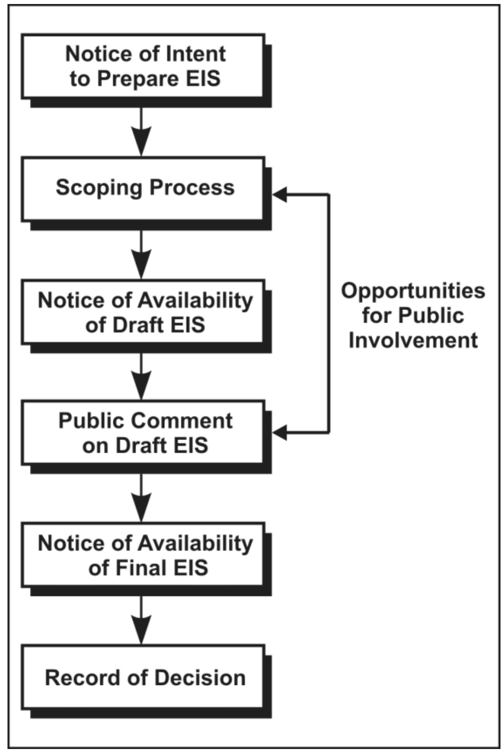

Figure 1–2 The National Environmental Policy Act Process

1.7.1 Scoping

As an early step in the development of an EIS, the regulations established by CEQ (40 CFR 1501.7) and DOE require "an early and open process for determining the scope of issues to be addressed and for identifying the significant issues related to a Proposed Action." The purpose of the scoping process is (1) to inform the public about a proposed action and the alternatives being considered and (2) to identify and clarify issues relevant to the EIS by soliciting public comments.

The *NNSS SWEIS* public scoping process began with issuance of a Notice of Intent (NOI) (74 FR 36691) on July 24, 2009, and concluded on October 16, 2009. In the NOI, DOE/NNSA invited public comment on the scope of this SWEIS and described four alternatives (No Action, Expanded Operations, Reduced Operations, and Renewable Energy Operations) and environmental issues to be considered. As discussed in Table 1–2, the components of the Renewable Energy Operations Alternative were incorporated as part of the three other alternatives in response to public comments, and Renewable Energy Operations was removed as a separate alternative. Public scoping meetings for this SWEIS were conducted in Las Vegas, Nevada (September 10, 2009); Pahrump, Nevada (September 14, 2009); Tonopah, Nevada (September 16, 2009); and St. George, Utah (September 18, 2009). DOE/NNSA received approximately 150 scoping comment documents regarding this *NNSS SWEIS*, submitted by email, fax, U.S. mail, telephone message, written comment forms at public meetings, or transcribed oral statements at public meetings. In addition, comments provided on the *2008 Draft NTS SA* were considered in developing the scope of this SWEIS.

While many of the comment documents were from private individuals, comment documents were also received from government and nongovernmental organizations, including the U.S. Environmental Protection Agency, the State of Nevada (Office of the Attorney General, State Historic Preservation Officer, Commission on Minerals, and Division of State Lands), Nye County, the Western Shoshone National Council, Tri-Valley Communities Against a Radioactive Environment (Tri-Valley CAREs), the Western States Legal Foundation, Citizens for Dixie's Future, and Nuclear Watch New Mexico. Comments on similar or related topics were grouped into common categories as a means of summarizing them. After the issues were identified, they were evaluated to determine whether they were appropriately relevant to the SWEIS. Relevent issues are addressed in the appropriate chapters or appendices of this SWEIS.

Scoping comments are summarized in **Table 1–2**, including DOE/NNSA's response and how the comments were incorporated into this SWEIS.

Table 1–2 Summary of Major Scoping Comments and DOE/NNSA Responses

General Topic	***Issue and Response***
Land Withdrawal	Commentors asked DOE/NNSA to identify concrete steps to reconcile the current uses of the NNSS with the uses identified in existing land withdrawals (i.e., to assure that ongoing or proposed activities at the NNSS will be lawful and permitted under existing Federal law). One commentor also recommended that DOE/NNSA consider each of its activities within the context of the land withdrawals and make a judgment as to whether it meets the purpose for which the withdrawal was issued. One commentor was concerned about the status of the land withdrawal. ***Response:*** *DOE/NNSA believes the land withdrawals are not restrictive with respect to NNSS activities in support of its three missions (National Security/Defense, Environmental Management, and Nondefense). As part of a Settlement Agreement (April 1997) between the State of Nevada and DOE, consultation with the U.S. Department of the Interior was initiated concerning the status of existing land withdrawals with regard to LLW storage and disposal. The consultation process concluded in November 2009, when DOE/NNSA accepted custody and control of the approximately 740 acres constituting the NNSS Area 5 Radioactive Waste Management Complex. Land withdrawal is discussed in Chapter 4, Section 4.1.1.3.*
Alternatives	DOE/NNSA received several comments related to the range of reasonable alternatives and the recommended scope of those alternatives. One commentor requested that this SWEIS be a programmatic document, given the range of decisions intended to be supported by the proposed EIS. Some commentors favored the cessation of all defense-related activities at the NNSS and the removal of associated infrastructure, with only environmental remediation and monitoring activities allowed to continue. One commentor specifically favored expansion of programs aimed at controlling the illicit use and transportation of nuclear materials. Another commentor provided a detailed recommendation for a "curatorship" approach in lieu of the current Stockpile Stewardship and Management Program. A commentor also requested that DOE/NNSA evaluate an alternative whereby the NNSS lands would be withdrawn permanently and DOE/NNSA would take responsibility for environmental impacts far into the future. In addition, commentors supported the inclusion of renewable energy development projects under the No Action, Expanded Operations, and Reduced Operations Alternatives, as opposed to under a separate alternative. One commentor stated that the Expanded Operations Alternative and the Renewable Energy Operations Alternative described in the "Alternatives for the SWEIS" section of the *Federal Register* NOI should be combined into a single Expanded Operations Alternative. ***Response:*** *This SWEIS tiers from DOE/NNSA and DOE programmatic EISs that have facilitated decisionmaking regarding the assignment of missions to the NNSS, such as supporting stockpile stewardship, maintaining nuclear testing capability, and disposing LLW and MLLW. These NEPA documents and related decisions are described in Section 1.5 of this chapter. This* NNSS SWEIS *would not provide the basis for a DOE complex-wide programmatic decision, but would provide the basis for site-specific implementation of those decisions that have already been made in existing programmatic EISs and other NEPA documents. DOE NEPA regulations (10 CFR 1021.330(c)) require that large, multiple-facility DOE sites, such as the NNSS, prepare SWEISs. This* NNSS SWEIS *addresses the full range of missions, programs, capabilities, projects, and activities under the purview of DOE/NNSA in Nevada.* *In response to public comments, conservation and renewable energy projects are addressed under each of the SWEIS alternatives (No Action, Expanded Operations, and Reduced Operations), and the Renewable Energy Operations Alternative was eliminated from consideration as a separate alternative. A curatorship approach, or cessation of NNSS' primary activities in support of DOE/NNSA's Defense Mission would be counter to national security policy as established by the Congress and the President. Therefore, ending these activities at NNSS (including switching to a curatorship approach) is not being considered in the SWEIS. Expansion of programs aimed at controlling the illicit use and transportation of nuclear materials is evaluated under the Expanded Operations Alternative (see Section 3.2.1.1). Chapter 3, Section 3.5, of this SWEIS provides further discussion of alternatives eliminated from detailed study.*

General Topic	***Issue and Response***
Alternatives (continued)	A commentor stated that the only actions that should be considered within the No Action Alternative are actions that are currently ongoing or in existence at the NNSS. ***Response:*** *In response to this comment, SWEIS alternatives were restructured. The No Action Alternative now reflects the current missions, programs, capabilities, projects, and activities. It includes reasonably foreseeable actions not yet implemented, but analyzed and approved under previous NEPA decisions.* Commentors showed preferences for particular alternatives. One commentor stated that the Nation's pressing needs in the areas of defense technology testing and counterterrorism preparedness, along with the suitability of the NNSS to support such programs, make the Expanded Operations Alternative the preferred choice. Another commentor favored the Reduced Operations Alternative, with a focus on phasing out unnecessary defense programs in light of changing national policies to focus more on remediation and alternative energy research. ***Response:*** *DOE/NNSA has selected a Preferred Alternative and included it in this* Final NNSS SWEIS. *The Preferred Alternative is a hybrid that incorporates programs and projects from all three of the analyzed alternatives. Additional information on the Preferred Alternative is included in Chapter 3, Section 3.6, of this SWEIS. Renewable energy projects have been consolidated into the Conservation and Renewable Energy Program under the Nondefense Mission and have been incorporated into each of the three alternatives considered in this NNSS SWEIS: No Action, Expanded Operations, and Reduced Operations.* A commentor stated that this SWEIS should evaluate a potential future scenario in which DOE/NNSA must maintain sole control of vast areas of the NNSS that must remain perpetually isolated from other uses. This alternative would require DOE/NNSA to seek congressional legislation to establish a perpetual withdrawal of land and would have significant implications in terms of long-term stewardship, costs, etc. Additionally, a commentor stated that this SWEIS should consider closing the NNSS in its entirety (Discontinued Operations Alternative). ***Response:*** *Closure of the NNSS with or without perpetual control and isolation would not meet the purpose and need for agency action as identified in Section 1.2 of this chapter. Should the missions of the NNSS change such that perpetual control and isolation is a valid scenario during the 10-year planning period, either through presidential decision directives or congressional direction, DOE/NNSA would determine through the supplement analysis process whether additional NEPA analysis is warranted.* A commentor stated that this SWEIS should describe how each alternative was developed, how it addresses each project objective, and how it would be implemented. ***Response:*** *Chapter 3 of this SWEIS describes how each alternative was developed and presents information on programs supporting the missions, as well as specific information on the implementation of the projects (such as the number of tests, experiments, or training activities; location/facility; and purpose of activity).*

General Topic	***Issue and Response***
Transportation	DOE/NNSA received comments regarding how analyses such as transportation of waste and other materials should be addressed. Commentors stated that this SWEIS should evaluate impacts associated with the transportation of wastes on communities along the shipping routes within Nevada and in corridor states. In addition, a commentor asked for assurances that shipments from offsite waste generators would continue to be prohibited from routes through the Las Vegas metropolitan area. One commentor asked that the waste disposal analysis identify waste volumes by specific generator or origin location, as well as specific transportation routes and times. ***Response:*** *This SWEIS presents the potential transportation impacts on communities along shipping routes in Nevada including routes through Las Vegas and representative routes in corridor states (see Chapter 5, Section 5.1.3.1, and Appendix E, "Evaluation of Human Health Effects from Transportation"). DOE/NNSA sought to understand the differences in potential environmental effects between different routing options, which incorporated changes to local transportation infrastructure since the* 1996 NTS EIS*; communicate those differences to the public; and seek stakeholder comments on the range of transportation routes. Specific LLW/MLLW waste generators tied to specific waste streams are not addressed in the transportation analysis; instead, reference routes were used. Existing waste generators are identified in Appendix A, "Detailed Description of Alternatives." Total estimated waste volumes by waste type were used to calculate transportation impacts.* A commentor stated that this SWEIS should contain an analysis of how intermodal transport (rail-to-truck transfer) would be done (if planned) and a comprehensive evaluation of risks and impacts, regardless of where the intermodal transfer(s) would take place. ***Response:*** *An analysis of rail-to-truck transport is included in the transportation analysis of this SWEIS (see Chapter 5, Section 5.1.3.1).*
Contamination	DOE/NNSA received comments requesting that this SWEIS contain the following analyses: • A comprehensive analysis of contamination from all activities that have occurred and are ongoing at the NNSS and offsite locations • An assessment of what has been "cleaned up" since the inception of DOE's Environmental Management Mission and what remains to be assessed and remediated for industrial sites, contaminated soils, and groundwater under the Environmental Management Mission programs at the NNSS and all offsite locations for the foreseeable future • An extensive analysis of groundwater contamination within the NNSS to determine to what extent and where contamination is or could be migrating off site ***Response:*** *Impacts from contamination (including impacts to groundwater) are analyzed in Chapter 5, "Environmental Consequences," and Chapter 6, "Cumulative Impacts." A description of the Environmental Restoration Program, (including an update on Environmental Restoration Program projects and activities and remaining projects and activities to clean up the NNSS) is included in Chapter 3, Section 3.1.2.2, and in more detail in Appendix A, Section A.1.2.2.*
Nye County Impacts	DOE/NNSA received the following comments from Nye County, in summary: (1) Nye County believes that significant adverse impacts and losses of natural resources have occurred that must be mitigated; (2) environmental monitoring will not suffice as a mitigation measure; and (3) this SWEIS must address the legacy of environmental insult that has occurred and define appropriate measures to mitigate the massive loss of natural resources. ***Response:*** *Groundwater resources at the NNSS, including groundwater groundwater monitoring and quality and known contamination, are described in Chapter 4, Section 4.1.6.2, of this SWEIS. Section 4.1.5.4 describes soil contamination at the NNSS. Impacts from previous activities at the NNSS and offsite locations are included in the analysis of cumulative impacts presented in Chapter 6, "Cumulative Impacts," of this SWEIS. Chapter 6 analyses of potential environmental impacts generally encompass the impacts of past, present, and reasonably foreseeable actions. Text provided by Nye County describing its perspective on cumulative impacts of primarily Federal actions has been included in its entirety in Chapter 6. Programs to identify contamination from previous activities are ongoing and the results made public when available.*

General Topic	*Issue and Response*
Waste Disposal	Commentors requested that this SWEIS contain a comprehensive and thorough evaluation of all current and potential waste disposal activities at the NNSS, including LLW, MLLW, transuranic waste, GTCC waste, depleted uranium, and any other existing or foreseeable waste stream. ***Response:*** *The Waste Management Program is part of the Environmental Management Mission performed at the NNSS. Chapter 3 describes the Waste Management Program activities to be performed under each of the alternatives analyzed in this SWEIS. Under all of the alternatives, the NNSS would continue to receive LLW and MLLW, including depleted uranium waste streams, for disposal. Transuranic waste would not be disposed at the NNSS, but would be transferred off site for disposal at the Waste Isolation Pilot Plant. DOE has prepared the* Draft Environmental Impact Statement for the Disposal of Greater-Than-Class C (GTCC) Low-Level Radioactive Waste and GTCC-Like Waste *(DOE/EIS-0375) to evaluate the potential environmental impacts of siting and operating a GTCC disposal facility or facilities. The GTCC facility is included in the cumulative impacts analysis in Chapter 6. Chapter 5, Section 5.1.11, of this SWEIS contains a thorough analysis of the capacity of the waste management system to manage all current and potential NNSS waste streams.* Commentors requested that this SWEIS also identify waste volumes by generator/origin location, where such waste would be disposed, the facilities required (existing and new), the transportation requirements for moving various waste streams from generator locations to the NNSS for disposal, the interrelationships of waste disposal activities, and the cumulative impacts associated with all of the current and future NNSS onsite and offsite waste disposal activities. ***Response:*** *Consistent with the* 1996 NTS EIS *Record of Decision and the 2000 amended 1996 ROD, this SWEIS does not evaluate specific generators tied to specific waste streams because of the variability that can occur in both waste stream characteristics and future waste volumes. Instead, this SWEIS evaluates the potential impacts of transporting and disposing LLW and MLLW that meet the NNSS WAC based on transportation from various regions of the country. The list of waste generators used in the analysis of potential impacts is included in Appendices A and E.*
	Commentors requested that this SWEIS discuss the following topics and assess their programmatic, environmental, and legal ramifications: disposal of various waste streams; the interrelationships of waste disposal activities; and the cumulative impacts associated with all of the current and future on- and offsite NNSS waste disposal activities, and, in particular, plans to accept new LLW streams, including any that may be of commercial origin. ***Response:*** *Chapter 5, Section 5.1.11, of this SWEIS contains a thorough analysis of all current and potential NNSS waste disposal activities and waste streams. Additionally, cumulative impacts of waste management activities are evaluated in Chapter 6, "Cumulative Impacts." See the next response concerning waste of commercial origin.* A commentor requested that this SWEIS address DOE's proposal for taking LLW from commercial entities, subsequently declaring it to be DOE waste, and disposing it at the NNSS. ***Response:*** *In reference to activities performed by DOE's Office of Global Threat Reduction, the goal of the Offsite Source Recovery Project is to recover excess, unwanted, or abandoned sealed (radioactive material) sources that pose a potential risk to health, safety, and national security. DOE/NNSA takes ownership of some sealed sources under its Global Threat Reduction Initiative. If no reuse of these sealed sources is identified, they may be declared waste and be disposed as LLW. Within this SWEIS these sealed sources are included in the waste management and transportation analyses, representing less than 0.03 percent of the volume of LLW for the No Action and Reduced Operations Alternatives and less than 0.02 percent of the Expanded Operations Alternative LLW volume.*

General Topic	*Issue and Response*
Coordination and Consultation	A commentor stated that this SWEIS should acknowledge Nevada's important role in overseeing aspects of NNSS activities that are of special concern to the state and the importance of the Agreement in Principle framework for cooperative efforts. In addition, commentors stated that this SWEIS should evaluate the potential for more formal state regulatory oversight of LLW activities, such as the application of the state's authority (delegated by the U.S. Nuclear Regulatory Commission) to oversee LLW disposal operations at the NNSS. ***Response:*** *LLW is managed solely under DOE directives pursuant to DOE's Atomic Energy Act authority. The U.S. Nuclear Regulatory Commission does not have regulatory authority over DOE's LLW program. However, DOE and NDEP have an Agreement in Principle whereby NDEP participates in the Low-Level Waste Acceptance Program. The discussion of the Agreement in Principle, under which the State of Nevada provides enhanced oversight of DOE's management of MLLW is included in Section 9.1.1 of this SWEIS.* DOE/NNSA received several comments addressing outreach and consultations. Commentors urged continued dialogue and collaborative planning efforts with local American Indian groups in the NEPA process. A commentor stressed the need for consultations with the State Historic Preservation Office on this SWEIS and recommended that the alternatives describe the consultation process for key issues, including cultural resources surveys and impact assessments. Commentors stated that the NNSS should pursue more partnerships with local organizations, including the University of Nevada at Las Vegas and Nye County businesses, for future research and testing projects. One commentor stated that DOE/NNSA should consider additional opportunities for training local first responder personnel at the NNSS. ***Response:*** *Outreach and consultations are discussed in Section 1.6 and Chapter 10, "Consultation and Coordination." American Indian groups have been invited to participate in the preparation of this SWEIS. Text prepared by the Consolidated Group of Tribes and Organizations' American Indian Writers Subgroup appears in text boxes throughout this SWEIS and as Appendix C. DOE/NNSA is carrying out consultations with the State Historic Preservation Office and the U.S. Fish and Wildlife Service, as appropriate. Descriptions of these consultation processes appear in the cultural resources and biological resources impacts sections of this SWEIS. DOE/NNSA will consider proposals for research and development projects from academic institutions, other government agencies, and private companies and individuals. First responder training is included under the Nuclear Emergency Response, Nonproliferation and Conterterrorism Programs, and the Work for Others Program described in Chapter 3.* Nye County requested that DOE/NNSA consider the benefits of partnering with Nye County for delivery of infrastructure services. ***Response:*** *Although this comment is not within the scope of this SWEIS, DOE/NNSA will take this under consideration.*
	Nye County suggested that it conduct the groundwater characterization program for DOE/NNSA. Nye County offered to provide a fully developed programmatic alternative for review in this SWEIS. ***Response:*** *DOE/NNSA conducts a robust Underground Test Area (UGTA) Project. DOE/NNSA will continue to interact with Nye County on this UGTA Project. Nye County did not prepare an alternative for the SWEIS.*
	Nye County suggested that the draft and final SWEIS incorporate text it prepared for inclusion in the discussion of cumulative impacts presenting the Nye County perspective. ***Response:*** *Nye County text has been included in its entirety in the cumulative impacts discussion in Chapter 6.*

General Topic	*Issue and Response*
Land Use	A comment was made that this SWEIS should address the land transfer and all incidental activities contemplated for this area, including closure of Pit 3 and new state-imposed permitting requirements under RCRA. ***Response:*** *In November 2009, 740 acres in Area 5 of the NNSS were transferred for custody and control to DOE/NNSA. Chapter 5, Section 5.1.11, of this SWEIS contains a thorough analysis of all current and potential NNSS waste disposal activities, including establishment of a new mixed-waste cell under a new RCRA permit.*
Yucca Mountain	A commentor stated that this *NNSS SWEIS* must: • Fully evaluate the relationship between the potential repository and NNSS activities • Assess any potential cumulative impacts with respect to the former DOE Yucca Mountain Project • Identify, assess, and address the combined effects of these two facilities and related associated activities ***Response:*** *As indicated in the fiscal year 2010, 2011, and 2012 budget requests, the Administration decided to cease funding and activities related to development of a repository at Yucca Mountain while developing alternative storage and disposal approaches for spent nuclear fuel and high-level radioactive waste. Proposed actions associated with the former Yucca Mountain Project included construction, operation, monitoring, and eventual closure of a geologic repository at Yucca Mountain for disposal of spent nuclear fuel and high-level radioactive waste in storage or projected to be generated at 72 commercial and 5 DOE sites across the United States. In 1994, the DOE/Nevada Operations Office (the predecessor of the DOE/NNSA NSO) entered into a management agreement with the DOE Yucca Mountain Site Characterization Office for use of about 58,000 acres of NNSS land for site characterization activities related to the former Yucca Mountain Project. Under the agreement, the former Yucca Mountain Project was responsible for meeting the same environmental requirements that applied to the NNSS independent of, but in coordination with, the NNSS organizations. DOE/NNSA now maintains the infrastructure and buildings and provides security and support to DOE to remain compliant with Federal and state regulations pursuant to existing site permits.* *DOE recognizes that it has an obligation to remediate lands disturbed by past activities associated with the former Yucca Mountain Project. Accordingly, DOE has evaluated the potential cumulative impacts of remediating the lands and closing the infrastructure and buildings at Yucca Mountain (see Chapter 6 of this SWEIS). This analysis is based on the preliminary approach to remediating and closing the Yucca Mountain Site and facilities described under the No Action Alternative in the* Final Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada *(DOE 2002e). The preliminary approach analyzed in Chapter 6 of this SWEIS represents but one of many approaches. Upon receipt of appropriations, DOE plans to prepare a detailed proposal to remediate the lands and close the infrastructure and buildings, as required by law, regulations, and applicable agreements, and then undertake further NEPA review, as appropriate. After completion of site closure, DOE will initiate a long-term surveillance program.*
Cumulative Impacts	A commentor stated that the analysis of cumulative impacts in this SWEIS must include the following: • A comprehensive evaluation of the combined impacts of all activities, programs, and projects currently ongoing at the NNSS or reasonably foreseeable in the future • An assessment of impacts from past NNSS activities and an examination of how they interact with impacts from current and future activities • An assessment of the cumulative impacts on groundwater from past activities, in combination with potential additional contamination from current and future NNSS activities ***Response:*** *Chapter 6, "Cumulative Impacts," contains a comprehensive evaluation of cumulative impacts, including past, present, and reasonably foreseeable activities and cumulative groundwater impacts.*

General Topic	*Issue and Response*
Project Shoal, Central Nevada Test Area, and the Tonopah Test Range	A commentor stated that this SWEIS should contain an assessment of environmental conditions (surface and subsurface) for Project Shoal and the Central Nevada Test Area to establish environmental baselines against which any future impacts may be measured. ***Response:*** *Remediation of the surface contamination at the Project Shoal and Central Nevada Test Area sites was completed. Responsibility for the sites and ongoing characterization, monitoring, and/or remediation of subsurface impacts has been transferred to the DOE Office of Legacy Management for long-term stewardship. These sites are no longer under DOE/NNSA control and, by agreement with the DOE Office of Legacy Management, they are not addressed in this* NNSS SWEIS.
	A commentor stated that this SWEIS should address DOE/NNSA Environmental Management Mission and DOE/NNSA activities at the NNSS and NNSS-related sites and locations. Of particular concern is plutonium contamination on the Tonopah Test Range. ***Response:*** *DOE/NNSA Environmental Management Mission activities (under the Environmental Restoration Program) at the NNSS, Tonopah Test Range, and Nevada Test and Training Range are evaluated in this SWEIS.*
NEPA Implementation	A commentor requested that the period for comments on the draft SWEIS should be no less than 180 days. ***Response:*** *DOE/NNSA lengthened the comment period from 60 days (see NOI) to 126 days in response to commentors' requests.* A commentor requested that the public hearings be held in locations throughout Nevada and in other states affected by NNSS activities (including, but not limited to, the transportation of radioactive and hazardous materials to and from the NNSS). ***Response:*** *Public hearings were held in Las Vegas, Pahrump, Tonopah, and Carson City in Nevada and St. George in Utah.* A commentor requested that the hearings be structured so as to meaningfully facilitate public comments, i.e., in such a way that permits individuals to make comments for the record in a public forum. ***Response:*** *Comments were taken and recorded in a public hearing format. In addition, the open-house format was set up to allow the general public a better forum to ask questions and have one-on-one discussions with the DOE/NNSA subject matter experts.* A commentor requested that all related EISs, environmental assessments, categorical exclusions, and referenced documents be made publicly available online. ***Response:*** *Many DOE EISs and environmental assessments are available online at the DOE NEPA website (http://nepa.energy.gov). Occasionally, due to national security requirements, some NEPA documents are not available online. The references for this SWEIS are available at the public reading rooms listed on the cover page of this SWEIS, and copies also may be obtained by request.* A commentor stated that the purpose and need should be a clear, objective statement of the rationale for the proposed project. ***Response:*** *DOE/NNSA has provided a detailed description of the purpose and need in Section 1.2.*
Terrorism and Sabotage	A commentor requested that this SWEIS evaluate risks and impacts relating to acts of terrorism and sabotage against NNSS-related radioactive materials shipments. ***Response:*** *A classified appendix with this information was prepared in conjunction with this SWEIS. Pertinent unclassified data from the appendix are included in Chapter 5, Section 5.1.12.3.*

General Topic	*Issue and Response*
Renewable Energy	Commentors stated that renewable energy should be adopted as a secondary mission. ***Response:*** *Renewable energy research and development, as well as commercial development, are discussed in this SWEIS.* A commentor stated that the environmental consequences associated with reasonable buildout of renewable energy facilities should be evaluated in this SWEIS. ***Response:*** *DOE/NNSA concurs with the commentor and has included renewable energy projects in all alternatives evaluated in this SWEIS.* The U.S. Environmental Protection Agency commented that it supports increasing the development of renewable energy resources. ***Response:*** *DOE/NNSA acknowledges the U.S. Environmental Protection Agency's support for renewable energy.* Commentors asked for clarification of the renewable energy technologies considered in this SWEIS. ***Response:*** *Each of the three alternatives includes renewable energy projects. Each alternative includes a commercial solar power generation facility that varies among the alternatives in terms of electricity-generating capacity, as described in Chapter 3. All the commercial solar projects would be located in Area 25 of the NNSS. In addition, the Expanded Operations Alternative includes a project to install a photovoltaic system in Area 6 and a project to demonstrate the feasibility of enhanced geothermal electricity-generating systems in other locations on the NNSS. Because there are no proposals for the commercial-scale solar power generation facilities or geothermal electricity generation, additional NEPA review would be required if a specific proposal is considered by DOE/NNSA.*
Water Resources	Nye County stated that access limitations to water resources on withdrawn lands constitute a significant, adverse impact on the socioeconomic condition of Nye County. The impact is an indirect result of land access restrictions that have no demonstrated basis and must be recognized and identified as an impact on Nye County in this SWEIS. ***Response:*** *Access restrictions are an integral part of the security of the NNSS. Nye County text concerning lack of access to water resources on withdrawn lands is incorporated in its entirety in Chapter 6, "Cumulative Impacts."*
Potential Impacts	The U.S. Environmental Protection Agency requested that specific discussions and data regarding the following issues related to renewable energy projects be incorporated into this SWEIS: • Water supply and quality • Disposal of discharges • Clean Water Act, Sections 404 and 303(d) • Biological resources and habitat • Invasive species • Indirect and cumulative impacts • Implementation of adaptive management techniques for mitigation measures • Climate change • Air quality • Coordination with American Indian tribal governments • Environmental justice • Hazardous materials/hazardous waste/solid waste • Mitigation and pollution prevention • Coordination with land use planning activities ***Response:*** *The renewable energy projects in this SWEIS are not sufficiently defined to include this level of detail and would require additional NEPA review before being implemented.*

General Topic	*Issue and Response*
Potential Impacts (cont'd)	A commentor stated that this SWEIS should clearly describe the rationale used to determine whether impacts of an alternative are significant and suggested that thresholds of significance consider the context and intensity of an action and its effects. ***Response:*** *Wherever possible, impacts are quantified and compared with regulatory standards, system capacities, or other appropriate data. The criteria for determining whether the proposed alternatives impact each resource are identified in each of the Chapter 5 resource impacts sections.* A commentor requested that groundwater contamination from radionuclides or other materials, airborne pollutants, and the full range of other environmental impacts be evaluated in relation to their impacts on people and the environment in communities and areas surrounding the site and along transportation corridors leading to and from the NNSS. ***Response:*** *This SWEIS analyzes the potential direct and indirect impacts on people and the environment from groundwater contamination, transportation impacts, airborne pollutants, and all other emissions, as well as impacts on other resources (such as cultural resources and socioeconomic resources). These impacts are presented in Chapter 4, "Affected Environment," Chapter 5, "Environmental Consequences," and Chapter 6, "Cumulative Impacts."* A commentor stated that impacts must be considered in a global context. ***Response:*** *Global impacts such as the contribution of greenhouse gas emissions from activities at the NNSS and offsite locations and as a result of the transportation of radioactive materials and wastes are analyzed and included in Section 5.1.8, Air Quality and Climate. DOE/NNSA complex-wide impacts were analyzed in a separate programmatic EIS (*Final Complex Transformation Supplemental Programmatic Environmental Impact Statement *[DOE 2008l]).*
Treaty of Ruby Valley	A commentor was in favor of returning lands to the Western Shoshone. ***Response:*** *The U.S. Supreme Court ruled against claims by the Western Shoshone under the Ruby Valley Treaty. DOE/NNSA is aware of significant disagreement with the rulings of the U.S. Supreme Court by the Western Shoshone.*

CFR = *Code of Federal Regulations*; EIS = environmental impact statement; GTCC = greater-than-Class C; LLW = low-level radioactive waste; MLLW = mixed low-level radioactive waste; NDEP = Nevada Division of Environmental Protection; NEPA = National Environmental Policy Act; NNSA = National Nuclear Security Administration; NNSS = Nevada National Security Site; NOI = Notice of Intent; NSO = Nevada Site Office; NTS = Nevada Test Site; RCRA = Resource Conservation and Recovery Act; SWEIS = site-wide environmental impact statement; UGTA = Underground Test Area; WAC = waste acceptance criteria.

1.7.2 *Draft NNSS SWEIS* Public Involvement

On July 29, 2011, DOE/NNSA published a notice in the *Federal Register* (76 FR 45548) announcing the availability of the *Draft NNSS SWEIS*, the duration of the period for the public to submit comments, the location and timing of the public hearings, and the various methods for submitting comments on the draft to DOE/NNSA (such as online, email, fax, telephone, U.S. postal service, or oral/written comments at public meetings). DOE/NNSA announced a 90-day comment period, from July 29, 2011, to October 27, 2011, to provide time for interested parties to review the *Draft NNSS SWEIS*. In response to requests for additional review time, the comment period was extended by 36 days, through December 2, 2011, giving commentors a total review and comment period of 126 days (76 FR 65508).

During the public comment period, five public hearings were held to provide interested members of the public with opportunities to learn more about DOE/NNSA missions, programs and activities and the content of the draft SWEIS from exhibits, factsheets, and discussion with DOE/NNSA subject matter experts. From September 20 through 28, 2011, public hearings were held in Las Vegas, Pahrump, Tonopah, and Carson City, Nevada and St. George, Utah. An additional SWEIS hearing was conducted for the CGTO on October 6, 2012. Members of the public provided oral and written comments during the hearings. Additional information on the public hearing and other stakeholder informational meetings is contained in the Comment Response Document (Volume 3 of this *NNSS SWEIS*).

Additionally, a website (www.nv.energy.gov/sweis) was established to further inform the public about the draft SWEIS, how to submit comments, and other pertinent information.

1.7.2.1 *Draft NNSS SWEIS* Comment Summary

In reviewing the comments on the *Draft NNSS SWEIS*, DOE/NNSA identified several topics that were of heightened interest or concern to stakeholders, or resulted in generally substantive changes to relevant information and analyses in this SWEIS. These topics include:

- ***Radioactive Waste Transportation***. Commentors were concerned that DOE/NNSA was considering changing routes for shipping radioactive waste to allow shipment of waste through Las Vegas, and indicated the analysis should address site-specific conditions along the routes in the vicinity of Las Vegas. Additionally, commentors stated that the analysis of rail transfer stations was incomplete because specific operations and accidents that could occur at the analyzed rail transfer stations were not addressed.
- ***Groundwater Quality and Use***. Commentors stated that groundwater contamination from historic nuclear weapons testing poses an unacceptable risk to human health, and that the *Draft NNSS SWEIS* did not characterize this risk adequately. Commentors allege that this groundwater contamination and restrictions on public access to other groundwater on the NNSS constituted a loss of a valuable resource, which contributed to a lack of economic development.
- ***Former Yucca Mountain Project Site***. Commentors believed that DOE/NNSA should analyze, as a reasonably foreseeable future action, either the construction and operation of a high-level radioactive waste repository at Yucca Mountain, or the remediation and reclamation of the Yucca Mountain Site.
- ***American Indian Rights***. Commentors expressed concern that the U.S. Government is not abiding by the terms of the Treaty of Ruby Valley, and the lands encompassing the NNSS rightfully belong to the Western Shoshone people.
- ***Use of the NNSS***. Commentors contended that ongoing and proposed activities at the NNSS were not consistent with the purposes for which the land was originally withdrawn from public use, and stated that DOE/NNSA should consider returning some or all of the lands to public use.
- ***Nuclear Weapons Testing***. Commentors were opposed to resumption of nuclear weapons testing, and were concerned that resumption of testing was possible, despite the current moratorium on such tests.
- ***Renewable Energy***. Commentors were generally supportive of using the NNSS for research- and commercial-scale renewable energy projects, but expressed concerns that such projects, particularly commercial-scale projects, have the potential to cause adverse environmental impacts on many resources.

DOE/NNSA has responded to each public comment in the Comment Response Document (Volume 3) of this *Final NNSS SWEIS*.

1.7.2.2 Changes from the Draft Site-Wide Environmental Impact Statement

DOE/NNSA revised the *Draft NNSS SWEIS* in response to public comments, and provided additional environmental baseline information and new and revised analyses, including, but not limited to, the following:

- DOE/NNSA added information (figures and supporting text) regarding current and projected levels of surface soil and groundwater contamination.
- DOE/NNSA enhanced its cumulative effects analysis by including the remediation of the former Yucca Mountain Project Site as a reasonably foreseeable future action.
- DOE/NNSA added a human health impacts analysis for an alternate maximally exposed individual based upon a "subsistence consumer" lifestyle pattern.
- DOE/NNSA added an analysis of potential impacts associated with wildland fire events.
- DOE/NNSA has included new information regarding existing environmental conditions based upon more-recent, routine sampling and field data collection (e.g., groundwater contaminant sampling).

DOE/NNSA also corrected inaccuracies, made editorial corrections, and clarified text.

1.7.3 Next Steps

DOE/NNSA will announce its decision regarding the selected alternative or alternatives in a ROD no sooner than 30 days after the U.S. Environmental Protection Agency Notice of Availability for this *Final NNSS SWEIS* is published. The ROD will be published in the *Federal Register* and explain all factors, including the potential environmental impacts, considered by DOE/NNSA in reaching its decision. The ROD will identify the environmentally preferred alternative or alternatives. If mitigation measures, monitoring, or other conditions are adopted as part of DOE/NNSA's decision, these will be summarized in the ROD, as applicable, and included in a mitigation action plan that would be prepared following issuance of the ROD. The mitigation action plan would explain how and when mitigation measures would be implemented and how DOE/NNSA would monitor the mitigation measures over time to judge their effectiveness.

After DOE/NNSA issues its ROD, both the ROD and the mitigation action plan will be posted on DOE's NEPA website (http://nepa.energy.gov), and copies will be placed in the DOE/NNSA Reading Room in Las Vegas, Nevada, and in public libraries in southern Nevada and southwestern Utah; they also would be made available to interested parties upon request.

CHAPTER 2
SITE OVERVIEW AND UPDATE

2.0 SITE OVERVIEW AND UPDATE

Among the responsibilities of the U.S. Department of Energy and National Nuclear Security Administration (DOE/NNSA) are continued stewardship of the Nation's nuclear weapons stockpile and maintenance of a nuclear weapons testing capability. Historically, the primary mission at the Nevada National Security Site (NNSS) (formerly known as the Nevada Test Site) was to conduct nuclear weapons tests. Since the moratorium on nuclear weapons testing in October 1992, the focus at the NNSS has been to support the Stockpile Stewardship and Management Program. However, under a November 1993 Presidential Decision Directive, DOE/NNSA must be able to resume underground nuclear tests within 24 to 36 months if so directed by the President. The DOE/NNSA Nevada Site Office (NSO) maintains this test readiness at the NNSS. Because of its favorable environment and infrastructure, the NNSS also supports DOE waste management and disposal; DOE/NNSA counterterrorism training, research, and development; nuclear emergency response; nonproliferation; and other research related to national security and nondefense-related research, development, and testing programs.

This chapter of the *Site-Wide Environmental Impact Statement for the Continued Operation of the Department of Energy/National Nuclear Security Administration Nevada National Security Site and Off-Site Locations in the State of Nevada (NNSS SWEIS)* provides background on the NNSS and its main facilities, as well as other locations used to support DOE/NNSA missions. These facilities include the Remote Sensing Laboratory (RSL), the North Las Vegas Facility (NLVF), and the Tonopah Test Range (TTR) (see Chapter 1, Figure 1–1). While many programs and activities take place on the NNSS, several administrative and technical operations occur at other locations. Research, testing, and operations at RSL focus on conducting emergency response procedures and support, remote sensing, counterterrorism, and radiological incident response. RSL houses fabrication laboratories, shops, and advanced scientific equipment. The DOE/NNSA NSO's primary administrative offices are located at NLVF and house Federal and contractor personnel. In addition, facilities for engineering, fabrication, assembly, and calibration and laboratories are located at NLVF. Activities at the TTR support the Stockpile Stewardship and Management Program, as well as research and design of new weapons and weapon components. An overview of the changes that have occurred since DOE issued the *Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada (1996 NTS EIS)* (DOE 1996c) is also provided. Some of the site descriptions include American Indian perspectives prepared by the American Indian Writers Subgroup (AIWS); the AIWS input is in text boxes identified with a Consolidated Group of Tribes and Organizations (CGTO) feather icon.

2.1 Nevada National Security Site

The NNSS occupies approximately 1,360 square miles of desert and mountain terrain in southern Nevada at the southern end of the Great Basin. Elevations range from 2,700 feet on Jackass Flats in the southern part of the NNSS to 7,680 feet on Rainier Mesa in the mountainous northern region (DOE/NV 2009d) (see **Figure 2–1**). Sparsely vegetated basins or flats, separated by low mountains, dominate the eastern side and southern end of the NNSS—Jackass Flats in the southwestern quadrant, Frenchman Flat and Mercury Valley in the southeastern quadrant, and Yucca Flat in the northeastern quadrant. Frenchman and Yucca Flats each contain a large playa. The northwestern quadrant of the site comprises mountains with a pinyon-juniper forest and sagebrush shrublands separated by canyons; the dominant topographic features in this area are the Shoshone and Timber Mountains near the center and western border and Rainier Mesa and Pahute Mesa in the northwestern region of the site (DOE 2002f; Wills and Ostler 2001).

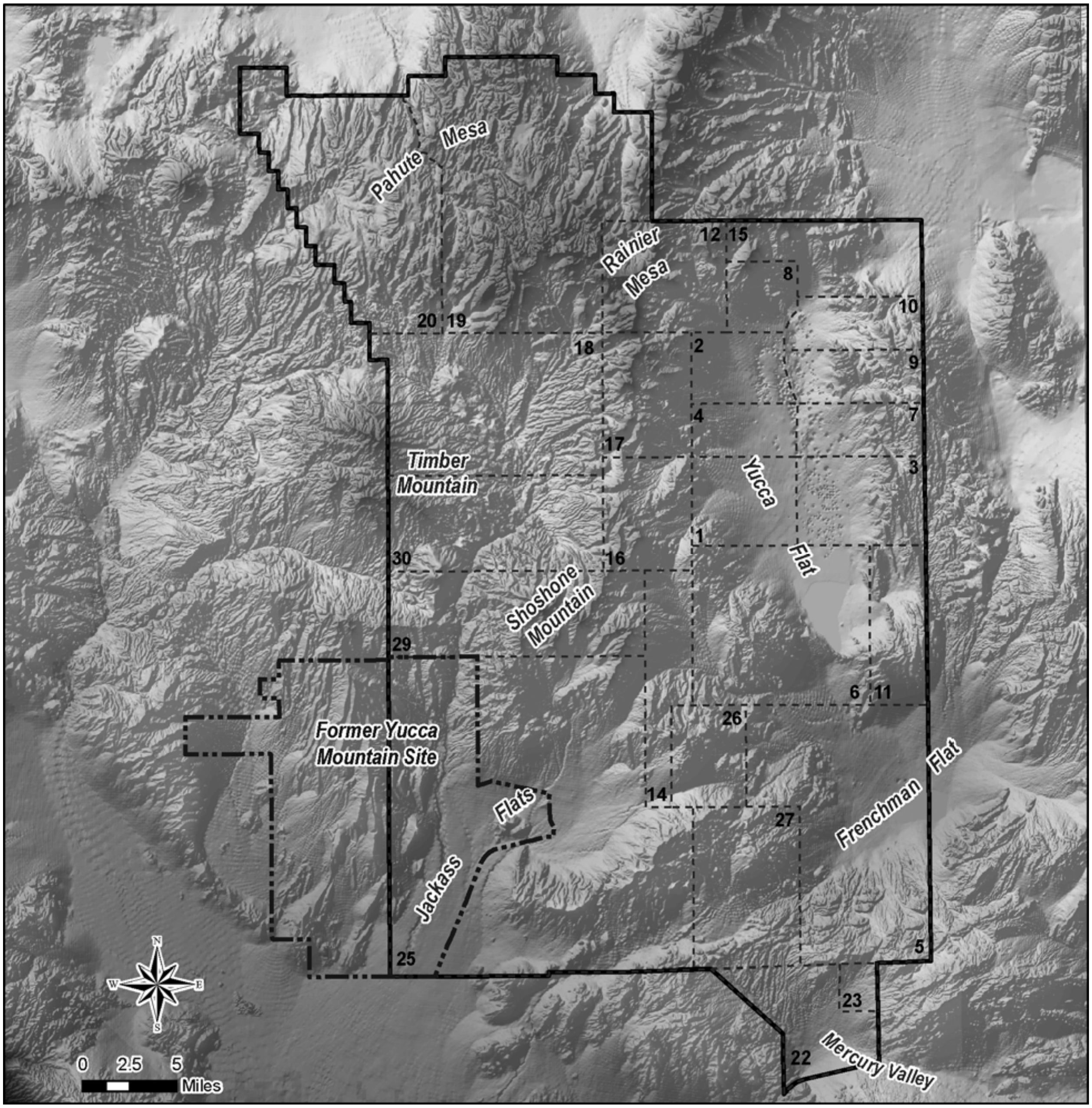

Figure 2–1 Geographic Areas of the Nevada National Security Site

About 6,500 square miles of the U.S. Air Force's (USAF's) Nevada Test and Training Range (formerly the Nellis Air Force Range) and the Desert National Wildlife Refuge surround the NNSS on the northern, western, and eastern sides. Most of the land adjacent to the NNSS is the Nevada Test and Training Range, which is used by the USAF for armament and high-hazard testing; aerial gunnery, rocketry, electronic warfare, and tactical maneuvering training; and equipment and tactics development and training. Public access to this land is restricted, so it serves as an additional buffer between NNSS activities and the general public. The overland distance from the southern edge of the NNSS (Gate 100 near Mercury) to downtown Las Vegas (the intersection of Interstate 15 and U.S. Route 95) is about 57 miles (NNSA 2007).

The NNSS is divided into numbered areas to facilitate management; communications; and the distribution, use, and control of resources (see **Figure 2–2**). The areas are numbered from 1 to 30, although four numbers are missing from the sequence (there are no Areas 13, 21, 24, or 28 on the NNSS). The numbering designations originated when the NNSS was part of the former Nellis Air Force Range (now called the Nevada Test and Training Range). The USAF has since changed the designations for the Nevada Test and Training Range, but the old numerical designations remain for the NNSS. The missing area numbers previously denoted areas on the range. The approximate size of each area (rounded to whole square miles) and a description of its function are provided in **Table 2–1**.

In addition to dividing the site into administrative areas, DOE/NNSA also categorizes the NNSS into land use zones. These zones are discussed in Chapter 4, Section 4.1.1.

American Indian Perspective of the NNSS Area and Offsite Locations

CGTO The Nevada National Security Site (NNSS) area and offsite locations are part of the traditional holy lands of the Southern Paiute, Western Shoshone, and Owens Valley Paiute and Shoshone people. We share this land for medicinal purposes, food, and culturally significant places necessary for traditional narratives and religious ceremonies.

The Consolidated Group of Tribes and Organizations (CGTO) knows these lands contain archaeological remains left by our ancestors. They are home to countless natural resources, such as plants, animals, water, and minerals which are critical to American Indian daily life and religious beliefs. Our ancestral lands contain natural landforms that mark important locations for keeping our history alive and for teaching our children about our culture in detailed Winter Stories. We use traditional sites within these lands to make doctoring tools, stone objects, and ceremonial items. They contain many sites associated with traditional healing ceremonies and power places necessary for our cultural survival. Despite the current physical separation of tribes from our ancestral lands stemming from the actions by the Federal Government, American Indians continue to value and recognize their meaningful role in our culture and continued survival.

Numerous sites have been identified within the NNSS boundaries that are important to American Indian People. For example, Fortymile Canyon is a significant crossroad where trails from distant places such as Owens Valley, Death Valley, and the Avawatz Mountain come together. Black Cone in Crater Flat is an important religious site that is considered an entry to the underworld. Prow Pass is a unique ceremonial site and, because of this religious significance, tribal representatives have recommended DOE avoid affecting this area. Oasis Valley is a known area for trade and doctoring ceremonies. Other locations throughout this area are considered important based on the abundance of artifacts, traditional-use plants and animals, rock art, and potential burial sites.

See Appendix C for more details.

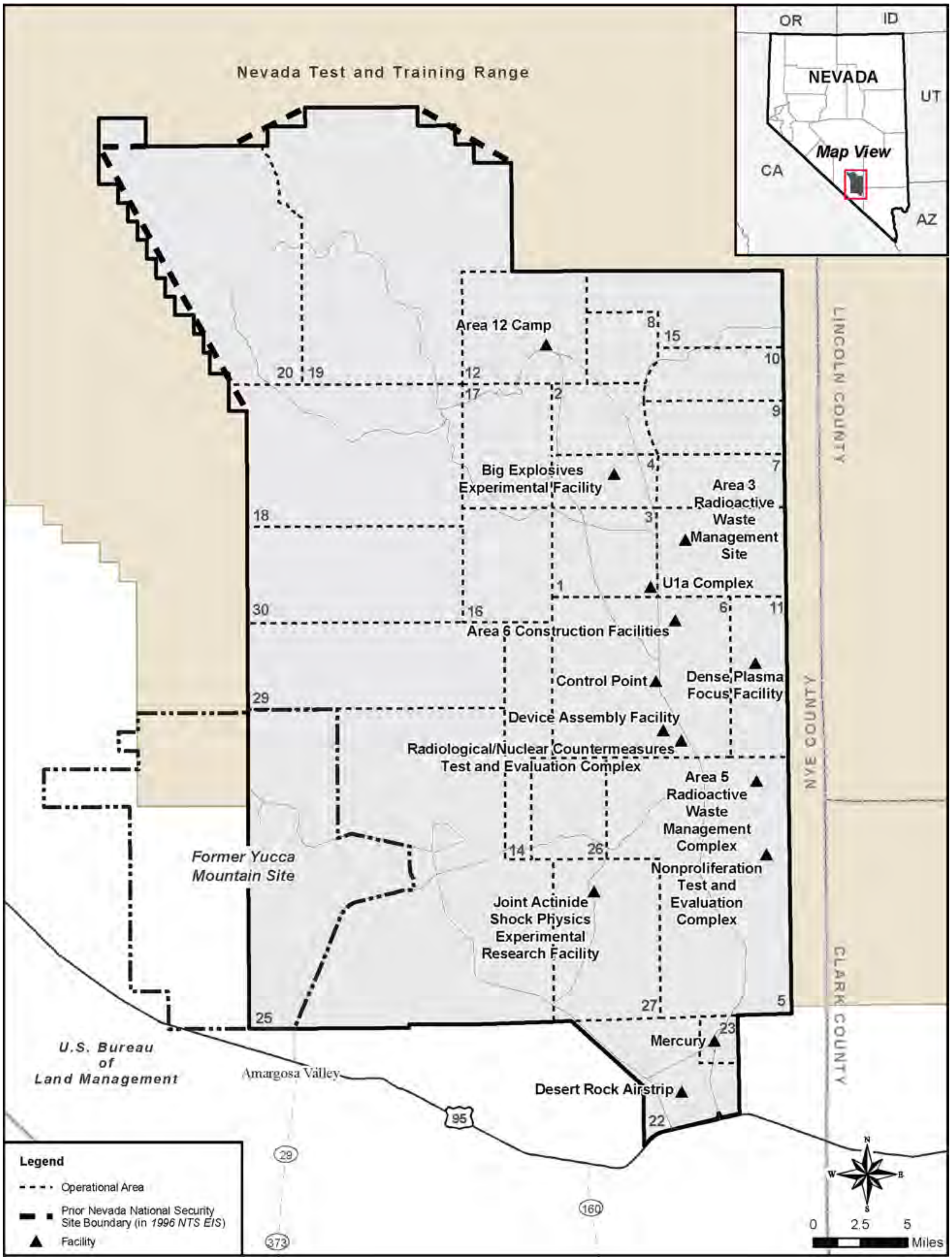

Figure 2–2 Nevada National Security Site Areas and Major Facilities

Table 2–1 Description and Historical Use of Nevada National Security Site Areas

Description of Nevada National Security Site (NNSS) Areas
Area 1—Area 1 occupies approximately 26 square miles of the Yucca Flat basin near the center of the site. The U1a Complex and the Area 1 Industrial Complex are located in Area 1. Area 1 was the site of four atmospheric nuclear tests between 1952 and 1955, and three underground tests (one in 1971 and two in 1990).
Area 2—Area 2 occupies approximately 19 square miles in the northern half of the Yucca Flat basin. The eastern portion of Area 2 was the site of 7 atmospheric nuclear tests conducted between 1952 and 1957. The first of 137 underground nuclear tests in Area 2 took place in late 1962, and tests continued through 1990.
Area 3—Area 3 occupies approximately 32 square miles near the center of the Yucca Flat basin. The Area 3 Radioactive Waste Management Site, which makes use of a group of subsidence craters for low-level radioactive waste disposal, is located in this area. Area 3 was the site of 17 atmospheric tests conducted between 1952 and 1958, and 251 underground nuclear tests from 1958 through 1992.
Area 4—Area 4 occupies approximately 16 square miles near the center of the Yucca Flat basin. The Big Explosives Experimental Facility is located in Area 4. Area 4 was the site of 5 atmospheric nuclear tests conducted between 1952 and 1957. From the mid-1970s through 1991, 35 underground nuclear tests were conducted in Area 4, mainly in the northeastern corner.
Area 5—Area 5 occupies approximately 111 square miles in the southeastern portion of the site and includes the Area 5 Radioactive Waste Management Complex, the Nonproliferation Test and Evaluation Complex, and the Nevada Desert Free Air Carbon Dioxide Enrichment and Mojave Global Change Facility environmental research sites. From 1951 through early 1962, 14 atmospheric tests were conducted at Frenchman Flat, in the northeastern portion of Area 5. Five underground nuclear weapons tests were conducted at Frenchman Flat between 1965 and 1968.
Area 6—Area 6 occupies approximately 81 square miles from the northern part of Frenchman Flat to the southern part of Yucca Flat, straddling Frenchman Mountain. Facilities in Area 6 include the Control Point Complex, Area 6 Construction Facilities, the Device Assembly Facility, the Radiological/Nuclear Countermeasures Test and Evaluation Complex, the Yucca Lake Aerial Operations Facility, and a Hydrocarbon Contaminated Soils Disposal Site. One atmospheric nuclear test was conducted in Area 6 (in 1957). Between 1968 and 1990, five underground nuclear tests were conducted in this area.
Area 7—Area 7 occupies approximately 19 square miles in the northeastern quadrant of the Yucca Flat basin. Twenty-six atmospheric tests were conducted in this area between 1951 and 1958. From 1964 through 1991, 62 underground nuclear tests were conducted in Area 7.
Area 8—Area 8 occupies approximately 14 square miles in the northern part of the Yucca Flat basin. Area 8 was the site of 3 atmospheric nuclear tests conducted in 1958. From 1966 through 1988, 10 underground nuclear tests were conducted in this area.
Area 9—Area 9 occupies approximately 20 square miles in the northeastern quadrant of the Yucca Flat basin. A construction and demolition debris landfill, using a subsidence crater, operates in Area 9. In Area 9, 17 atmospheric tests were conducted between 1951 and 1958, and 100 underground tests were conducted from 1961 to 1992.
Area 10—Area 10 occupies approximately 20 square miles in the northeastern quadrant of the Yucca Flat basin. Area 10 was the location of the Nation's first nuclear missile system test, an air-to-air rocket, detonated in mid-1957. There were 57 underground and shallow (called cratering) nuclear tests conducted in Area 10 between 1962 and 1991. The Sedan Crater, formed by a thermonuclear device in July 1962 as part of the Plowshare Program, is in Area 10. The Plowshare Program was designed as a research and development activity to explore the technical and economic feasibility of using nuclear explosives for industrial applications. The Sedan Crater is listed in the National Register of Historic Places.
Area 11—Area 11 occupies approximately 26 square miles along the central-eastern border of the NNSS. The Dense Plasma Focus Facility and an explosives ordnance disposal site are located in this area. Because of residual radioactive contamination from historic uses, this area is used intermittently for realistic drills in radiation monitoring and sampling. Four atmospheric safety tests were conducted in the northern portion of Area 11 in 1955 and 1956 in what is now known as Plutonium Valley. In addition to the aboveground safety tests, five underground nuclear weapons effects tests were conducted in Area 11 between 1966 and 1971.
Area 12—Area 12 occupies approximately 40 square miles along the northern boundary of the NNSS on Rainier Mesa. There are a number of tunnel complexes mined into Rainier Mesa that are used for experiments, including E-, G-, N-, P-, and T-Tunnel complexes. The Area 12 Camp was renovated and upgraded and will provide a secure base camp for military units and other government agencies for conducting counterterrorism and other exercises in the northern region of the NNSS. It provides an urban terrain setting, utilizing existing commercial, residential, and industrial buildings. The camp includes 200 dormitory rooms, a cafeteria, weapons and munitions storage, and numerous operations and support buildings. The DOE/NNSA Office of Secure Transportation currently uses it as a training facility. No atmospheric tests were conducted in Area 12; 61 underground nuclear tests were conducted in Area 12 between 1957 and 1992.

Table 2–1 Description and Historical Use of Nevada National Security Site Areas (continued)

Area 14—Area 14 occupies approximately 26 square miles in the central portion of the NNSS. Various outdoor experiments are conducted in this area. No atmospheric or underground nuclear tests were conducted in Area 14.
Area 15—Area 15 occupies approximately 35 square miles in the northeastern corner of the NNSS. No atmospheric tests were conducted in this area; between 1962 and 1966, three underground nuclear tests were carried out in Area 15. A facility that evaluated the effects of residual radiation on farm animals, called the EPA Farm, previously operated in this area.
Area 16—Area 16 consists of approximately 29 square miles in the central portion of the NNSS. Currently, DoD uses this area for high-explosives research and development in support of programs involving the detonation of conventional or prototype nonnuclear explosives and munitions and for developing tactics to defeat deeply buried and hardened targets. Area 16 was established in 1961 for DoD to conduct nuclear effects experiments. From mid-1962 through mid-1971, six underground nuclear weapons effects tests (all in the U16a Tunnel complex) were conducted in this area.
Area 17—Area 17 occupies approximately 31 square miles in the north-central portion of the NNSS. This area has been used primarily as a buffer between testing activities in other areas. No atmospheric or underground nuclear weapons tests were conducted in Area 17.
Area 18—Area 18 occupies approximately 88 square miles along the western border of the NNSS. The inactive Pahute Airstrip is located in the east-central portion of the area. The airstrip was used for the shipment of supplies and equipment for Pahute Mesa test operations. Area 18 was the site of five nuclear weapons tests from 1962 to 1964, two atmospheric tests, two cratering tests, and one underground test.
Area 19—Area 19 occupies approximately 146 square miles along the northern side of the NNSS. Area 19 was developed for high-yield underground nuclear tests. No atmospheric nuclear tests were conducted in Area 19. From the mid-1960s through 1992, 35 underground nuclear tests were conducted in this area.
Area 20—This area occupies approximately 97 square miles on Pahute Mesa in the northwestern corner of the NNSS. Area 20 was developed in the mid-1960s for high-yield underground nuclear tests. No atmospheric nuclear tests were conducted in Area 20. From the mid-1960s through 1992, 46 underground nuclear weapons tests were conducted in Area 20. In addition, 1 nuclear test detection experiment and 3 Plowshare Program tests were conducted in this area.
Area 22—Area 22 occupies approximately 31 square miles in the southernmost portion of the NNSS and serves as the main entrance (Gate 100) to the NNSS. Before 1958, this area included Camp Desert Rock, a U.S. Army installation used for housing troops taking part in military exercises at the NNSS. After 1958, the camp was removed, with the exception of the Desert Rock Airport. The airport is currently operational, but is only used by those authorized by DOE/NNSA.
Area 23—Area 23 occupies approximately 5 square miles near the southeastern corner of the NNSS. It is the location of Mercury, the largest operational support complex on the NNSS. Mercury was established in 1951 and serves as the main administrative and industrial support center at the NNSS. Mercury is located approximately 5 miles from U.S. Route 95. The Area 23 landfill, used to dispose nonhazardous solid waste, is located west of Mercury.
Area 25—Area 25, the largest area on the NNSS, occupies approximately 254 square miles in the southwestern corner of the site and includes an inactive entrance gate to the NNSS. Portions of Area 25 are used by the military for training exercises. The U.S. Army Ballistic Research Laboratory conducts open-air and X-tunnel tests using depleted uranium in Area 25. Research sites within Area 25 include the Treatability Test Facility (inactive) and Bare Reactor Experiment Nevada Tower, a 1,527-foot tower used by a number of organizations for a wide variety of research (e.g., sonic booms, meteorology, gravity drop tests, satellite infrared imaging). Located roughly in the center of Area 25, Jackass Flats was the site of ground experiments for reactors, engines, and rocket stages as part of a program to develop nuclear reactors for use in the Nation's space program.
Area 26—Area 26 occupies approximately 21 square miles in the south-central part of the NNSS. The southern portions of this area were used for nuclear-powered ramjet engine experiments, known as Project Pluto.
Area 27—Area 27 occupies approximately 49 square miles in the south-central portion of the NNSS. The Joint Actinide Shock Physics Experimental Research Facility is located in Area 27. Area 27 was used for weapons assembly and staging.
Area 29—Area 29 occupies approximately 62 square miles on the west-central border of the NNSS and includes portions of Fortymile Canyon. It is used primarily for military training and exercises. No nuclear weapons tests were conducted in Area 29.
Area 30—Area 30 occupies approximately 59 square miles at the center of the western edge of the NNSS. Area 30 has rugged terrain and includes the northern reaches of Fortymile Canyon. It is used primarily for military training and exercises. Area 30 had limited use in support of the Nation's nuclear weapons testing program, but was the site of Project Buggy, an experiment in the Plowshare Program.

DoD = U.S. Department of Defense; EPA = U.S. Environmental Protection Agency; NNSA = National Nuclear Security Administration; NNSS = Nevada National Security Site.
Source: DOE 1996c; DOE/NV 2000e.

2.1.1 Major Facilities

The NNSS provides a large area remote from the public at which a broad variety of research, experimentation, and training can be performed. Some of the activities conducted take advantage of the expanses of land at the NNSS. However, a comparatively small part of the NNSS is developed and has facilities that are routinely occupied or visited by NNSS personnel. The following is a list of the more prominent facilities at the NNSS. The locations of these facilities are shown in Figure 2–2.

U1a Complex. The U1a Complex (formerly called the Lyner Complex) in Area 1 is an underground laboratory used for performing subcritical experiments (see text box) in support of the Stockpile Stewardship and Management Program. **Figure 2–3** shows the aboveground facilities at the U1a Complex. It consists of a series of underground alcoves and test chambers about 960 feet below the ground surface. Three vertical shafts connect to the underground tunnels to provide ventilation, as well as personnel, equipment, instrumentation, and utility access. At the surface are 27 support buildings and a mechanical hoist for accessing the belowground areas. Experiments with high explosives and special nuclear material, including dynamic plutonium experiments (see text box), are conducted in small alcoves mined into the sidewalls or floors of the underground tunnels (DOE/NV 2004b). A Large-Bore Powder Gun used for shock physics experiments is scheduled to be installed in an alcove of the U1a Complex in 2015.

Subcritical Experiments

Subcritical experiments are performed using special nuclear material (for example, plutonium) in a manner that prevents it from achieving a nuclear explosion. Subcritical experiments are designed to improve knowledge of the dynamic properties of new or aged nuclear weapons parts and materials and to assess the effects of new manufacturing techniques on weapon performance. Subcritical experiments can vary any or all factors that influence criticality (mass, density, shape, volume, concentration, moderation, reflection, neutron absorption, enrichment, and interactions). Because there is no nuclear explosion, subcritical experiments are consistent with the U.S. nuclear testing moratorium.

Dynamic Plutonium Experiments

Dynamic plutonium experiments are designed to improve knowledge of plutonium material properties, including equation of state (an equation that expresses the relationship between temperature, pressure, and volume of a substance) and strength, over broad ranges of relevant pressures, temperatures, and time scales. They range from essentially static experiments to increasingly dynamic experiments. None of these experiments reaches nuclear criticality or involves a self-sustaining nuclear reaction.

Area 3 Radioactive Waste Management Site (RWMS). The Area 3 RWMS consists of five disposal cells that contain waste and two unused disposal cells located in subsidence craters created by previous nuclear weapons tests. The approximately 120-acre site has been used for disposal of bulk and containerized low-level radioactive waste (LLW). The Area 3 RWMS is maintained in a standby condition and could be activated if necessary to dispose nonhazardous solid waste or particular, usually large-volume, LLW streams.

Hydrodynamic Experiments

Hydrodynamic experiments are high-explosives-driven experiments to assess the performance and safety of nuclear weapons. During a nuclear weapon function test, the behavior of solid materials is similar to liquids, hence the term "hydrodynamic." These experiments do not use special nuclear material (plutonium or enriched uranium), but are conducted using test assemblies that are representative of nuclear weapons.

Hydrodynamic experimentation is a central component in maintaining nuclear weapons design and assessment capability. It is coupled with high-performance computer modeling and simulation to certify, without underground nuclear testing, the safety, reliability, and performance of the nuclear physics package of weapons.

Big Explosives Experimental Facility (BEEF). BEEF, located in Area 4, is an open-air hydrodynamic experimentation facility (see text box) where high-explosives-driven experiments are performed to provide data to support the Stockpile Stewardship and Management Program (DOE/NV 2005c). The facility consists of two earth-covered bunkers, a control bunker, a camera bunker, a gravel firing table, and other support facilities.

Figure 2–3 Aboveground Facilities of the U1a Complex

Diagnostics equipment used to monitor explosions includes high-speed optics and x-ray radiography. Scientists conduct weapons physics experiments using explosives, pulsed laser power, and shaped charges. BEEF is certified to handle high-explosives loads up to 70,000 pounds. Materials used in explosives experiments may include beryllium and depleted uranium, among others.

Nonproliferation Test and Evaluation Complex (NPTEC). NPTEC (previously called the Liquefied Gaseous Fuels Spill Test Facility and the Hazardous Materials Spill Center) supports experimentation using open-air releases of chemical and biological simulants to create realistic environments for experiments and training (see **Figure 2–4**). The main NPTEC facility has the means of releasing materials from stacks or a wind tunnel, or on spill pads. Experimental data are collected using video cameras, sensors, arrays, and meteorological instrumentation. NPTEC is in Area 5, but experiments using low-concentration chemical or biological simulant releases and portable release systems can be performed at various locations at the NNSS. Public and private users perform experiments at NPTEC to independently analyze and evaluate sensor systems to determine their operational characteristics before their transition from the developmental to the operational phase (DOE/NV 2005e).

Figure 2–4 Large-scale Release Experiment Under Way at the Nonproliferation Test and Evaluation Complex

Area 5 Radioactive Waste Management Complex (RWMC). The Area 5 RWMC comprises about 740 acres, including about 160 acres of existing and proposed disposal cells for burial of LLW and mixed low-level radioactive waste. The Waste Examination Facility and Transuranic (TRU) Pad and TRU Pad Cover Building are also included in the Area 5 RWMC. Approximately 580 acres of land are available for future radioactive waste management facilities and disposal cells.

Control Point Complex. The Control Point Complex is located in Area 6 on the ridge between Yucca Flat and Frenchman Flat. The Control Point Complex consists of facilities to support testing and experiments in the forward areas of the NNSS (i.e., the experimental areas away from Mercury and areas of daily occupancy). It houses the command center used for nuclear tests and experiments (Control Point 1).

Device Assembly Facility (DAF). DAF, in Area 6, is a collection of more than 30 heavy-steel-reinforced concrete buildings connected by a common corridor (see **Figure 2–5**). The entire 100,000-square-foot complex is covered by compacted earth. Operational buildings in DAF include five assembly cells, three assembly bays (one with a downdraft table and one with a glovebox), four high bays, and two radiography bays. Support buildings include five bunkers for staging nuclear components or high explosives, two shipping/receiving bays, three small vaults, two decontamination areas, two laboratories, and an administration building (DOE/NV 2004c). Operations at DAF include staging and preparing special nuclear material for transportation and preparation of dynamic plutonium experiments and other unique experiments. DAF is approved for nuclear explosives operations and special nuclear material assemblies. DAF is also the home of the National Criticality Experiments Research Center, which was transferred from Technical Area 18 at Los Alamos National Laboratory in New Mexico and includes critical assemblies and machines used to conduct criticality experiments and training. In addition, DAF provides nuclear weapons assembly and disassembly capabilities; a damaged nuclear weapon could be sent to DAF for disassembly.

Figure 2–5 Device Assembly Facility at the Nevada National Security Site

Radiological/Nuclear Countermeasures Test and Evaluation Complex (RNCTEC). RNCTEC, in Area 6, is a facility constructed on behalf of the U.S. Department of Homeland Security for analyzing and evaluating countermeasures against potential terrorist attacks using radiological and/or nuclear weapons. The facility consists of several venues that simulate various transportation-related facilities (see **Figure 2–6**) (DOE 2004f).

Area 6 Construction Facilities. The Area 6 Construction Facilities provide craft and logistical support to activities performed in the forward areas of the NNSS (i.e., the experimental areas away from Mercury and areas of daily occupancy). The Area 6 Construction Facilities are also home to the Atlas Facility, a pulsed-power machine used to investigate the properties of nonnuclear materials under extreme conditions. The Atlas Facility can be used to conduct dynamic experiments and produce hydrodynamic data to validate computer models of material response for weapons applications; it was last used for such purposes in 2006. Since 2007, it has been maintained in cold standby, meaning that it can be reactivated, but may require repair and maintenance actions to ready it for use.

Figure 2–6 Radiological/Nuclear Countermeasures Test and Evaluation Complex Provides Capabilities for Evaluating Transportation Monitoring Equipment

Dense Plasma Focus Facility. The Dense Plasma Focus Facility in Area 11 supports research that provides active interrogation (a process that uses an external radiation source to interrogate an unknown object and induce a response) of special nuclear material and calibration of nuclear detection equipment. The focus of this research is enhancement of national security, with the goal of improving capabilities of detecting a smuggled nuclear device or material. The dense plasma focus machines use mixtures of deuterium and tritium.

Area 12 Camp. The Area 12 Camp is generally maintained in a standby condition, but can be reactivated for special projects. Most recently, DOE/NNSA activated the Area 12 Camp for use as a training facility by the Office of Secure Transportation. The camp includes 200 dormitory rooms, a full-service cafeteria, weapons and ammunition storage, and support buildings. Office of Secure Transportation training and exercises occur on roadways in Area 12 and throughout the NNSS.

The Area 12 Camp also supports activities at the tunnel complexes in Area 12. DOE/NNSA and the Defense Threat Reduction Agency use the various tunnels at the NNSS to conduct experiments and training in support of hard/deeply buried target location and defeat, conventional munitions effects and demilitarization, and other experiments and testing. Additionally, tunnel complexes in the northern area of the NNSS support DOE/NNSA programmatic activities, including safe management of improvised nuclear devices, if needed.

Desert Rock Airstrip. Desert Rock Airstrip in Area 22 supports operations of aircraft up to the size of a C-130 (about the length of a Boeing 727-200, but with a much larger wingspan). The airstrip is closed to public carriers, but is used by DOE/NNSA and others approved by DOE/NNSA for transport of material and personnel to the NNSS.

Mercury. Mercury (formerly called Base Camp Mercury), in Area 23 north of the entrance to the NNSS, is equivalent to a small town. It provides office facilities, dormitories, a cafeteria, classrooms, and various other support facilities for the NNSS. The Homeland Security and Defense Applications Operations and Coordination Center is located in Mercury. This center provides critical information exchange during exercises or real-world events and incidents.

Joint Actinide Shock Physics Experimental Research Facility (JASPER). JASPER, located in Area 27, houses a two-stage light-gas gun that is designed to propel a projectile into a target at extremely high velocities of up to 8 kilometers per second (see **Figure 2–7**). The JASPER gas gun is specifically designed to conduct research on plutonium and surrogate target materials. JASPER plays an integral role in the certification of the Nation's nuclear weapons stockpile by providing a means of generating and measuring data pertaining to the properties of materials (radioactive chemical elements) at high shock pressures, temperatures, and strain rates. These extreme laboratory conditions approximate those experienced in nuclear weapons. Data from the experiments are used to determine material equations of state (equations that express the relationship among temperature, pressure, and volume of a substance) and to validate computer models of material response for weapons applications. Experiment results are used for code refinement to provide better predictive capability and to ensure confidence in the U.S. nuclear stockpile.

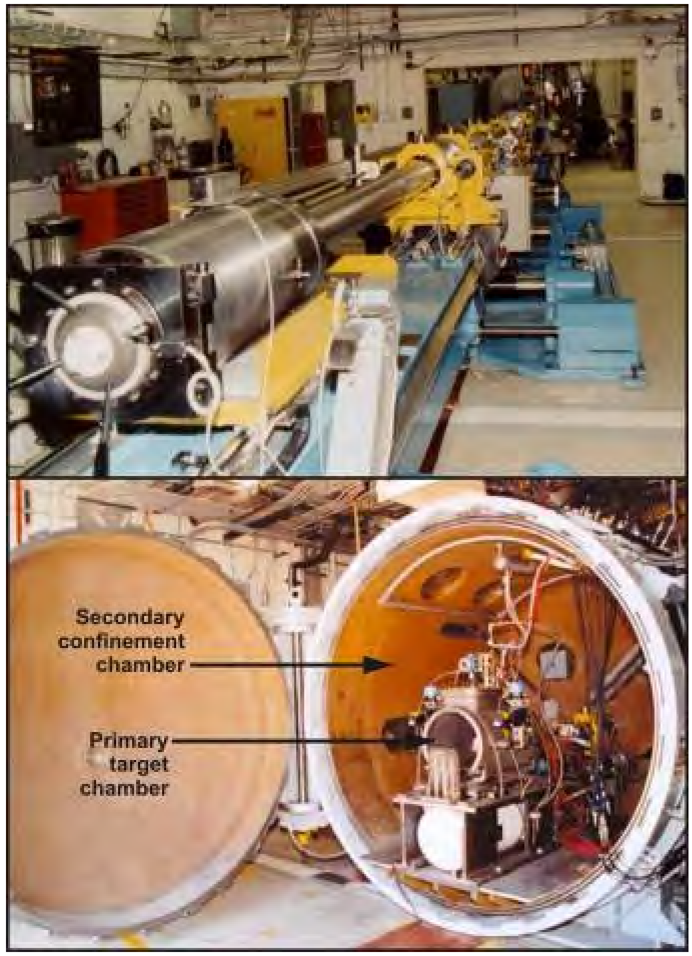

Figure 2–7 The Joint Actinide Shock Physics Experimental Research Facility Two-stage Gas Gun (top) and Target Chamber (bottom)

The nearby Baker Compound supports activities at JASPER, as well as other locations on the NNSS, by providing staging and storage necessary to support high-explosives experiments. The Baker Compound can receive shipments and safely store and transport explosives materials.

2.2 Remote Sensing Laboratory

RSL is located on 35 acres at Nellis Air Force Base in North Las Vegas, approximately 59 miles southeast of the nearest NNSS boundary (60 miles southeast of Gate 100, near Mercury, on the NNSS). RSL is adjacent to the Nellis Air Force Base runway and has seven permanent buildings. Radiological emergency response, the Aerial Measuring System, radiological sensor development and testing, Secure Systems Technologies, nuclear nonproliferation capabilities, and information and communication technologies are maintained at RSL.

2.3 North Las Vegas Facility

NLVF, located approximately 55 miles southeast of the nearest NNSS boundary (56 miles southeast of Gate 100, near Mercury, on the NNSS), comprises 29 buildings that support ongoing NNSS missions. The facility includes office buildings, a high bay, machine shop, laboratories, experimental facilities, and various other mission-support facilities. Among the NLVF buildings is the Nevada Support Facility, the location of most of the DOE/NNSA personnel offices.

2.4 Tonopah Test Range

The TTR, located approximately 12 miles north of the nearest NNSS boundary (73 miles north of Gate 100, near Mercury, on the NNSS), is a USAF facility. It consists of a 280-square-mile area north of the NNSS on the Nevada Test and Training Range. DOE/NNSA operations at the TTR are conducted pursuant to a land use permit from the USAF under the direction of Sandia National Laboratories and the DOE/NNSA Sandia Site Office. DOE/NNSA operations at the TTR include flight-testing of gravity weapons (bombs) and research, development, and evaluation of nuclear weapons components and delivery systems.

In its December 15, 2008, Record of Decision for the *Complex Transformation Supplemental Programmatic Environmental Impact Statement (Complex Transformation SPEIS)* (73 FR 77656), DOE/NNSA decided to implement a campaign mode of operations at the TTR, reducing its permitted operating area and upgrading its equipment. The "campaign mode of operations" would continue operations at the TTR but reduce permanent staff and conduct tests and experiments by deploying DOE and national laboratory personnel from other locations, as needed. The intent of reducing the footprint for the TTR and instituting a campaign mode of operations was to continue to meet mission and program requirements and reduce costs. After further review, DOE/NNSA, in consultation with the USAF, determined that maintaining the current footprint for the TTR would actually be the most cost-effective option. In addition, DOE/NNSA is reviewing implications of instituting a campaign mode of operations. The *Complex Transformation SPEIS* addresses operating with the existing TTR footprint in both campaign mode (Campaign Mode Operation of TTR, Option 2 – Campaign under existing Agreement) and in the existing (non-campaign) mode (No Action).

2.5 Overview of Changes Since the *1996 NTS EIS*

The *1996 NTS EIS* analysis of the potential environmental impacts was based on the physical site, facilities, and activities in existence or contemplated by DOE at the time the environmental impact statement was prepared. The primary missions at the NNSS and other sites in the state of Nevada remain unchanged; however, since the *1996 NTS EIS* was prepared, the administration of the sites and their physical boundaries and facilities have changed and there has been an evolution in the programs and activities conducted in support of the DOE/NNSA missions. This section provides an overview of these changes to bridge the gap between the sites, data, and analyses in the *1996 NTS EIS* and this *NNSS SWEIS*.

2.5.1 Administrative Changes

Creation of NNSA. Established by Congress in 2000 through the National Nuclear Security Administration Act (Title XXXII of the National Defense Authorization Act for Fiscal Year 2000, Public Law [P.L.] 106-65), NNSA is a separately organized, semiautonomous agency within DOE. DOE/NNSA is responsible for the management and security of the Nation's nuclear weapons, certain nuclear nonproliferation programs, and naval reactor programs. It also responds to nuclear and radiological emergencies in the United States and abroad. Additionally, DOE/NNSA Federal agents provide safe, secure transportation of nuclear weapons and components and special nuclear material, as well as support for other missions related to national security. DOE/NNSA administers the NNSS, RSL, and NLVF and is a tenant on the USAF's TTR.

Transfer of Responsibility for Project Shoal and the Central Nevada Test Area. Responsibility for Project Shoal and Central Nevada Test Area environmental restoration sites was transferred to the DOE Office of Legacy Management in 2006. The DOE/NNSA NSO's Environmental Management Program completed surface remediation at these sites before the transfer; the remaining work is associated with long-term surveillance (groundwater monitoring) and maintenance. These sites are no longer under DOE/NNSA control and, by agreement with the DOE Office of Legacy Management, are not further addressed in this *NNSS SWEIS.*

Renaming the Nevada Test Site. In order to better reflect the diversity of nuclear, energy, and homeland security activities conducted at the site, the former Nevada Test Site was renamed the Nevada National Security Site in 2010.

2.5.2 Physical Changes

The NNSS boundary and land withdrawal changes. The *1996 NTS EIS* identified various public land orders and withdrawals, as well as a Memorandum of Understanding between the USAF and the DOE Nevada Operations Office (the predecessor of the DOE/NNSA NSO), as the basis for the lands composing the NNSS. The Military Lands Withdrawal Act of 1999 (P.L. 106-65) revoked Public Land Order 1662 in its entirety and legislatively withdrew the area that makes up the northwestern corner of the NNSS for exclusive DOE use. The Military Lands Withdrawal Act resulted in changes to the border around the northwestern corner of the NNSS, which was historically used for nuclear weapons testing under the Memorandum of Understanding. Figure 2–2 shows both the current NNSS boundary and the boundary as it existed in 1996.

Area 5 Land Transfer. As part of an April 1997 settlement agreement (which resulted in dismissal of *Nevada v. Pena* [CV-5-94-00576-PMP (RLH)] by the U.S. District Court in Nevada) between the State of Nevada and DOE, consultation with the U.S. Department of Interior was initiated concerning the status of existing land withdrawals with regard to LLW waste storage and disposal. This consultation process concluded with DOE/NNSA's formal acceptance of custody and control of the approximately 740 acres constituting the Area 5 RWMC in a land transfer action.

Yucca Mountain Management Agreement. As indicated in the fiscal year 2010, 2011, and 2012 budget requests, the Administration decided to cease funding and activities related to the development of a repository at Yucca Mountain, while developing alternative storage and disposal approaches for spent nuclear fuel and high-level radioactive waste. Proposed actions associated with the former Yucca Mountain Project included construction, operation, monitoring, and eventual closure of a geologic repository at Yucca Mountain for disposal of spent nuclear fuel and high-level radioactive waste already in storage or projected to be generated at 72 commercial and 5 DOE sites across the United States. In 1994, the DOE Nevada Operations Office entered into a management agreement with the DOE Yucca Mountain Site Characterization Office for use of about 58,000 acres of the NNSS land for site characterization activities related to the former Yucca Mountain Project. Under the agreement, the Yucca Mountain Project was responsible for meeting the same environmental requirements that applied to the NNSS independent of, but in coordination with, the NNSS organizations. DOE/NNSA maintains the infrastructure and buildings and provides security and support to DOE to remain compliant with Federal and state regulations pursuant to existing site permits. DOE recognizes that it has an obligation to remediate lands disturbed by past activities associated with the former Yucca Mountain Project. Accordingly, DOE has evaluated the potential cumulative impacts of remediating the lands and closing the infrastructure and buildings at Yucca Mountain (see Chapter 6 of this SWEIS). This analysis is based on the preliminary approach to remediating and closing the Yucca Mountain site and facilities described under the No Action Alternative in the *Final Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada* (DOE 2002e). The preliminary approach analyzed in Chapter 6 of this SWEIS represents but one of many potential approaches. Upon receipt of appropriations, DOE plans to prepare a detailed proposal to remediate the lands and close the infrastructure and buildings, as required by law, regulations, and applicable agreements, and then undertake further National Environmental Policy Act reviews, as appropriate. After the completion of site closure, DOE would initiate a long-term surveillance program.

Notwithstanding the decision to terminate the Yucca Mountain Project, DOE remains committed to meeting its obligations to manage and ultimately dispose spent nuclear fuel and high-level radioactive waste. The Blue Ribbon Commission on America's Nuclear Future was established in March 2010 to conduct a comprehensive review of the back end of the fuel cycle and evaluate alternative approaches for meeting these obligations. The Blue Ribbon Commission provided a final report in January 2012 that highlights the Commission's findings and conclusions and presents recommendations for consideration by the Administration and Congress, as well as interested state, tribal, and local governments; other stakeholders; and the public (BRC 2012).

Higher-than-expected growth in Clark and Nye Counties. The *1996 NTS EIS* projected that, in 2005, the populations of Clark and Nye Counties would be 1,380,920 and 38,516 persons, respectively (DOE 1996c). The actual populations in mid-2005 were 1,796,380 and 41,302 persons for Clark and Nye Counties, respectively (NSBDC 2010). These numbers represent an approximate 30 percent increase over projected values for Clark County and a 7 percent increase for Nye County. In Clark County, much of the growth occurred in the northwestern portion of the Las Vegas Valley, projecting toward the NNSS. This growth is potentially relevant to the analysis in this *NNSS SWEIS* because it creates a greater demand for resources and a larger number of people closer to the NNSS. Most recently, however, there has been a small decrease in population for both Clark and Nye Counties. Clark County decreased 0.8 percent from a high of 1,967,716 in mid-2008 to 1,952,040 in mid-2009. Nye County decreased 2.1 percent from a high of 47,370 in mid-2008 to 46,360 in mid-2009. The population used as the baseline for analysis in this *NNSS SWEIS* is provided in Chapter 4, Section 4.1.4. Information on the analysis of socioeconomic impacts is located in Chapter 5, Section 5.1.4.

As the populations in Clark and Nye Counties have increased, concern over water rights and water use has also increased. The Southern Nevada Water Authority has sought to purchase water rights in Lincoln, White Pine, and Nye Counties to meet the growing demand in Clark County. Nye County established the Nye County Water District in 2009 to manage, evaluate, and mitigate groundwater and surface-water resources in Nye County and to develop a long-range sustainability plan (Nye 2010). Water consumption at the NNSS has decreased compared with the 2,975 million gallons per year projected in the *1996 NTS EIS* over the 10-year planning period. While NNSS water use has decreased, solar power generation facilities, described in Chapter 3 of this *NNSS SWEIS*, could increase the demand for water in the southern areas of the NNSS. Further information on NNSS water use and groundwater availability is presented in Chapter 4, Sections 4.1.2.1 and 4.1.6.2. Potential impacts from implementation of alternatives are presented in Chapter 5, Sections 5.1.2.1 and 5.1.6.2, and in Chapter 6, Section 6.3.6.2.

2.5.3 Program and Activity Changes

A number of changes related to NNSS programs and activities have occurred since the *1996 NTS EIS* after the appropriate level of National Environmental Policy Act review was conducted. The most important of these changes are described as follows:

- DOE/NNSA relocated its operational capabilities associated with Security Category I and II special nuclear material and the critical assembly machines from Technical Area 18 at Los Alamos National Laboratory in New Mexico to DAF at the NNSS. DOE/NNSA conducts nuclear criticality operations at DAF to enable personnel to gain knowledge and expertise in advanced nuclear technologies that support nuclear materials management and criticality safety, emergency response, nonproliferation, safeguards, arms control, and stockpile stewardship science.

- DOE/NNSA expanded BEEF (initial operation began in 1994), as planned and analyzed in the *1996 NTS EIS*. It was modified to perform explosives-driven, pulsed-power experiments.

- DOE/NNSA completed construction and modifications of JASPER to conduct experiments that provide data on the Nation's nuclear weapons stockpile.

- DOE/NNSA relocated the Atlas Facility from Los Alamos National Laboratory to the NNSS. The Atlas Facility was used to conduct pulsed-power experiments until it was placed in standby mode in 2007.

- DOE/NNSA identified the U12g Tunnel for the activities of the Improvised Nuclear Device Program. If an improvised nuclear device were to be recovered, the tunnel would be used to stage, assess, and safeguard the weapon.

- A Counterterrorism Support Program was instituted that makes use of site facilities for training and adds activities at NPTEC in Area 5 to address emergency response and counterterrorism training.

- RNCTEC was constructed in Area 6 to provide analysis and evaluation capability for radiological and nuclear detection devices.

- DOE/NNSA completed upgrades to the Aerial Operations Facility in Area 6, including construction of a runway and a broad variety of infrastructure improvements.

- A Solar Enterprise Zone was identified at the NNSS, as described in the *1996 NTS EIS*, but a proposed commercial solar facility was cancelled by the project proponent.

- The Nevada Desert Free Air Carbon Dioxide Enrichment Facility and the Mojave Global Change Facility were built in Area 5. These facilities are used to perform controlled manipulative experiments (e.g., analyses of carbon dioxide enrichment, increased precipitation, and evolving soil conditions on natural systems) under controlled conditions.

- The U.S. Military Development and Training in Tactics and Procedures for Counterterrorism Threats and National Security Defense Program was instituted to develop methods for combating adversaries in a desert environment. This activity could occur at any location on the NNSS.

- The Area 5 RWMC resumed acceptance of mixed low-level radioactive waste from approved offsite generators in 2006 after a restriction on the receipt of these wastes was lifted by the Nevada Division of Environmental Protection during the renewal of the interim status permit in December 2005.

- Environmental Restoration Program activities have been ongoing since the *1996 NTS EIS* (DOE 1996c) was published. These activities have included the following:
  - Underground Test Area Project – Activities included conducting groundwater characterization and monitoring, drilling new monitoring wells, and developing groundwater flow and transport models.
  - Soils Project – Activities included characterization, monitoring, sampling, and corrective actions.
  - Industrial Sites Project – The majority of sites under the Federal Facility Agreement and Consent Order have been closed. Activities under this project included remediating, decontaminating, and decommissioning unneeded facilities.
  - Defense Threat Reduction Agency sites – The Defense Threat Reduction Agency is responsible for these sites. Surface-disturbing activities associated with these sites have been completed. Environmental monitoring, such as water sampling, was initiated and is ongoing.
  - Borehole Management Program – Most unneeded boreholes have been plugged at the NNSS. The program's expected completion date is the end of 2013.

Overview of Changes to the American Indian Writing Contributions Since the *1996 NTS EIS*

In 1995, the U.S. Department of Energy (DOE) invited the Consolidated Group of Tribes and Organizations (CGTO) to participate in the development of the *Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada (1996 NTS EIS)*, to represent the American Indian perspective of the actions proposed and analyzed by DOE, and to consider and address the resources impacted. In response, the CGTO developed Appendix G for the *1996 NTS EIS* and provided italicized text for selected sections.

Appendix G and the italicized Final Environmental Impact Statement (EIS) text presented the American Indian perspective and recommended impact mitigation approaches for reducing potential impacts to Indian resources and other heritage values within the analyzed areas. American Indian involvement with the *1996 NTS EIS* and the development of Appendix G followed an American Indian Consultation Model[1] for government-to-government interactions among DOE and culturally affiliated American Indian Tribes. This was considered an innovative approach by Federal agencies at that time.

During the 2009 DOE Annual Tribal Meeting with the CGTO, DOE invited the CGTO to revisit the *1996 NTS EIS* and subsequent National Environmental Policy Act (NEPA) Supplement Analyses, to review the current and proposed activities presented in this site-wide environmental impact statement (SWEIS), and to develop text that reflects the CGTO's perspective and current concerns. DOE also expanded the CGTO's involvement by providing us with the opportunity to write culturally appropriate text summarizing our perspective and concerns for every section and appendix within the SWEIS, as appropriate, in addition to writing Appendix C, "The American Indian Assesment of Resources and Alternatives Presented in the SWEIS".

See Appendix C for more details.

[1] *The American Indian Consultation Model was based on the Consultation Model produced for the DoD Legacy Project, which was modified by the American Indian Writers Subgroup (AIWS) for the CGTO and implemented during the development of the 1996 NTS EIS. This model was again revisited and implemented by the AIWS for the CGTO in the development of the SWEIS, and is presented in Section 10.2.1.*

CHAPTER 3
DESCRIPTION OF ALTERNATIVES

3.0 DESCRIPTION OF ALTERNATIVES

This chapter contains descriptions of the alternatives that are being evaluated by the U.S. Department of Energy and National Nuclear Security Administration (DOE/NNSA) for continued operation of the Nevada National Security Site (NNSS) (formerly known as the Nevada Test Site), the Remote Sensing Laboratory (RSL) at Nellis Air Force Base, the North Las Vegas Facility (NLVF), the Tonopah Test Range (TTR), and environmental restoration sites located on the Nevada Test and Training Range (formerly the Nellis Air Force Range). Three alternatives are addressed in this *Site-Wide Environmental Impact Statement for the Continued Operation of the Department of Energy/National Nuclear Security Administration Nevada National Security Site and Off-Site Locations in the State of Nevada* (*NNSS SWEIS*)*:* (1) the No Action Alternative, described in Section 3.1; (2) the Expanded Operations Alternative, described in Section 3.2; and (3) the Reduced Operations Alternative, described in Section 3.3. Other sections of this chapter include Section 3.4, Comparison of Potential Consequences of the Alternatives; Section 3.5, Alternatives Eliminated from Detailed Study; and Section 3.6, Identification of the Preferred Alternative. Appendix A of this *NNSS SWEIS* provides a more detailed description of the alternatives. Some of the descriptions include American Indian perspectives prepared by the American Indian Writers Subgroup; the American Indian Writers Subgroup input is in text boxes identified with a Consolidated Group of Tribes and Organizations feather icon.

Descriptions of the alternatives are organized under three mission areas, each with two or more associated programs. These missions and their associated programs are: (1) the National Security/Defense Mission, which includes the Stockpile Stewardship and Management, Nuclear Emergency Response, Nonproliferation, Counterterrorism, and Work for Others Programs; (2) the Environmental Management Mission, which includes the Waste Management and Environmental Restoration Programs; and (3) the Nondefense Mission, which includes the General Site Support and Infrastructure, Conservation and Renewable Energy, and Other Research and Development Programs.

The three alternatives include similar types of projects and activities, but differ primarily in operational intensity and facilities requirements. Under all of the alternatives in this site-wide environmental impact statement (SWEIS), DOE/NNSA would maintain the capability to conduct an underground nuclear test. Only if directed by the President in the interest of national security would DOE/NNSA conduct such a test; however, conducting such a test is not included or analyzed under any of the alternatives in this SWEIS. A brief description of underground nuclear test phenomenology is included for informational purposes in Appendix H. The No Action Alternative generally reflects the use of existing facilities to maintain operations at levels consistent with those experienced since 1996, as well as those anticipated by project-specific National Environmental Policy Act (NEPA) analyses and agency decisions made since 1996 (see Chapter 2, Section 2.5). The Expanded Operations Alternative differs from the No Action Alternative in that, for many activities, the levels of operation would be higher and a number of new facilities would be constructed to support these higher levels of operation. In addition, under the Expanded Operations Alternative, DOE/NNSA would modify NNSS land use zones to better reflect the kinds of activities that would be undertaken. Under the Reduced Operations Alternative, DOE/NNSA would conduct some activities at levels similar to those under the No Action Alternative, but for other activities, the levels of operations would be lower or would cease. DOE/NNSA would also make NNSS land use zone changes under the Reduced Operations Alternative that would limit most activities in the northwestern portion of the NNSS. Mission-related capabilities, projects, and programmatic activities are identified for each of the proposed alternatives in the following sections and **Table 3–1** summarizes the similarities and differences among the three alternatives evaluated in this SWEIS. Detailed descriptions of the activities included under each alternative are provided in Appendix A.

DOE "National Environmental Policy Act Implementing Procedures" (10 *Code of Federal Regulations* [CFR] Part 1021) define site-wide NEPA documents as broad-scope environmental impact statements (EISs) or environmental assessments (EAs) that are programmatic in nature and identify and assess the individual and cumulative impacts of ongoing and reasonably foreseeable future actions at a DOE/NNSA site. This SWEIS considers ongoing and proposed programs, capabilities and projects (i.e., activities) at DOE/NNSA facilities in Nevada over the next 10 years.

The nature of ongoing activities and their associated environmental impacts are well understood. In contrast, however, the nature of some proposed activities is less well known. In the interest of disclosing potential environmental impacts that could occur at the NNSS and offsite locations over the next 10 years, this SWEIS includes ongoing activities, as well as activities that are more conceptual in nature.

To assess potential environmental impacts from all such activities, it was necessary for DOE/NNSA to estimate at a programmatic level certain aspects of the more conceptual proposed activities, such as the potential area of land disturbance or the amount of groundwater that may be required. DOE/NNSA incorporated these programmatic-level estimates, along with more-detailed information on ongoing and better-understood activities, into the analysis of impacts. For instance, estimated areas of land disturbance for both potential future activities and well-defined activities were used in estimating impacts on resources such as soils (area of disturbance and erosion), cultural resources (number of sites potentially affected), and biology (vegetation/habitat loss, number of desert tortoises affected).

DOE/NNSA understands that the level of NEPA analysis conducted for some proposed future activities may not be sufficient to permit implementation, and such activities could require additional NEPA analysis. These activities are identified in this chapter. DOE/NNSA will conduct NEPA reviews for these activities, as appropriate, in the future. DOE/NNSA's NEPA review procedures are described in Chapter 9, Section 9.1.1.

DOE/NNSA has at various times considered the possibility of supporting commercial solar projects at the NNSS. In this *NNSS SWEIS*, DOE/NNSA evaluates potential commercial solar power generation facilities under each of the three alternatives; however, there is no specific proposal for such a project at this time. For this reason, DOE/NNSA cannot be certain regarding the size of any solar power generation facility that might be constructed or whether DOE/NNSA support for such a facility might extend beyond providing access to land and certain infrastructure, such as providing partial funding. However, to ensure consideration of potential environmental impacts in a decision by DOE/NNSA to actively support development of one or more commercial solar power generation facilities at the NNSS, each alternative in this *NNSS SWEIS* addresses commercial-scale projects (the size of the potential facility varies with each alternative). DOE/NNSA selected the potential size of the generation facility under each alternative in terms of megawatts of generating capacity to provide a reasonable range of generating capacities, not to portray any actual project under consideration. Neither did DOE/NNSA intend to stipulate a certain generating capacity per unit of land area, realizing that as technology improves, smaller parcels of land may be sufficient to generate the same amount of electricity than are currently required. The assumptions used in the analyses of impacts from a potential solar power generation facility at the NNSS were selected to provide conservative analyses that would not underestimate impacts. If a commercial solar power project were proposed at the NNSS in the future, project-specific NEPA review would be required.

Detailed Description of Alternatives—American Indian Perspective

The Consolidated Group of Tribes and Organizations (CGTO) is concerned about culturally perceived harmful land disturbing U.S. Department of Energy (DOE) actions described in this chapter and Appendix A of this site-wide environmental impact statement (SWEIS). We are concerned because these actions adversely impact the Nevada National Security Site (NNSS) land and offsite locations, which in turn affect the American Indian cultural landscape.

Since 1987, DOE has provided opportunities for representatives of the CGTO to visit portions of the NNSS and identify important places, spiritual trails, and landscapes of traditional and contemporary cultural significance. [1] These actions by DOE are considered positive steps towards fulfilling its trust responsibility through facilitating co-stewardship and land management strategies between DOE and the CGTO; however, this is an ongoing process.

To avert or minimize further impacts, the CGTO recommends DOE and the CGTO develop co-management strategies to help protect the land by implementing the following actions before continuing with these current or proposed activities:

- Identify those areas that have been disrespected and culturally damaged, so that balance can once again be restored.
- Avoid further harmful ground-disturbing activities
- Make mitigation of restorable areas a top priority
- Avert or minimize damage to geological formations important to the cultural and ecological landscape, songscapes and storyscapes
- Implement collaborative environmental restoration techniques that require minimal ground disturbing activities (see CGTO response to Section 3.1.2.2)
- Continue to pursue systematic consultations with American Indians so potentially impacted resources can be readily identified, alternative solutions discussed, and adverse impacts averted
- Provide American Indian people increased access to culturally significant areas so that we can use our knowledge, prayers, and traditions to effectively restore balance to the natural and spiritual harmony of the NNSS area and offsite locations

In addition, the CGTO recommends DOE and the CGTO continue to hold annual meetings to discuss current and proposed actions in greater depth, deliberate potential impacts, and consider and develop mutually acceptable mitigation measures. This is particularly necessary for those actions requiring additional National Environmental Policy Act (NEPA) analysis, including but not limited to solar and geothermal energy development.

In the view of Indian people, the ideal alternative would be to avoid any action that further disturbs the land and resources associated with the NNSS and the offsite locations.

We believe we have been created and placed on these lands. Because of our birth-right and strong ties to our ancestral land, the CGTO believes we have undeniable rights to interact with its precious resources, and a continuous obligation to protect it. The CGTO takes this responsibility very seriously and has developed our input for the alternatives presented throughout Chapter 3 so we may fulfill this obligation.

See Appendix C for more details.

[1] *Because this is a public document, the exact locations of these areas will not be revealed unless determined necessary during government-to-government consultation.*

Table 3–1 Comparison of Mission-Based Program Activities Under the Proposed Alternatives

NO ACTION ALTERNATIVE	EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
National Security/Defense Mission		
Stockpile Stewardship and Management Program (see Sections 3.1.1.1, 3.2.1.1, and 3.3.1.1 of this chapter for additional information)		
Maintain readiness to conduct underground nuclear tests.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Conduct up to 10 dynamic experiments per year within NNSS Areas 1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 16, 19, or 20.	Conduct up to 20 dynamic experiments per year within NNSS Areas 1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 16, 19, or 20.	Conduct up to 6 dynamic experiments per year at the NNSS; no dynamic experiments would be conducted in Areas 19 or 20.
Conduct up to 20 conventional explosives experiments per year at BEEF and up to 10 per year within NNSS Areas 1, 2, 3, 4, 12, or 16 using up to 70,000 pounds TNT-equivalent of explosive charges; would also support Work for Others Program.	• Conduct up to 100 conventional explosives experiments per year within NNSS Areas 1, 2, 3, 4, 12, or 16 using up to 120,000 pounds TNT-equivalent of explosive charges (50 of these would be at BEEF with a TNT-equivalent limitation of 70,000 pounds); would also support Work for Others Program. • Add second firing table and high-energy x-ray capability at BEEF. • Establish up to three areas at the NNSS for conducting explosive experiments with depleted uranium and conduct up to 20 experiments per year.	Conduct up to 10 conventional explosives experiments per year at BEEF using up to 70,000 pounds TNT-equivalent of explosive charges per year to directly support the Stockpile Stewardship and Management Program; no other explosives experiments would be conducted.
Conduct up to 12 shock physics experiments per year at the NNSS using actinide targets at JASPER in Area 27 and up to 10 experiments per year using the Large-Bore Powder Gun in Area 1.	Conduct up to 36 shock physics experiments per year at the NNSS using actinide targets at JASPER in Area 27 and up to 24 experiments per year using the Large-Bore Powder Gun in Area 1.	Conduct up to 6 shock physics experiments per year at the NNSS using actinide targets at JASPER in Area 27 and up to 8 experiments per year using the Large-Bore Powder Gun in Area 1.
Conduct up to 500 criticality operations (experiments, training, and other operations) per year at the National Criticality Experiments Research Center at DAF in Area 6.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Maintain the Atlas Facility in standby with the capability to conduct up to 12 pulsed-power experiments per year.	Activate the Atlas Facility and conduct up to 24 pulsed-power experiments per year.	Decommission and disposition the Atlas Facility.
Conduct up to 600 plasma physics and fusion experiments each year at NLVF and 50 per year in NNSS Area 11.	Conduct up to 1,000 plasma physics and fusion experiments each year at NLVF and 650 per year in NNSS Area 11, increasing the size and complexity of such experiments.	Conduct up to 350 plasma physics and fusion experiments each year at NLVF and 25 per year in NNSS Area 11.
Conduct five drillback operations at the NNSS over about a 10-year period.	Same as under the No Action Alternative.	Same as under the No Action Alternative.

NO ACTION ALTERNATIVE	EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
Conduct Stockpile Stewardship and Management Program activities in NNSS Areas 1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 16, 19, or 20, including the following:	Same as under the No Action Alternative, plus:	Same as under the No Action Alternative, except: Stockpile Stewardship and Management Program activities would not be conducted in Areas 19 and 20.
– Disposition damaged U.S. nuclear weapons on an as-needed basis.	– Stage nuclear devices pending dismantlement, modification/maintenance, and/or transportation to another location. – Dismantle up to 100 nuclear weapons per year. – Replace limited-life components of up to 360 nuclear devices and conduct associated maintenance activities. – Test weapons components for quality assurance under the Limited Life Component Exchange Program.	
– Stage special nuclear material, including nuclear weapon pits.	– Transfer special nuclear material, including nuclear weapon pits, to and from other parts of the DOE complex for staging and use in experiments at the NNSS.	
Conduct training for the Office of Secure Transportation up to six times per year at various locations on NNSS roads.	Same as under the No Action Alternative, plus: Develop facilities in Area 17 and upgrade or construct new facilities in Area 6, 12, or 23 to support training for the Office of Secure Transportation.	Conduct training for the Office of Secure Transportation up to four times per year at various locations on NNSS roads.
Conduct the following stockpile stewardship operations at the TTR: – Conduct tests and experiments, including flight test operations for gravity weapons (i.e., bombs). – Conduct ground/air-launched rocket and missile operations. – Conduct impact testing. – Conduct passive testing of joint test assemblies and conventional weapons. – Conduct fuel-air explosives testing.	Same as under the No Action Alternative, except: Certain safeguards and security functions and other administrative functions would be returned to the U.S. Air Force	Same as under the No Action Alternative, except: – Discontinue ground/air-launched rocket and missile operations. – Discontinue fuel-air explosives testing at the TTR.
Nuclear Emergency Response, Nonproliferation, and Counterterrorism Programs (see Sections 3.1.1.2, 3.2.1.2, and 3.3.1.3 of this chapter for more information)		
Provide support for the Nuclear Emergency Support Team, the Federal Radiological Monitoring and Assessment Center, the Accident Response Group, and the Radiological Assistance Program. Most of this support is out of RSL at Nellis Air Force Base.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Conduct Aerial Measuring System activities from RSL at Nellis Air Force Base.	Same as under the No Action Alternative.	Same as under the No Action Alternative.

NO ACTION ALTERNATIVE	EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
Conduct WMD emergency responder training at various DOE/NNSA NSO venues.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Support the DOE Emergency Communications Network.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Disposition improvised nuclear devices and deploy the DOE/NNSA Disposition Program and FBI Disposition Forensic Program to the NNSS for training and exercises or for an actual event, as needed.	Same as under the No Action Alternative, plus disposition of radiological dispersion devices, as needed.	Same as under the No Action Alternative.
Integrate existing activities and primarily NNSS facilities to support U.S. efforts to control the spread of WMDs, particularly nuclear WMDs, including arms control, nonproliferation activities, nuclear forensics, and counterterrorism capabilities.	Same as under the No Action Alternative, plus: At the NNSS: • Construct laboratory space and other facilities for design and certification of treaty verification technology, training of inspectors, and development of arms control confidence-building measures as part of the Arms Control Treaty Verification Test Bed.[a] • Develop and construct new facilities to support a Nonproliferation Test Bed to simulate chemical and radiological processes that an adversary would clandestinely conduct.[a] • Construct an Urban Warfare Complex to support counterterrorism training.[a]	Same as under the No Action Alternative.
Work for Others Program (see Sections 3.1.1.3, 3.2.1.3, and 3.3.1.3 of this chapter for more information)		
Continue to conduct Work for Others Program activities in all appropriate zones on the NNSS, and at RSL and NLVF.	Same as under the No Action Alternative, except: The NNSS land use zone designation for Area 15 would be changed from “Reserved Zone” to “Research, Test, and Experiment Zone.”	Same as under the No Action Alternative, except: Work for Others Program activities, with the exception of military training and exercises, would not be conducted in Areas 18, 19, 20, 29, and 30 at the NNSS.
Host treaty verification activities.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Conduct nonproliferation projects and counterproliferation research and development at the NNSS, including:	Same as under the No Action Alternative.	Same as under the No Action Alternative, except:
– Conduct conventional weapons effects and other explosives experiments.		Discontinue Work for Others Program conventional weapons effects and other explosives experiments.
– Support development of capabilities to detect and defeat military assets in deeply buried hardened targets.		Discontinue development of capabilities to defeat military assets in deeply buried hardened targets.
– Conduct up to 20 controlled chemical and biological simulant release experiments per year (each experiment would include multiple releases by a variety of means, including explosive).		Discontinue projects requiring explosive releases of chemical or biological simulants.

NO ACTION ALTERNATIVE	EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
– Support training, research and development of equipment, specialized munitions, and tactics related to counterterrorism.		
Support the U.S. Department of Defense and other Federal agencies in developing counterterrorism capabilities.	Develop and construct new facilities to support counterterrorism training and research and development activities.	Same as under the No Action Alternative.
Conduct criticality experiments to support NASA's deep space power source development within the parameters for criticality experiments established under the Stockpile Stewardship and Management Program.	Same as under the No Action Alternative, plus: Support NASA's deep space power source development, including conducting experiments using existing boreholes at the NNSS to sequester emissions such as radionuclides.[a]	Same as under the No Action Alternative.
Host the use of various aerial platforms, such as airplanes, unmanned aerial systems and helicopters, at various locations at the NNSS for research and development, training, and exercises.	• Increase use of various aerial platforms, such as airplanes, unmanned aerial systems, and helicopters, for research and development, training, and exercises, including constructing additional hangars, shops, and buildings at existing airports at the NNSS. • Conduct up to 3 underground and 12 open-air radioactive tracer experiments per year. • Host treaty verification activities, including development of a facility for simulating nuclear fuel cycle-related radionuclide release detection and characterization.[a] • Develop a facility for specialized explosive experiments and simulated manufacture to support high-explosives experiments.[a] • Support increased research and development of active interrogation equipment, methods, and training. • Develop new facilities to support research and development in radio frequency generation and infrasonic observations.[a] • Develop new facilities, including simulated clandestine laboratories, to support chemical and biological simulant experiments.[a]	Same as under the No Action Alternative.
Conduct Work for Others Program activities at the TTR, including robotics testing, smart transportation-related testing, smoke obscuration operations, infrared tests, and rocket development.	Same as under the No Action Alternative, except: Certain safeguards and security functions and other administrative functions would be turned over to the U.S. Air Force.	Same as under the No Action Alternative.

NO ACTION ALTERNATIVE	EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
Environmental Management Mission		
Waste Management Program (see Sections 3.1.2.1, 3.2.2.1, and 3.3.2.1 of this chapter for more information)		
Dispose up to 15,000,000 cubic feet of LLW and 900,000 cubic feet of MLLW [b] in the Area 5 RWMC.	Dispose up to 48,000,000 cubic feet of LLW and 4,000,000 cubic feet of MLLW at the Area 5 RWMC and Area 3 RWMS.	Same as under the No Action Alternative.
Maintain the Area 3 RWMS on standby.	Open the Area 3 RWMS for disposal of authorized and/or permitted waste.	Same as under the No Action Alternative.
Repackage onsite-generated MLLW.	Same as under the No Action Alternative, plus: At the Area 5 RWMC, store MLLW received from on- and offsite generators pending treatment via macroencapsulation and microencapsulation (i.e., repackaging), sorting/segregating, and bench-scale mercury amalgamation, as appropriate, and/or dispose this waste.	Same as under the No Action Alternative.
Store onsite-generated TRU waste (up to 9,600 cubic feet over the next 10 years) pending offsite disposal.	Same as under the No Action Alternative, except a larger volume (up to 19,000 cubic feet over the next 10 years) of TRU waste would be generated by increased activities at NNSS facilities, such as JASPER.	Same as under the No Action Alternative, except smaller volumes (up to 7,100 cubic feet over the next 10 years) of TRU waste would be generated by reduced operational levels at NNSS facilities, such as JASPER.
Store onsite-generated hazardous waste as needed at the Area 5 Hazardous Waste Storage Unit pending offsite treatment or disposal. Up to 170,000 cubic feet would be generated over the next 10 years.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Operate the Area 11 Explosives Ordnance Disposal Unit. No more than 41,000 pounds of explosives would be treated over the next 10 years.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Operate the Area 6 Hydrocarbon Landfill.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Operate the Area 23 Solid Waste Disposal Site and the U10c Solid Waste Disposal Site. Up to 3,400,000 cubic feet would be disposed over the next 10 years.	Same as under the No Action Alternative, plus: Larger volumes of solid sanitary waste (up to 8,500,000 cubic feet) would be generated by increased activity levels at the NNSS over the next 10 years. Construct new sanitary solid waste disposal facilities as needed in Area 23 and develop a new solid waste disposal site in Area 25 to support environmental restoration activities.	Same as under the No Action Alternative, except lower volumes of solid sanitary waste (up to 3,300,000 cubic feet) would be generated by reduced activity levels at the NNSS over the next 10 years.

NO ACTION ALTERNATIVE	EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
Environmental Restoration Program (see Sections 3.1.2.2, 3.2.2.2, and 3.3.2.2 of this chapter for more information)		
Underground Test Area Project – Comply with the FFACO; monitor groundwater from existing wells; drill new characterization and monitoring wells; develop groundwater flow and transport models; and continue to evaluate closure strategies.	Same as under the No Action Alternative, except: Characterization and monitoring wells would be developed more quickly.	Same as under the No Action Alternative.
Soils Project – Identify and characterize areas with contaminated soils and perform corrective actions in compliance with the FFACO.	Same as under the No Action Alternative, except: If stricter cleanup standards are implemented, larger volumes of radioactive waste would be generated and disposed.	Same as under the No Action Alternative.
Industrial Sites Project – Identify, characterize, and remediate industrial sites under the FFACO and continue decontaminating and decommissioning facilities.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Defense Threat Reduction Agency sites – In accordance with the FFACO, perform remediation activities at sites that are the responsibility of the Defense Threat Reduction Agency.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Execute the Borehole Management Program.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Nondefense Mission		
General Site Support and Infrastructure Program (see Sections 3.1.3.1, 3.2.3.1, and 3.3.3.1 of this chapter for more information)		
Conduct small projects to maintain the present capabilities of DOE/NNSA NSO facilities in all areas of the NNSS and at NLVF, RSL, and the TTR. Maintain existing infrastructure, manage various permits and agreements, and provide security for the former Yucca Mountain site.	Same as under the No Action Alternative, plus: • Construct a new 85,000-square-foot multistory security building in Area 23. • Replace the NNSS 138-kilovolt electrical transmission system. • Expand cellular telecommunication system on the NNSS. • Reconfigure Mercury.[a]	Same as under the No Action Alternative, except: Only critical infrastructure would be maintained within Areas 18, 19, 20, 29, and 30 of the NNSS, including certain communications facilities; electrical transmission lines and substations; and Well 8. Roads within these areas would only be maintained to provide access to the infrastructure and environmental restoration sites.
Conservation and Renewable Energy Program (see Sections 3.1.3.2, 3.2.3.2, and 3.3.3.2 of this chapter for more information)		
Continue to identify and implement energy conservation measures and renewable energy projects in compliance with applicable Executive Orders and DOE Orders.	Same as under the No Action Alternative, plus:	Same as under the No Action Alternative, except:
– Reduce energy intensity by 3 percent annually through the end of fiscal year 2015, for a total 30 percent reduction.		
– Reduce greenhouse gas emissions by 28 percent by fiscal year 2020.		
– Install advanced electric metering systems.		

NO ACTION ALTERNATIVE	EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
– Obtain at least 7.5 percent of the NNSS annual electricity and thermal consumption from renewable energy sources.		
– Support development of a 240-megawatt commercial solar power generation facility in Area 25.[a c]	• Modify NNSS land use zones to establish a 39,600-acre Renewable Energy Zone in Area 25 and support development of commercial solar power generation facilities in Area 25 with a maximum combined generating capacity of 1,000 megawatts.[a, c] • Construct a 5-megawatt photovoltaic solar power generation facility near the Area 6 Construction Facilities. • Support a Geothermal Demonstration Project and Geothermal Research Center at the NNSS.[a]	Support development of a 100-megawatt commercial solar power generation facility in Area 25.[a c]
– Reduce water use by 16 percent by 2015.		
– Maximize use of alternative fuels (e.g., E85 and biodiesel).		
– Ensure all new construction and renovation projects implement high-performance building goals.		
Other Research and Development Programs (see Sections 3.1.3.3, 3.2.3.3, and 3.3.3.3 of this chapter for more information)		
Support the DOE National Environmental Research Park Program and other non-DOE/NNSA research and development activities in all areas of the NNSS.	Same as under the No Action Alternative.	National Environmental Research Park Program and other non–DOE/NNSA research and development activities would be conducted in all areas of the NNSS except Areas 18, 19, 20, 29, and 30.

BEEF = Big Explosives Experimental Facility; DAF = Device Assembly Facility; FBI = Federal Bureau of Investigation; FFACO = Federal Facilities Agreement and Consent Order; JASPER = Joint Actinide Shock Physics Experimental Research Facility; LLW = low-level radioactive waste; MLLW = mixed low-level radioactive waste; NASA = National Aeronautics and Space Administration; NLVF = North Las Vegas Facility; NNSA = National Nuclear Security Administration; NNSS = Nevada National Security Site; NSO = Nevada Site Office; NNSS = Nevada National Security Site; RSL = Remote Sensing Laboratory; RWMC = Radioactive Waste Management Complex; RWMS = Radioactive Waste Management Site; TNT = 2,4,6-trinitrotoluene; TRU = transuranic; TTR = Tonopah Test Range; WMD = weapon of mass destruction.

[a] These potential projects have not reached a point of development to allow full analysis in this *NNSS SWEIS* and would be subject to project-specific NEPA review before DOE/NNSA would make any decision regarding implementation.

[b] The actual permitted capacity of the Mixed Waste Disposal Unit (Cell 18) is 899,996 cubic feet.

[c] DOE/NNSA has not received or solicited proposals for any commercial solar power generation projects.

3.1 No Action Alternative

As defined in this *NNSS SWEIS*, the No Action Alternative reflects the use of existing facilities and ongoing projects to maintain operations consistent with those experienced in recent years at the NNSS and offsite locations in Nevada. For each mission and its supporting programs, levels of operations for associated capabilities and projects were determined by evaluating historic operational values since 1996, such as the number of experiments performed at the Joint Actinide Shock Physics Experimental Research Facility (JASPER) or the U1a Complex; reasonable expectations for newer projects, such as the number of projected shots for the Large-Bore Powder Gun; or the nature and number of proposed activities, such as training undertaken for the Office of Secure Transportation. For example, in 2004 and 2006, DOE/NNSA conducted 8 experiments with plutonium at JASPER; for the No Action Alternative, DOE/NNSA is analyzing up to 12 such experiments at JASPER. The operational level for disposal operations of low-level radioactive waste (LLW) in the No Action Alternative was based on the volumes of LLW actually disposed during fiscal years (FY) 1997 through 2010. The No Action Alternative level of operations represents the baseline against which the other alternatives are compared. In the *Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada* (*1996 NTS EIS*) (DOE 1996c), DOE/NNSA identified land use zones in which certain categories of activities, such as nuclear, dynamic, and hydrodynamic experiments and other compatible defense and nondefense research and development and testing, would be conducted. The land use zones are used to manage activities at the NNSS to prevent interference among the various missions, programs, projects, and activities, but are not considered absolute descriptors of the range of activities that may occur in a particular zone. **Figure 3–1** depicts these land use zones and the major facilities at the NNSS that would continue under the No Action Alternative.

3.1.1 National Security/Defense Mission

Under the No Action Alternative, DOE/NNSA would continue to pursue the Stockpile Stewardship and Management, Nuclear Emergency Response, Nonproliferation, Counterterrorism, and Work for Others Programs.

3.1.1.1 Stockpile Stewardship and Management Program

The term "stockpile stewardship" refers to core competencies in activities associated with research, design, development, and testing of nuclear weapons components, as well as assessment and certification of their safety and reliability. DOE/NNSA's science-based Stockpile Stewardship and Management Program maintains and enhances the safety, reliability, and performance of the U.S. nuclear weapons stockpile, including the ability to design, produce, and test weapons, to meet national security requirements. Stockpile stewardship and management activities at DOE/NNSA facilities in Nevada are conducted via a variety of methods, including experiments involving special nuclear materials (SNM) and high explosives (either in combination or separately), shock physics, nuclear criticality, pulsed power, and plasma physics and nuclear fusion. Under the No Action Alternative, diagnostics and other instrumentation would be developed and used in related tests and experiments. In addition, DOE/NNSA would conduct drillback operations; support Office of Secure Transportation training; and, as necessary, disposition damaged nuclear weapons. Major facilities at the NNSS where stockpile stewardship and management activities would be performed include the Device Assembly Facility (DAF), the U1a Complex, the Big Explosives Experimental Facility (BEEF), and JASPER. DOE/NNSA also conducts stockpile stewardship and management activities at the TTR.

Special Nuclear Material (SNM)

SNM is (1) plutonium, uranium-233, uranium enriched in isotopes of uranium-233 or -235, or any other material that the U.S. Nuclear Regulatory Commission determines to be SNM, or (2) any material artificially enriched by any of these radioactive materials.

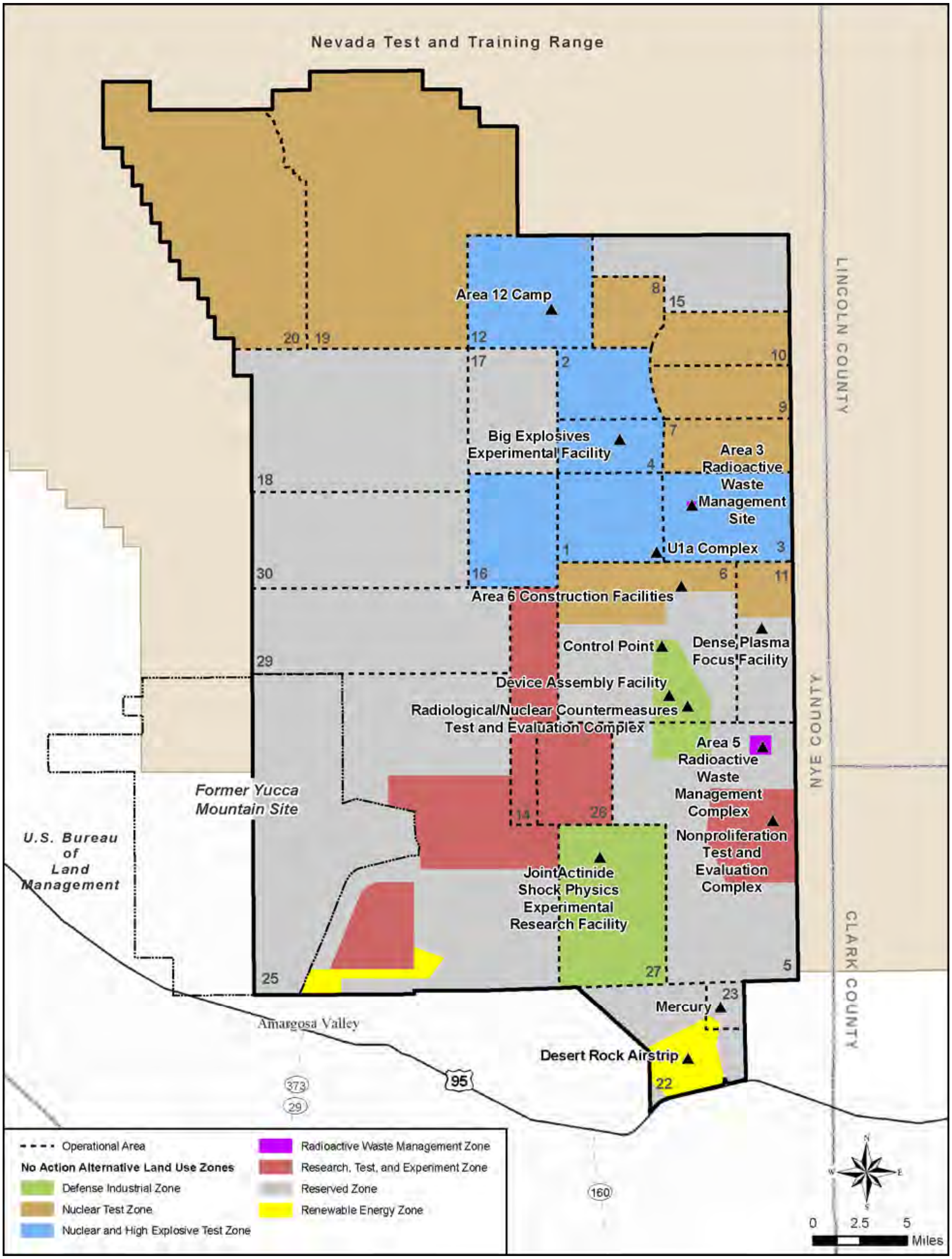

Figure 3–1 Nevada National Security Site Land Use Zones and Major Facilities Under the No Action Alternative

Stockpile stewardship and management activities would continue at DOE/NNSA facilities in Nevada under the conditions of the ongoing nuclear testing moratorium. These activities would emphasize science-based stockpile stewardship tests, experiments, and projects to maintain the safety and reliability of the nuclear weapons stockpile without underground nuclear testing. However, the No Action Alternative includes those activities necessary to maintain the capability to conduct underground nuclear tests. Such a test would be conducted only if so directed by the President in the interest of national security. Therefore, conducting an underground nuclear test is neither included nor analyzed under any of the alternatives in this *NNSS SWEIS*. Readiness-to-test capabilities include maintaining the necessary infrastructure and, more importantly, exercising the research and engineering disciplines of the U.S. nuclear weapons program through an active science-based Stockpile Stewardship and Management Program at the NNSS to ensure the continued competence of its technical staff. As part of its readiness-to-test activities, DOE/NNSA would conduct training and exercises using various kinds of nuclear weapon simulators. A generic description of underground nuclear testing is provided in Appendix H.

In addition to maintaining the capability to conduct nuclear weapon tests and in support of stockpile stewardship and management at the NNSS, DOE/NNSA would perform a variety of national security activities under the No Action Alternative, consistent with the program goals and direction provide in Annex D of DOE/NNSA's *2011 Biennial Plan and Budget Assessment on the Modernization and Refurbishment of the Nuclear Security Complex* (NNSA 2010) and as summarized in the following descriptions. Detailed descriptions of these activities are included in Appendix A of this *NNSS SWEIS.*

Dynamic experiments. Dynamic experiments, including subcritical and hydrodynamic experiments, would be conducted in alcoves at the U1a Complex, in unused nuclear test vertical emplacement holes, or at other sites within the Nuclear Test and Nuclear and High Explosives Test Zones of the NNSS, which include all or parts of Areas 1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 16, 19, and 20. Under the No Action Alternative, DOE/NNSA would conduct up to 10 dynamic tests per year. Over the next 10 years, a total of 5 dynamic experiments would be conducted in emplacement holes and cause new land disturbances.

Dynamic Experiments

Dynamic Plutonium Experiments

Dynamic plutonium experiments are designed to improve knowledge of plutonium material properties, including equation of state (an equation that expresses the relationship between temperature, pressure, and volume of a substance) and strength, over broad ranges of relevant pressures, temperatures, and time scales. They range from essentially static experiments to increasingly dynamic experiments. None of these experiments reaches nuclear criticality nor involves a self-sustaining nuclear reaction.

Hydrodynamic Experiments

Hydrodynamic experiments are high-explosives-driven experiments to assess the performance and safety of nuclear weapons. During a nuclear weapon function test, the behavior of solid materials is similar to liquids, hence the term "hydrodynamic." These experiments do not use special nuclear material (plutonium or enriched uranium), but are conducted using test assemblies that are representative of nuclear weapons.

Hydrodynamic experimentation is a central component in maintaining nuclear weapons design and assessment capability. It is coupled with high-performance computer modeling and simulation to certify, without underground nuclear testing, the safety, reliability, and performance of the nuclear components of weapons.

Subcritical Experiment

Subcritical experiments are performed with special nuclear material (for example, plutonium) in a manner that prevents it from achieving a nuclear explosion. Subcritical experiments are designed to improve current knowledge of the dynamic properties of new or aged nuclear weapons parts and materials and to assess the effects of new manufacturing techniques on weapon performance. Subcritical experiments can vary any or all factors that influence criticality (mass, density, shape, volume, concentration, moderation, reflection, neutron absorption, enrichment, and interactions). Because there is no nuclear explosion, subcritical experiments are consistent with the U.S. nuclear testing moratorium.

Conventional explosives experiments. Experiments using explosives, including high explosives, would be conducted at BEEF and other locations at the NNSS. Experiments would use up to 70,000 pounds

TNT [2,4,6-trinitrotoluene]-equivalent of explosive charges. Experiments within the BEEF operational area could include potentially hazardous materials such as beryllium, depleted uranium, deuterium, and tritium. Up to 20 conventional explosives experiments would be conducted each year at BEEF and up to 10 per year would be conducted at other locations at the NNSS under the No Action Alternative. The experiments would consist of both open-air and contained (no release to the atmosphere) research and diagnostic experiments using a variety of explosive compounds. These totals do not include the dynamic experiments addressed in the preceding paragraph. Conventional explosives operations supporting other programs at the NNSS are described under those programs. All explosive operations would be conducted in compliance with DOE Manual 440.1-1A, *DOE Explosives Safety Manual*.

Shock physics experiments. Shock physics experiments are a subset of dynamic experiments, but are not included in the dynamic experiments described above. There are two shock physics facilities at the NNSS: JASPER in Area 27, and the Large-Bore Powder Gun at the U1a Complex in Area 1. Up to 12 SNM experiments per year would be conducted at JASPER under the No Action Alternative. The Large-Bore Powder Gun would be operated in an alcove in the U1a Complex and would be used to conduct up to 10 experiments per year using SNM. Additional operations would be conducted without SNM at each of these facilities.

Criticality experiments, training, and other activities. Under the No Action Alternative, DOE/NNSA would conduct up to 500 criticality operations at the National Criticality Experiments Research Center within DAF each year for experiments, training, and other purposes in support of Stockpile Stewardship and Management and other programs.

Categories of Special Nuclear Material (SNM)
(Security Categories I, II, III, and IV)

The U.S. Department of Energy (DOE) uses a graded approach to provide SNM safeguards and security. Quantities of SNM stored at each DOE site are categorized into Security Categories I, II, III, and IV, with the greatest quantities included under Security Category I, and lesser quantities included in descending order under Security Categories II through IV.

Pulsed-power experiments. Under the No Action Alternative, the Atlas Facility would be maintained in a standby status with the capability to conduct up to 12 pulsed-power experiments per year. A description of the Atlas Facility may be found in Appendix A, Section A.1.1.1.

Plasma physics and fusion experiments. Using the Dense Plasma Focus Machines located in Area 11 of the NNSS and at NLVF, DOE/NNSA would conduct plasma physics and fusion experiments to support the Stockpile Stewardship and Management and Work for Others Programs. In the future, fusion experiments at the NNSS and NLVF could support energy production research. Up to 650 plasma physics and fusion experiments would be conducted yearly under the No Action Alternative: 50 in Area 11 of the NNSS and 600 at NLVF.

Drillback operations. DOE/NNSA assumes that five drillback operations to obtain samples from former underground nuclear test cavities would take place under the No Action Alternative over the next 10 years. Each drillback operation would be conducted near a former underground nuclear test location and would disturb approximately 5 acres of land.

Stockpile management activities. Stockpile management activities are the hands-on, day-to-day functions and operations involved in maintaining an enduring nuclear weapons stockpile. The following stockpile management activities would be conducted by DOE/NNSA at the NNSS under the No Action Alternative:

Nuclear Weapon Pit

The pit is the central core of a nuclear weapon containing plutonium-239 and/or highly enriched uranium that undergoes fission when compressed by high explosives. The pit and the high explosive are known as the "primary" of a nuclear weapon.

- Disposition of damaged U.S. nuclear weapons, as needed
- Staging, assembly, and disassembly of nuclear devices –

"Staging" means to maintain programmatic material, such as nuclear devices, SNM, or other materials, in a safe and secure manner until needed for a test, experiment, or other activity. Staging does not include maintaining material with no reasonable expectation of use in the foreseeable future.

- SNM staging, including nuclear weapon pits

Training for the Office of Secure Transportation. The DOE/NNSA Office of Secure Transportation would use existing NNSS infrastructure to conduct training and exercises up to six times per year to maintain and improve the skills of its agents to safely and securely transport nuclear weapons, weapons components, and SNM. Training includes practicing convoy activities on existing NNSS roads and adjacent off-road areas.

TTR operations. The primary mission of DOE/NNSA at the TTR is to ensure that U.S. nuclear weapons systems meet the highest standards of safety and reliability. In addition, Work for Others Program activities are conducted at the TTR. DOE/NNSA activities at the TTR are conducted under the conditions set forth in a land use permit from the U.S. Air Force (USAF) and are the responsibility of the Sandia Site Office, located in Albuquerque, New Mexico. Under the No Action Alternative, in support of stockpile stewardship and management, DOE/NNSA would use the TTR for the following activities:

- Tests and experiments, including flight tests for gravity weapons (bombs), would be conducted to ensure the compatibility of the hardware necessary for the interface between weapons and delivery systems and to assess weapon system functions in realistic delivery conditions. DOE/NNSA does not expect to use Category I/II SNM in flight tests.
- Testing would be conducted to test various parameters of a weapon while in flight or when dropped, including penetration of the ground surface. Weapons tested would include joint test assemblies and conventional and inert projectiles. Joint test assemblies are nuclear weapons with a portion of the nuclear package omitted, making them incapable of achieving the criticality required to produce a nuclear detonation. Impact tests would include the following:
  - Air-drop operations
  - Ground/air-launched rocket operations
  - Ground/air-launched missile operations
  - Compressed-air gun operations
  - Davis Gun operations
  - Fuel-air explosives operations
  - Open-air and underground detonation of explosives
  - Post-test procedures and recovery operations
- Tests would be conducted to check the systems in joint test assemblies and conventional weapons. Tests would also be conducted on behalf of nonproliferation research to develop equipment and techniques for determining whether other countries are using or developing nuclear capabilities. Passive tests would include the following:
  - Telemetry, microwave, and photometrics operations
  - Radar operations
  - Laser tracker operations
  - Radiographic operations
  - Electromagnetic radiation testing

Although not listed under the Work for Others description in Section 3.1.1.3, all of these Stockpile Stewardship and Management Program activities listed for the TTR are similar to activities that may be conducted as Work for Others at the TTR.

3.1.1.2 Nuclear Emergency Response, Nonproliferation, and Counterterrorism Programs

DOE/NNSA facilities in Nevada provide a broad support base for Nuclear Emergency Response Program activities, including a variety of areas and facilities that may be used for training and exercise activities. Under the No Action Alternative, DOE/NNSA would support the Nuclear Emergency Response, Nonproliferation, and Counterterrorism Programs by conducting the activities summarized in the following discussion. Detailed descriptions of these activities are included in Appendix A of this *NNSS SWEIS.*

- Personnel and logistical support for the Nuclear Emergency Support Team would be provided at RSL. Nuclear Emergency Support Team activities would also occur at the NNSS and other locations.
- Support consequence management, including personnel and early-phase activities management, would be provided for the Federal Radiological Monitoring and Assessment Center (FRMAC).
- Fixed-wing and rotary-wing aircraft would be provided for emergency response and aerial mapping activities as part of the Aerial Measuring System. These assets are based at RSL and activities are conducted at various locations around the country.
- Personnel and logistical support would be provided to the Accident Response Group.
- Logistical support would be provided to the Radiological Assistance Program.
- Weapons of mass destruction emergency responder training would be provided.
- Equipment and technical support would be provided for the DOE-dedicated Emergency Communications Network.

Radiological Emergency Response Assets

Nuclear Emergency Support Team (NEST) – NEST provides specialized technical expertise in resolving nuclear or radiological terrorist incidents. The National Nuclear Security Administration (NNSA) assists the Federal Bureau of Investigation and the U.S. Department of State with conducting, directing, and coordinating search and recovery operations for nuclear materials, weapons, or devices, and assists in identifying and deactivating improvised nuclear devices or radiological dispersal devices.

Aerial Measuring System (AMS) – AMS provides rapid response to radiological emergencies with helicopters and fixed-wing aircraft equipped to detect and measure radioactive material. In addition, AMS surveys U.S. Department of Energy (DOE) sites, participates in interagency exercises, and performs work for other Federal agencies. AMS can also provide detailed aerial photographs and multi-spectral imagery and analyses.

Radiological Assistance Program (RAP) – RAP is a first-response resource in assessing a radiological emergency, conducting the initial radiological assessment of the area of the emergency and providing assistance to minimize immediate radiation risks. RAP also provides emergency response training to first responders, and is involved in the Weapons of Mass Destruction First Responder Training Program. RAP is implemented on a regional basis, with eight Regional Coordinating Offices in the United States. The NNSA Nevada Site Office (NSO) is part of Region 7, headquartered in Oakland, California.

Federal Radiological Monitoring and Assessment Center (FRMAC) – FRMAC coordinates the efforts of 17 agencies to integrate the Federal response to a radiological emergency within the United States. DOE's responsibility is to set up and initially manage a FRMAC and NNSA provides the Consequence Management Response Team, which draws from NNSA Emergency Response Assets, including the RAP and AMS. The Phase 1 Consequence Management Response Team is deployed from among NNSA/NSO assets.

Accident Response Group (ARG) – ARG develops and maintains readiness to efficiently manage the resolution of accidents or significant incidents involving nuclear weapons that are in DOE's custody and support the U.S. Department of Defense for similar incidents with weapons in its custody. ARG's role in an emergency situation involving a nuclear weapon includes initial onsite assessment; performing evaluations for the safety and health of emergency response personnel, the public, and the environment; weapon recovery; and support for onsite radiological monitoring, analysis, and assessment.

- Improvised nuclear devices would be dispositioned as needed, including conducting forensics activities on such a device and its components under the DOE/NNSA Disposition Program and the Federal Bureau of Investigation (FBI) Disposition Forensics Program. Training drills and exercises would be conducted at existing NNSS facilities to maintain a readiness capability for the NNSA Disposition Program and FBI Disposition Forensics Program.

  The NNSA Disposition Program and FBI Disposition Forensics Program would deploy to the NNSS for periodic exercises and training or for an actual incident. All activities would take place in existing facilities at the NNSS.

> **Nuclear Forensics**
>
> Nuclear forensics is the analysis of nuclear materials recovered from either the capture of unused materials or the radioactive debris following a nuclear explosion. Nuclear forensics can contribute significantly to the identification of the sources of the materials and the industrial processes used to obtain them. In the case of an explosion, nuclear forensics can also reconstruct key features of the nuclear device (AAAS 2008).

- Nonproliferation- and counterterrorism-related activities would continue in the areas of arms control (see below), nonproliferation, and counterterrorism. Nonproliferation- and counterterrorism-related activities would provide scientific research and development, technology realization, process and procedure development, equipment testing and certification, and training. The kinds of activities that would be involved in supporting nonproliferation and counterterrorism include use of underground detonations of conventional explosives for seismic studies, releases of biological and chemical simulants, geological studies, and experiments to simulate radio frequencies resulting from various nuclear fuel cycle technologies. These activities are addressed in more detail in Section 3.1.1.3. Some activities supporting U.S. nonproliferation and counterterrorism efforts would occur at RSL and NLVF, but activities would primarily be conducted at the NNSS.

  Under the No Action Alternative, nonproliferation- and counterterrorism-related activities would integrate existing capabilities (i.e., research and development, training, nonproliferation tests and experiments, counterterrorism training, etc.) under an overall program. There would be no new facilities constructed, although existing buildings and other facilities would be modified to accommodate these activities.

Arms control. A key component of nonproliferation activities would be the use of existing facilities as part of an Arms Control Treaty Verification Test Bed dedicated to supporting U.S. arms control initiatives and commitments. This component would support design and certification of treaty verification technology, training of inspectors, and development of arms control confidence-building measures.

> **Test Bed**
>
> A test bed is an area that includes physical structures or designated terrain where tests and experiments are conducted. Test beds may be permanent facilities or temporary sites.

Nonproliferation. Facilities would be provided for Federal agencies to develop remote sensing equipment, methodologies, and training to support national and international nonproliferation programs. Under the No Action Alternative, DOE/NNSA would use existing facilities in Nevada to support research and development in the following areas:

- Safeguarding fissile materials in nations with nuclear weapons or nuclear industries
- Tightening export controls on technology with potential application to weapons of mass destruction
- Improving border protection by installing detectors for radioactive materials

- Inspecting commercial shipments for smuggled nuclear materials

Counterterrorism. DOE/NNSA would support research, development, and training associated with detecting and countering various types of improvised explosive devices, including those that are vehicle-borne. These activities would occur at BEEF, the Nonproliferation Test and Evaluation Complex, and other locations at the NNSS. Detonations of high explosives associated with counterterrorism-related activities would be conducted at various existing facilities and other locations on the NNSS. All explosive operations would be conducted in compliance with DOE Manual 440.1-1A, *DOE Explosives Safety Manual*.

3.1.1.3 Work for Others Program

The Work for Others Program, hosted by DOE/NNSA, facilitates the use by other agencies and organizations of DOE/NNSA facilities and capabilities, such as BEEF, the Nonproliferation Test and Evaluation Complex, T-1 Training Area, and other areas of the NNSS as well as resources at RSL, NLVF, and the TTR. Under the No Action Alternative, DOE/NNSA would continue to host the projects of agencies such as the U.S. Department of Defense (DoD) and the U.S. Department of Homeland Security (DHS), as well as other Federal, state, and local government agencies and nongovernmental organizations, by conducting the activities summarized in the following discussion. Detailed descriptions of these activities are included in Appendix A of this *NNSS SWEIS.*

Treaty verification. DOE/NNSA would continue to host projects related to verification of compliance under a number of nuclear weapon-related treaties. The projects would range from hosting inspections by other nations to conducting research and development in the area of detecting violations of treaties by others.

Nonproliferation projects and counterproliferation research and development. DOE/NNSA would continue to provide support for the following types of activities by other agencies:

- Conventional weapons effects testing, including live-drop and static detonations
- Development and demonstration of capabilities and technologies using conventional high explosives and other methods to effectively threaten and defeat military missions protected in tunnels and other deeply buried and hardened facilities
- Explosives experiments and other explosives operations using up to 2,000 pounds of explosives at various locations on the NNSS. All explosive operations would be conducted in compliance with DOE Manual 440.1-1A, *DOE Explosives Safety Manual*.
- Controlled experiments involving releases (including explosive releases) of biological and chemical simulants. Up to 20 controlled chemical and biological simulant release experiments (each experiment would consist of multiple releases) would be conducted yearly. More-detailed information regarding releases of chemicals and biological simulants is included in Appendix A, Section A.1.1.3.

Counterterrorism. DOE/NNSA would continue to support DoD and other Federal agencies in developing methods for engaging or neutralizing an adversary in a variety of topographical environments. In addition to ground-based operations, military operations would be conducted in the restricted airspace above the NNSS and the TTR.

DHS and DoD would continue to use facilities at the NNSS to develop technology for homeland security applications. The NNSS would continue to provide land and infrastructure to support testing and evaluation of radiological and nuclear detection devices for use in transportation-related applications. DHS would continue to use the Radiological/Nuclear Countermeasures Test and Evaluation Complex (RNCTEC), a facility constructed at the NNSS on behalf of DHS, as well as other NNSS land and infrastructure, to conduct its activities.

DOE/NNSA's Counterterrorism Operations Support Program would continue to support the Federal Emergency Management Agency's efforts to develop and implement national programs to enhance the capability of state and local agencies to respond to incidents involving weapons of mass destruction through coordinated training, equipment acquisition, technical assistance, and support for state and local exercise planning.

Military Training and Exercises. DOE/NNSA would continue to support DoD by providing land, airspace, and infrastructure for use by various branches of the military to conduct training and exercises. These activities range from small-scale exercises, i.e., focused at a specific building or site, to large-scale exercises involving multiple air and/or ground assets with live-fire operations. These activities would include live fire of military munitions, including small arms, hand grenades, rocket-propelled grenades, etc. Military training and exercises may be conducted throughout the NNSS, but would be primarily conducted in the western portions, including Areas 18, 19, 20, 25 (northern portion), 29, and 30 to preclude interference with and from other NNSS activities. Military training and exercises are subject to all applicable regulatory requirements and to DOE/NNSA NSO work authorization processes (NSO O 412.X1E, *Real Estate/Operations Permit*), which are designed to minimize hazards to workers, the environment, and NNSS physical assets.

Support for the U.S. National Aeronautics and Space Administration (NASA). DOE/NNSA would conduct criticality experiments at DAF in support of NASA's efforts to develop power sources for use in future missions to Mars and similar deep space exploration.

Miscellaneous Work for Others Program activities. DOE/NNSA would continue to provide facilities and airspace for use of aerial platforms for various purposes, including research and development to assess and mitigate operational safety and efficiency of unmanned aerial systems, training and exercises, and deployment of sensors for detection of various items. These types of operations would use a variety of manned and unmanned aerial systems, including fixed-wing aircraft (airplanes) and helicopters.

Work for Others Program activities at the TTR. These activities would be similar to those addressed under the Stockpile Stewardship and Management Program, with the following additions:

- Robotics testing and development (handling, application, and recovery of hazardous [chemical] material)
- Smart transportation-related testing – preprogrammed/remote-controlled air and ground vehicles
- Smoke obscuration operations
- Infrared tests
- Rocket development, testing, and deployment

National Security/Defense Mission—American Indian Perspective

The Consolidated Group of Tribes and Organizations' (CGTO) concerns and perspective regarding the National Security/Defense Mission are presented in the following text, which summarizes our views and applies to all aspects of this mission, including those pertaining to the Stockpile Stewardship and Management Program; the Nuclear Emergency Response, Nonproliferation, and Counterterrorism Program; and the Work for Others Program.

According to tribal elders, *"There is always going to be testing. Areas such as U1a that support underground testing are where the effects are evaluated. There are programs and facilities where stockpile stewardship and management activities are currently performed. The CGTO knows that the U.S. Department of Energy (DOE) maintains and conducts experiments and testing at various locations throughout the NNSS. We continue to be concerned about these activities and their impacts to the cultural landscape. Our involvement is essential to restoring and maintaining the balance to the land and its resources."*

The CGTO understands the National Security Defense Mission includes complying with the nuclear weapons test moratorium of 1992, which precludes new underground nuclear testing. We also understand DOE is required to maintain a state of readiness to resume nuclear tests if so directed by the President. The CGTO continues to be intensely opposed to all nuclear testing. In consideration of our ancestral ties and proximity to the land, the DOE, as a representative of the Federal government, must fulfill its trust responsibility by fully informing the CGTO and culturally affiliated tribal governments prior to any proposed testing activities. This step is vital to protecting the spiritual and physical health of our people by preparing for the desecration of our Holy Land and its resources.

The CGTO understands the fundamental intent of the Nonproliferation and Counterterrorism projects is to promote world peace and reduce the need to use the Nevada National Security Site (NNSS) and its offsite locations for nuclear weapons production, storage, assembly, and testing. However, the CGTO believes these activities may increase the number of weapons stored, disassembled, and disposed. These dangerous conditions may result in the land becoming angry and further contaminated, thereby impeding our ability to access important resources on our ancestral land.

The CGTO knows from past experience, but not formal study, that military training exercises and weaponry tests can adversely impact cultural resources. Military people move across the land on foot and in vehicles without either the time or the purpose to pay attention to delicate plants being disturbed, animals that are being dislocated, or the archaeological material and other important resources underfoot.

Often geographically distinctive power places or culturally sensitive areas are targeted without regard or knowledge of the significance to Indian people. Military exercises involving aircraft disrupt the harmony within the cultural landscape. Cultural resources may be damaged when conventional weapons are fired nearby. The environmental setting is disrupted from the noise and vibrations associated with these military operations and overflights. Noise and vibrations upset the spirituality and solitude of the area, negatively impacting songscapes and storyscapes. When the thoughts and focus are interrupted, the balance and well-being of the community as a whole become affected. Cultural resources are damaged when conventional weapons are fired nearby. Without a formal study, the exact impacts of military training exercises will not be fully understood. Thus, the CGTO again recommends adequate funds and time be provided for the CGTO to develop a guidance document. At a minimum, applicable CGTO representatives must obtain appropriate military clearances and access to pray for (talk to) and prepare the land and its resources prior to these military exercises.

See Appendix C for more details.

3.1.2 Environmental Management Mission

DOE/NNSA's Environmental Management Mission includes the Waste Management and Environmental Restoration Programs. Related activities under the No Action Alternative are described in the following sections. A more detailed description of these activities is provided in Appendix A, Section A.1.2.

Environmental Management Mission—American Indian Perspective

The Consolidated Group of Tribes and Organizations' (CGTO) concerns and perspective regarding the Environmental Management Mission are presented under the Waste Management Program (Section 3.1.2.1) and the Environmental Restoration Program (Section 3.1.2.2), as appropriate.

See Appendix C for more details.

3.1.2.1 Waste Management Program

The Waste Management Program would continue to store, treat, and/or dispose various wastes at the NNSS. These wastes include LLW, mixed low-level radioactive waste (MLLW), transuranic (TRU) waste, mixed TRU waste, hazardous waste, asbestos and polychlorinated biphenyl (PCB) wastes, hydrocarbon-contaminated soil and debris, and solid wastes such as construction debris or sanitary solid waste. Liquid nonhazardous wastes (such as sewage and other wastewater) are not included under the Waste Management Program, but are addressed in Section 3.1.3.1, General Site Support and Infrastructure Program. All DOE/NNSA waste management activities operate in compliance with applicable regulatory requirements and DOE Orders. Waste management activities at DOE/NNSA sites in Nevada under the No Action Alternative would include the following:

LLW and MLLW management. LLW and MLLW from approved generators that meet the NNSS waste acceptance criteria would be accepted for disposal. The volume of LLW projected for disposal at the NNSS over the next 10 years and analyzed under the No Action Alternative is based on the actual volume of LLW disposed at the NNSS during FY 1997 through FY 2010, and is estimated to total about 15,000,000 cubic feet. Up to 1 percent of the total projected LLW volume could consist of nonradioactive, classified waste forms that require disposal in a manner similar to LLW. These classified waste forms would be disposed in the Area 5 Radioactive Waste Management Complex (RWMC) at the NNSS. In order to provide a conservative analysis of potential human health impacts, DOE/NNSA assumed that the entire volume of waste was composed of only radioactive wastes. The volume of MLLW projected for disposal at the NNSS over the next 10 years is based on the disposal capacity of the new Mixed Waste Disposal Unit, Cell 18,[1] and is estimated to total about 900,000 cubic feet.

DOE/NNSA would continue to manage onsite-generated MLLW by a combination of several options: (1) treatment at the TRU Pad in the Area 5 RWMC, when appropriate; (2) storage at the TRU Pad or at a new MLLW storage facility, pending

Waste Definitions

Radioactive Waste – Solid, liquid, or gaseous materials that contains radionuclides regulated under the Atomic Energy Act of 1954, as amended, and of negligible economic value, considering costs of recovery.

Transuranic (TRU) Waste – Radioactive waste containing alpha particle-emitting radionuclides having an atomic number greater than 92 (the atomic number of uranium) and half-lives greater than 20 years, in concentrations greater than 100 nanocuries per gram.

Low-Level Radioactive Waste (LLW) – Radioactive waste not classified as high-level radioactive waste, TRU waste, spent fuel, or byproduct material as defined by Section 11e(2) of the Atomic Energy Act of 1954, as amended. Test specimens of fissionable material irradiated for research and development only, and not for the production of power or plutonium, may be classified as LLW, provided the concentration of TRU elements is less than 100 nanocuries per gram.

Hazardous Waste – A category of waste regulated under the Resource Conservation and Recovery Act (RCRA). To be considered hazardous, waste must be a solid waste under RCRA and must exhibit at least one of four characteristics described in 40 *Code of Federal Regulations* (CFR) 261.20-24 (ignitability, corrosivity, reactivity, and toxicity) or be specifically listed by the U.S. Environmental Protection Agency in 40 CFR 261.31-33.

Mixed Waste – Waste containing both radioactive and hazardous components, as defined by the Atomic Energy Act and RCRA, respectively. Mixed waste intended for disposal must meet the Land Disposal Restrictions as listed in 40 CFR Part 268. Mixed waste is a generic term for specific types of mixed waste, such as mixed low-level radioactive waste (MLLW) and mixed TRU waste.

Waste Generator – An individual, facility, corporation, government agency, or other institution that produces waste material for certification, treatment, storage, or disposal.

Waste Acceptance Criteria – A document that establishes the National Nuclear Security Administration Nevada Site Office waste acceptance criteria. The document provides the requirements, terms, and conditions under which the Nevada National Security Site (NNSS) accepts LLW and MLLW for disposal. It includes requirements for the generator's waste certification program, characterization, traceability, waste form, packaging, and transfer. The criteria apply to radioactive waste received at the NNSS Area 3 Radioactive Waste Management Site and Area 5 Radioactive Waste Management Complex for storage or disposal.

[1] *The actual permitted volume of MLLW that may be disposed in Cell 18 is 899,996 cubic feet.*

certification for disposal; and/or (3) shipment to a permitted facility, such as Energy Solutions in Clive, Utah, or the Materials and Energy Corporation in Oak Ridge, Tennessee, for appropriate treatment. Onsite-generated MLLW treated at another location would be returned to the NNSS for disposal or would be disposed at a permitted commercial facility. Under the No Action Alternative, offsite-generated MLLW would not be treated at the NNSS.

Under the No Action Alternative, the Area 5 RWMC would continue to operate within the approximately 740-acre area set aside for waste management purposes. LLW disposal units would be developed, filled, and closed as needed, in compliance with applicable regulatory requirements and DOE Orders. NNSS- and offsite-generated LLW would be disposed within these units. The Nevada Division of Environmental Protection (NDEP) issued a Resource Conservation and Recovery Act (RCRA) Part B permit effective December 1, 2010, for a new MLLW disposal unit, Cell 18, at the Area 5 RWMC. Construction of the new MLLW disposal unit is complete and it began accepting MLLW for disposal in January 2011. Temporary storage operations for MLLW would continue at RCRA-permitted facilities. Support facilities within the Area 5 RWMC would continue to operate.

The Area 3 Radioactive Waste Management Site (RWMS) would not be utilized under the No Action Alternative.

Small quantities (a few cubic feet over the next 10 years) of LLW may be generated at RSL and NLVF. Normal operations at the TTR are not expected to generate radioactive waste, but environmental restoration activities at the TTR would generate LLW and possibly unknown quantities of TRU waste. These environmental restoration wastes would be disposed at appropriate disposal sites, such as the Area 5 RWMC and/or the Waste Isolation Pilot Plant, as appropriate.

TRU and mixed TRU waste management. TRU waste generated by DOE/NNSA operations or by the Environmental Restoration Program (an estimated 9,600 cubic feet over the next 10 years) would be safely stored at the TRU Pad, pending characterization and shipment either to the Waste Isolation Pilot Plant for disposal or to another facility, such as Idaho National Laboratory, for processing before being sent to the Waste Isolation Pilot Plant.

TRU and mixed TRU wastes would not be generated at RSL, NLVF, or by DOE/NNSA Sandia Site Office activities at the TTR. However, an unknown quantity of TRU waste may be generated by environmental restoration projects at the TTR.

Hazardous waste management. DOE/NNSA activities would generate about 170,000 cubic feet of hazardous waste at the NNSS over the next 10 years under the No Action Alternative. The Hazardous Waste Storage Unit in Area 5 of the NNSS would continue to operate under a RCRA Part B permit issued by NDEP. Onsite-generated hazardous waste would be stored for up to 1 year prior to shipment to offsite treatment and/or disposal facilities.

RSL is a small-quantity generator of hazardous waste. As it is generated, hazardous waste would be accumulated at RSL for no more than 90 days and then transported off site to a permitted facility for treatment and/or disposal. Waste management field activities at RSL are provided by the USAF as landlord services under a Memorandum of Agreement. USAF personnel pick up and dispose miscellaneous laboratory and process equipment wastes under the terms of Nellis Air Force Base Plan 12 (Hazardous Waste Management Plan, October 2007).

NLVF is a conditionally exempt, small-quantity generator of hazardous waste. Hazardous waste would continue to be accumulated at NLVF and transferred off site to a commercially permitted facility for treatment and/or disposal.

Excess materials that may otherwise be considered hazardous waste would continue to be shipped off site for recycling. Excess materials are those that are no longer needed or are unusable but can be recycled.

The TTR is a small-quantity generator of hazardous waste. Hazardous wastes would continue to be accumulated at the TTR for no more than 180 days before being transferred off site to a permitted treatment, storage, and disposal facility.

Used oil from all DOE/NNSA NSO facilities and the TTR would continue to be collected and sent off site for recycling.

Asbestos and PCB waste management. Friable, nonradioactive asbestos waste would continue to be disposed at the Area 23 Solid Waste Disposal Site and possibly at the U10c Solid Waste Disposal Site, pending permit modification and review. Radioactive asbestos waste would continue to be disposed at the Area 5 RWMC. Nonfriable asbestos waste would continue to be disposed at the U10c Solid Waste Disposal Site. Nonradioactive PCB wastes would be accumulated at the Hazardous Waste Storage Unit in Area 5, pending transfer to a permitted treatment and/or disposal facility. Radioactive PCB-contaminated waste meeting 40 CFR Part 761 requirements would continue to be disposed in the MLLW Disposal Unit at the Area 5 RWMC.

DOE/NNSA would continue to dispose asbestos and PCB wastes generated at the TTR at a permitted treatment, storage, and disposal facility.

Explosives waste treatment. DOE/NNSA would continue to treat old and/or unusable explosives by open-air detonation at the permitted Explosive Ordnance Disposal Unit in Area 11.

Hydrocarbon-contaminated soil and debris management. The Area 6 Hydrocarbon Solid Waste Disposal Site would continue to operate under a permit issued by NDEP and would accept onsite-generated soil and debris contaminated with hydrocarbons. The U10c Solid Waste Disposal Site would also continue to operate under a permit issued by NDEP and would accept limited amounts of onsite-generated soil and debris contaminated with hydrocarbons. Onsite-generated hydrocarbon-contaminated LLW would continue to be disposed in the Area 5 RWMC. During routine activities at RSL and NLVF, no hydrocarbon-contaminated waste would be generated. If an accidental release of hydrocarbon-contaminated waste were generated, it would be disposed at a facility permitted to receive such waste. The TTR would continue to dispose hydrocarbon-contaminated soil and debris at an offsite permitted/approved landfill.

Solid waste management. DOE/NNSA activities would generate about 3,700,000 cubic feet of sanitary solid waste and construction and demolition waste over the next 10 years. Sanitary solid waste would be disposed at existing permitted facilities at the NNSS. DOE/NNSA would continue to operate the Area 23 Solid Waste Disposal Site. This permitted facility accepts less than 20 tons of sanitary waste per day. Industrial solid waste and construction and demolition debris would continue to be disposed at the U10c Solid Waste Disposal Site. An estimated 370,000 cubic feet of sanitary solid waste would be sent off site for recycling, rather than landfill disposal during the next 10 years.

At RSL and NLVF, sanitary solid waste would continue to be disposed off site by a municipal waste service.

At the TTR, sanitary solid waste would continue to be disposed at the USAF sanitary waste landfill. Industrial solid waste such as construction or demolition debris would be disposed at a USAF landfill or shipped off site for disposal at the NNSS or a permitted commercial landfill.

Excess materials that are suitable for recycling or reuse, such as scrap metal, would be shipped off site for recycling.

Waste Management Program—American Indian Perspective

The Consolidated Group of Tribes and Organizations (CGTO) understands current and proposed waste management activities identified under the Environmental Management Mission include high-hazard experiments involving nuclear material and high explosives, and storing nuclear materials. The CGTO is aware the Nevada National Security Site (NNSS) is used to store hazardous waste, to store and dispose of non-hazardous waste and debris, and to secure and dispose of low-level radioactive waste, low-level mixed radioactive waste (i.e., containing certain hazardous wastes). After many years, the CGTO continues to be greatly concerned with the ongoing storage and disposal of these various waste streams at the NNSS, and the transportation of radioactive waste to the NNSS from locations in Nevada and from other states.

We understand the radioactive and hazardous materials and waste described in this site-wide environmental impact statement (SWEIS) are defined in scientific terms and governed by state and federal regulations. For example, to scientists, radioactive rocks are well understood with specific quantifiable physical properties. Scientists believe if they manage radioactivity in a purely scientifically appropriate manner, they are largely safe for use and disposal at the NNSS, an area often perceived by non-Indian people as a barren wasteland.

Contrary to scientific belief, American Indian people hold complex traditional views of radioactivity, based upon the fundamental knowledge that all resources—including the rocks—are alive. Indian people believe radioactive rocks are very powerful.

We know that radioactive rocks can become “angry rocks” if they are removed without proper ceremony, used in a culturally inappropriate way, disposed of without ceremony, or placed where they do not want to be. The angry rock constitutes a threat that can neither be contained nor controlled by conventional means. It has the power to pollute food, medicine, and places, none of which can be used afterward by Indian people. Spiritual impacts are even more threatening, considering the angry rock would be transported along highways before ultimately being disposed of at the NNSS, affecting animal creation places, access to spiritual beings, and unsung human souls.

Indian knowledge and use of radioactive rocks, or minerals, in the western United States goes back for thousands of years. Areas with high concentrations of these minerals are called dead zones. Such areas contain places of power or energy and could only be visited or certain minerals used under the supervision of specially-trained Indian people, who are sometimes referred to in the English language as a shaman or medicine man Therefore, the U.S. Department of Energy would benefit from this knowledge if applied correctly.

Continuing to transport the waste is detrimental to the public and the tribes. We are specifically concerned about the downtown transportation route. According to a tribal elder, “The springs are located there and, if contaminated, can seep into many other water sources and contaminate the people and the environment.”

According to tribal elders, *“We are not sure how long Nellis and the NNSS have been designated as these types of facilities, and how much waste has been created, stored, and transported. This information is necessary for the CGTO to fully understand how significant the people and our resources may have been affected, and to prepare ceremonies, prayers, and culturally appropriate mitigation measures to attempt to restore balance. For example, Sunrise Mountain is a very significant mountain. Behind this mountain is an important cave, Gypsum Cave, which some Indian people fear but is highly respected. There are traditional stories surrounding this area. The mountain and the cave are both culturally significant. Caves are supposed to hold much power. They are supposed to interact with your mind. When you leave a cave, you are much more powerful.”* Gypsum Cave, which is protected and monitored by culturally affiliated tribes and the Bureau of Land Management (BLM), is awaiting designation as a Traditional Cultural Property that may be impacted by the transportation of the waste.

See Appendix C for more details.

3.1.2.2 Environmental Restoration Program

Under the No Action Alternative, the DOE/NNSA Environmental Restoration Program would continue, in compliance with the most recent version of the Federal Facility Agreement and Consent Order (FFACO), to characterize, monitor, and remediate identified contaminated areas, facilities, soils, and groundwater. The Environmental Restoration Program is organized into three projects and supports the Defense Threat Reduction Agency in addressing its environmental restoration sites at the NNSS. The three projects are the Underground Test Area (UGTA) Project, Soils Project (includes contaminated soil sites from the TTR and the Nevada Test and Training Range), and the Industrial Sites Project (includes the Decontamination and Decommissioning Project and facilities to be remediated at the TTR and the NNSS described in the *1996 NTS EIS*). In addition, DOE/NNSA’s Borehole Management Program work is executed by the Environmental Restoration Program. Activities that would be undertaken over the next 10 years by the Environmental Restoration Program are described in the following discussion. More-detailed descriptions of these activities are provided in Appendix A of this *NNSS SWEIS*.

Underground Test Area Project. In compliance with the FFACO, the UGTA Project would continue to characterize and monitor groundwater from existing wells; drill new characterization wells; expand groundwater monitoring to include new wells; develop groundwater flow and transport models; and evaluate closure strategies including adaptive monitoring and management. Up to 50 new groundwater characterization and monitoring wells would be developed over the next 10 years. UGTA Project activities would occur on the NNSS, Nevada Test and Training Range, U.S. Bureau of Land Management land, and privately owned land as necessary and as permission is obtained.

Federal Facility Agreement and Consent Order

The Nevada National Security Site Environmental Restoration Program includes activities to comply with the Federal Facility Agreement and Consent Order (FFACO), which was entered into in 1996 by the U.S. Department of Energy, the U.S. Department of Defense, and the State of Nevada. The FFACO provides a process for identifying sites having potential historic contamination, implementing state-approved corrective actions, and instituting closure actions for remediated sites.

Soils Project. The Soils Project would continue to investigate and characterize soil sites (using in situ monitoring, air monitoring, surface-water contaminant transport studies, and soil sampling) and perform corrective actions, as necessary. The Soils Project would ensure that proper use restrictions are in place to implement site closure so that worker doses are below the applicable regulatory limits and are kept as low as reasonably achievable. Under the FFACO, one of two strategies is implemented in remediating contaminated soils sites: clean closure or closure-in-place. Clean closure would include removing contaminated media from a site, rendering the site "clean" (i.e., the remaining levels would be below levels considered safe for the designated use of the site). In cases where the benefit (including reducing hazards to workers, the public, and environment) derived from removal of contaminated material justifies the cost of removal, clean closure would be the preferred closure strategy. However, because the NNSS, TTR, and Nevada Test and Training Range are remote, secure sites with no unescorted public access allowed, most soils sites may be closed using the closure-in-place strategy. Under a closure-in-place scenario, potential source material (e.g., lead bricks, batteries, hazardous waste) would generally be removed, with the radioactively contaminated soil left in place. Under either closure strategy, the Soils Project would implement the controls necessary to prevent the spread of unsafe concentrations of remaining contamination, and, if necessary, would ensure that proper use restrictions are in place to implement the site closure. The current closure strategy for soil project sites at the NNSS is based on current industrial land use scenarios with a 25-millirem-per-year exposure action level. Soils sites on the Nevada Test and Training Range, including the TTR, would be remediated to action levels that are mutually agreed upon by DOE/NNSA, the USAF, and NDEP. The potential for stricter cleanup levels is addressed under the Expanded Operations Alternative. NNSA anticipates that all identified Soils Project sites will be closed under the FFACO by the end of 2022.

Industrial Sites Project. The Industrial Sites Project would continue its field program to identify, characterize, and remediate industrial sites under the FFACO and to decontaminate and decommission unneeded facilities. The majority of FFACO industrial sites have been closed. Remediation, decontamination, and decommissioning activities are projected to be complete by the end of 2018. Industrial Sites Project activities would continue at present levels, although alternate uses of remediated facilities may require revised cleanup levels.

Defense Threat Reduction Agency sites. The Defense Threat Reduction Agency sites are identified as part of the DOE/NNSA Environmental Restoration Program because their site activities are considered environmental remediation on the NNSS. However, the Defense Threat Reduction Agency is responsible for implementing and funding these activities in compliance with applicable agreements with NDEP. Surface-disturbing activities associated with these sites have been completed and environmental monitoring, such as water sampling, would continue.

Borehole Management Program. Under the No Action Alternative, DOE/NNSA would continue to plug unneeded boreholes on the NNSS. Based on the current schedule and known inventory of unneeded boreholes on the NNSS that need to be plugged, the Borehole Management Program would be complete by the end of 2012.

Environmental Restoration Program—American Indian Perspective

According to tribal elders, *"The Creator placed everything—the land, rocks, plants and animals-where they are for a purpose. However, now that the NNSS land is disturbed and has become upset, we must come up with the appropriate prayers and ceremonies to rebalance the land and its resources."*

The Consolidated Group of Tribes and Organizations (CGTO) views environmental restoration activities attributed to the Environmental Management Mission as a positive effort to rebalance the world as everything is connected. Individual restoration projects are insufficient alone but are starting points and should be considered as stages or steps in a comprehensive and complex spiritual and ecological restoration program. The CGTO's view coincides with the principles of holistic ecosystem management subscribed to by the public and many Federal agencies.

A key component to environmental restoration is revegetating the disturbed areas to resemble its original condition. According to tribal elders, *"Prior to re-vegetation efforts, we talk to the land to apologize for what has been done and to let it know what we plan to do. Then we ask the Creator for its help. We choose our seeds from the sweetest and/or best plants, and store them for the winter to dry. When the winter is over, we place the seeds in a moist towel or sock and allow the new plant to sprout. We then plant the sprouts in small containers with soil until they are strong enough to be transplanted into the ground. This is a long and delicate process, requiring patience and traditional ecological knowledge passed down from our ancestors. If the plants are struggling to grow, we tag them and move them to face the same direction as the Sun."*

The U.S. Department of Energy (DOE) would benefit from this unique knowledge to further enhance their re-vegetation efforts of disturbed sites. The CGTO knows DOE struggles with the success rates of the density and diversity of native plants during their re-vegetation efforts. A co-stewardship approach between the CGTO and DOE to collectively manage this land would enable DOE to enhance their re-vegetation efforts, thereby saving time, money, and resources.

In the 1996 *Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada (1996 NTS EIS)* and in the 2002 *Supplement Analysis for the Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada (2002 NTS SA)*, the CGTO continued to express concerns about the removal of contaminated soils and the need for religious leaders to conduct balancing ceremonies and healing prayers at these disturbed locations. The CGTO recommended that tribal representatives provide information about the re-vegetation of a portion of the Double Tracks Site located on the Tonopah Test Range (TTR). The CGTO maintains our involvement is still necessary for the Double Tracks site as well as for the Clean Slates site located at TTR; however, we are awaiting DOE's approval to proceed. Because of the long lapse of time since the last visits, the CGTO believes it is necessary to revisit and reevaluate site conditions.

As stated earlier, the CGTO is supportive of restoring the environment. However, we are concerned about the future plans to decontaminate and decommission (D&D) some buildings that may have asbestos and other contamination, which will be released during the process. Specifically, the CGTO is concerned about potential impacts to the air, water, plants and animals. In addition, nearby tribes may be performing ceremonies and prayers and need to be notified so the D&D process does not negatively impact these important religious and traditional events through elevated noise, vibration levels and the spreading of dead air.[1]

Over the past 14 years, various initiatives have been undertaken to restore animal habitats and reintroducing certain animals, such as the desert big horn sheep near the southern portion of the Nevada National Security Site (NNSS), without participation from the CGTO. Modification of habitat or the restocking of animals is considered a highly sensitive religious act and requires participation from the CGTO. For these activities to be successful and to properly restore environmental balance, it is essential to have tribal representatives involved throughout this process.

In the 2008 *Draft Supplement Analysis for the Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada (2008 Draft NTS SA)*, the AIWS presented information regarding the successful reintroduction of a gray wolf in Idaho during the late 1970's, which was a collaborative effort between American Indians and a Federal agency. On the day of release, a Federal liaison unlatched the door of the cage and the animal scrambled out. Waiting for the wolf was an American Indian holy man in traditional regalia, sitting on a horse and watching. The wolf and man gazed at each other and the man spoke words welcoming the wolf back to its natural habitat. The wolf stood for a few more seconds and accepted the holy man's encouragement and blessing. Then the wolf turned and ran into the forest. Everyone present was very moved by the welcoming back ceremony. They knew that was the right thing to do. The CGTO believes collaborative projects such as this underscores the need for American Indian involvement whenever plant or animal species transplanted from other locations are reintroduced to the NNSS area.

We recommend conducting ethnographic studies involving the CGTO to better understand sites such as, but not limited to, Water Bottle Canyon, Timber Mountain, Shoshone Mountain, and other sites identified by the CGTO. Spiritual and ecological restoration assessments and projects require traditional management practices, and the involvement of tribal cultural experts to be successful. These specialists are needed to conduct initial assessments and site inventories, and to make recommendations for the next steps of the restoration effort. This strategy will result in the identification of resources, features, and other site aspects both tangible and intangible, that are in need of healing and restoration using culturally appropriate steps necessary to achieve restoration and balance.

[1] *Refer to Appendix C.2.8, Air Quality and Climate, for additional information regarding dead air.*

Environmental Restoration Program—American Indian Perspective (cont'd)

Clearly, members of the CGTO have unique and extensive experience in collaborative spiritual and ecological restoration. We have many examples of successful collaboration among our tribal members and Federal agencies. For example, the Big Warm Spring near the Duckwater Shoshone Tribe has been used throughout history for spiritual cleansing and healing. Young men are taken there during the "coming of age" to wash and cleanse themselves. In 2005, in collaboration with the U.S. Fish and Wildlife Service, the Duckwater Shoshone Tribe restored the Big Warm Spring to its original size and removed the non-native fish species. In 2007, during the final phase of the project, tribal members reintroduced the Railroad Valley Spring Fish to the Big Warm Spring in a culturally appropriate manner, successfully completing the spiritual and ecological restoration for this collaborative effort.

There are many potential spiritual and ecological restoration projects on the NNSS in need of attention, all with the goal of balancing the spiritual, cultural, and ecological inner-workings of those places. Based on CGTO experience with environmental restoration projects, we encourage DOE to implement a more aggressive collaborative environmental restoration program. Potential projects focusing on the protection of wildlife, plant resources, and geological features, include the following:

Restoration of Water Bottle Canyon

Water Bottle Canyon is a natural water tank area and an exceptional cultural site. Cultural resources include *pohs*, tanks, rock rings, tonal rocks, and traditional-use plants. Any activities impacting the side canyon or Water Bottle Canyon affect the rest of the gully system, which is connected through physical and spiritual flows. Presently, the spiritual aspects of Water Bottle Canyon are out of balance and require cultural interactions to bring the canyon back into balance. The cleaning of the *pohs* and tanks in this canyon system is one of several cultural practices needed to begin spiritual and ecological restoration. This project can reduce drought conditions, and provide spiritual, cultural, and ecological benefits to the area while concurrently fulfilling the primary goal of spiritual and ecological rebalancing. Implementation of this project will require the appropriate cultural experts to identify project sites, inventory and evaluate the conditions, resources, and features of the sites, and develop a compatible restoration plan. The Project would require overnight camping, annual activities, and monitoring of site conditions.

Evaluation of Traditional Cultural Property

During the DOE Annual Tribal Meeting with the CGTO, held September 12, 2009, the CGTO recommended the DOE support the nomination of a Traditional Cultural Property, previously identified as *Wunjikuda*. The CGTO recommended expanding the studies to enhance previously collected ethnographic information, and determining an appropriate title using knowledgeable tribal elders identified by the CGTO. The CGTO also recommended the DOE sponsor overnight camping activities at this site to elicit additional information from knowledgeable tribal representatives for the development and submittal of the nomination to the National Register of Historic Places.

Cleaning Pohs and Tanks

The *pohs* and tanks found throughout the NNSS require traditional attention and cultural management to function effectively. The *pohs* and tanks at Water Bottle Canyon and Ammonia Tanks, for example, are interrelated and tie each location to one another. Both sites are used to store water from the rain needed and used for ceremonial purposes to restore balance. American Indian people have Rain Shaman who have the ability to talk to all of the elements responsible for bringing water or rain to the land, people and animals. According to tribal elders, *"When the water arrives, it is approached with great respect and awakened very carefully when prayed upon. In appreciation and in honor of the water's return, the animals come back, the plants flourish and people will continue to pray and give thanks all ultimately leading to balance and restoration of the area."* Customarily, Indian people cleaned the *pohs* and tanks through the use of songs, stories and prayers. Cleaning of the *pohs* and tanks were followed by the Rain Shaman who called the rain.

By supporting the CGTO's proposed project to clean the *pohs* and tanks, DOE will reduce drought conditions and restore balance to the area. It will provide spiritual, cultural, and ecological benefits to the land and environment, thereby facilitating our obligation of spiritual and ecological rebalancing. Implementation of this project will require the appropriate cultural experts to identify project sites, to inventory and evaluate the conditions, resources, and features of the site, and to develop a culturally compatible restoration plan.

See Appendix C for more details.

3.1.3 Nondefense Mission

The Nondefense Mission generally includes those activities that are necessary to support mission-related programs, such as constructing and maintaining facilities, providing supplies and services, warehousing, and similar activities. Activities related to supply and conservation of energy, including renewable energy and other research and development projects, are included under the Nondefense Mission. Sections 3.1.3.1 and 3.1.3.2 describe Nondefense Mission activities that DOE/NNSA would undertake at its facilities in Nevada under the No Action Alternative. A more detailed description of these activities is included in Appendix A of this *NNSS SWEIS*.

3.1.3.1 General Site Support and Infrastructure Program

Like any large facility, the NNSS has a substantial infrastructure that provides all site-support services. Under the No Action Alternative, infrastructure-associated activities would continue, including projects such as repairs and replacements to maintain present facility capabilities. For instance, maintenance and repair projects include: repair Area 23 sewer main, remediate underground storage tanks, replace five roll-up doors, renovate and reactivate several water tanks, replace electric hot water heaters, install water tank security ladders, replace roofs on several buildings, and repair/maintain NNSS roadways.

In addition to maintaining and repairing its infrastructure at the NNSS, RSL, NLVF, and the TTR, DOE/NNSA would maintain the existing infrastructure, provide site security, and manage all applicable existing permits and agreements for the former Yucca Mountain site. DOE/NNSA would perform these functions pending decisions on the disposition of the former Yucca Mountain site.

Nondefense Mission—American Indian Perspective

There are a variety of current and proposed actions considered under the Nondefense Mission. Many of these are related to the Nevada National Security Site (NNSS) Environmental Research Park, which allows universities and other Federal agencies to conduct research. Other projects involve solar and geothermal energy development, and constructing the Nevada Desert Free-Air Carbon Dioxide Enrichment and the Mojave Global Change facilities proposed in Area 5. The Consolidated Group of Tribes and Organizations' (CGTO) concerns and perspective regarding the Nondefense Mission, including activities associated with the Infrastructure, Conservation and Renewable Energy, and Other Research and Development Programs, are summarized here.

Indian people view each proposed project under the Nondefense Mission as potentially impacting cultural resources. Non-Indian people unfamiliar with the importance of leaving cultural resources untouched may find and collect artifacts or remove plants that are significant to American Indian people. Construction of the proposed solar generating facility in Area 25 involves draining the Sun of its power unnaturally and making it weak. Construction also involves scraping the land, generating dust emissions, facilitating erosion, and impeding visual resources.

All landforms within the NNSS are highly sensitive to American Indians. The ability to see the land without the distraction of buildings, towers, cables, roads, and other objects is central to the spiritual interaction between Indian people and their traditional lands. Visual resources may be negatively impacted if proposed solar and geothermal projects are pursued. The CGTO must be part of any future discussions of these projects due to potential impacts on visual resources that may impede traditional and cultural ceremonies.

Only Indian people know which places are appropriate for visits by non-Indian people and how to manage plants, animals, and soil samples so that these activities do not disrupt the land and its associated spirituality. Because of the potential effects on the environment and its resources from Nondefense Mission projects, the CGTO must become an integral part of site-specific studies and develop culturally appropriate text for future National Environmental Policy Act (NEPA) analyses, including environmental assessments and mitigation plans.

See Appendix C for more details.

Although they are part of DOE/NNSA's infrastructure, characterization and monitoring wells developed under the UGTA Project are addressed under the Environmental Management Program, and proposed and potential renewable energy projects are addressed under the Conservation and Renewable Energy Program, rather than the General Site Support and Infrastructure Program.

3.1.3.2 Conservation and Renewable Energy Program

Under the No Action Alternative, DOE/NNSA would continue to identify and implement conservation measures and renewable energy projects in the following areas:

- Energy efficiency
- Renewable energy

- Water conservation
- Transportation/fleet management
- High-performance and sustainable buildings

Table 3–2 summarizes the NNSS Conservation and Renewable Energy Program.

Commercial solar power facility. Under the No Action Alternative, DOE/NNSA is evaluating a hypothetical 240-megawatt parabolic trough commercial solar power generation facility at the NNSS. DOE/NNSA has determined that the southwestern portion of Area 25 would be the only reasonable location on the NNSS for a commercial solar power generation facility. Area 25 includes an extensive area of suitable terrain for solar power generation facilities, has existing vehicular access from Highway 95 via Lathrop Wells Road and an existing 138-kilovolt transmission line, and is removed from national security-related activities on the NNSS that require limited access to uncleared individuals. Although it possesses many of the same attributes as Area 25, Area 22 is not being considered as a potential location for solar power development in this *NNSS SWEIS* because all current solar power technologies require the use of substantial amounts of water for cooling and other purposes and there would be potential impacts on Devil's Hole (see Chapter 5, Section 5.1.6) resulting from construction of any facility built in Area 22 that would draw water from the underlying hydrographic basin. Low-water-use renewable energy projects may be considered for Area 22 in the future.

The solar technologies that are most likely to be deployed at utility scale over the next 20 years are photovoltaic and concentrating solar power, such as parabolic trough, power tower, and dish engine (DOE/BLM 2012). It is unknown what technology would be used in a solar power generation facility at the NNSS, but the analysis in this *NNSS SWEIS* assumes a concentrating solar power parabolic trough facility using a dry-cooling system, based on the prevalence of that technology in other operating, proposed, and potential solar energy projects in southern Nevada (see Chapter 6, Table 6–2), and because impacts on sensitive resources, such as groundwater, would be greater than those from a photovoltaic facility, resulting in a more conservative analysis (i.e., impacts would not likely be underestimated). It is estimated that a concentrating solar power facility using parabolic trough technology would require between 9 and 10 acres of land for each megawatt of generating capacity, based on the proposed Amargosa Farm Road Solar Project (BLM 2010c). This acres-per-megawatt rate of generating capacity is about double that used in the *Final Programmatic Environmental Impact Statement for Solar Energy Development in Six Southwestern States* (DOE/BLM 2012), but is consistent with proposed parabolic trough solar power facilities currently being considered in southern Nevada. The assumptions used in the *Final Programmatic Environmental Impact Statement for Solar Energy Development in Six Southwestern States* are shown in Appendix A, Section A.1.3.2. Using the ratio scaled from the Amargosa Farm Road Solar Energy Project, the projected amount of power generated from a 2,400-acre Renewable Energy Zone on the NNSS is about 240 megawatts (West 2010). As stated in Chapter 5, Section 5.1.6.2.1, operation of a 240-megawatt commercial solar power generation facility using concentrating solar power technology would require up to approximately 250 acre-feet of water per year. In addition, electrical transmission capacity would be required to integrate the electricity generated by a 240-megawatt facility into the regional grid system. Approximately 10 miles of new 230-kilovolt transmission line, disturbing about 250 acres of land (all of it off of the NNSS) is assumed to be required for purposes of this analysis. Valley Electric Association is in the process of upgrading parts of its 138-kilovolt transmission line system in Amargosa Valley to 230 kilovolts, and other entities are planning/proposing construction of 500-kilovolt transmission lines into Amargosa Valley (see Chapter 6, Section 6.2.4.4). Currently, there are no specific proposals for commercial-scale solar power generation projects at the NNSS. Therefore, additional project-specific NEPA review would be required to identify, analyze, and document project-specific impacts if such a commercial-scale solar power generation facility were proposed.

Table 3–2 The National Nuclear Security Administration Conservation and Renewable Energy Program Under the No Action Alternative [a]

Energy Efficiency – DOE/NNSA would improve energy efficiency and reduce greenhouse gas emissions at the NNSS by reducing energy intensity by 3 percent annually, or a total of 30 percent through the end of FY 2015, relative to the 2003 baseline. Energy efficiency can be defined for a component or service as the amount of energy required in the production of that component or service; for example, the amount of steel that can be produced with one billion British thermal units of energy. Energy efficiency is improved when a given level of service is provided with reduced amounts of energy inputs, or services or products are increased for a given amount of energy input. Energy intensity is defined as the amount of energy used in producing a given level of output or activity. It is measured by the quantity of energy required to perform a particular activity (service), expressed as energy per unit of output or activity measure of service. Energy intensity measures energy consumption per gross square foot of building space, including industrial and laboratory facilities. Additional activities to improve energy efficiency would include the following: • Installing advanced electric metering systems to the maximum extent practicable at all NNSS buildings and implementing a centralized data collection, reporting, and management system • Using standardized operations and maintenance and measurement and verification protocols coupled with real-time information collection and centralized reporting capabilities to the extent practicable • Expediting improvement in the quality, consistency, and centralization of data collected and reported through the use of commercially available software • Reducing greenhouse gas emissions by 28 percent by FY 2020
Renewable Energy – DOE/NNSA would maximize installation of onsite renewable energy projects at the NNSS where technically and economically feasible. The initial goal would be to acquire at least 7.5 percent of the NNSS' annual electricity and thermal consumption from onsite renewable sources. In the event commercial-scale renewable energy projects are implemented at the NNSS (following additional National Environmental Policy Act analysis), DOE/NNSA would enter into an agreement with a commercial entity to construct a solar power generation project at the NNSS with the provision that a portion of the electric power generated would be provided to meet NNSS electrical needs.
Water – In FY 2007, DOE/NNSA established a water production baseline (210.6 million gallons) in accordance with Executive Order 13423 (72 FR 3919). Specific water consumption figures are not available by facility because the NNSS does not meter individual buildings. Instead, water production data were used to provide metrics in this area. DOE/NNSA sites began saving water through several conservation measures, including installation of WaterSense™ products, xeric landscaping, use of nonpotable water for dust suppression, and 4-day workweeks. DOE/NNSA established a goal of reducing potable water production at the NNSS by 2 percent a year, to 177 million gallons per year, by FY 2015. Water production was reduced by 18 percent in FY 2008 compared with the FY 2007 baseline, thereby exceeding the FY 2015 goal of 16 percent water reduction. Water production was reduced by an additional 8 percent in FY 2009. Efforts to identify water-saving projects and obtain funding to complete them are ongoing to ensure that the water production goals that have been met are maintained.
Transportation/Fleet Management – The current DOE/NNSA fleet has 540 alternative-fuel vehicles, equal to 96 percent of the covered fleet. DOE/NNSA requires that its fleet operate any alternative-fuel vehicles on alternative fuels to the maximum extent practicable. In FY 2007, DOE/NNSA constructed an E85 fuel station in Mercury and implemented a plan to promote the use of E85 fuel (an alcohol–fuel mixture that typically contains a mixture of up to 85 percent denatured fuel ethanol and gasoline or other hydrocarbon by volume). In FY 2007, the total actual usage of E85 was 135,141 gallons; the consumption for FY 2008 was 182,997 gallons, a 35 percent increase in usage. For every gallon of E85 used, 85 percent of the petroleum base fuel is reduced; for every gallon of B-20 biodiesel used, 20 percent is reduced; and for every gallon of unleaded gasoline used, 10 percent is reduced. Biodiesel fuel is used in all equipment, with the exception of emergency generators and boilers, and is currently at the maximum possible usage level.
High-Performance Sustainable Buildings – DOE/NNSA would ensure that (1) all new construction and renovation projects implement design, construction, maintenance, and operation practices in support of the high-performance building goals of Executive Order 13423 (72 FR 3919) and statutory requirements and (2) existing facilities' maintenance and operations practices meet the goals of Executive Order 13423. The DOE/NNSA NSO's High-Performance Building Plan would also align with Executive Order 13327 (69 FR 5897) and DOE Order 430.1B, *Real Property Asset Management*. At a minimum, the High-Performance Building Plan would include employment of integrated design principles, optimization of energy efficiency, use of renewable energy, protection and conservation of water, enhancement of indoor environmental quality, and reduction of environmental impacts of materials in accordance with the annual Site Sustainability Plan for DOE/NNSA facilities in Nevada.

FR = *Federal Register*; FY = fiscal year; NNSA = National Nuclear Security Administration; NSO = Nevada Site Office; NNSS = Nevada National Security Site.

[a] Goals and information as of December 2009.

3.1.3.3 Other Research and Development Programs

In 1992, the NNSS became the seventh unit of the DOE National Environmental Research Park Program. The NNSS program operated under a cooperative agreement between the DOE Nevada Operations Office (now the DOE/NNSA NSO); the University of Nevada, Reno; and the University of Nevada, Las Vegas, whereby the DOE Nevada Operations Office's Environmental Management Office provided financial assistance for scientific research projects unique to the Nevada National Environmental Research Park. In addition, scientific research projects conducted by parties other than those in the above-mentioned agreement could be conducted, but would be funded by sources other than DOE/NNSA.

Nevada National Security Site (NNSS) Environmental Research Facilities

The Nevada Desert Free-Air Carbon Dioxide Enrichment (FACE) Facility and Mojave Global Change Facility (MGCF) are two environmental research facilities located in Area 5 of the NNSS that conduct long-term environmental research. FACE is a state-of-the-art facility designed to study responses of an undisturbed desert ecosystem to increasing levels of atmospheric carbon dioxide. This facility is in a standby condition due to lack of funding.

MGCF was established in Area 5 of the NNSS to examine the impact of global climate change factors other than increased carbon dioxide (i.e., increasing summer monsoon rains, increased nitrogen deposition, and disturbance or destruction of the desert soil crust) on the Mojave Desert ecosystem.

3.2 Expanded Operations Alternative

The scope of the Expanded Operations Alternative in this SWEIS is defined to include the capabilities and projects described under the No Action Alternative, plus additional newly proposed capabilities and projects. These additional activities would include modification and/or expansion of existing facilities and construction of new facilities. In addition, some ongoing activities would be conducted more frequently than under the No Action Alternative. For each activity addressed in this section, the differences from the No Action Alternative are noted. In addition to changes in activities, under the Expanded Operations Alternative, there would be two changes in NNSS land use zones: (1) the designated use for Area 15 would be changed from "Reserved" to "Research, Test, and Experiment"; and (2) approximately 39,600 acres within Area 25 would be designated as a Renewable Energy Zone. These land use zone changes would clarify the availability of Area 15 as a location for conducting various types of research, tests, and experiments, and the Renewable Energy Zone would designate an area where the DOE/NNSA NSO has determined it would be reasonable and feasible to locate commercial renewable energy projects, as explained in Section 3.1.3.2 of this chapter. **Figure 3–2** depicts the land use zones and major facilities at the NNSS under the Expanded Operations Alternative.

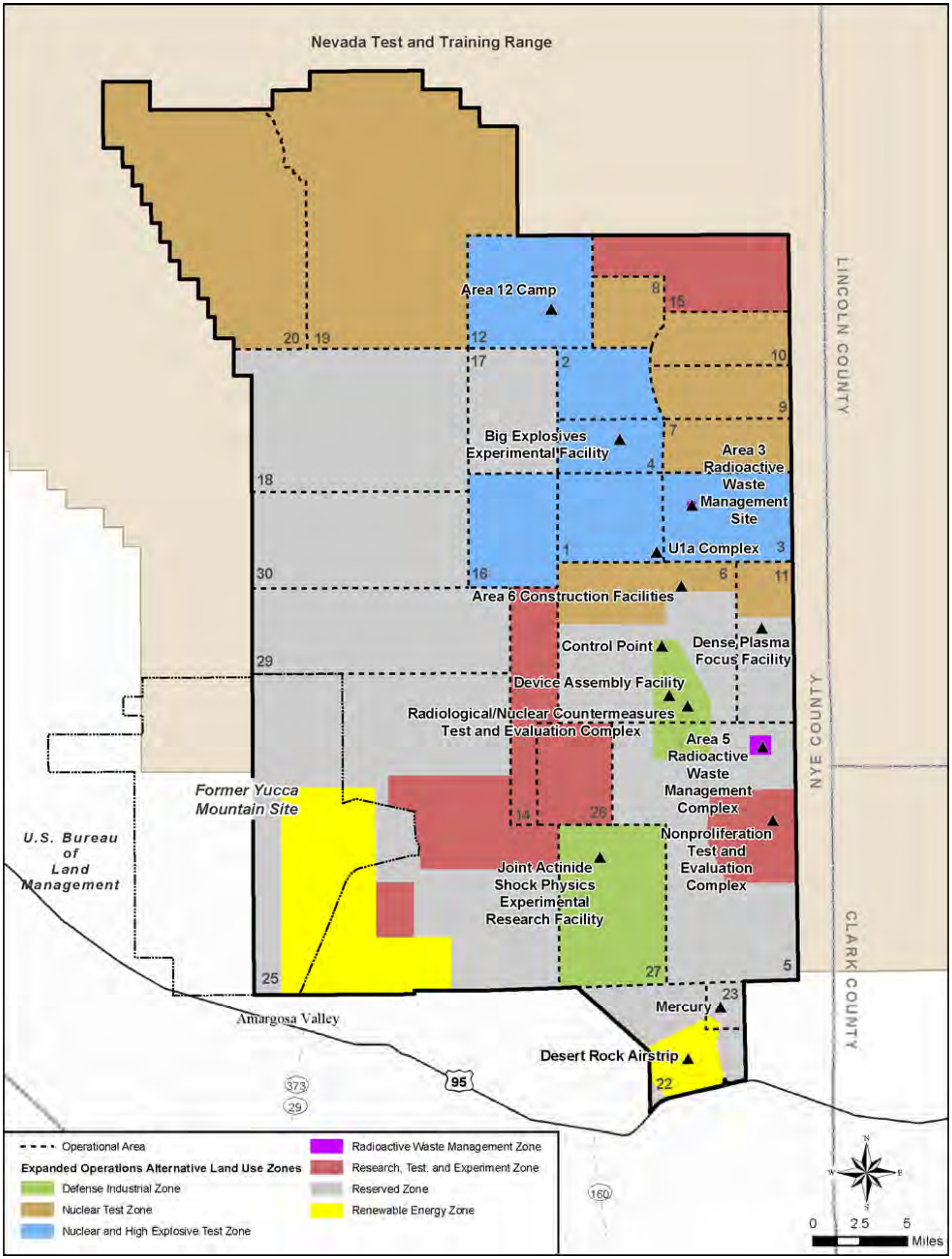

Figure 3–2 Nevada National Security Site Land Use Zones and Major Facilities Under the Expanded Operations Alternative

3.2.1 National Security/Defense Mission

Under the Expanded Operations Alternative, DOE/NNSA would pursue additional activities associated with the Stockpile Stewardship and Management, Nuclear Emergency Response, Nonproliferation, Counterterrorism, and Work for Others Programs.

3.2.1.1 Stockpile Stewardship and Management Program

Stockpile Stewardship and Management Program activities are described in more detail in Appendix A of this *NNSS SWEIS*. As under the No Action Alternative, the Expanded Operations Alternative includes those activities necessary to maintain the capability to conduct underground nuclear tests. Such a test would be conducted only if so directed by the President in the interest of national security. Therefore, conducting an underground nuclear test is neither included nor analyzed under any of the alternatives in this *NNSS SWEIS*. A generic description of underground nuclear testing is provided in Appendix H.

Under the Expanded Operations Alternative, there would be no changes from the No Action Alternative for the following Stockpile Stewardship and Management Program projects and activities:

- Criticality experiments in DAF
- Drillback operations
- Disposition of damaged U.S. nuclear weapons

Stockpile stewardship and management activities that would change relative to the No Action Alternative under the Expanded Operations Alternative include the following:

Dynamic experiments. DOE/NNSA would conduct up to 20 dynamic experiments per year. Over the next 10 years, a total of 5 dynamic experiments would be conducted in emplacement holes and cause new land disturbances.

Conventional explosive experiments at BEEF and other locations in the Nuclear and High Explosives Test Zone. DOE/NNSA would conduct up to 100 explosives experiments per year. DOE/NNSA would add a second firing table and ancillary features within the already developed area at BEEF, and would develop and test for proof-of-concept a high-energy x-ray capability at BEEF. Following successful testing, the new x-ray system would be moved to the U1a Complex for operational use.

In addition to explosives experiments at BEEF (limited to 70,000 pounds TNT-equivalent based on facility design), at the request of the Defense Threat Reduction Agency, DOE/NNSA would support experiments using up to 120,000 pounds of TNT-equivalent of explosives at various locations other than BEEF within the Nuclear and High Explosives Test Zone at the NNSS. These detonations would be conducted both underground and in the open air. Conventional explosives operations supporting other programs at the NNSS are described under those programs. All explosive operations would be conducted in compliance with DOE Manual 440.1-1A, *DOE Explosives Safety Manual*.

DOE/NNSA would establish one or more areas dedicated to conducting explosives experiments with depleted uranium. Up to three depleted uranium experiment areas, each about 40 acres in size, may be established in Areas 2, 4, 12, or 16. An annual maximum of 4,000 pounds of depleted uranium and 12,000 pounds of explosives (TNT-equivalent) would be used to conduct up to 20 of these experiments per year.

Shock physics experiments. DOE/NNSA would make the shock physics experimental facilities available for academic and other research on a no-conflict basis and would increase the number of experiments with actinide materials up to 36 per year at JASPER and 24 at the Large-Bore Powder Gun.

Pulsed-power experiments. The Atlas Facility would be activated, and up to 24 pulsed-power experiments per year would be conducted. A description of the Atlas Facility is included in Appendix A, Section A.1.1.1.

Fusion experiments at the NNSS and NLVF. New experimental uses would be pursued for the Dense Plasma Focus Machines that require deuterium-deuterium, deuterium-tritium, and tritium-tritium fusion and pulsed x-ray production. These experiments would require a much larger capacitive energy storage bank than the one currently in use at the Area 11 facility. To facilitate the new uses for the Dense Plasma Focus Machine currently located in Area 11 of the NNSS, it would be relocated to an existing building in Area 6 of the NNSS. Following the relocation, the Area 11 facility would be placed in standby. DOE/NNSA would conduct up to 1,650 plasma physics and fusion experiments per year: 1,000 would use the Dense Plasma Focus Machine at NLVF, and 650 would use the machine in Area 11 (or Area 6 if it were moved).

Stockpile management activities. As it would under each alternative, DOE/NNSA would conduct nuclear explosives operations at the NNSS in association with conducting an underground nuclear test, if such a test were directed by the President. In addition, under the Expanded Operations Alternative, DOE/NNSA would conduct the following activities:

- Stage (i.e., maintain programmatic material, such as SNM, or other materials, in a safe and secure manner until needed in a test, experiment, or other activity; staging does not include maintaining material with no reasonable expectation of use in the foreseeable future) nuclear devices pending disassembly, modification/maintenance, and/or transportation to or from another location
- Conduct dismantlement of weapons or weapon systems to aid the United States in meeting its commitment to reduce its nuclear weapons stockpile (weapons shipments to the NNSS under this activity would not exceed 100 per year)
- Modify and maintain nuclear devices at DAF, including replacing limited-life components in nuclear weapons systems (weapons shipments to the NNSS under this activity would not exceed 360 per year)
- Test weapons components for quality assurance purposes at DAF

SNM staging, including pits. DOE/NNSA would continue to stage SNM at appropriate facilities on the NNSS. SNM would be relocated from and/or to other DOE/NNSA sites, as necessary to meet program needs. For example, the following materials would be moved to the NNSS: up to 4 metric tons of SNM from the Zero Power Physics Reactor Program at Idaho National Laboratory (for use in criticality experiments); about 200 kilograms of global security SNM staged at Lawrence Livermore National Laboratory (for use in detector development and as radiation test objects); 2 kilograms of uranium-233 staged at Los Alamos National Laboratory (associated with test readiness); and 500 kilograms of highly enriched uranium, depleted uranium, and uranium staged at Lawrence Livermore National Laboratory (associated with criticality safety). In addition, DOE/NNSA would stage weapon pits at DAF, pending their transport to the Pantex Plant in Texas or another appropriate location.

Training for the Office of Secure Transportation. In addition to hosting training and exercises on NNSS roads, DOE/NNSA would construct new facilities in Area 17 to support Office of Secure Transportation training programs. The new facilities would occupy approximately 10,000 acres. A total of about 25 miles of roads and fire breaks would be developed surrounding active training areas and between individual training venues. Potable water would be obtained from an existing well approximately

4.5 miles away, requiring construction of a water pipeline. An electrical distribution line would also be constructed to extend electrical service from the vicinity of the well to the new facilities. Main access to the complex would be from the Tippipah Highway.

Facilities would be expanded in the 12 Camp (Area 12), Area 6 Control Point, or Mercury (Area 23), and maintenance and administrative buildings and a dormitory would be constructed to support training operations. These facilities would also be available to other NNSS customers when not in use by the Office of Secure Transportation.

These new and expanded facilities projects are conceptual at this time and would require an appropriate level of NEPA review before they could be implemented.

Stockpile stewardship and management activities at the TTR. There would be changes in some site support functions, such as site security, which would be transferred to the USAF and could affect the number of employees.

3.2.1.2 Nuclear Emergency Response, Nonproliferation, and Counterterrorism Programs

Nuclear Emergency Response, Nonproliferation, and Counterterrorism Program projects and activities are described in detail in Appendix A of this *NNSS SWEIS*. Under the Expanded Operations Alternative, there would be no changes from the No Action Alternative for the following Nuclear Emergency Response, Nonproliferation, and Counterterrorism Program projects and activities:

- Support for the Nuclear Emergency Support Team
- Consequence management support for FRMAC, the Aerial Measuring System, Accident Response Group, and Radiological Assistance Program
- Training for weapons of mass destruction emergency responders
- Equipment provision and technical support for the DOE-dedicated Emergency Communications Network

Nuclear emergency response, nonproliferation, and counterterrorism activities that would change relative to the No Action Alternative under the Expanded Operations Alternative include the following:

Disposition of improvised nuclear devices on an as-needed basis. In addition to improvised nuclear devices, radiological dispersion devices would be dispositioned on an as-needed basis at the NNSS under the Expanded Operations Alternative.

Nonproliferation- and counterterrorism-related activities. DOE/NNSA nonproliferation- and counterterrorism-related activities would include four related areas: arms control, nonproliferation, nuclear forensics, and counterterrorism. Although the purpose of nonproliferation- and counterterrorism-related activities would be the same as that under the No Action Alternative, new nonproliferation and counterterrorism facilities, described below, would be constructed at various locations on the NNSS to undertake enhanced activities. Because the new nonproliferation and counterterrorism facilities (Arms Control Treaty Verification Test Bed, Nonproliferation Test Bed, and Urban Warfare Complex) are still conceptual in nature and their locations are unknown, they are analyzed at a programmatic level in this SWEIS, and an appropriate level of NEPA review would be required before they could be implemented.

Arms control. The Arms Control Treaty Verification Test Bed would require construction of both indoor and outdoor laboratory space and test areas for design and certification of treaty verification technologies, training of inspectors, and development of arms control-related confidence-building measures. These facilities would be sited at various locations at the NNSS, and construction of new facilities would require a total of about 100 acres of land. A new facility for data fusion, analysis, and visualization would be constructed. The new building would have approximately 10,000 square feet of floor space and would be integrated with a building constructed to house other Arms Control Treaty Verification functions.

Nonproliferation. A Nonproliferation Test Bed would require construction of a new facility for simulations of chemical and radiological processes that could be conducted clandestinely by an adversary.

Counterterrorism. In addition to counterterrorism training at existing facilities, an Urban Warfare Complex would be constructed at the NNSS. This complex would include full-scale, modular replicas of the types of urban areas where terrorists and insurgents typically seek refuge. The Urban Warfare Complex would be constructed on about 100 acres in a remote area on the NNSS.

3.2.1.3 Work for Others Program

Work for Others Program activities are described in more detail in Appendix A of this *NNSS SWEIS*. Under the Expanded Operations Alternative, there would be no changes from the No Action Alternative for the following Work for Others Program activities:

- Treaty verification
- Military training and exercises
- Work for Others Program activities at the TTR

Work for Others Program activities that would change relative to the No Action Alternative under the Expanded Operations Alternative include the following:

Nonproliferation projects and counterproliferation research and development. Support would be provided for development of radiation detection capabilities, additional sensor technologies, and active interrogation programs to detect nuclear material.

Counterterrorism. Counterterrorism activities would include research, development, testing, and evaluation of unmanned aerial systems, as well as integration of training and exercises. Other activities would include development and testing of sensors for detection and defeat of improvised explosive devices, which would require construction of test beds (roads, intersections, small towns, etc.) and support facilities. Construction of these facilities would include new buildings with about 10,000 square feet of new floor space and would disturb about 75 acres of land.

DHS counterterrorism operations support would include construction of new training facilities (about 10,000 square feet of floor space). In addition, RNCTEC would be operated up to the level of a Hazard Category 2 nonreactor nuclear facility, which would allow larger amounts of radioactive material in alternative configurations to be used in tests and experiments. A high-speed road, a short section of full-scale railroad line, a simulated seaport facility, and a mock urban area would also be added to RNCTEC (DOE 2004f), requiring about 125 acres of additional land in Area 6. These new facilities are still conceptual in nature and their potential locations have not been identified; however, their potential impacts are analyzed at a programmatic level in this *NNSS SWEIS*. An appropriate level of NEPA review (beyond this SWEIS) would be required before DOE/NNSA makes any decision regarding these facilities.

Support for NASA. DOE/NNSA would support NASA nuclear rocket motor development, including using existing boreholes to examine for proof of concept the use of deep alluvial basins for sequestering radionuclides released as part of emissions from tests of a yet-to-be-developed prototype nuclear rocket motor. Over about a 10-year period, NASA would not likely test a nuclear rocket motor, but may conduct proof-of-concept tests using a surrogate, such as spiked xenon, in a borehole to evaluate the effectiveness of the alluvium for this purpose. DOE/NNSA would identify and comply with all applicable regulatory requirements for both proof-of-concept experiments and any actual test of a nuclear rocket motor. If NASA proposes to test an actual nuclear rocket motor, a NEPA review would be conducted.

Aviation Work for Others. Activities would include increased research, development, and use of aerial platforms at the NNSS. To support these activities, additional facilities would be required at Desert Rock Airport (hangars, shops, and other buildings occupying approximately 200,000 square feet) and the Area 6 Aerial Operations Facility (a hangar occupying approximately 20,000 square feet). Additional facilities occupying approximately 5,000 square feet may be required at other locations to support air operations, including testing of various types of manned and unmanned aerial systems such as small, remote-controlled, fixed-wing airplanes and helicopters. Research and development would be conducted with unmanned aerial systems to assess and mitigate operational safety and efficiency issues. In addition, unmanned aerial systems would be tested for a wide variety of potential uses, such as carrying sensors for collecting environmental data (e.g., multi- and hyperspectral imagery) to be used in digital environmental model development and for terrain analysis in arid and semiarid regions.

Active interrogation. Active interrogation involves the use of a radiation source to detect nuclear material. Under the Expanded Operations Alternative, Work for Others Program activities would include support for development of active interrogation systems to detect nuclear material and other materials of interest. DOE/NNSA would support research and development of active interrogation equipment, including accelerators and other radiation-generating devices and associated radiation detection systems/methods, and training. DHS would conduct active interrogation activities at RNCTEC, but other Federal agencies would require an additional facility, most likely located in Area 12 or 16. In addition to fixed facilities, temporary test beds would be used to provide various terrain, roadway patterns, and other factors to simulate conditions that may be encountered in actual deployment of the active interrogation system. The temporary test beds would be used primarily for testing mobile accelerators and other radiation-generating devices (from man-portable up to units housed in large transportation containers) and detectors. In general, temporary active interrogation test beds would use existing NNSS roads, but could also include some off-road areas. Construction of additional support facilities and temporary test beds would disturb about 100 acres of previously undisturbed land over the next 10 years.

Active interrogation research and development would involve operation of accelerators/radiation-generating devices at energy levels in the range of 10 to 100 million electron volts to irradiate various materials using, for example, electrons, protons, or other types of radiation such as x-rays or neutrons (proton-generating units may attain energy levels of up to 4 billion electron volts). The devices would be used for either radiography or for interrogation of objects to detect and identify such things as fissionable materials, chemicals, or contraband. Other devices may produce gamma rays to be used for the same purposes. Still other systems would include deuterium-deuterium or deuterium-tritium neutron generators (see description of fusion experiments in Sections 3.1.1.1 and 3.2.1.1) that produce from 2.5 to 14 million electron volt neutrons.

Test objects would be irradiated using interrogation beams produced by the accelerators/radiation-generating devices. Test objects would consist in part of fissionable materials such as uranium and plutonium. Fissionable material in a test object would be limited to quantities that can be demonstrated to be subcritical under all normal, abnormal, and accident conditions (quantity and nature of process activities must preclude the potential for a nuclear criticality). Test objects that incorporate fissionable material would be used in either shielded or unshielded configurations or surrounded by, for example, naturally occurring radioactive material. The interrogation beams would also be used to irradiate nonfissionable materials, such as chemicals or simulated contraband, to determine the signatures produced by the real materials. Test objects would be placed up to 1.25 miles from the beam source, and radiation and other detection systems would be placed at various distances away to detect radiation from the test objects.

Radioactive tracer experiments. Radioactive tracer experiments would be conducted to validate sensor technology. These experiments would include both underground releases and open-air releases of radioactive noble gases and nonradioactive gases (i.e., helium and sulfur hexafluoride). The underground experiments would release up to 27 curies of radioactive noble gases with short half-lives (5 to 36 days); nonradioactive releases would include up to 300 gallons of helium and 2,000 gallons of sulfur hexafluoride. The underground experiments would include explosive gas releases, pressurized releases, explosive radioactive particulate releases, and a baseline survey of contamination from previous activities. The open-air experiments would release small quantities of radionuclides with short half-lives. Up to 12 experiments involving open-air releases would be conducted each year. DOE/NNSA would comply with all relevant regulatory and reporting requirements, including applicable requirements of 40 CFR Part 61, Subpart H, for all experiments that could result in a release of radioactive material to the air. DOE/NNSA would ensure that the cumulative annual radiological dose at the boundary of the NNSS resulting from all activities involving radioactive materials would comply with the U.S. Environmental Protection Agency's annual emission standard of 10 millirem (40 CFR 61.92).

New test beds. Additional test beds would be developed to support research and development for sensors, high-power microwaves, and high-power lasers. New test beds (including approximately 50,000 square feet of new building spaces) would be constructed at various locations on the NNSS and would disturb approximately 200 acres of previously undisturbed land. Because there are no specific plans for construction of these new test beds at this time, additional NEPA reviews would be necessary before they could be implemented.

The following new test beds would be developed at the NNSS under the Expanded Operations Alternative:

Nuclear-Fuel-Cycle-Related Radionuclide Release, Diagnostics and Solids Detection, and Characterization Test Bed. In support of the various nuclear nonproliferation treaties in which the United States participates or anticipates participation, DOE/NNSA would create test beds for use in developing sensors to support treaty verification and nonproliferation validation. Facilities to support deployment of fixed uranium oxides and controlled amounts of depleted uranium would include static concrete display pads, static target display pans, thermal targets, and ponds and pools of water.

Specialized Explosive Testing and Manufacture Test Bed. Support for DoD and the U.S intelligence community would expand to include development of sensors and techniques for detection and defeat of improvised explosive devices, homemade explosives, conventional military ordnance, and chemical explosives, as well as explosives-driven, shaped-charge development and evaluation.

Radio Frequency Generation Test Bed. Technologies would be developed to detect, sample, characterize, and identify radio frequency signatures and observables. The test bed would be used to develop the ability to generate specific signals, to characterize the radio frequency environment, and to monitor tests.

Infrasonic Observations Test Bed. Technologies would be developed to monitor earthquakes and underground disturbances. This test bed would be used to develop the ability to detect specific signals, characterize the seismic environment, and monitor tests.

Chemical Test Bed. Activities at this test bed would include simulated manufacture and release of illegal drugs by authorized Federal organizations to develop detection and prevention technologies. An existing facility would be used to train personnel and test sensors and procedures for detection of toxic industrial chemicals.

Biological Simulants Test Bed. These operations would include production of biological simulants in an appropriate laboratory by authorized Federal organizations for use in detection technology development. Biological simulant releases to the soil, the air, or an NNSS sewer/septic system would emulate anticipated real-world scenarios. Construction to support these functions would disturb up to 50 acres of land.

3.2.2 Environmental Management Mission

The DOE/NNSA Environmental Management Mission includes the Waste Management and Environmental Restoration Programs. Under the Expanded Operations Alternative, the Waste Management Program would accept greater volumes of LLW and MLLW from both offsite and onsite sources. As under the No Action Alternative, the Environmental Restoration Program would continue to meet the requirements of the most recent FFACO.

3.2.2.1 Waste Management Program

Under the Expanded Operations Alternative, waste management activities associated with some waste types would increase. In particular, up to approximately 48,000,000 cubic feet of LLW and 4,000,000 cubic feet of MLLW would be disposed at the NNSS over the next 10 years. Up to 1 percent of the total projected LLW volume could consist of nonradioactive, classified waste forms that require disposal in a manner similar to LLW. These classified waste forms would be disposed in the Area 5 RWMC at the NNSS. In order to provide a conservative analysis of potential human health impacts, DOE/NNSA assumed that the entire volume of waste was composed of only radioactive wastes. Within the existing Area 5 RWMC, new disposal units would be constructed, filled, and closed to accommodate these additional waste volumes. New MLLW disposal cells would require a RCRA permit(s) from NDEP. Under the Expanded Operations Alternative, the Area 3 RWMS could be opened to receive LLW generated from environmental restoration and other activities at DOE/NNSA sites within the State of Nevada. Specifically, this action could be triggered by a need for additional disposal space beyond that available in the Area 5 RWMC for disposal of large on-site remediation debris, or soils from clean-up activities on the NTTR. While there is no near-term need to use the Area 3 RWMS, However, should DOE/NNSA need to activate the Area 3 Radioactive Waste Management Site, it would first undergo detailed consultation with the State of Nevada, and would limit disposal to in-state generated LLW.

The basis for the estimated waste volumes under this alternative is described in Appendix A. The increase in waste volumes between this and the No Action Alternative is largely due to an assumed extensive removal of contaminated soil from cleanup activities at Nevada locations outside the NNSS (e.g., the TTR and the Nevada Test and Training Range) with shipment to the NNSS for disposal, and to increased projections of wastes that may be shipped to the NNSS from out-of-state generators. These projections of waste are considered upper-bound estimates; actual volumes that may be generated depend on programmatic and regulatory decisions by the generators that would be addressed in separate NEPA reviews, as well as funding considerations. Although for purposes of analysis it was assumed that the projected wastes would be disposed at the NNSS, there may be other cost-effective options for disposing the wastes, such as the use of commercial disposal capacity.

Use of rail-to-truck transloading would increase, including the use of transloading facilities within Nevada, should commercial vendors establish such a facility. DOE/NNSA is not proposing to construct or cause to be constructed any new rail-to-truck transfer facilities to accommodate shipments of radioactive waste or materials under any of the alternatives considered in this SWEIS.

Under the Expanded Operations Alternative, DOE/NNSA would treat and store various types of MLLW received from on- and offsite generators. MLLW treatment capacity would be developed within the Area 5 RWMC, including repackaging by means of macroencapsulation and/or stabilization/microencapsulation, sorting/segregating, and bench-scale mercury amalgamation of both onsite- and offsite-generated MLLW. Initially, MLLW storage capacity would be developed on the TRU Pad to accommodate MLLW treatment (for either onsite- or offsite-generated wastes), pending development of MLLW storage capacity in existing or new facilities within the Area 5 RWMC. To handle the increased volumes and more-frequent shipment receipt rates of LLW and/or MLLW, a waste offloading and staging area would be established at the Area 5 RWMC. Appropriate permits would be obtained before expanding MLLW storage capacity or implementing any of these treatment technologies.

In addition, waste management activities at the NNSS under the Expanded Operations Alternative would include the following:

- Because of the projected increased annual number of experiments at JASPER and other national security activities, somewhat larger quantities of TRU waste would be generated annually (about 1,900 cubic feet per year from all activities). As with the No Action Alternative, TRU waste generated by DOE/NNSA activities in Nevada would be safely stored at the TRU Pad pending shipment off site for disposition along with other legacy waste (waste or contamination resulting from previous nuclear weapons-related activities) or newly generated environmental restoration waste.
- Continued treatment by evaporation of liquids containing small concentrations of tritium; and continued management of hazardous waste, asbestos and PCB wastes, and hydrocarbon-contaminated soil and debris in compliance with applicable regulations and permits. An estimated 170,000 cubic feet of hazardous waste would be generated by DOE/NNSA activities.
- Continued treatment of explosives at the Explosives Ordnance Disposal Unit in Area 11.
- Continued operation of the Area 23 Class II Solid Waste Disposal Site, the Area 6 Class III Solid Waste Disposal Site (Hydrocarbon Landfill), and the U10c Class III Solid Waste Disposal Site. To accommodate the potential increases in solid wastes (up to about 9,400,000 cubic feet generated over the next 10 years) that may be generated by various operations at the NNSS under the Expanded Operations Alternative, DOE/NNSA would seek permits to construct and operate new solid waste disposal facilities, as needed. A new sanitary waste landfill in Area 23 would require approximately 15 acres of land. To support environmental restoration work in Area 25, DOE/NNSA would obtain appropriate permits to construct and operate a construction/demolition debris landfill that would disturb up to 20 acres in Area 25 of the NNSS. Approximately 970,000 cubic feet of the generated sanitary solid waste would be sent off site for recycling during the next 10 years.
- Under the Expanded Operations Alternative, DOE/NNSA would establish staging and maintenance support capacity at the Area 5 RWMC for radioactive material transport packagings. DOE/NNSA would temporarily stage, inspect, and perform maintenance on DOE/NNSA-certified (and possibly commercial) and U.S. Department of Transportation (DOT)-authorized transport packagings for transport of radioactive material.

> ***Packaging*** means the assembly of components necessary to ensure compliance with Federal packaging requirements. It may consist of use of one or more receptacles; absorbent materials; spacing structures; thermal insulation; radiation shielding; service equipment for filling, emptying, venting, and pressure relief; or devices for cooling or absorbing mechanical shocks.
>
> ***Package*** means, for radioactive materials, the packaging together with its radioactive contents as presented for transport.
>
> Source: 49 CFR 173.403

The transport packagings would be emptied of radioactive material before inspection, maintenance, or staging. This proposed capability would allow consolidation of specialty packagings at a centralized location that is convenient to DOE/NNSA sites in the western United States. The proposed capability would be located in a fenced area within the Area 5 RWMC on approximately 1 acre of previously disturbed land. The area would be graded and covered with a gravel or asphalt pad. No more than 15 transport packagings would be staged within the area at any time. Operation of the area would use a small amount of electrical power and require only two to three workers on an as-needed basis to perform radiation surveys, container maintenance, or pre-use inspections. Minimal waste generation is expected.

3.2.2.2 Environmental Restoration Program

Under the Expanded Operations Alternative, the DOE/NNSA Environmental Restoration Program would continue in compliance with the FFACO in the form of characterization, monitoring, and, if necessary, remediation of identified contaminated areas, facilities, and environmental media. The UGTA and Industrial Sites Projects, remediation of Defense Threat Reduction Agency sites, and Borehole Management Program would all continue as under the No Action Alternative, although the pace of cleanup activities could be accelerated. Cleanup standards for Soils Project sites on lands under the jurisdiction of the USAF are subject to agreement among the USAF, NDEP, and DOE/NNSA. The No Action Alternative addressed cleanup levels consistent with current land uses; however, if more-stringent cleanup standards are adopted than currently planned or additional sites are included under the FFACO, the volumes of waste requiring transport and disposal would increase. Although the FFACO is the primary driver for the Soils Project, for purposes of analysis under the Expanded Operations Alternative, this SWEIS assumes that a clean closure strategy would be implemented for a number of contaminated soil sites on the Nevada Test and Training Range and the TTR (i.e., Clean Slate 2 and 3, Project 57, and Small Boy), whereby a total of about 504 acres would be excavated to a depth of 0.5 feet and the removed soil would be disposed as LLW. The impact of this estimated additional volume of waste that would need to be disposed at the NNSS is analyzed in Chapter 5, Section 5.1.11.

3.2.3 Nondefense Mission

The Nondefense Mission generally includes those activities that are necessary to support mission-related programs, such as construction and maintenance of facilities, provision of supplies and services, warehousing, and similar activities. Activities related to energy supply and conservation, including renewable energy, are considered part of the Nondefense Mission, as are other research and development activities that may occur at DOE/NNSA facilities in Nevada, including activities at the Nevada National Environmental Research Park. As described in the following paragraphs, all Nondefense Mission programs would be modified to some extent under the Expanded Operations Alternative.

3.2.3.1 General Site Support and Infrastructure Program

Under the Expanded Operations Alternative, in addition to small projects to maintain the present capabilities of the NNSS, infrastructure-associated activities would include increasing capacities and capabilities or extending the ranges of facilities and/or services to accommodate new operational programs and projects. A detailed description of new activities associated with the General Site Support and Infrastructure Program and the reasons they are proposed under the Expanded Operations Alternative may be found in Appendix A, Section A.2.3.1.

In addition to accommodating operational requirements and constructing the new facilities described in Sections 3.2.1 and 3.2.2, the following infrastructure enhancements would be implemented:

- A security building in Area 23 would be constructed to replace outdated facilities and consolidate security facilities and functions into a new, approximately 85,000-square-foot, two-story facility. The buildings replaced would be evaluated and either demolished or used for another purpose.
- The existing 138-kilovolt electrical transmission system would be replaced between Mercury Switching Center in Area 23 and Valley Substation in Area 2 to increase the capacity of the system from about 40 megawatts to 100 megawatts. The efficiency of the system would be improved, but the system operating voltage would not increase.
- The telecommunication system on the NNSS would be upgraded to better integrate wired and wireless systems.
- Buildings in Mercury are typically 30 to 50 years old. To maintain an efficient and effective operation in support of national security activities, it is necessary to replace most of these facilities and supporting infrastructure due to their lack of energy efficiencies and deteriorating condition. Under the Expanded Operations Alternative, Mercury would be reconfigured to provide the modern facilities and infrastructure necessary to support advanced experimentation and production at the NNSS. Because the reconfiguration of Mercury is conceptual in nature, an appropriate level of NEPA review would be required before it could be implemented.

These projects would contribute to meeting DOE/NNSA Strategic Goal 2.1: Transform the Nation's nuclear weapons stockpile and supporting infrastructure to be more responsive to the threats of the twenty-first century.

As under the No Action Alternative, in addition to maintaining and repairing its infrastructure at the NNSS, RSL, NLVF, and the TTR, DOE/NNSA would maintain the existing infrastructure, provide site security, and manage all applicable existing permits and agreements for the former Yucca Mountain site. DOE/NNSA would perform these functions pending decisions on the disposition of the former Yucca Mountain site.

As noted under the No Action Alternative, although considered infrastructure, characterization and monitoring wells developed under the UGTA Project are addressed as part of the Environmental Management Program and proposed and potential renewable energy projects are addressed under the Conservation and Renewable Energy Program, rather than the General Site Support and Infrastructure Program.

3.2.3.2 Conservation and Renewable Energy Program

Under the Expanded Operations Alternative, DOE/NNSA would continue to identify and implement energy conservation measures and renewable energy projects as described under the No Action Alternative. In addition, NNSA would pursue renewable energy projects, including geothermal and solar.

NNSS Photovoltaic Power Project. Under the Expanded Operations Alternative, DOE/NNSA proposes to build a 5-megawatt photovoltaic solar power system near the Area 6 Construction Facilities. The 5-megawatt photovoltaic system would require about 50 acres of land, based on a similar project at Nellis Air Force Base (USAF 2006c).

Commercial solar power generation. Under the Expanded Operations Alternative, DOE/NNSA would allow development of one or more full-scale commercial solar power generation facilities in Area 25 of the NNSS with a combined generating capability of up to 1,000 megawatts. As shown in Figure 3–2, the solar power generation facilities would be located within an area of about 39,600 acres in the southwestern part of the NNSS. The reasons for DOE/NNSA's consideration of commercial solar power development only in Area 25 and decision to assess the concentrating solar power parabolic trough technology in this *NNSS SWEIS* are addressed in Section 3.1.3.2. The facility(ies) could use a variety of solar power-generating technologies (i.e., parabolic trough, power tower, dish engine, photovoltaic) with a combined generating capability of up to 1,000 megawatts. Construction of 1,000 megawatts of commercial solar power generation facilities using concentrating solar power technology and a hybrid cooling system would disturb up to about 10,000 acres of land, as noted in Chapter 5, and operation would require up to approximately 700 acre-feet of water per year, as noted in Section 5.1.6.2.2. Approximately 10 miles of new 500-kilovolt electrical transmission line (outside of the NNSS) would be required to integrate the electricity generated into the regional system, which would disturb approximately 350 acres of land. The analysis in this SWEIS is based on assumptions for a representative commercial solar project (West 2010). Because there is no specific proposal for a commercial solar power generation project, a NEPA review would be required to evaluate any such proposals in the future.

Geothermal Demonstration Project. There are no proposals to develop a Geothermal Demonstration Project at the NNSS, at this time; however, there has been recent interest in such a project. Under such a project, the NNSS would be evaluated to determine the feasibility of demonstrating an enhanced geothermal electrical generating system. If the initial evaluation were favorable, the location for a Geothermal Demonstration Project on the NNSS would depend on a combination of factors, including the system's potential, land use zone restrictions, and environmental and economic considerations. Approximately 30 to 50 acres of land would be disturbed by construction of a Geothermal Demonstration Project. Several boreholes would be drilled up to 20,000 feet deep. Up to 20 acre-feet of water would be required to initially prime the system. A continuously operating 50-megawatt power plant would require an estimated 50 acre-feet of water per year. As a separate but related project, a Geothermal Research Center, would be established in Mercury using existing facilities. A Geothermal Demonstration Project would be interconnected to the NNSS electrical transmission system, but would not generate sufficient power to exceed the capacity of the rebuilt NNSS 138-kilovolt transmission system addressed in Section 3.2.3.1. Because there are no specific proposals for geothermal exploration or development on the NNSS at this time, additional NEPA review would be required before such work could be conducted.

3.2.3.3 Other Research and Development Programs

Under the Expanded Operations Alternative, DOE/NNSA would continue to host existing environmental research projects at the NNSS and would actively promote and expand the National Environmental Research Park Program. DOE/NNSA would consider new environmental or other proposed research and/or development projects not related to DOE/NNSA National Security/Defense or Environmental Management missions on a case-by-case basis.

Expanded Operations Alternative—American Indian Perspective

CGTO The Consolidated Group of Tribes and Organizations' (CGTO) concerns and perspective regarding the Expanded Operations Alternative include those discussed previously under Sections 3.0, 3.1.1, 3.1.2, 3.1.2.1, 3.1.2.2, and 3.1.3, as well as those summarized here. Under the Expanded Operations Alternative, the U.S. Department of Energy (DOE) would pursue geothermal electrical generation in a variety of locations depicted in Figure A.2.3-1, and solar energy systems and facilities in Areas 6 and 25, respectively.

The CGTO understands that DOE is proposing to construct modular geothermal power plants that have a relatively small surface footprint. However, the initial project support activities will reportedly impact 30 to 50 acres. The CGTO also understands that DOE may pursue solar power by constructing a 5 megawatt photovoltaic system, and commercial solar power generating facilities. These proposed solar power electrical generation projects would impact approximately 50 acres and 39,600 acres of land, respectively. The CGTO is particularly concerned with the land and resources potentially impacted by these projects.

Construction of the proposed solar power electrical generation system and facilities, and the geothermal electrical generation facility involves scraping the land, irreparably destroying the land and vegetation. Facility construction will facilitate erosion, impede visual resources, and will emit dust and other potentially hazardous pollutants into the air. This will, in turn, impact the land, water, air, plants, animals, and cultural resources, and will affect the solitude and cultural integrity of the land. Some examples of resources impacted have been highlighted throughout this section.

The CGTO is concerned that DOE's proposed activities unnaturally harnesses the earth's power without understanding the implications of these actions or all that is necessary to begin to prepare the earth and its resources. Numic people have a complex understanding of *power* and believe it is special force that was placed in all things at the time the world was created. It is that spark which keeps the world going and all of its elements thinking, talking, moving, and interacting. This special *power* moves and has the ability to move down hill, often concentrating or pooling in certain places like mineral outcrops, cliffs, and caves. It has characteristics similar to water, and can be understood as having the ability to return to the sky to become like rain and snow, which are called down from the sky by the highest mountains. This special *power* has a rotation of movement similar to the hydrological cycle and has the ability to impact all things.

The CGTO is concerned about unnaturally harnessing the power of the Sun. According to tribal elders, *"The Sun is like a big battery. Once you drain its power, will it die? For those of us spiritually connected to the Sun, what will happen to us if it is killed? We know the Sun has only so much energy. If the Sun is drained, how will it be replenished? If the Sun goes away, everything will die. Because of the complexity and potential implications to the environment, cultural landscape, and our own survival, we strongly encourage the DOE to pursue a study that evaluates the cultural implications of pursuing solar energy. The stories and activities of our ancestors are tied greatly to the Sun. Today, our prayers and ceremonies still travel or rely on its strength."*

According to information presented throughout the site-wide environmental impact statement, the proposed geothermal electrical generation facilities would use the power of rocks that are hot. Rocks, or minerals, are culturally important and have significant roles in many aspects of Indian life. For example, the Chalcedony would have made an attractive offering acquired and then left at the vision quest or medicine site located to the north on top of a volcano like Scrugham Peak. In particular, Indian people have observed the presence of the following minerals used as offerings on the Nevada National Security Site (NNSS): (1) Obsidian, (2) Chalcedony, (3) Yellow Chert (otherwise known as Jasper), (4) Black Chert, (5) Pumice, (6) Quartz Crystal, and (7) Rhyolite Tuff.

Obsidian is a glass-like stone produced by volcanoes when they talk. According to information obtained by Dr. Richard Stoffle with the University of Arizona and presented in the report *Black Mountain: Traditional Uses of Volcanic Landscapes*, Southern Paiutes use a green volcanic glass during curing ceremonies that involved bleeding the patient. Volcanic glass found below Scrugham Peak was used in the first arrow making lessons for young men. Such lessons were held in small rock shelters found along the base of the basalt flow that constitutes Buckboard Mesa. Obsidian flakes were placed before important rock art panels as offering to the spirits who lived on the other side of the passageway provided by the panel. Small obsidian stones, commonly called *Apache Tears*, cover a depth of 4 inches on the face of Shoshone Mountain in southern Nevada. This massive deposit of obsidian stones is interpreted by Indian people as being provided by the mountain as both a spiritual backdrop and a location for vision quests.

Volcanic rocks are used in a wide range of ceremonial activities. According to a tribal elder, *"Indian women enhance the quality of breast milk by squirting it on heated rocks."* Volcanic rocks are used for medicine society sweat lodge meetings. Indian people call some volcanic rocks "grandfather stones," a designation that reflects reverence as well as wisdom. Such rocks are sought in special places of power and carried over long distances to serve as the heated stones in sweat lodges.

Other traditional use minerals are known to exist throughout the NNSS and offsite locations. In order to document the cultural significance of these areas, additional ethnographic mineral studies are needed to fully understand the location and importance of these minerals at the proposed project site locations prior to any surface disturbing activities. The CGTO is particularly apprehensive about the potential impacts or use of these minerals resulting from proposed geothermal activities.

Expanded Operations Alternative—American Indian Perspective (cont'd)

Some of the locations proposed for geothermal electrical power plants are recognized as traditionally or spiritually important. In particular, the CGTO is concerned about activities that have the potential to impact Oasis Valley, Amargosa River, Timber Mountain Caldera Complex, Black Mountain, Gold Meadows, Cane Springs, Calico Hills area, Crater Flats, Scrugham Peak, Shoshone Mountain, Devil's Hole, Ash Meadows, and Death Valley. The CGTO is concerned about locating the proposed geothermal project along hydrological basins, whose power is derived from volcanic activity.

We know the forces of power in the world move along channels and combine into specific nodes or places of power. A common set of these channels follows the path of water. From this beginning, the water moves downhill in rivulets, washes, and streams. The water often goes underground where it forms similar networks of channels moving in various directions, corresponding to hydrological basins. Water is often attracted to volcanic activity, thus producing power places like hot mineral springs.

The CGTO is concerned the DOE may impact hot springs in their pursuit of geothermal power. According to information obtained by Dr. Richard Stoffle with the University of Arizona and presented in the report *Black Mountain: Traditional Uses of Volcanic Landscapes*, hot springs come from the earth where volcanic activity still occurs even if the magma cannot be seen on the surface. Such springs are a combination of water and volcanoes producing a special place where both ceremonial and medicine activities occur. Indian people from Owens Valley have a single origin story for all of the hot springs in the southern Great Basin and northern Mohave Desert. According to traditional stories, a great ball of fire came from the sky and landed at Coso Hot Springs and then splashed to form at once all of the other hot springs.

Hydrological Impacts

According to information presented in the Site-Wide Environmental Impact Statement, the proposed solar and geothermal projects will require a tremendous amount of water. A modular geothermal power plant alone will require up to 20 acre-feet to initially prime the system.

Indian people believe water is a living being that is fully sentient and willful. Water is already stressed throughout the region. The CGTO is concerned about the use of this very limited and important resource.

Because water is a powerful being it is associated with other powerful beings, such as water babies, a supernatural being that lives in and protects the water. These beings are like the people of the water. They are highly respected by American Indian culture. If water is contaminated and misused, the water babies may cause harm and move to other areas that are not contaminated.

Air Quality and Climate Impacts

Construction of these proposed facilities will impact large areas of land, potentially emitting dust and contaminants. The CGTO knows the air is alive. The Creator puts life into the air, which is shared by all living things. Air can be destroyed, causing pockets of dead air. There is only so much living air that surrounds the world. If it is destroyed, it is gone forever and cannot be restored. Dead air lacks the spirituality and life necessary to support other life forms. The CGTO is concerned about emitting things into the air that are unnatural, and raises the potential health and environmental issues associated with these emissions.

Visual Resource Impacts

All landforms within the NNSS have high sensitivity levels for American Indians. The ability to see the land without obstructions like buildings, towers, cables, roads, and other objects is essential for the spiritual interaction between Indian people and their traditional homelands. Visual resources may be negatively impacted if proposed solar and geothermal projects are pursued. The CGTO must be part of any future discussions as these may impact visual resources and may impede traditional and cultural ceremonies.

Final Thoughts

Only Indian people have traditional ecological knowledge that tells us how and where to interact with plants and animals, water sources, and collect soil samples to minimize impacts to the land while maintaining its spiritual integrity. Because of the potential effects to our ancestral land and its delicate resources, the CGTO must be an integral part of the solar power electrical generation and geothermal electrical generating power projects by conducting systematic ethnographic studies before the ground is disturbed.

The CGTO strongly encourages DOE to evaluate the cultural impacts of pursuing solar and geothermal energy in culturally sensitive areas because of the complexity and potential implications to the environment, cultural landscape, and our survival. The CGTO recommends developing culturally appropriate text for future National Environmental Policy Act (NEPA) analyses, including the environmental assessments and mitigation plans required for these proposed undertakings.

See Appendix C for more details.

3.3 Reduced Operations Alternative

The Reduced Operations Alternative addressed in this SWEIS includes the same types of activities as the No Action Alternative; however, for many programs, the levels of operations would be reduced. Perhaps the most important change from No Action under the Reduced Operations Alternative would be cessation of all activities other than environmental restoration, environmental monitoring, site security operations, military training and exercises, and maintenance of Well 8 and critical communications and electrical transmission systems in the northwestern portion of the NNSS (Areas 18, 19, 20, 29, and 30). Maintenance of Pahute Mesa, Stockade Wash, and Buckboard Mesa Roads would be minimized to provide only access for maintaining necessary infrastructure and conducting environmental restoration activities and operations at Pahute Mesa Airstrip would be limited to those necessary to provide access for the activities that would continue in these areas. The electrical transmission/distribution system beyond the Echo Peak Substation in Areas 19 and 20 would be de-energized. Ceasing all activities other than those mentioned in Areas 18, 19, 20, 29, and 30 would reduce DOE/NNSA's maintenance requirements at the NNSS and allow scarce resources to be focused on the more used areas of the NNSS. It may also reduce impacts on some resources, relative to the No Action and Expanded Operations Alternatives. **Figure 3–3** illustrates the configuration of the NNSS under the Reduced Operations Alternative.

Reduced Operations Alternative—American Indian Perspective

The Consolidated Group of Tribes and Organizations' (CGTO) concerns and perspective regarding the Reduced Operations Alternative include those discussed previously under Sections 3.0, 3.1.1, 3.1.2, 3.1.2.1, 3.1.2.2, and 3.1.3. The CGTO is supportive of a decrease in culturally perceived harmful land-disturbing activities within the Nevada National Security Site (NNSS) area and the offsite locations. To successfully reduce operations and restore environmental balance, it is essential to have tribal representatives involved throughout the process to help guide the U.S. Department of Energy (DOE) in conducting culturally appropriate activities. *See Appendix C for more details.*

The following description of the missions, programs, capabilities, projects, and activities that would be conducted under the Reduced Operations Alternative primarily addresses only this alternative's differences from the No Action Alternative; that is, those projects and activities that would be conducted at a lower level of intensity or not at all.

3.3.1 National Security/Defense Mission

Under the Reduced Operations Alternative, DOE/NNSA would continue to pursue activities in support of the Stockpile Stewardship and Management, Nuclear Emergency Response, Nonproliferation, Counterterrorism, and Work for Others Programs.

3.3.1.1 Stockpile Stewardship and Management Program

Stockpile stewardship and management operations would continue under the conditions of the ongoing nuclear testing moratorium. As under the No Action Alternative, the Reduced Operations Alternative includes those activities necessary to maintain the capability to conduct underground nuclear tests. Such a test would be conducted only if so directed by the President in the interest of national security. Conducting an underground nuclear test is neither included nor analyzed under any of the alternatives in this *NNSS SWEIS*. A generic description of underground nuclear testing is provided in Appendix H. Detailed descriptions of Stockpile Stewardship and Management Program activities under the Reduced Operations Alternative are provided in Appendix A, Section A.3.1.1.

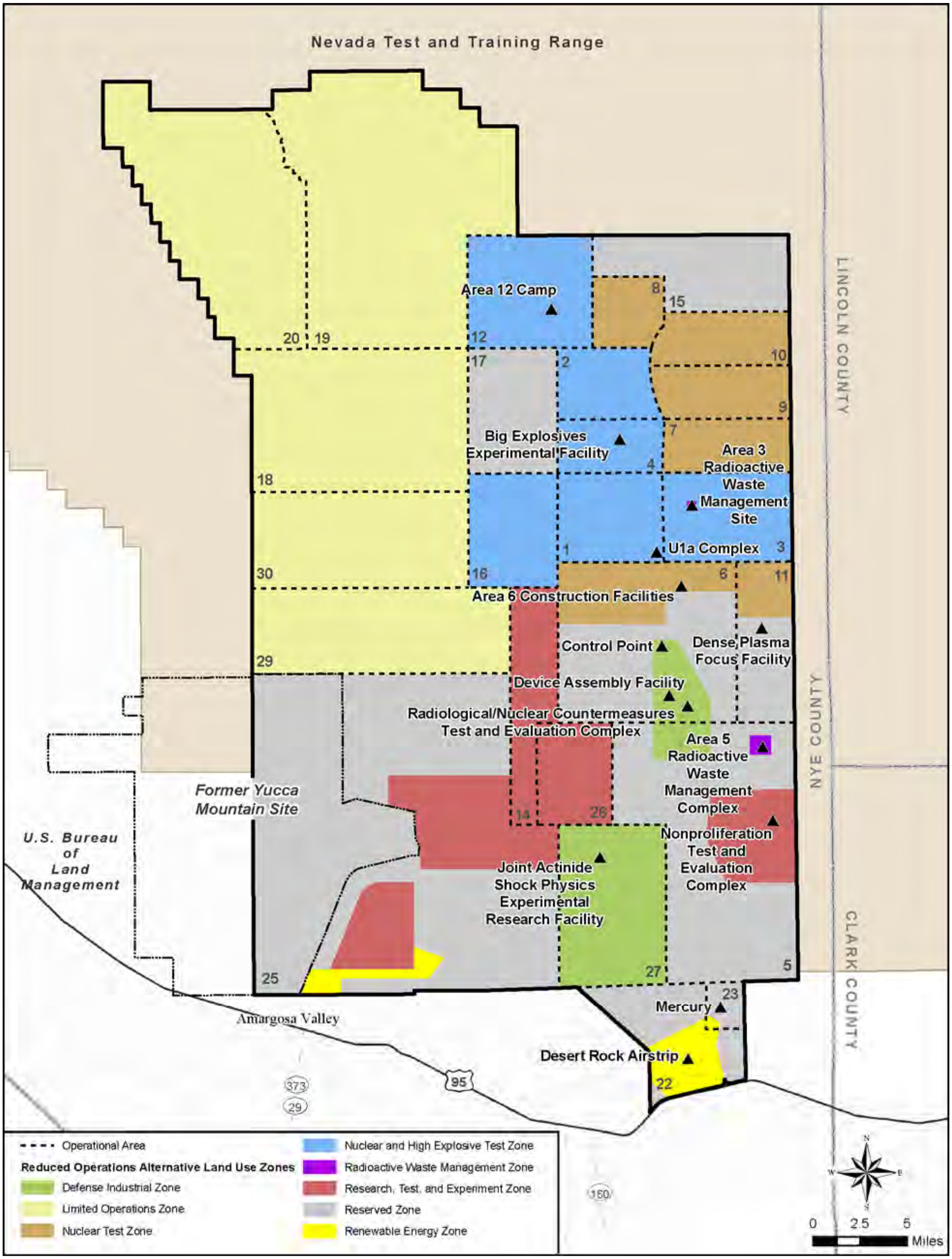

Figure 3–3 Nevada National Security Site Land Use Zones and Major Facilities Under the Reduced Operations Alternative

Under the Reduced Operations Alternative, there would be no change from the No Action Alternative for the following Stockpile Stewardship and Management Program projects and capabilities:

- Shock physics experiments at the Large-Bore Powder Gun
- Criticality experiments at DAF
- Disposition of damaged U.S. nuclear weapons
- Storage and staging of nuclear devices
- Staging of SNM, including pits
- Readiness-related training and exercises using various kinds of nuclear weapon simulators

In addition to maintaining these capabilities, under the Reduced Operations Alternative, the following changes in stockpile stewardship and management capabilities at DOE/NNSA facilities in Nevada would occur:

Dynamic experiments. DOE/NNSA would conduct no more than six of these experiments per year. Over the next 10 years, a total of five dynamic experiments would be conducted in emplacement holes and cause land disturbances. No dynamic experiments would occur in Areas 19 or 20 of the NNSS.

Conventional explosives experiments. DOE/NNSA would annually conduct up to 10 conventional explosives experiments in the Nuclear and High Explosives Test Zone to directly support the Stockpile Stewardship and Management Program. No other explosives experiments would be conducted.

Shock physics experiments. No more than six shock physics experiments with SNM would be annually conducted at JASPER.

Pulsed Power Experiments at the Atlas Facility. The Atlas Facility would be decommissioned and dispositioned.

Fusion experiments at the NNSS and NLVF. DOE/NNSA would conduct up to 375 plasma physics and fusion experiments per year: up to 350 would use the Dense Plasma Focus Machine at NLVF, while no more than 25 would use the machine in Area 11.

Support for Office of Secure Transportation Training. The number of times per year that Office of Secure Transportation training and exercises would be supported would be reduced to four.

Stockpile stewardship and management activities at the TTR. DOE/NNSA would not conduct fixed rocket launcher operations, cruise missile operations, or fuel-air explosives operations at the TTR.

3.3.1.2 Nuclear Emergency Response, Nonproliferation, and Counterterrorism Programs

There would be no change from the No Action Alternative for Nuclear Emergency Response, Nonproliferation, or Counterterrorism Program activities. See Appendix A, Section A.1.1.2, for a detailed description of these activities.

3.3.1.3 Work for Others Program

Under the Reduced Operations Alternative, DOE/NNSA would continue to host the projects of other Federal agencies, state and local governments, and nongovernmental organizations; however, certain activities, such as large-scale explosives tests and experiments, would not be conducted. DOE/NNSA also would no longer support the following Work for Others Program activities, which are associated with nonproliferation projects and counterproliferation research and development:

- Conventional weapons effects tests, including live-drop and static high-explosives detonations
- Development and demonstration of capabilities and technologies to attack and defeat military targets protected in tunnels and other deeply buried hardened facilities
- Explosives experiments
- Experiments requiring explosive releases of chemical and biological simulants

No Work for Others Program activities, except military training and exercises, would be conducted in Areas 18, 19, 20, 29, and 30 of the NNSS under the Reduced Operations Alternative. The reason for this exception is that military training and exercises are currently conducted primarily in the western half of the NNSS to ensure adequate separation and avoid interference with other DOE/NNSA activities. This separation would need to be continued for safety and security considerations.

3.3.2 Environmental Management Mission

The DOE/NNSA Environmental Management Mission includes the Waste Management and Environmental Restoration Programs. Under the Reduced Operations Alternative, both of these programs would be the same as under the No Action Alternative, except that less TRU waste would be generated annually (about 710 cubic feet per year from all activities) because of the projected reduced annual number of experiments at JASPER and other national security activities. As with the No Action Alternative, this waste would be safely stored at the TRU Pad pending shipment off site for disposition along with other legacy or newly generated environmental restoration waste. DOE/NNSA activities would generate an estimated 170,000 cubic feet of hazardous waste. Smaller quantities of solid wastes (3,600,000 cubic feet) were also projected (compared to the No Action Alternative) because of reduced employment and construction activities. About 360,000 cubic feet of sanitary solid waste would be sent off site for recycling. Under the Reduced Operations Alternative, environmental restoration activities would continue in accordance with the most recent FFACO.

3.3.3 Nondefense Mission

The Nondefense Mission generally includes those projects and capabilities necessary to support DOE/NNSA-related programs such as construction and maintenance of facilities, provision of supplies and services, warehousing, and similar activities. Activities related to supply and conservation of energy, including renewable energy and other research and development, are considered part of the Nondefense Mission. Activities under the Reduced Operations Alternative would be the same as those under the No Action Alternative, including maintenance of the "cold standby" status of the former Yucca Mountain site, but at a lower level of effort, reflective of operational levels and establishment of the "Limited Use Zone."

3.3.3.1 General Site Support and Infrastructure Program

Under the Reduced Operations Alternative, infrastructure-associated activities would include repairs, replacements, and projects to maintain the reduced capabilities of the NNSS. DOE/NNSA would maintain only critical infrastructure within Areas 18, 19, 20, 29, and 30, including the Echo Peak, Motorola, and Shoshone communications facilities; the Echo Peak, Castle Rock, and Stockade Wash Substations; electrical transmission lines interconnecting these substations; and Well 8. Roads within Areas 18, 19, 20, 29, and 30 would be minimally maintained to provide the basic access necessary to maintain the noted infrastructure and to access environmental restoration sites in those areas. As noted under the No Action Alternative, although considered infrastructure, characterization and monitoring wells developed under the UGTA Project are addressed under the Environmental Management Program and proposed and potential renewable energy projects are addressed under the Conservation and Renewable Energy Program, rather than the General Site Support and Infrastructure Program.

3.3.3.2 Conservation and Renewable Energy Program

Commercial Solar Power Generation. Under the Reduced Operations Alternative, DOE/NNSA assumes development of a 100-megawatt commercial solar power generation plant in Area 25 of the NNSS. The reasons for DOE/NNSA's consideration of commercial solar power development only in Area 25 and decision to assess the concentrating solar power parabolic trough technology in this *NNSS SWEIS* are addressed in Section 3.1.3.2. DOE/NNSA estimated 1,200 acres of land would be required for a 100-megawatt parabolic trough solar power generation facility. Operation of a commercial 100-megawatt concentrating solar power generation facility using hybrid cooling technology would require up to approximately 175 acre-feet of groundwater per year, as noted in Section 5.1.6.2.3. Unlike under the No Action and Expanded Operations Alternatives, the existing electrical transmission system on the NNSS has sufficient capacity to transmit the electrical energy produced by a 100-megawatt facility and new transmission line construction would not be required. Minor infrastructure construction and maintenance may be required to support the development of up to 100 megawatts of solar power generation within Area 25. The analysis in this SWEIS was based on assumptions for a representative commercial solar project. Because there are no current proposals for a commercial solar power generation facility on the NNSS, a separate NEPA review would be required for any specific proposal.

3.3.3.3 Other Research and Development Programs

Under the Reduced Operations Alternative, DOE/NNSA would continue to host existing environmental research projects at the NNSS, but would not actively promote the National Environmental Research Park Program. DOE/NNSA would consider any new environmental or other proposed research and/or development projects not related to DOE/NNSA National Security/Defense or Environmental Management Missions in all areas of the NNSS except Areas 18, 19, 20, 28, 29, and 30 on a case-by-case basis.

3.4 Identification of the Preferred Alternative

Council on Environmental Quality regulations for implementing NEPA (40 CFR 1502.14(e)) require an agency to identify its preferred alternative or alternatives, if one or more exists, in the draft EIS. At the time the *Draft NNSS SWEIS* was published, DOE/NNSA had not selected a preferred alternative. Since publication of the *Draft NNSS SWEIS*, DOE/NNSA has identified its Preferred Alternative (see Table 3–3).

In identifying its Preferred Alternative, DOE/NNSA considered the current and future needs of DOE/NNSA and other users of the NNSS and offsite locations. In doing so, DOE/NNSA balanced mission requirements established by the U.S. Congress with contemporary goals and objectives identified in planning documents such as the *10 Year Site Plan Fiscal Year 2012* for the NNSS (DOE 2011c), and anticipated funding levels for DOE/NNSA, as well as other users of the NNSS and offsite locations, such as DHS. DOE/NNSA also considered the preferences expressed by commentors on the *Draft NNSS SWEIS* and sought to balance those preferences with the needs of the agency and other users of the NNSS and offsite locations in Nevada.

DOE/NNSA's Preferred Alternative is a "hybrid" comprising various programs, capabilities, projects, and activities selected from among the three alternatives. Table 3–3 provides a comparison of mission-based program activities under the three alternatives and visually identifies by light blue shading which elements of the three alternatives were selected for the Preferred Alternative. In some cases, DOE/NNSA identified preferences from each alternative for different activities within a single program area. For example, under the Stockpile Stewardship and Management Program, DOE/NNSA identified its preference for conducting up to 10 dynamic experiments per year (consistent with the No Action Alternative), conducting up to 36 shock physics experiments per year at JASPER (consistent with the Expanded Operations Alternative), while also decommissioning the Atlas Facility (consistent with the Reduced Operations Alternative) as part of the Preferred Alternative.

As the Preferred Alternative is a "hybrid" composed of elements of each of the three alternatives that were examined in the Draft *NNSS SWEIS*, DOE/NNSA determined that the potential environmental consequences of the Preferred Alternative would fall within the range of magnitudes seen between the No Action and Expanded Operations Alternatives, varying by the affected environmental resource area, and there would be no synergistic effects resulting in previously unanalyzed impacts stemming from the hybrid alternative. For some environmental resources, the range of potential impacts is closer to that estimated for the No Action Alternative. For example, land disturbance under the Preferred Alternative is estimated at 8,107 acres, with the No Action and Expanded Operations Alternatives resulting in approximately 4,460 and 25,877 acres, respectively. Impacts on environmental resources closely tied to land disturbance (e.g., habitat loss, takes of threatened or endangered species, loss of cultural resources) would therefore also be closer in magnitude to those estimated for the No Action Alternative. For other environmental resources, the potential impacts would be much closer or identical to those estimated for the Expanded Operations Alternative. For example, radiological human health impacts result largely from LLW transportation and disposal activities. Under the Preferred Alternative, the volume of LLW requiring transportation and disposal would be identical to that identified under the Expanded Operations Alternative; thus, the potential impacts would be the same. **Tables 3–4, 3–5, 3–6** and **3–7** provide summaries of the potential impacts of the Preferred Alternative for each DOE/NNSA site, as well as the impacts of the three alternatives examined in the *Draft NNSS SWEIS*.

3.5 Comparison of Potential Consequences of the Alternatives

A summary of the potential impacts of the alternatives evaluated in this SWEIS is provided in this section. Tables 3–4 through 3–7 present side-by-side comparisons of the impacts under the alternatives at the NNSS, RSL, NLVF, and the TTR, respectively. The information presented in Tables 3–4 through 3–7 is a summary only; for detailed discussion, please refer to the appropriate resource section(s) of Chapter 5.

Table 3–3 Mission-Based Program Activities Under the Preferred Alternative (in blue)

NO ACTION ALTERNATIVE	EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
National Security/Defense Mission		
Stockpile Stewardship and Management Program (see Sections 3.1.1.1, 3.2.1.1, and 3.3.1.1 of this chapter for additional information)		
Maintain readiness to conduct underground nuclear tests.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Conduct up to 10 dynamic experiments per year within NNSS Areas 1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 16, 19, or 20.	Conduct up to 20 dynamic experiments per year within NNSS Areas 1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 16, 19, or 20.	Conduct up to 6 dynamic experiments per year at the NNSS; no dynamic experiments would be conducted in Areas 19 or 20.
Conduct up to 20 conventional explosives experiments per year at BEEF and up to 10 per year within NNSS Areas 1, 2, 3, 4, 12, or 16 using up to 70,000 pounds TNT-equivalent of explosive charges; would also support Work for Others Program.	• Conduct up to 100 conventional explosives experiments per year within NNSS Areas 1, 2, 3, 4, 12, or 16 using up to 120,000 pounds TNT-equivalent of explosive charges (50 of these would be at BEEF with a TNT-equivalent limitation of 70,000 pounds); would also support Work for Others Program. • Add second firing table and high-energy x-ray capability at BEEF. • Establish up to three areas at the NNSS for conducting explosive experiments with depleted uranium and conduct up to 20 experiments per year.	Conduct up to 10 conventional explosives experiments per year at BEEF using up to 70,000 pounds TNT-equivalent of explosive charges per year to directly support the Stockpile Stewardship and Management Program; no other explosives experiments would be conducted.
Conduct up to 12 shock physics experiments per year at the NNSS using actinide targets at JASPER in Area 27 and up to 10 experiments per year using the Large-Bore Powder Gun in Area 1.	Conduct up to 36 shock physics experiments per year at the NNSS using actinide targets at JASPER in Area 27 and up to 24 experiments per year using the Large-Bore Powder Gun in Area 1.	Conduct up to 6 shock physics experiments per year at the NNSS using actinide targets at JASPER in Area 27 and up to 8 experiments per year using the Large-Bore Powder Gun in Area 1.
Conduct up to 500 criticality operations (experiments, training, and other operations) per year at the National Criticality Experiments Research Center at DAF in Area 6.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Maintain the Atlas Facility in standby with the capability to conduct up to 12 pulsed-power experiments per year.	Activate the Atlas Facility and conduct up to 24 pulsed-power experiments per year.	Decommission and disposition the Atlas Facility.
Conduct up to 600 plasma physics and fusion experiments each year at NLVF and 50 per year in NNSS Area 11.	Conduct up to 1,000 plasma physics and fusion experiments each year at NLVF and 650 per year in NNSS Area 11, increasing the size and complexity of such experiments.	Conduct up to 350 plasma physics and fusion experiments each year at NLVF and 25 per year in NNSS Area 11.
Conduct five drillback operations at the NNSS over about a 10-year period.	Same as under the No Action Alternative.	Same as under the No Action Alternative.

NO ACTION ALTERNATIVE	EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
Conduct Stockpile Stewardship and Management Program activities in NNSS Areas 1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 16, 19, or 20, including the following:	Same as under the No Action Alternative, plus:	Same as under the No Action Alternative, except: Stockpile Stewardship and Management Program activities would not be conducted in Areas 19 and 20.
– Disposition damaged U.S. nuclear weapons on an as-needed basis.	– Stage nuclear devices pending dismantlement, modification/maintenance, and/or transportation to another location. – Dismantle up to 100 nuclear weapons per year. – Replace limited-life components of up to 360 nuclear devices and conduct associated maintenance activities. – Test weapons components for quality assurance under the Limited Life Component Exchange Program.	
– Stage special nuclear material, including nuclear weapon pits.	– Transfer special nuclear material, including nuclear weapon pits, to and from other parts of the DOE complex for staging and use in experiments at the NNSS.	
Conduct training for the Office of Secure Transportation up to six times per year at various locations on NNSS roads.	Same as under the No Action Alternative, plus: Develop facilities in Area 17 and upgrade or construct new facilities in Area 6, 12, or 23 to support training for the Office of Secure Transportation.	Conduct training for the Office of Secure Transportation up to four times per year at various locations on NNSS roads.
Conduct the following stockpile stewardship operations at the TTR:	Same as under the No Action Alternative, except: Certain safeguards and security functions and other administrative functions would be returned to the U.S. Air Force	Same as under the No Action Alternative, except:
– Conduct tests and experiments, including flight test operations for gravity weapons (i.e., bombs). – Conduct ground/air-launched rocket and missile operations. – Conduct impact testing. – Conduct passive testing of joint test assemblies and conventional weapons. – Conduct fuel-air explosives testing.		– Discontinue ground/air-launched rocket and missile operations. – Discontinue fuel-air explosives testing at the TTR.
Nuclear Emergency Response, Nonproliferation, and Counterterrorism Programs (see Sections 3.1.1.2, 3.2.1.2, and 3.3.1.3 of this chapter for more information)		
Provide support for the Nuclear Emergency Support Team, the Federal Radiological Monitoring and Assessment Center, the Accident Response Group, and the Radiological Assistance Program. Most of this support is out of RSL at Nellis Air Force Base.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Conduct Aerial Measuring System activities from RSL at Nellis Air Force Base.	Same as under the No Action Alternative.	Same as under the No Action Alternative.

NO ACTION ALTERNATIVE	EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
Conduct WMD emergency responder training at various DOE/NNSA NSO venues.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Support the DOE Emergency Communications Network.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Disposition improvised nuclear devices and deploy the DOE/NNSA Disposition Program and FBI Disposition Forensic Program to the NNSS for training and exercises or for an actual event, as needed.	Same as under the No Action Alternative, plus disposition of radiological dispersion devices, as needed.	Same as under the No Action Alternative.
Integrate existing activities and primarily NNSS facilities to support U.S. efforts to control the spread of WMDs, particularly nuclear WMDs, including arms control, nonproliferation activities, nuclear forensics, and counterterrorism capabilities.	Same as under the No Action Alternative, plus: At the NNSS: • Construct laboratory space and other facilities for design and certification of treaty verification technology, training of inspectors, and development of arms control confidence-building measures as part of the Arms Control Treaty Verification Test Bed.[a] • Develop and construct new facilities to support a Nonproliferation Test Bed to simulate chemical and radiological processes that an adversary would clandestinely conduct.[a] • Construct an Urban Warfare Complex to support counterterrorism training.[a]	Same as under the No Action Alternative.
Work for Others Program (see Sections 3.1.1.3, 3.2.1.3, and 3.3.1.3 of this chapter for more information)		
Continue to conduct Work for Others Program activities in all appropriate zones on the NNSS, and at RSL and NLVF.	Same as under the No Action Alternative, except: The NNSS land use zone designation for Area 15 would be changed from "Reserved Zone" to "Research, Test, and Experiment Zone."	Same as under the No Action Alternative, except: Work for Others Program activities, with the exception of military training and exercises, would not be conducted in Areas 18, 19, 20, 29, and 30 at the NNSS.
Host treaty verification activities.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Conduct nonproliferation projects and counterproliferation research and development at the NNSS, including:	Same as under the No Action Alternative.	Same as under the No Action Alternative, except:
– Conduct conventional weapons effects and other explosives experiments.		Discontinue Work for Others Program conventional weapons effects and other explosives experiments.
– Support development of capabilities to detect and defeat military assets in deeply buried hardened targets.		Discontinue development of capabilities to defeat military assets in deeply buried hardened targets.
– Conduct up to 20 controlled chemical and biological simulant release experiments per year (each experiment would include multiple releases by a variety of means, including explosive).		Discontinue projects requiring explosive releases of chemical or biological simulants.

NO ACTION ALTERNATIVE	EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
– Support training, research and development of equipment, specialized munitions, and tactics related to counterterrorism.		
Support the U.S. Department of Defense and other Federal agencies in developing counterterrorism capabilities.	Develop and construct new facilities to support counterterrorism training and research and development activities.	Same as under the No Action Alternative.
Conduct criticality experiments to support NASA's deep space power source development within the parameters for criticality experiments established under the Stockpile Stewardship and Management Program.	Same as under the No Action Alternative, plus: Support NASA's deep space power source development, including conducting experiments using existing boreholes at the NNSS to sequester emissions such as radionuclides.[a]	Same as under the No Action Alternative.
Host the use of various aerial platforms, such as airplanes, unmanned aerial systems and helicopters, at various locations at the NNSS for research and development, training, and exercises.	• Increase use of various aerial platforms, such as airplanes, unmanned aerial systems, and helicopters, for research and development, training, and exercises, including constructing additional hangars, shops, and buildings at existing airports at the NNSS. • Conduct up to 3 underground and 12 open-air radioactive tracer experiments per year. • Host treaty verification activities, including development of a facility for simulating nuclear fuel cycle-related radionuclide release detection and characterization.[a] • Develop a facility for specialized explosive experiments and simulated manufacture to support high-explosives experiments.[a] • Support increased research and development of active interrogation equipment, methods, and training. • Develop new facilities to support research and development in radio frequency generation and infrasonic observations.[a] • Develop new facilities, including simulated clandestine laboratories, to support chemical and biological simulant experiments.[a]	Same as under the No Action Alternative.
Conduct Work for Others Program activities at the TTR, including robotics testing, smart transportation-related testing, smoke obscuration operations, infrared tests, and rocket development.	Same as under the No Action Alternative, except: Certain safeguards and security functions and other administrative functions would be turned over to the U.S. Air Force.	Same as under the No Action Alternative.

NO ACTION ALTERNATIVE	EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
Environmental Management Mission		
Waste Management Program (see Sections 3.1.2.1, 3.2.2.1, and 3.3.2.1 of this chapter for more information)		
Dispose up to 15,000,000 cubic feet of LLW and 900,000 cubic feet of MLLW [b] in the Area 5 RWMC.	Dispose up to 48,000,000 cubic feet of LLW and 4,000,000 cubic feet of MLLW at the Area 5 RWMC and Area 3 RWMS. [d]	Same as under the No Action Alternative.
Maintain the Area 3 RWMS on standby.	Open the Area 3 RWMS for disposal of authorized and/or permitted waste.	Same as under the No Action Alternative.
Repackage onsite-generated MLLW.	Same as under the No Action Alternative, plus: At the Area 5 RWMC, store MLLW received from on- and offsite generators pending treatment via macroencapsulation and microencapsulation (i.e., repackaging), sorting/segregating, and bench-scale mercury amalgamation, as appropriate, and/or dispose this waste.	Same as under the No Action Alternative.
Store onsite-generated TRU waste (up to 9,600 cubic feet over the next 10 years) pending offsite disposal.	Same as under the No Action Alternative, except a larger volume (up to 19,000 cubic feet over the next 10 years) of TRU waste would be generated by increased activities at NNSS facilities, such as JASPER.	Same as under the No Action Alternative, except smaller volumes (up to 7,100 cubic feet over the next 10 years) of TRU waste would be generated by reduced operational levels at NNSS facilities, such as JASPER.
Store onsite-generated hazardous waste as needed at the Area 5 Hazardous Waste Storage Unit pending offsite treatment or disposal. Up to 170,000 cubic feet would be generated over the next 10 years.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Operate the Area 11 Explosives Ordnance Disposal Unit. No more than 41,000 pounds of explosives would be treated over the next 10 years.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Operate the Area 6 Hydrocarbon Landfill.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Operate the Area 23 Solid Waste Disposal Site and the U10c Solid Waste Disposal Site. Up to 3,400,000 cubic feet would be disposed over the next 10 years.	Same as under the No Action Alternative, plus: Larger volumes of solid sanitary waste requiring disposal (up to 8,500,000 cubic feet) would be generated by increased activity levels at the NNSS over the next 10 years. Construct new sanitary solid waste disposal facilities as needed in Area 23 and develop a new solid waste disposal site in Area 25 to support environmental restoration activities.	Same as under the No Action Alternative, except lower volumes of solid sanitary waste requiring disposal (up to 3,300,000 cubic feet) would be generated by reduced activity levels at the NNSS over the next 10 years.

NO ACTION ALTERNATIVE	EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
Environmental Restoration Program (see Sections 3.1.2.2, 3.2.2.2, and 3.3.2.2 of this chapter for more information)		
Underground Test Area Project – Comply with the FFACO; monitor groundwater from existing wells; drill new characterization and monitoring wells; develop groundwater flow and transport models; and continue to evaluate closure strategies.	Same as under the No Action Alternative, except: Characterization and monitoring wells would be developed more quickly.	Same as under the No Action Alternative.
Soils Project – Identify and characterize areas with contaminated soils and perform corrective actions in compliance with the FFACO.	Same as under the No Action Alternative, except: If stricter cleanup standards are implemented, larger volumes of radioactive waste would be generated and disposed.	Same as under the No Action Alternative.
Industrial Sites Project – Identify, characterize, and remediate industrial sites under the FFACO and continue decontaminating and decommissioning facilities.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Defense Threat Reduction Agency sites – In accordance with the FFACO, perform remediation activities at sites that are the responsibility of the Defense Threat Reduction Agency.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Execute the Borehole Management Program.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Nondefense Mission		
General Site Support and Infrastructure Program (see Sections 3.1.3.1, 3.2.3.1, and 3.3.3.1 of this chapter for more information)		
Conduct small projects to maintain the present capabilities of DOE/NNSA NSO facilities in all areas of the NNSS and at NLVF, RSL, and the TTR. Maintain existing infrastructure, manage various permits and agreements, and provide security for the former Yucca Mountain site.	Same as under the No Action Alternative, plus: • Construct a new 85,000-square-foot multistory security building in Area 23. • Replace the NNSS 138-kilovolt electrical transmission system. • Expand cellular telecommunication system on the NNSS. • Reconfigure Mercury.[a]	Same as under the No Action Alternative, except: Only critical infrastructure would be maintained within Areas 18, 19, 20, 29, and 30 of the NNSS, including certain communications facilities; electrical transmission lines and substations; and Well 8. Roads within these areas would only be maintained to provide access to the infrastructure and environmental restoration sites.
Conservation and Renewable Energy Program (see Sections 3.1.3.2, 3.2.3.2, and 3.3.3.2 of this chapter for more information)		
Continue to identify and implement energy conservation measures and renewable energy projects in compliance with applicable Executive Orders and DOE Orders.	Same as under the No Action Alternative, plus:	Same as under the No Action Alternative, except:
– Reduce energy intensity by 3 percent annually through the end of fiscal year 2015, for a total 30 percent reduction.		
– Reduce greenhouse gas emissions by 28 percent by fiscal year 2020.		
– Install advanced electric metering systems.		
– Obtain at least 7.5 percent of the NNSS annual electricity and thermal consumption from renewable energy sources.		

NO ACTION ALTERNATIVE	EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
– Support development of a 240-megawatt commercial solar power generation facility in Area 25.[a c]	• Modify NNSS land use zones to establish a 39,600-acre Renewable Energy Zone in Area 25 and support development of commercial solar power generation facilities in Area 25 with a maximum combined generating capacity of 1,000 megawatts.[a, c] • Construct a 5-megawatt photovoltaic solar power generation facility near the Area 6 Construction Facilities. • Support a Geothermal Demonstration Project and Geothermal Research Center at the NNSS.[a]	Support development of a 100-megawatt commercial solar power generation facility in Area 25.[a c]
– Reduce water use by 16 percent by 2015.		
– Maximize use of alternative fuels (e.g., E85 and biodiesel).		
– Ensure all new construction and renovation projects implement high-performance building goals.		
Other Research and Development Programs (see Sections 3.1.3.3, 3.2.3.3, and 3.3.3.3 of this chapter for more information)		
Support the DOE National Environmental Research Park Program and other non-DOE/NNSA research and development activities in all areas of the NNSS.	Same as under the No Action Alternative.	National Environmental Research Park Program and other non–DOE/NNSA research and development activities would be conducted in all areas of the NNSS except Areas 18, 19, 20, 29, and 30.

[shaded] = Activities included as part of the Preferred Alternative.

BEEF = Big Explosives Experimental Facility; DAF = Device Assembly Facility; FBI = Federal Bureau of Investigation; FFACO = Federal Facilities Agreement and Consent Order; JASPER = Joint Actinide Shock Physics Experimental Research Facility; LLW = low-level radioactive waste; MLLW = mixed low-level radioactive waste; NASA = National Aeronautics and Space Administration; NLVF = North Las Vegas Facility; NNSA = National Nuclear Security Administration; NNSS = Nevada National Security Site; NSO = Nevada Site Office; RSL = Remote Sensing Laboratory; RWMC = Radioactive Waste Management Complex; RWMS = Radioactive Waste Management Site; TNT = 2,4,6-trinitrotoluene; TRU = transuranic; TTR = Tonopah Test Range; WMD = weapon of mass destruction.

[a] These potential projects have not reached a point of development to allow full analysis in this *NNSS SWEIS* and would be subject to project-specific NEPA review before DOE/NNSA would make any decision regarding implementation.

[b] The actual permitted capacity of the Mixed Waste Disposal Unit (Cell 18) is 899,996 cubic feet.

[c] DOE/NNSA has not received or solicited proposals for any commercial solar power generation projects.

[d] Reactivation of the Area 3 RWMS would only occur based upon mission need and as stated in Section 4.1.11.1.1.1, including detailed consultation with the State of Nevada.

Table 3–4 Summary of Potential Impacts at the Nevada National Security Site

	No Action Alternative	*Expanded Operations Alternative*	*Reduced Operations Alternative*	*Preferred Alternative*
Land Use (for details go to Chapter 5, Sections 5.1.1.1, 5.1.1.2, and 5.1.1.3)				
National Security/ Defense Mission	No impacts were identified from the continuation of activities at the current levels of operations or foreseeable actions because activities under this alternative would continue to be compatible with existing land use designations on the NNSS and primary land uses adjacent to the site.	No impacts were identified from the increased activities and change in land use designations under this alternative because activities would be compatible with the proposed land use designations and primary land uses adjacent to the NNSS. The Reserved Zone would decrease in area by 5.5 percent; the Research, Test, and Experiment Zone would increase by 21 percent.	No impacts were identified from the decreased activities and change in land use designations under this alternative because activities would be compatible with the proposed land use designations and primary land uses adjacent to the NNSS. The Reserved Zone would decrease in area by 71 percent, and Areas 18, 19, 20, and 30 would change from Reserved to Limited Use, which is a new land use zone designation.	No impacts were identified from the increased activities and change in land use designations under this alternative because activities would be compatible with the proposed land use designations and primary land uses adjacent to the NNSS. Area 15 would change from the Reserved to the Research, Test, and Experiment zone designation. Areas 18, 19, 20, and 30 would change from Reserved to Limited Use, which is a new land use zone designation.
	Airspace No new impacts were identified from airspace activities because these activities would be maintained at the current level of air traffic, navigational aid services, and airspace structure, and would be coordinated and scheduled by the controlling entity responsible for NNSS airspace, the Nellis Air Traffic Control Facility.	_Airspace_ Minimal impacts would result from increased usage of aerial platforms and airspace usage, as these activities would continue to be coordinated with the Nellis Air Traffic Control Facility.	_Airspace_ Same as under the No Action Alternative.	_Airspace_ Minimal impacts would result from increased usage of aerial platforms and airspace usage, as these activities would continue to be coordinated with the Nellis Air Traffic Control Facility.
Environmental Management Mission	No impacts were identified from the continuation of activities at the current levels of operations because activities under this alternative would not change.	No impacts were identified from the increased activities under this alternative, as these activities would be compatible with land use designations and primary land uses adjacent to the site.	Same as under the No Action Alternative.	No impacts were identified from the increased activities under this alternative, as these activities would be compatible with land use designations and primary land uses adjacent to the site.
Nondefense Mission	No impacts were identified from the continuation of activities at the current levels of operations or foreseeable actions because activities under this alternative would continue to be compatible with existing land use designations on the NNSS and primary land uses adjacent to the site. The Solar Enterprise Zone would be renamed the Renewable Energy Zone.	Same as the No Action Alternative, plus: Area 15 would be changed from a Reserved Zone to a Research, Test, and Experiment Zone, and the Solar Enterprise Zone would be renamed the Renewable Energy Zone and increase in area by 276 percent.	Same as under the No Action Alternative.	Same as the No Action Alternative, plus: Area 15 would be changed from a Reserved Zone to a Research, Test, and Experiment Zone.

	No Action Alternative	*Expanded Operations Alternative*	*Reduced Operations Alternative*	*Preferred Alternative*
Infrastructure and Energy (for details go to Chapter 5, Sections 5.1.2.1 and 5.1.2.2)				
Infrastructure	Buildings, transportation, water supply, and services are adequate to handle temporary increases in demands during construction and long-term demands during operations. Infrastructure would be maintained as needed to accommodate ongoing activities. In addition, new LLW cells would be developed to accommodate disposal of those waste types. Up to 50 new wells would be developed by the UGTA Project.	Same as under the No Action Alternative, plus: New buildings (about 479,000 square feet), ranges and training facilities (13,455 acres), water distribution lines, wastewater treatment systems (septic tanks), power lines, and communication systems would be added and improvements would be made to existing infrastructure. In addition, new LLW/MLLW cells would be developed to accommodate disposal of increased volumes of those waste types and new sanitary and construction/D&D waste landfills in Areas 23 and 25. An upgrade to the NNSS electrical transmission system would increase capacity from 40 to 100 megawatts. A 5-megawatt photovoltaic solar power generation facility would be developed in Area 6.	Same as under the No Action Alternative, except: Buildings, transportation, water supply, and services would experience reduced demands. Because most operations in the northwestern portion of the NNSS (within Areas 18, 19, 20, 29, and 30) would be discontinued, non-essential infrastructure in those areas would be shut down or removed.	Same as under the No Action Alternative, plus: New buildings (about 350,000 square feet), ranges and training facilities (approximately 3,455 acres), water distribution lines, wastewater treatment systems (septic tanks), power lines, and communication systems would be added and improvements would be made to existing infrastructure. In addition, new LLW/MLLW cells would be developed to accommodate disposal of increased volumes of those waste types and new sanitary and construction/D&D waste landfills in Areas 23 and 25. An upgrade to the NNSS electrical transmission system would increase capacity from 40 to 100 megawatts. A 5-megawatt photovoltaic solar power generation facility would be developed in Area 6. Because most operations in the northwestern portion of the NNSS (within Areas 18, 19, 20, 29, and 30) would be discontinued, non-essential infrastructure in those areas would be shut down or removed.
	A commercial 240-megawatt solar power generation plant would be developed in Area 25 of the NNSS. Up to 10 miles of new 230-kilovolt transmission lines would be required to interconnect the new generation facility with the main power grid. The commercial facility would provide a portion of the electrical power at the NNSS. Sanitary needs of construction and operational employees would be provided by the commercial entity and are not	Up to 1,000 megawatts of commercial solar power generating capacity would be developed in Area 25 of the NNSS. Up to 10 miles of new 500-kilovolt transmission lines would be required to interconnect the new generating facilities with the main power grid. The commercial facilities would provide a portion of the electrical power at the NNSS. Sanitary needs of construction and operational employees would be provided by the commercial entity and are not expected to affect the NNSS solid waste or	A commercial 100-megawatt solar power generation plant would be developed in Area 25 of the NNSS. No new transmission lines would be required to interconnect the new generating facility with the main power grid. The commercial facility would provide a portion of the electrical power at the NNSS. Sanitary needs of construction and operational employees would be provided by the commercial entity and are not expected to affect the NNSS solid waste or	A commercial 240-megawatt solar power generation facility would be developed in Area 25 of the NNSS. Up to 10 miles of new 230-kilovolt transmission lines would be required to interconnect the new generation facility with the main power grid. The commercial facility would provide a portion of the electrical power at the NNSS. Sanitary needs of construction and operational employees would be provided by the commercial entity and are not

	No Action Alternative	*Expanded Operations Alternative*	*Reduced Operations Alternative*	*Preferred Alternative*
	expected to affect the NNSS solid waste or wastewater infrastructure.	wastewater infrastructure.	wastewater infrastructure.	expected to affect the NNSS solid waste or wastewater infrastructure.
Energy	Average electric power demand would be 22 megawatts, with a peak demand of 30 megawatts.	Average electrical power demand would be 28 megawatts, with a peak demand of 41 megawatts. As noted under Infrastructure, DOE/NNSA would rebuild the 138-kilovolt transmission system on the NNSS to accommodate increased loads.	Average electrical power demand would be 20 megawatts, with a peak demand of 27 megawatts.	Average electrical power demand would be 28 megawatts, with a peak demand of 41 megawatts. As noted under Infrastructure, NNSA would rebuild the 138-kilovolt transmission system on the NNSS to accommodate increased loads.
	Annual usage of various liquid fuels was estimated, as follows: Fuel oil for heating – 66,000 gallons Unleaded gasoline – 427,000 gallons Ethanol/E85 – 217,000 gallons #2 diesel – 65,000 gallons Biodiesel – 343,000 gallons	Annual usage of various liquid fuels was estimated, as follows: Fuel oil for heating – 83,000 gallons Unleaded gasoline – 534,000 gallons Ethanol/E85 – 271,000 gallons #2 diesel – 81,000 gallons Biodiesel – 429,000 gallons	Annual usage of various liquid fuels was estimated, as follows: Fuel oil for heating – 59,000 gallons Unleaded gasoline – 384,000 gallons Ethanol/E85 – 195,000 gallons #2 diesel – 59,000 gallons Biodiesel – 309,000 gallons	Annual usage of various liquid fuels was estimated, as follows: Fuel oil for heating – 83,000 gallons Unleaded gasoline – 534,000 gallons Ethanol/E85 – 271,000 gallons #2 diesel – 81,000 gallons Biodiesel – 429,000 gallons
	DOE/NNSA would maintain and repair energy infrastructure.	DOE/NNSA would maintain and repair energy infrastructure.	DOE/NNSA would maintain and repair energy infrastructure for PA.	DOE/NNSA would maintain and repair energy infrastructure.
Transportation [a] and Traffic (for details go to Chapter 5, Sections 5.1.3.1 and 5.1.3.2, and Appendix E)				
Transportation (for details go to Chapter 5, Sections 5.1.3.1.1, 5.1.3.1.2, and 5.1.3.1.3, and Appendix E)				
Out-of-state LLW/MLLW (All values are projected from shipment of the entire LLW inventory over a 10-year period)				
Truck transport				
Worker risk (LCF)	1 (1.3)	3 (3.1)	1 (1.3)	3 (3.1)
Population risk (LCF)	0 (0.2)	1 (0.6)	0 (0.2)	1 (0.6)
Radiological accident (LCF)	0 (0.0002)	0 (0.01)	0 (0.0002)	0 (0.01)
Traffic fatality	2	6	2	6
Rail transport only				
Worker risk (LCF)	0 (0.3)	1 (1.1)	0 (0.3)	1 (1.1)
Population risk (LCF)	0 (0.1)	0 (0.3)	0 (0.1)	0 (0.3)
Radiological accident (LCF)	0 (0.00006)	0 (0.005)	0 (0.00006)	0 (0.005)
Traffic fatality	6	15	6	15
Combined rail-truck transport				
Worker risk (LCF)	0 (0.5)	2 (1.7)	0 (0.5)	2 (1.7)
Population risk (LCF)	0 (0.1)	1 (0.5)	0 (0.1)	1 (0.5)
Radiological accident (LCF)	0 (0.00008)	0 (0.005)	0 (0.00008)	0 (0.005)
Traffic fatality	6	16	6	16

	No Action Alternative	***Expanded Operations Alternative***	***Reduced Operations Alternative***	***Preferred Alternative***
Traffic (for details go to Chapter 5, Sections 5.1.3.2.1, 5.1.3.2.2, and 5.1.3.2.3)				
Onsite traffic impacts	There would be about 20 additional vehicle trips per day on Mercury Highway, which would operate at a level of service A during peak traffic hours. Construction of a 240-megawatt commercial solar power generation facility would result in 500 (average over the period of construction) and 1,000 (during the peak of the construction period) additional vehicle trips on a daily basis during the peak commute hours on Lathrop Wells Road; increased roadway maintenance or improvements may be required.	There would be about 800 additional vehicle trips per day on Mercury Highway, which would operate at a level of service B or better during peak traffic hours. Construction of 1,000 megawatts of commercial solar power generation facilities would result in 750 (average over the period of construction) and 1,500 (during the peak of the construction period) additional vehicle trips on a daily basis during the peak commute hours on Lathrop Wells Road; increased roadway maintenance or improvements may be required.	There would be about 150 fewer vehicle trips per day on Mercury Highway, which would operate at a level of service A during peak traffic hours. Construction of a 100-megawatt commercial solar power generation facility would result in 400 (average over the period of construction) and 800 (during the peak of the construction period) additional vehicle trips on a daily basis during the peak commute hours on Lathrop Wells Road; increased roadway maintenance or improvements may be required.	There would be about 800 additional vehicle trips per day on Mercury Highway, which would operate at a level of service B or better during peak traffic hours. Construction of a 240-megawatt commercial solar power generation facility would result in 500 (average over the period of construction) and 1,000 (during the peak of the construction period) additional vehicle trips on a daily basis during the peak commute hours on Lathrop Wells Road; increased roadway maintenance or improvements may be required.
Regional traffic impacts	U.S. Route 95, State Route 160, and State Route 372 would experience the greatest increases in daily traffic volumes in the area around the NNSS; however, these would be relatively minor and would not affect the levels of service on regional roadways. Overall traffic volumes would increase during peak hours because of additional traffic attributable to the construction of a solar power generation facility.	Segments of State Route 372, State Route 160, U.S. Route 95, and State Route 164 would experience moderately high percent increases in daily traffic compared to the No Action Alternative. Most of the increase in daily traffic volumes during the peak hours would be attributable to workers commuting to the NNSS. Any detectable changes in traffic volumes would primarily occur during the main commuting hours and at the entry gates of the NNSS (the main entrance gate for regular NNSS employees and Gate 510 for those associated with the construction and operation of the commercial solar power generation facilities in Area 25). However, the levels of service on public roadways in the region would not change.	Although the number of commuter trips for the reduced NNSS workforce would decrease, overall traffic volumes would increase slightly during peak hours because of additional traffic volumes attributable to construction and operation of the solar power generation facility. Impacts on regional traffic under this alternative would, therefore, be slightly less than or similar to those described under the No Action Alternative; volume-to-capacity ratios and levels of service would not change.	Segments of State Route 372, State Route 160, U.S. Route 95, and State Route 164 would experience moderately high percent increases in daily traffic compared to the No Action Alternative. Most of the increase in daily traffic volumes during the peak hours would be attributable to workers commuting to the NNSS. Any detectable changes in traffic volumes would primarily occur during the main commuting hours and at the entry gates of the NNSS (the main entrance gate for regular NNSS employees and Gate 510 for those associated with the construction and operation of a commercial solar power generation facility in Area 25). However, the levels of service on public roadways in the region would not change.

	No Action Alternative	Expanded Operations Alternative	Reduced Operations Alternative	Preferred Alternative
Socioeconomics (for details go to Chapter 5, Sections 5.1.4.1, 5.1.4.2, and 5.1.4.3)				
	Operation of a 240-megawatt commercial solar power facility would increase employment by 150 FTEs, of which about 15 solar power facility employees would relocate from outside of the region. Sufficient housing exists to support the increased population. A total of 22 new students relocating to Clark County would create a need for 1 additional teacher to maintain the student-to-teacher ratio. An increase of 6 new students in Nye County would not result in a need for additional teachers. Direct jobs would reduce unemployment by 0.07 and 0.99 percent, respectively, in Clark and Nye Counties.	Site employment would increase by 625 FTEs; about 63 employees would relocate from outside of the region. Sufficient housing exists in the area to support the increased population. A total of 92 new students relocating to Clark County would create a need for 4 new teachers to maintain the student-to-teacher ratio. An increase of 27 new students in Nye County would create a need for 1 new teacher to maintain the student-to-teacher ratio. Direct jobs would reduce unemployment by 0.31 and 4.2 percent, respectively, in Clark and Nye Counties.	Site employment would decrease by 45 FTEs, increasing unemployment in Clark County by about 0.03 percent and in Nye County by about 0.39 percent. Additional employees would not relocate to Clark or Nye County and there would be no need for new housing or teachers.	Site employment would increase by approximately 575 FTEs; about 60 employees would relocate from outside of the region. Sufficient housing exists in the area to support the increased population. A total of approximately 90 new students relocating to Clark County would create a need for 4 new teachers to maintain the student-to-teacher ratio. An increase of approximately 25 new students in Nye County would create the need for 1 new teacher to maintain the student-to-teacher ratio. Direct jobs would reduce unemployment by 0.3 and 4.0 percent, respectively, in Clark and Nye Counties.
	Approximately 500 FTEs over 35 months, with a peak of 1,000 FTEs, would need to be hired for construction of the solar power generation facility.	Approximately 750 FTEs over 42 months, with a peak of 1,500 FTEs, would need to be hired for construction of the solar power generation facility. Other construction projects at the NNSS would require approximately 250 FTEs over the 10-year period.	Approximately 400 FTEs over 32 months, with a peak of 800 FTEs, would need to be hired for construction of the solar power generation facility.	Approximately 500 FTEs over 35 months, with a peak of 1,000 FTEs, would need to be hired for construction of the solar power generation facility. Other construction projects at the NNSS would require approximately 250 FTEs over the 10-year period.
	Direct jobs, indirect jobs, and construction materials purchases would reduce unemployment and have a beneficial effect on local government revenues.	Direct jobs, indirect jobs, and construction materials purchases would reduce unemployment and have a beneficial effect on the local economy and government revenues.	Job loss would have a small negative impact on the local economy; construction material purchases for the solar power generation facility would have a small positive economic impact, including generating additional revenues for local governments. Direct construction jobs and indirect jobs would reduce unemployment and would have a beneficial impact on the economy in the region.	Direct jobs, indirect jobs, and construction materials purchases would reduce unemployment and have a beneficial effect on local government revenues.
	Buildings associated with construction and operation of a solar power generation facility and increased site personnel would create an increased demand for onsite security and fire and rescue services.	Buildings associated with construction and operation of a larger solar power generation facility and other facilities on site and the increase in personnel would create a greater demand for onsite security and fire and rescue services.	Buildings associated with construction and operation of a solar power generation facility would create an increased demand for onsite security and fire and rescue services.	Buildings associated with construction and operation of a solar power generation facility and increased site personnel would create an increased demand for onsite security and fire and rescue services.

	No Action Alternative	*Expanded Operations Alternative*	*Reduced Operations Alternative*	*Preferred Alternative*
Geology and Soils (for details go to Chapter 5, Sections 5.1.5.1, 5.2.5.2, and 5.1.5.3)				
National Security/ Defense Mission	About 700 acres of soil would be disturbed by dynamic experiments in boreholes, explosives experiments, drillback operations, OST training and exercises, experiments involving biological simulants, and counterterrorism training.	About 13,455 acres of soil would be disturbed by the same kinds of activities as under the No Action Alternative, including: Up to 10,000 acres of soil would be disturbed for an OST training facility, 120 acres for depleted uranium experiment sites, and 3,335 acres for additional explosives experiments, new test beds and training facilities, drillback operations, and additions to existing aviation facilities at the NNSS.	About 430 acres of soil would be disturbed by many of the same kinds of activities as under the No Action Alternative, except: There would be 50 percent fewer explosive experiments and 33 percent less OST training and exercises.	About 3,455 acres of soil would be disturbed by the activities including: dynamic experiments, explosives experiments, drillback operations, OST training and exercises, experiments involving biological simulants, counterterrorism training, depleted uranium experiments, new test beds and training facilities, and additions to existing aviation facilities at the NNSS.
Environmental Management Mission	About 190 acres of soil would be disturbed for construction of new waste cells at the Area 5 RWMC. Up to 420 acres of soil would be disturbed as part of the Environmental Restoration Program, Soils Project cleanup. Up to 500 acres of soil would be disturbed for development of UGTA Project monitoring wells.	About 600 acres of soil would be disturbed for construction of new waste cells at the Area 5 RWMC. About 35 acres of soil would be disturbed for new sanitary and D&D/construction waste landfills in Areas 23 and 25. Environmental Restoration Program impacts would be the same as under the No Action Alternative.	Same as under the No Action Alternative.	About 600 acres of soil would be disturbed for construction of new waste cells at the Area 5 RWMC. About 35 acres of soil would be disturbed for new sanitary and D&D/construction waste landfills in Areas 23 and 25. Up to 420 acres of soil would be disturbed as part of the Environmental Restoration Program, Soils Project cleanup. Up to 500 acres of soil would be disturbed for development of UGTA Project monitoring wells.
Nondefense Mission	Construction of a 240-megawatt commercial solar power generation facility and associated transmission lines would disturb approximately 2,650 acres.	Construction of 1,000 megawatts of commercial solar power generation facilities and associated transmission lines would disturb up to 10,300 acres. Replacing the existing 138-kilovolt NNSS electrical transmission line would temporarily disturb about 467 acres of soil. Construction of a DOE/NNSA photovoltaic solar power generation facility would disturb about 50 acres of land. Minor soil disturbance is expected from several additional research projects. Development of a Geothermal Demonstration Project would disturb up to 50 acres of soil.	Construction of a 100-megawatt commercial solar power generation facility could disturb up to 1,200 acres.	Construction of a 240-megawatt commercial solar power generation facility and associated transmission lines would disturb approximately 2,650 acres. Replacing the existing 138-kilovolt NNSS electrical transmission line would temporarily disturb about 467 acres of soil. Construction of a DOE/NNSA photovoltaic solar power generation facility would disturb about 50 acres of land. Minor soil disturbance is expected from several additional research projects. Development of a Geothermal Demonstration Project would disturb up to 50 acres of soil.

	No Action Alternative	*Expanded Operations Alternative*	*Reduced Operations Alternative*	*Preferred Alternative*
Hydrology (for details go to Chapter 5, Section 5.1.6)				
Surface Water Resources (for details go to Chapter 5, Sections 5.1.6.1, 5.1.6.1.1, 5.1.6.1.2, and 5.1.6.1.3)				
National Security/ Defense Mission	Disturbance of about 700 acres of land by dynamic experiments in boreholes, explosives experiments, drillback operations, OST training and exercises, experiments involving releases of chemicals and biological simulants, and counterterrorism training would cause alterations of natural drainage pathways, contamination of ephemeral surface waters via chemical agents, and sedimentation to ephemeral surface waters.	About 13,455 acres of soil and near-surface geologic media would be disturbed by activities similar to those under the No Action Alternative, including: Up to 10,000 acres of disturbance for OST training facilities, 120 acres for depleted uranium experiment sites, and 3,335 acres for additional explosives experiments, new test beds and training facilities, drillback operations and additions to existing aviation facilities at the NNSS. This would result in proportionately larger impacts on ephemeral waters compared to the No Action Alternative.	About 430 acres of soil and near-surface geologic media would be disturbed by many of the same kinds of activities as under the No Action Alternative, except: There would be 50 percent fewer explosives experiments, and 33 percent less OST training and exercises. This would result in proportionately smaller impacts on ephemeral waters compared to the No Action Alternative.	Disturbance of about 3,455 acres of land would cause alterations of natural drainage pathways, contamination of ephemeral surface waters via chemical agents, and sedimentation to ephemeral surface waters.
Environmental Management Mission	Disturbance of up to 190 acres of soil to construct, use, cover, and close disposal units within the existing Area 5 RWMC would result in impacts on ephemeral waters due to alteration of natural drainage pathways, increased erosion, and subsequent sedimentation.	Disturbance of up to 600 acres of soil to construct, use, cover, and close disposal units within the existing Area 5 RWMC, plus up to 35 acres of disturbance for new sanitary/D&D/construction waste landfills would result in impacts on ephemeral waters due to alteration of natural drainage pathways, increased erosion, and subsequent sedimentation.	Same as under the No Action Alternative for both Waste Management and Environmental Restoration.	Disturbance of up to 600 acres of soil to construct, use, cover, and close disposal units within the existing Area 5 RWMC, plus up to 35 acres of disturbance for new sanitary/D&D/ construction waste landfills would result in impacts on ephemeral waters due to alteration of natural drainage pathways, increased erosion, and subsequent sedimentation.
	The Soils Project would reduce or stabilize legacy contamination in soil and could result in disturbance of up to 420 acres. Soil disturbance on about 500 acres of land from drilling additional wells for the UGTA Project could cause localized erosion, as could D&D of industrial sites, remediation of Defense Threat Reduction Agency sites, and the Borehole Management Program. These activities would affect ephemeral waters by altering natural drainage pathways and increasing sedimentation. Stabilization and/or removal of contaminated facilities	Environmental Restoration impacts would be the same as under the No Action Alternative.		The Soils Project would reduce or stabilize legacy contamination in soil and could result in disturbance of up to 420 acres. Soil disturbance on about 500 acres of land from drilling additional wells for the UGTA Project could cause localized erosion, as could D&D of industrial sites, remediation of Defense Threat Reduction Agency sites, and the Borehole Management Program. These activities would affect ephemeral waters by altering natural drainage pathways and increasing sedimentation. Stabilization and/or removal of contaminated facilities

	No Action Alternative	***Expanded Operations Alternative***	***Reduced Operations Alternative***	***Preferred Alternative***
	and soils would reduce the potential for contamination of ephemeral waters.			and soils would reduce the potential for contamination of ephemeral waters.
Nondefense Mission	No new land disturbances would occur during infrastructure-related activities under the No Action Alternative.	Up to 517 acres of land would be disturbed by rebuilding the existing 138-kilovolt transmission line on the NNSS and constructing a 5-megawatt photovoltaic solar power generation facility. These disturbances would result in alterations of natural drainage pathways and increased sedimentation of ephemeral waterways.	Same as under the No Action Alternative, except: The land area associated with the development of a 100-megawatt solar power generation facility would be 1,200 acres.	Development of a 240-megawatt commercial solar power generation facility and associated transmission lines would alter natural drainage pathways over 2,650 acres in Area 25, though it is expected that larger ephemeral waters (e.g., Fortymile Wash) would be avoided; however, there would be a potential for chemical contamination of and sedimentation to ephemeral waters during construction-related land preparation. Up to 517 acres of land would be disturbed by rebuilding the existing 138-kilovolt transmission line on the NNSS and constructing a 5-megawatt photovoltaic solar generating facility. Development of a Geothermal Demonstration Project would disturb up to 50 acres. These disturbances would result in alterations of natural drainage pathways and increased sedimentation of ephemeral waterways.
	Development of a 240-megawatt commercial solar power generation facility and associated transmission lines would alter natural drainage pathways over 2,650 acres in Area 25, though it is expected that larger ephemeral waters (e.g., Fortymile Wash) would be avoided; however, there would be a potential for chemical contamination of and sedimentation to ephemeral waters during construction-related land preparation.	Development of up to 1,000 megawatts of commercial solar power generation facilities and associated transmission lines would disturb drainage pathways over 10,300 acres and increased erosion and construction/operational activities would potentially increase sedimentation to and chemical contamination of ephemeral waterways. Development of a Geothermal Demonstration Project would disturb up to 50 acres and cause sedimentation to ephemeral waters, as well as long-term alteration of natural drainage pathways.		

	No Action Alternative	*Expanded Operations Alternative*	*Reduced Operations Alternative*	*Preferred Alternative*
Groundwater Resources (for details go to Chapter 5, Sections 5.1.6.2, 5.2.6.2.1, 5.1.6.2.2, and 5.1.6.2.3)				
Total water use (excluding solar power facility)				
	Total water use for DOE/NNSA activities would not exceed 691 acre-feet per year. This water demand would exceed published estimates of the sustainable yield for Basin 160 (Frenchman Flat), although other yield estimates suggest that adverse impacts on water supply may not occur.	Total water use for DOE/NNSA activities would increase by 25 percent from the No Action Alternative, to 862 acre-feet per year. This water demand would exceed published estimates of the sustainable yield for Basin 160 (Frenchman Flat), although other yield estimates suggest that adverse impacts on water supply may not occur.	Total water use for DOE/NNSA activities would decrease by 10 percent from the No Action Alternative, to 622 acre-feet per year. This water demand would exceed published estimates of the sustainable yield for Basin 160 (Frenchman Flat), although other yield estimates suggest that adverse impacts on water supply may not occur.	Total water use for DOE/NNSA activities would total as much as 862 acre-feet per year. This water demand would exceed published estimates of the sustainable yield for Basin 160 (Frenchman Flat), although other yield estimates suggest that adverse impacts on water supply may not occur.
National Security/ Defense Mission	No new or additional impacts on groundwater resources.	The following would be additional impacts on the groundwater resource, compared to the No Action Alternative: • 5.5 acre-feet per year of potable water for construction workers. • Water use for new construction of facilities included in the overall 25 percent increase in all water uses.	Same as under the No Action Alternative.	The following would be additional impacts on the groundwater resource, compared to the No Action Alternative: • 5.5 acre-feet per year of potable water for construction workers. • Water use for new construction of facilities included in the 862 acre-feet per year.
Environmental Management Mission	Through 2020, 30 acre-feet per year of nonpotable water for the drilling of new wells under the UGTA Project. Less than 7 acre-feet of total water use for dust suppression during D&D of facilities.	Same as under the No Action Alternative.	Same as under the No Action Alternative.	Through 2020, 30 acre-feet per year of nonpotable water for the drilling of new wells under the UGTA Project. Less than 7 acre-feet of total water use for dust suppression during D&D of facilities.
Nondefense Mission	Positive impact of reducing potable water production 16 percent by 2015 utilizing water conservation measures.	Same as under the No Action Alternative, plus: • A 5-megawatt photovoltaic solar power system near Area 6 would use 0.5 acre-feet per year of nonpotable water. • A one-time nonpotable water demand of 20 acre-feet to prime a geothermal power plant. Once operational, the geothermal power plant would use 50 acre-feet of water per year.	Same as under the No Action Alternative.	Positive impact of reducing potable water production 16 percent by 2015 utilizing water conservation measures and partially offset by: • A 5-megawatt photovoltaic solar power system near Area 6 would use 0.5 acre-feet per year of nonpotable water. • A one-time nonpotable water demand of 20 acre-feet to prime a geothermal power plant. Once operational, the geothermal power plant would use 50 acre-feet of water per year.

	No Action Alternative	***Expanded Operations Alternative***	***Reduced Operations Alternative***	***Preferred Alternative***
Commercial Solar Power Generation Facilities				
Construction	350 acre-feet per year from Fortymile Canyon, Jackass Flats Subdivision	1,000 acre-feet per year from Fortymile Canyon, Jackass Flats Subdivision	200 acre-feet per year from Fortymile Canyon, Jackass Flats Subdivision	350 acre-feet per year from Fortymile Canyon, Jackass Flats Subdivision
Operation	250 acre-feet per year from Fortymile Canyon, Jackass Flats Subdivision These water demands are below the sustainable yield of the Fortymile Canyon, Jackass Flats Subdivision Basin (4,000 acre-feet per year).	700 acre-feet per year from Fortymile Canyon, Jackass Flats Subdivision These water demands are below the sustainable yield of the Fortymile Canyon, Jackass Flats Subdivision Basin (4,000 acre-feet per year).	175 acre-feet per year from Fortymile Canyon, Jackass Flats Subdivision These water demands are below the sustainable yield of the Fortymile Canyon, Jackass Flats Subdivision Basin (4,000 acre-feet per year).	250 acre-feet per year from Fortymile Canyon, Jackass Flats Subdivision These water demands are below the sustainable yield of the Fortymile Canyon, Jackass Flats Subdivision Basin (4,000 acre-feet per year).
Biological Resources (for details go to Chapter 5, Sections 5.1.7, 5.1.7.1.1, 5.1.7.2, and 5.1.7.3)				
National Security/ Defense Mission	Approximately 295 acres of currently undisturbed desert tortoise habitat would be affected by activities in Frenchman Flat, Yucca Flat, Jackass Flats, Mercury Valley, and Fortymile Canyon. Estimated number of desert tortoises affected ranges from 4 to 21, all by harassment.	Approximately 1,930 acres of currently undisturbed desert tortoise habitat would be affected in the same areas as under the No Action Alternative. Estimated number of desert tortoises affected ranges from 30 to 136, all by harassment.	Approximately 160 acres of currently undisturbed desert tortoise habitat would be affected in the same areas as under the No Action Alternative. Estimated number of desert tortoises affected ranges from 2 to 11, all by harassment.	Approximately 1,910 acres of currently undisturbed desert tortoise habitat would be affected in the same areas as under the No Action Alternative. Estimated number of desert tortoises affected ranges from 30 to 136, all by harassment.
	Total new disturbed area (about 700 acres) would be 0.09 percent of undisturbed land on the NNSS.	Total new disturbed area (about 13,455 acres) would be 1.70 percent of undisturbed land on the NNSS.	Total new disturbed area (about 430 acres) would be 0.05 percent of undisturbed land on the NNSS.	Total new disturbed area (about 3,455 acres) would be 0.47 percent of undisturbed land on the NNSS.
Environmental Management Mission	Approximately 760 acres of currently undisturbed desert tortoise habitat would be affected, primarily by environmental restoration activities in Frenchman Flat, Yucca Flat, Jackass Flats, and Mercury Valley. Estimated number of desert tortoises affected ranges from 4 to 26, all by harassment.	Approximately 1,205 acres of currently undisturbed desert tortoise habitat would be affected because of additional waste management activities. Estimated number of desert tortoises affected ranges from 4 to 33, all by harassment.	Same as under the No Action Alternative.	Approximately 1,205 acres of currently undisturbed desert tortoise habitat would be affected because of additional waste management activities. Estimated number of desert tortoises affected ranges from 4 to 33, all by harassment.
	Total new disturbed area (about 1,110 acres) would be 0.14 percent of undisturbed land on the NNSS.	Total new disturbed area (about 1,555 acres) would be 0.2 percent of undisturbed land on the NNSS.		Total new disturbed area (about 1,555 acres) would be 0.2 percent of undisturbed land on the NNSS.
Nondefense Mission	Over the next 10 years, up to 125 desert tortoises would be taken on NNSS roadways, due to non-project vehicle travel. Fewer than 20 of these desert tortoises are expected to be taken by injury or mortality.	Over the next 10 years, up to 125 desert tortoises would be taken on NNSS roadways, due to non-project vehicle travel. Fewer than 20 of these desert tortoises are expected to be taken by injury or mortality.	Over the next 10 years, up to 125 desert tortoises would be taken on NNSS roadways, due to non-project vehicle travel. Fewer than 20 of these desert tortoises are expected to be taken by injury or mortality.	Over the next 10 years, up to 125 desert tortoises would be taken on NNSS roadways, due to non-project vehicle travel. Fewer than 20 of these desert tortoises are expected to be taken by injury or mortality.
	Approximately 2,650 acres of currently undisturbed desert tortoise habitat in Jackass Flats, Mercury	Approximately 10,535 acres of currently undisturbed desert tortoise habitat in Jackass Flats, Mercury Valley, and	Approximately 1,200 acres of currently undisturbed desert tortoise habitat in Jackass Flats, Mercury Valley, and	Approximately 2,885 acres of currently undisturbed desert tortoise habitat in Jackass Flats, Mercury

	No Action Alternative	Expanded Operations Alternative	Reduced Operations Alternative	Preferred Alternative
	Valley, and Frenchman Flat would be affected by DOE/NNSA activities, including a 240-megawatt commercial solar power generation facility and associated transmission lines in Jackass Flats. Estimated number of desert tortoises affected ranges from 0 to 41, all by harassment.	Frenchman Flat would be affected by DOE/NNSA activities, including 1,000 megawatts of commercial solar power generation facilities and associated transmission lines in Jackass Flats. Estimated number of desert tortoises affected ranges from 4 to 178, all by harassment.	Frenchman Flat would be affected by DOE/NNSA activities, including a 100-megawatt commercial solar power generation facility in Jackass Flats. Estimated number of desert tortoises affected ranges from 0 to 19, all by harassment.	Valley, and Frenchman Flat would be affected by DOE/NNSA activities, including a 240-megawatt commercial solar power generation facility and associated transmission lines in Jackass Flats. Estimated number of desert tortoises affected ranges from 4 to 62, all by harassment.
	Total new disturbed area (about 2,650 acres) would be 0.34 percent of undisturbed land on the NNSS.	Total new disturbed area (about 10,867 acres) would be 1.37 percent of undisturbed land on the NNSS.	Total new disturbed area (about 1,200 acres) would be 0.15 percent of undisturbed land on the NNSS.	Total new disturbed area (about 3,167 acres) would be 0.40 percent of undisturbed land on the NNSS.
Air quality (for details go to Chapter 5, Sections 5.1.8, 5.1.8.1, 5.1.8.2, and 5.1.8.3 and Appendix D)				
Annual Average Operational Emissions in 2015 (tons per year)				
PM_{10}	6.8	20.1	4.4	7.9
$PM_{2.5}$	3.4	8.1	2.6	4.4
CO	123.3	160.9	109.8	155.6
NO_x	39.7	56.6	36.3	54.8
SO_2	0.73	1.1	0.43	0.80
VOCs	5.9	11.0	4.8	7.2
Lead	0.030	~0.010	0.0024	0.01
Hazardous air pollutants	0.41	0.53	0.40	0.53
CO_2-equivalent	39,690	49,303	38,045	49,298
Peak Year Construction Emissions (tons per year)				
PM_{10}	20.0	129.1	8.4	65.7
$PM_{2.5}$	6.0	35.6	2.6	16.8
CO	44.8	296.5	24.4	193.6
NO_x	56.0	388.6	24.4	218.9
SO_2	0.14	0.68	0.08	0.29
VOCs	6.2	41.6	2.8	23.1
Lead	0.0000089	0.000013	0.0000071	0.0000089
Hazardous air pollutants	0.038	0.058	0.030	0.038
CO_2-equivalent	5,686	21,158	2,774	5,689
Radiological Air Quality				
	No activities are expected to produce aboveground radiation beyond those documented for 2008 baseline conditions.	Except for depleted uranium and radiotracer experiments, no additional activities are expected to produce aboveground radiation beyond those documented for 2008 baseline conditions.	No activities are expected to produce aboveground radiation beyond those documented for 2008 baseline conditions.	Except for depleted uranium and radiotracer experiments, no additional activities are expected to produce aboveground radiation beyond those documented for 2008 baseline conditions.

	No Action Alternative	Expanded Operations Alternative	Reduced Operations Alternative	Preferred Alternative
Visual Resources (for details go to Chapter 5, Sections 5.1.9, 5.1.9.1, 5.1.9.2, and 5.1.9.3)				
National Security/ Defense Mission	No impacts on visual resources.	No impacts on visual resources.	No impacts on visual resources.	No impacts on visual resources.
Environmental Management Mission	No impacts on visual resources.	No impacts on visual resources.	No impacts on visual resources.	No impacts on visual resources.
Nondefense Mission	Construction and operation of a commercial solar power generation facility and associated transmission lines would disturb about over 2,650 acres of land and would reduce the visual quality from a Class B to a Class C rating in portions of Area 25 visible to viewers on U.S. Route 95.	Construction of approximately 200,000 square feet of additional facilities would be added to Desert Rock Airport that would have an adverse effect on visual resources visible from U.S. Route 95. Construction and operation of commercial solar power generation facilities and associated transmission lines over about 10,300 acres of land would reduce the visual quality from a Class B to a Class C rating in portions of Area 25 visible to viewers on U.S. Route 95. A Geothermal Demonstration Project could alter the visual character and reduce visual quality if facilities are built along U.S. Route 95.	Construction and operation of a commercial solar power generation facility over 1,200 acres of land may occur; if so, it would reduce the visual quality from a Class B to a Class C rating in portions of Area 25 visible to viewers on U.S. Route 95.	Construction and operation of a commercial solar power generation facility and associated transmission lines would disturb about 2,650 acres of land and would reduce the visual quality from a Class B to a Class C rating in portions of Area 25 visible to viewers on U.S. Route 95. Construction of approximately 200,000 square feet of additional facilities would be added to Desert Rock Airport that would have an adverse effect on visual resources visible from U.S. Route 95. A Geothermal Demonstration Project could alter the visual character and reduce visual quality if facilities are built along U.S. Route 95.
Cultural Resources (for details go to Chapter 5, Section 5.1.10, 5.5.1.10.1, 5.1.10.2, and 5.1.10.3)				
National Security/ Defense Mission	Approximately 700 acres of undisturbed land would be affected by activities in Frenchman Flat, Yucca Flat, Jackass Flats, Mercury Valley, and Fortymile Canyon. An estimated 24 cultural resources sites would be involved, of which an estimated 10 may be NRHP-eligible.	Approximately 13,455 acres of undisturbed land would be affected in the same areas as under the No Action Alternative. An estimated 624 cultural resources sites would be involved, of which an estimated 265 may be NRHP-eligible.	Approximately 430 acres of undisturbed land would be affected in the same areas as under the No Action Alternative. An estimated 16 cultural resources sites would be involved, of which an estimated 6 may be NRHP-eligible.	Approximately 3,335 acres of undisturbed land would be affected in the same areas as under the No Action Alternative. An estimated 180 cultural resources sites would be involved, of which an estimated 63 may be NRHP-eligible.
Environmental Management Mission	Approximately 1,110 acres of undisturbed land would be affected, primarily by environmental restoration activities in Frenchman Flat, Yucca Flat, Jackass Flats, Emigrant Valley, Mercury Valley, and Fortymile Canyon. An estimated 29 cultural resources sites would be involved, of which an estimated 7 may be NRHP-eligible.	Approximately 1,555 acres of undisturbed land would be affected because of additional waste management activities. An estimated 43 cultural resources sites would be involved, of which an estimated 12 may be NRHP-eligible.	Same as under the No Action Alternative.	Approximately 1,555 acres of undisturbed land would be affected because of additional waste management activities. An estimated 43 cultural resources sites would be involved, of which an estimated 12 may be NRHP-eligible.

	No Action Alternative	*Expanded Operations Alternative*	*Reduced Operations Alternative*	*Preferred Alternative*
Nondefense Mission	No impacts on cultural resources for DOE/NNSA infrastructure and energy conservation activities.	Approximately 517 acres of undisturbed land would be affected by DOE/NNSA infrastructure and renewable energy projects. An estimated 15 cultural resources sites may be involved, of which an estimated 6 would be NRHP-eligible.	Same as under the No Action Alternative.	Approximately 517 acres of undisturbed land would be affected by DOE/NNSA infrastructure and renewable energy projects. An estimated 15 cultural resources sites may be involved, of which an estimated 6 would be NRHP-eligible.
	Approximately 2,650 acres of undisturbed land in the Jackass Flats area would be affected by development of a 240-megawatt commercial solar power generation facility and associated transmission lines. An estimated 1,802 cultural resources sites would be involved, of which an estimated 557 would be NRHP-eligible.	Approximately 10,300 acres of undisturbed land in the Jackass Flats area would be affected by development of up to 1,000 megawatts of commercial solar generation facilities and associated transmission lines. An estimated 7,004 cultural resources sites would be involved, of which an estimated 2,163 would be NRHP-eligible. Approximately 50 acres of undisturbed land would be affected by development of a Geothermal Demonstration Project in the Yucca Flat area. An estimated 2 cultural resources sites may be involved, of which 1 would be NRHP-eligible.	Approximately 1,200 acres of undisturbed land in the Jackass Flats area would be affected by development of a 100-megawatt commercial solar power generation facility. An estimated 816 cultural resources sites would be involved, of which an estimated 252 may be NRHP-eligible.	Approximately 2,650 acres of undisturbed land in the Jackass Flats area would be affected by development of a commercial solar power generation facility and associated transmission lines. An estimated 1,802 cultural resources sites would be involved, of which an estimated 557 would be NRHP-eligible.
Waste Management (10-year volumes) (for details go to Chapter 5, Sections 5.1.11.1, 5.1.11.2, and 5.1.11.3)				
LLW	15,000,000 cubic feet of LLW is within the disposal capacity of the Area 5 RWMC.	48,000,000 cubic feet of LLW is within the disposal capacity of the Area 3 RWMS and the Area 5 RWMC.[i]	Same as under the No Action Alternative.	48,000,000 cubic feet of LLW is within the disposal capacity of the Area 3 RWMS and the Area 5 RWMC.[i]
MLLW	900,000 cubic feet of MLLW is within the permitted disposal capacity of Cell 18 in the Area 5 RWMC.	Disposal of 4,000,000 cubic feet of MLLW would require additional permitted MLLW disposal capacity at the Area 5 RWMC.	Same as under the No Action Alternative.	Disposal of 4,000,000 cubic feet of MLLW would require additional permitted MLLW disposal capacity at the Area 5 RWMC.
TRU waste	9,600 cubic feet generated by DOE/NNSA activities in Nevada. All TRU waste disposed within available capacity at WIPP.	19,000 cubic feet generated by DOE/NNSA activities in Nevada. All TRU waste disposed within available capacity at WIPP.	7,100 cubic feet generated by DOE/NNSA activities in Nevada. All TRU waste disposed within available capacity at WIPP.	19,000 cubic feet generated by DOE/NNSA activities in Nevada. All TRU waste disposed within available capacity at WIPP.

	No Action Alternative	*Expanded Operations Alternative*	*Reduced Operations Alternative*	*Preferred Alternative*
Hazardous waste	Total of 210,000 cubic feet, including 42,000 cubic feet generated by a commercial solar power generation facility. All would be recycled, treated, and/or disposed within available offsite capacity. Disposal of hazardous solid waste generated by a commercial solar power generation facility would be the responsibility of that project. NNSS hazardous waste management capabilities would not be impacted under current permit conditions.	Total of 340,000 cubic feet, including 170,000 cubic feet generated by commercial solar power generation facilities. All would be recycled, treated, and/or disposed within available offsite capacity. Disposal of hazardous solid waste generated by a commercial solar power generation facility would be the responsibility of that project. NNSS hazardous waste management capabilities would not be impacted under current permit conditions.	Total of 190,000 cubic feet, including 17,000 cubic feet generated by a commercial solar power generation facility. All would be recycled, treated, and/or disposed within available offsite capacity. Disposal of hazardous solid waste generated by a commercial solar power generation facility would be the responsibility of that project. NNSS hazardous waste management capabilities would not be impacted under current permit conditions.	Total of 212,000 cubic feet, including 42,000 cubic feet generated by a commercial solar power generation facility. All would be recycled, treated, and/or disposed within available offsite capacity. Disposal of hazardous solid waste generated by a commercial solar power generation facility would be the responsibility of that project. NNSS hazardous waste management capabilities would not be impacted under current permit conditions.
Solid waste	Total of 3,800,000 cubic feet, including 3,700,000 cubic feet generated by DOE/NNSA activities in Nevada and 160,000 cubic feet generated by operation of a 240-megawatt commercial solar power generation facility. DOE/NNSA solid waste disposed at the NNSS would not exceed the disposal capacity at NNSS landfills. Included in the DOE/NNSA volume are 370,000 cubic feet that would be transported off site to be recycled within available offsite capacity. Disposal of nonhazardous solid waste generated by a commercial solar power generation facility would be the responsibility of that project. NNSS disposal capacity would not be impacted under current permit conditions.	Total of 10,000,000 cubic feet, including 9,400,000 cubic feet generated by DOE/NNSA activities in Nevada and 630,000 cubic feet generated by operation of 1,000 megawatts of commercial solar power generation facilities. DOE/NNSA solid waste disposed at the NNSS would not exceed the disposal capacity at NNSS landfills. Included in the DOE/NNSA volume are 970,000 cubic feet that would be transported off site to be recycled within available offsite capacity. Disposal of nonhazardous solid waste generated by a commercial solar power generation facility would be the responsibility of that project. NNSS disposal capacity would not be impacted under current permit conditions.	Total of 3,700,000 cubic feet, including 3,600,000 cubic feet generated by DOE/NNSA activities in Nevada and 77,000 cubic feet generated by operation of a 100-megawatt commercial solar power generation facility. DOE/NNSA solid waste disposed at the NNSS would not exceed the available capacity at NNSS landfills. Included in the DOE/NNSA volume are 360,000 cubic feet that would be transported off site to be recycled within available offsite capacity. Disposal of nonhazardous solid waste generated by a commercial solar power generation facility would be the responsibility of that project. NNSS disposal capacity would not be impacted under current permit conditions.	Total of 9,560,000 cubic feet, including 9,400,000 cubic feet generated by DOE/NNSA activities in Nevada and 160,000 cubic feet generated by operation of a 240-megawatt commercial solar power generation facility. DOE/NNSA solid waste disposed at the NNSS would not exceed the disposal capacity at NNSS landfills. Included in the DOE/NNSA volume are 970,000 cubic feet that would be transported off site to be recycled within available offsite capacity. Disposal of nonhazardous solid waste generated by a commercial solar power generation facility would be the responsibility of that project. NNSS disposal capacity would not be impacted under current permit conditions.

	No Action Alternative		***Expanded Operations Alternative***		***Reduced Operations Alternative***		***Preferred Alternative***	
Human Health (for details go to Chapter 5, Sections 5.1.12, 5.1.12.1, 5.1.12.2, and 5.1.12.3, and Appendix G)								
Annual Radiological Impacts of Normal Operations (for details go to Chapter 5, Sections 5.1.12.1.1, 5.1.12.1.2, 5.1.12.1.3, and 5.1.12.1.4 and Appendix G)								
Offsite Population								
Collective Dose (person-rem)	0.50		0.89		0.48		0.89	
LCF risk	3×10^{-4}		5×10^{-4}		3×10^{-4}		5×10^{-4}	
MEI								
Dose (millirem)	2.8		4.8		2.7		4.8	
LCF risk	2×10^{-6}		3×10^{-6}		2×10^{-6}		3×10^{-6}	
Workers								
Collective Dose (person-rem)	5.2		6.6		4.8		6.6	
LCF risk	3×10^{-3}		4×10^{-3}		3×10^{-3}		4×10^{-3}	
Subsistence Consumer [b]								
Dose (millirem)	13		15		13		15	
Risk (LCF)	8×10^{-6}		9×10^{-6}		8×10^{-6}		9×10^{-6}	
Annual Industrial Accident Incidence Rate (unless noted otherwise)								
	TRC	***DART***	***TRC***	***DART***	***TRC***	***DART***	***TRC***	***DART***
Nevada National Security Site, including Commercial Solar Power Facility Operations	32	14	44	20	28	13	41.9	19
Commercial Solar Power Generation Facility – Operations	6.2	3.2	8.3	4.2	5.2	2.7	6.2	3.2
Commercial Solar Power Generation Facility – Construction (per project duration) [c]	60	31	110	56	44	23	60	31
Annual Industrial Accident Fatality Rates								
Nevada National Security Site, including Commercial Solar Power Facility – Operations (maximum annual incidence) [d]	0.019		0.031		0.015		0.021	
Commercial Solar Power Generation Facility – Construction (during construction period)	0.019 [e]		0.029 [f]		0.015 [g]		0.019	

	No Action Alternative	***Expanded Operations Alternative***	***Reduced Operations Alternative***	***Preferred Alternative***
Noise Impacts				
Workers	Mitigated through worker protection practices.	Same as under the No Action Alternative.	Same as under the No Action Alternative.	Mitigated through worker protection practices.
Public	Minimal due to remoteness of site and distance to receptors.	Same as under the No Action Alternative, but there would be some increased traffic noise due to larger workforce and increase in daily truck trips.	Similar to the No Action Alternative, but slightly reduced due to smaller workforce.	Same as under the No Action Alternative, but there would be some increased traffic noise due to larger workforce and increase in daily truck trips.
Facility Accident – Dose Consequence and Annual Risk [h] (for details go to Chapter 5, Sections 5.1.12.2.1, 5.1.12.2.2, and 5.1.12.2.3, and Appendix G)				
Highest Risk Facility Accident – DAF explosion involving 55 pounds of high explosive and 1 kilogram of plutonium (assumed frequency 1 in 1,250 years)				
Offsite Population				
Dose (person-rem)	23	Same as under the No Action Alternative.	Same as under the No Action Alternative.	23
LCF risk per year	1×10^{-5}	Same as under the No Action Alternative.	Same as under the No Action Alternative.	1×10^{-5}
MEI				
Dose (rem)	0.18	Same as under the No Action Alternative.	Same as under the No Action Alternative.	0.18
LCF risk per year	9×10^{-8}	Same as under the No Action Alternative.	Same as under the No Action Alternative.	9×10^{-8}
Noninvolved Worker				
Dose (rem)	6.5	Same as under the No Action Alternative.	Same as under the No Action Alternative.	6.5
LCF risk per year	3×10^{-6}	Same as under the No Action Alternative.	Same as under the No Action Alternative.	3×10^{-6}

	No Action Alternative	*Expanded Operations Alternative*	*Reduced Operations Alternative*	*Preferred Alternative*
Environmental Justice (for details go to Chapter 5, Sections 5.1.13.1, 5.1.13.2, and 5.1.13.3)				
	Impacts on low-income and minority populations would be identical to those of the general population. Therefore, no disproportionately high and adverse impacts on minority or low-income populations are expected. An increase in construction jobs for the solar power generation facility could provide jobs for unemployed individuals, which would have a beneficial impact on low-income individuals.	Same as under the No Action Alternative, except there would be a larger number of construction jobs created.	Same as under the No Action Alternative, except there would be fewer construction jobs created.	Impacts on low-income and minority populations would be identical to those of the general population. Therefore, no disproportionately high and adverse impacts on minority or low-income populations are expected. An increase in construction jobs for the solar power generation facility could provide jobs for unemployed individuals, which would have a beneficial impact on low-income individuals.

CO = carbon monoxide; CO_2-equivalent = carbon dioxide-equivalent; D&D = decontamination and decommissioning; DAF = Device Assembly Facility; DART = days away, restrictive, or transferred; FTE = full-time equivalent; LCF = latent cancer fatality; LLW = low-level radioactive waste; MEI = maximally exposed individual; MLLW = mixed low-level radioactive waste; NNSA = National Nuclear Security Administration; NNSS = Nevada National Security Site; NO_x = nitrogen oxides; NRHP = National Register of Historic Places; OST = Office of Secure Transportation; PM_n = particulate matter with an aerodynamic diameter of *n* micrometers or less; rem = roentgen equivalent man; RWMC = Radioactive Waste Management Complex; RWMS = Radioactive Waste Management Site; SO_2 = sulfur dioxide; TRC = total recordable cases; TRU = transuranic waste; UGTA = Underground Test Area; VOC = volatile organic compound; WIPP = Waste Isolation Pilot Plant.

[a] The reported radiological risks are the projected number of LCFs in the population and are therefore presented as whole numbers. The calculated value is shown in parentheses.

[b] Potential dose to a subsistence consumer includes the MEI dose plus a 10-millirem per year dose from consuming crops raised in soil contaminated by past testing and contaminated game animals. The latter dose component would be independent of current site operations.

[c] Based on 500 full-time equivalent workers for a 35-month construction period for the No Action Alternative; 750 full-time equivalent workers for a 42-month construction period for the Expanded Operations Alternative; and 400 full-time equivalent workers for a 32-month construction period for the Reduced Operations Alternative.

[d] Annual value includes value from DOE/NNSA construction activities and an annualized rate from solar power generation facility construction (see footnotes e, f, and g).

[e] Annualized value based on 500 full-time equivalent workers for a 35-month solar power generation facility construction period.

[f] Annualized value based on 750 full-time equivalent workers for a 42-month solar power generation facility construction period.

[g] Annualized value based on 400 full-time equivalent workers for a 32-month solar power generation facility construction period.

[h] The risk is the annual increased likelihood of an LCF in the MEI or the noninvolved worker or the increased likelihood of a single LCF occurring in the offsite population, accounting for the estimated probability (frequency) of the accident occurring.

[i] Reactivation of the Area 3 RWMS would only occur based upon mission need and as stated in 4.1.11.1.1.1, including detailed consultation with the State of Nevada.

Table 3–5 Summary of Potential Impacts at the Remote Sensing Laboratory

	No Action Alternative	*Expanded Operations Alternative*	*Reduced Operations Alternative*	*Preferred Alternative*
Land Use (for details go to Chapter 5, Section 5.2.1)				
	No impacts were identified from the continuation of activities at the current levels of operations or foreseeable actions because activities under this alternative would continue to be compatible with existing land use designations on Nellis Air Force Base.	Same as under the No Action Alternative.	Same as under the No Action Alternative.	No impacts were identified from the continuation of activities at the current levels of operations or actions because activities under this alternative would continue to be compatible with existing land use designations on Nellis Air Force Base.
Infrastructure and Energy (for details go to Chapter 5, Sections 5.2.2.1, and 5.2.2.2, and 5.2.2.3)				
	Infrastructure would be maintained as needed to accommodate ongoing activities. No new buildings or facilities are planned. Energy demand is expected to continue at about 4,850 megawatt-hours per year and the existing electrical distribution is adequate to support this demand. Natural gas use is expected to continue to be about 33,673 therms per year. There is adequate capacity to serve this demand and the condition of the gas lines is satisfactory. Approximately 11,000 gallons of JP-8 jet fuel are used each year for aircraft operations. An adequate supply of JP-8 fuel is available directly through Nellis Air Force Base.	Same as under the No Action Alternative.	Same as under the No Action Alternative.	Infrastructure would be maintained as needed to accommodate ongoing activities. No new buildings or facilities are planned. Energy demand is expected to continue at about 4,850 megawatt-hours per year and the existing electrical distribution is adequate to support this demand. Natural gas use is expected to continue to be about 33,673 therms per year. There is adequate capacity to serve this demand and the condition of the gas lines is satisfactory. Approximately 11,000 gallons of JP-8 jet fuel are used each year for aircraft operations. An adequate supply of JP-8 fuel is available directly through Nellis Air Force Base.

	No Action Alternative	*Expanded Operations Alternative*	*Reduced Operations Alternative*	*Preferred Alternative*
Transportation and Traffic (for details go to Chapter 5, Sections 5.2.3.1, and 5.2.3.2)				
Transportation	No radioactive materials transported. Nonradioactive material transports are included in Nevada National Security Site impacts.	Same as under the No Action Alternative.	Same as under the No Action Alternative.	No radioactive materials transported. Nonradioactive material transports are included in Nevada National Security Site impacts.
Traffic	The number of personnel at RSL is expected to remain the same, and there are no construction or other projects proposed that would result in increased traffic. There would be no additional impacts on onsite or regional traffic conditions.	Same as under the No Action Alternative.	Same as under the No Action Alternative.	The number of personnel at RSL is expected to remain the same, and there are no construction or other projects proposed that would result in increased traffic. There would be no additional impacts on onsite or regional traffic conditions.
Socioeconomics (for details go to Chapter 5, Section 5.2.4)				
	There would be no change in employment; therefore, there would be no change in socioeconomic impacts.	Same as under the No Action Alternative.	Same as under the No Action Alternative.	There would be no change in employment; therefore, there would be no change in socioeconomic impacts.
Geology and Soils (for details go to Chapter 5, Section 5.2.5)				
	There would be no impacts on geological and soil resources.	Same as under the No Action Alternative.	Same as under the No Action Alternative.	There would be no impacts on geological and soil resources.
Hydrology (for details go to Chapter 5, Sections 5.2.6.1, 5.2.6.2, and 5.2.6.3)				
Surface Water Resources	No proposed activities would affect surface hydrology.	Same as under the No Action Alternative.	Same as under the No Action Alternative.	No proposed activities would affect surface hydrology.
Groundwater Resources	No proposed facilities or activities would adversely affect groundwater quality or supply.	Same as under the No Action Alternative.	Same as under the No Action Alternative.	No proposed facilities or activities would adversely affect groundwater quality or supply.
Biological Resources (for details go to Chapter 5, Section 5.2.7)				
	All activities would occur in previously disturbed, developed areas and would not affect biological resources.	Same as under the No Action Alternative.	Same as under the No Action Alternative.	All activities would occur in previously disturbed, developed areas and would not affect biological resources.

	No Action Alternative	*Expanded Operations Alternative*	*Reduced Operations Alternative*	*Preferred Alternative*
Air Quality (for details go to Chapter 5, Sections 5.2.8.1.1, 5.2.8.1.2, and 5.2.8.1.3)				
Annual Average Operational Emissions in 2015 (tons per year)				
PM_{10} *$PM_{2.5}$* *CO* *NO_x* *SO_2* *Volatile organic compounds* *Lead* *Hazardous air pollutants* *CO_2-equivalent*	0.084 0.067 4.1 1.6 0.034 0.3 ~0.01 0.19 3,147	Same as under the No Action Alternative.	Same as under the No Action Alternative.	0.084 0.067 4.1 1.6 0.034 0.3 ~0.01 0.19 3,147
Radiological Air Quality	No activities are expected to produce radiation beyond those documented for 2008 baseline conditions.	Same as under the No Action Alternative.	Same as under the No Action Alternative.	No activities are expected to produce radiation beyond those documented for 2008 baseline conditions.
Visual Resources (for details go to Chapter 5, Sections 5.2.9.1, 5.2.9.2, and 5.1.9.3)				
	There would be no impacts on visual resources.	Same as under the No Action Alternative.	Same as under the No Action Alternative.	There would be no impacts on visual resources.
Cultural Resources (for details go to Chapter 5, Section 5.2.10)				
	All activities would occur in previously disturbed, developed areas and would not affect cultural resources.	Same as under the No Action Alternative.	Same as under the No Action Alternative.	All activities would occur in previously disturbed, developed areas and would not affect cultural resources.
Waste Management (for details go to Chapter 5, Section 5.2.11)				
Hazardous waste	Annually, about 680 cubic feet of hazardous waste generated and transported to be recycled, treated, and/or disposed within available offsite capacity.	Same as under the No Action Alternative.	Same as under the No Action Alternative.	Annually, about 680 cubic feet of hazardous waste generated and transported to be recycled, treated, and/or disposed within available offsite capacity.
Solid waste	Annually, about 4,550 cubic feet generated and transported to be recycled or disposed within available offsite capacity.	Same as under the No Action Alternative.	Same as under the No Action Alternative.	Annually, about 4,550 cubic feet generated and transported to be recycled or disposed within available offsite capacity.

<table>
<tr><th></th><th colspan="2">No Action Alternative</th><th>Expanded Operations Alternative</th><th>Reduced Operations Alternative</th><th colspan="2">Preferred Alternative</th></tr>
<tr><td colspan="7">Human Health (for details go to Chapter 5, Sections 5.2.12, 5.2.12.1, and 5.2.12.2)</td></tr>
<tr><td>Normal Operations</td><td colspan="2">There would be no radiological or hazardous chemical risks.</td><td>Same as under the No Action Alternative.</td><td>Same as under the No Action Alternative.</td><td colspan="2">There would be no radiological or hazardous chemical risks.</td></tr>
<tr><td rowspan="2">Annual Industrial Accident Incidence Rate</td><td>TRC</td><td>DART</td><td rowspan="2">Same as under the No Action Alternative.</td><td rowspan="2">Same as under the No Action Alternative.</td><td>TRC</td><td>DART</td></tr>
<tr><td>32</td><td>14</td><td>32</td><td>14</td></tr>
<tr><td>Noise</td><td colspan="2">Noise from RSL activities and traffic would be minimal compared to ambient traffic noise and aircraft noise at Nellis Air Force Base.</td><td>Same as under the No Action Alternative.</td><td>Same as under the No Action Alternative.</td><td colspan="2">Noise from RSL activities and traffic would be minimal compared to ambient traffic noise and aircraft noise at Nellis Air Force Base.</td></tr>
<tr><td>Facility Accidents</td><td colspan="2">There would be no radiological or hazardous chemical accident risks.</td><td>Same as under the No Action Alternative.</td><td>Same as under the No Action Alternative.</td><td colspan="2">There would be no radiological or hazardous chemical accident risks.</td></tr>
<tr><td colspan="7">Environmental Justice (for details go to Chapter 5, Section 5.2.13, 5.2.13.1, 5.2.13.2, and 5.2.13.3)</td></tr>
<tr><td></td><td colspan="2">Impacts on low-income and minority populations would be identical to those of the general population. Therefore, no disproportionately high and adverse impacts on minority or low-income populations are expected.</td><td>Same as under the No Action Alternative.</td><td>Same as under the No Action Alternative.</td><td colspan="2">Impacts on low-income and minority populations would be identical to those of the general population. Therefore, no disproportionately high and adverse impacts on minority or low-income populations are expected.</td></tr>
</table>

CO = carbon monoxide; CO_2-equivalent = carbon dioxide-equivalent; DART = days away, restrictive, or transferred; NO_x = nitrogen oxides; PM_n = particulate matter with an aerodynamic diameter of *n* micrometers or less; RSL = Remote Sensing Laboratory; SO_2 = sulfur dioxide; TRC = total recordable cases; VOC = volatile organic compound.

Table 3–6 Summary of Potential Impacts at the North Las Vegas Facility

	No Action Alternative	*Expanded Operations Alternative*	*Reduced Operations Alternative*	*Preferred Alternative*
Land Use (for details go to Chapter 5, Section 5.3.1)				
	No impacts were identified from the continuation of activities at the current levels of operations or foreseeable actions because activities under this alternative would continue to be compatible with existing land use designations.	Same as under the No Action Alternative.	Same as under the No Action Alternative.	No impacts were identified from the continuation of activities at the current levels of operations or foreseeable actions because activities under this alternative would continue to be compatible with existing land use designations.
Infrastructure and Energy (for details go to Chapter 5, Sections 5.3.2.1 and 5.3.2.2)				
	Infrastructure would be maintained as needed to accommodate ongoing activities. No new buildings or facilities are planned. Electric energy demand is expected to continue at about 15,000 megawatt-hours per year and the existing electrical distribution is adequate to support this demand. Natural gas use is expected to continue to be about 48,000 therms per year. There is adequate capacity to serve this demand.	Same as under the No Action Alternative for infrastructure. Electric energy demand would increase by no more than 10 percent. The capacity of the electrical distribution system and the capability of commercial providers are adequate to supply the needed electrical energy.	Same as under the No Action Alternative for infrastructure. Electrical energy demand is expected to be the same as under the No Action Alternative or slightly lower.	Infrastructure would be maintained as needed to accommodate ongoing activities. No new buildings or facilities are planned. Electric energy demand would increase by no more than 10 percent, for a total of 16,500 megawatt-hours per year, and the existing electrical distribution is adequate to support this demand. Natural gas use is expected to continue to be about 48,000 therms per year. There is adequate capacity to serve this demand.

	No Action Alternative	*Expanded Operations Alternative*	*Reduced Operations Alternative*	*Preferred Alternative*
Transportation [a] (for details go to Chapter 5, Sections 5.3.3.1 and 5.3.3.2)				
Transportation	No radioactive materials analyzed. Nonradioactive material transports are included in NNSS impacts.	Same as under the No Action Alternative.	Same as under the No Action Alternative.	No radioactive materials analyzed. Nonradioactive material transports are included in NNSS impacts.
Traffic	No increase in traffic volume due to NLVF-related traffic compared to the projected baseline; levels of service would remain the same.	Approximately a 2 percent increase in daily traffic volumes during peak hours on local roads, when compared to the projected baseline; levels of service would remain the same.	Less than 1 percent decrease in daily traffic volumes during peak hours on local roads; levels of service would remain the same.	Approximately a 2 percent increase in daily traffic volumes during peak hours on local roads, when compared to the projected baseline; levels of service would remain the same.
Socioeconomics (for details go to Chapter 5, Sections 5.3.4.1, 5.3.4.2, and 5.3.4.3)				
	There would be no change in employment; therefore, there would be no change in socioeconomic impacts.	Employment would increase by 361 FTEs; about 36 employees would relocate from outside the region. Up to 3 new teaching jobs would need to be filled to maintain the current student-to-teacher ratio. Sufficient housing exists in the region to support the increased population. Direct jobs would reduce unemployment by 0.27 and 0.12 percent in Clark and Nye Counties, respectively. Direct jobs and indirect jobs would have a beneficial effect on the local economy and government revenues. The addition of 361 employees would result in an increase in the number of service calls, but would have a negligible impact on area hospitals and hospital personnel.	Employment would decrease by 45 FTEs, increasing unemployment in Clark County by about 0.12 percent and in Nye County by about 0.04 percent. Additional employees would not relocate to Clark or Nye County and there would be no impact on student-to-teacher ratios. Job loss would have a small negative impact on the local economy and government revenues. There would be no impact on public services.	Employment would increase by 361 FTEs; about 36 employees would relocate from outside the region. Up to 3 new teaching jobs would need to be filled to maintain the current student-to-teacher ratio. Sufficient housing exists in the region to support the increased population. Direct jobs would reduce unemployment by 0.27 and 0.12 percent in Clark and Nye Counties, respectively. Direct jobs and indirect jobs would have a beneficial effect on the local economy and government revenues. The addition of 361 employees would result in an increase in the number of service calls, but would have a negligible impact on area hospitals and hospital personnel.

	No Action Alternative	*Expanded Operations Alternative*	*Reduced Operations Alternative*	*Preferred Alternative*
Geology and Soils(for details go to Chapter 5, Sections 5.3.5.1, 5.3.5.2, and 5.3.5.3)				
	Proposed activities would not affect geological and soil resources.	Same as under the No Action Alternative.	Same as under the No Action Alternative.	Proposed activities would not affect geological and soil resources.
Hydrology (for details go to Chapter 5, Sections 5.3.6.1, and 5.3.4.2)				
Surface Water Resources	Proposed activities would not affect surface hydrology.	Same as under the No Action Alternative.	Same as under the No Action Alternative.	Proposed activities would not affect surface hydrology.
Groundwater Resources	Proposed activities would not adversely affect groundwater quality or supply.	Same as under the No Action Alternative.	Same as under the No Action Alternative.	Proposed activities would not adversely affect groundwater quality or supply.
Biological Resources (for details go to Chapter 5, Sections 5.3.7)				
	All activities would occur in previously disturbed, developed areas and would not affect native biological resources.	Same as under the No Action Alternative.	Same as under the No Action Alternative.	All activities would occur in previously disturbed, developed areas and would not affect native biological resources.
Air Quality (for details go to Chapter 5, Sections 5.3.8.1, 5.3.8.2, and 5.3.8.3)				
Annual Average Operational Emission in 2015 (tons per year)				
PM_{10}	0.36	0.44	0.33	0.44
$PM_{2.5}$	0.24	0.28	0.21	0.28
CO	24.4	30.5	22.0	30.5
NO_x	5.9	7.2	5.4	7.2
SO_2	0.079	0.095	0.072	0.095
VOCs	0.77	0.96	0.70	0.96
Lead	<0.01	<0.01	<0.01	<0.01
Hazardous air pollutants	0.062	0.078	0.056	0.078
CO_2-equivalent	8,378	9,031	8,118	9,031
Radiological Air Quality	No activities are expected to produce radiation beyond those documented for 2008 baseline conditions.	Same as under the No Action Alternative.	Same as under the No Action Alternative.	No activities are expected to produce radiation beyond those documented for 2008 baseline conditions.

	No Action Alternative	*Expanded Operations Alternative*	*Reduced Operations Alternative*	*Preferred Alternative*
Visual Resources (for details go to Chapter 5, Sections 5.3.9.1, 5.3.9.2, and 5.3.9.3)				
	There would be no impacts on visual resources.	Same as under the No Action Alternative.	Same as under the No Action Alternative.	There would be no impacts on visual resources.
Cultural Resources (for details go to Chapter 5, Section 5.3.10)				
	All activities would occur in previously disturbed, developed areas and would not affect cultural resources.	Same as under the No Action Alternative.	Same as under the No Action Alternative.	All activities would occur in previously disturbed, developed areas and would not affect cultural resources.
Waste Management (for details go to Chapter 5, Section 5.3.11)				
LLW	150 cubic feet generated over the next 10 years and disposed within available capacity at the NNSS in the Area 5 RWMC.	Same as under the No Action Alternative.	Same as under the No Action Alternative.	150 cubic feet generated over the next 10 years and disposed within available capacity at the NNSS in the Area 5 RWMC.
Hazardous waste	1,100 cubic feet generated over the next 10 years and shipped off site to be recycled, treated, and/or disposed within available capacity.	Same as under the No Action Alternative.	Same as under the No Action Alternative.	1,100 cubic feet generated over the next 10 years and shipped off site to be recycled, treated, and/or disposed within available capacity.
Solid waste	500,000 cubic feet generated over the next 10 years and shipped off site to be recycled or disposed within available capacity.	590,000 cubic feet generated over the next 10 years and shipped off site to be recycled or disposed within available capacity.	460,000 cubic feet generated over the next 10 years and shipped off site to be recycled or disposed within available capacity.	590,000 cubic feet generated over the next 10 years and shipped off site to be recycled or disposed within available capacity.

	No Action Alternative		***Expanded Operations Alternative***		***Reduced Operations Alternative***		***Preferred Alternative***	
Human Health (for details go to Chapter 5, Sections 5.3.12.1 and 5.3.12.2)								
Offsite Population Collective Dose (person-rem) LCF risk MEI or noninvolved worker Dose (millirem) LCF risk	4.1×10^{-5} 2×10^{-8} 3.5×10^{-4} 2×10^{-10}		Same as under the No Action Alternative.		Same as under the No Action Alternative.		4.1×10^{-5} 2×10^{-8} 3.5×10^{-4} 2×10^{-10}	
Annual Industrial Accident Incidence Rate								
North Las Vegas Facility – Site Operations	***TRC***	***DART***	***TRC***	***DART***	***TRC***	***DART***	***TRC***	***DART***
	22	9.5	27	12	20	8.6	27	12
Noise	Noise from NLVF-related activities and traffic would not exceed ambient traffic noise.		Same as under the No Action Alternative.		Same as under the No Action Alternative.		Noise from NLVF-related activities and traffic would not exceed ambient traffic noise.	
Facility Accidents	There would be negligible radiological or hazardous chemical accident risks.		Same as under the No Action Alternative.		Same as under the No Action Alternative.		There would be negligible radiological or hazardous chemical accident risks.	
Environmental Justice (for details go to Chapter 5, Sections 5.3.13.1, 5.3.13.2, and 5.3.13.3)								
	Impacts on low-income and minority populations would be identical to those of the general population. Therefore, no disproportionately high and adverse impacts on minority or low-income populations are expected.		Same as under the No Action Alternative.		Same as under the No Action Alternative.		Impacts on low-income and minority populations would be identical to those of the general population. Therefore, no disproportionately high and adverse impacts on minority or low-income populations are expected.	

CO = carbon monoxide; CO_2-equivalent = carbon dioxide-equivalent; DART=days away, restrictive, or transferred; FTE = full-time equivalent; LCF = latent cancer fatality; LLW = low-level radioactive waste; MEI = maximally exposed individual; NLVF = North Las Vegas Facility; NNSS = Nevada National Security Site; NO_x = nitrogen oxides; PM_n = particulate matter with an aerodynamic diameter of *n* micrometers or less; rem = roentgen equivalent man; RWMC = Radioactive Waste Management Complex; SO_2 = sulfur dioxide; TRC = total recordable cases; VOC = volatile organic compound.

[a] Does not include tritiated liquids shipped from NLVF to the NNSS for treatment.

[b] The volumes of LLW generated at NLVF under the three alternatives shown in this table are included in the volumes of LLW to be disposed at the NNSS under the appropriate alternatives in Table 3–4.

Table 3–7 Summary of Potential Impacts at the Tonopah Test Range

	No Action Alternative	*Expanded Operations Alternative*	*Reduced Operations Alternative*	*Preferred Alternative*
Land Use (for details go to Chapter 5, Section 5.4.1)				
	There would be no impact on land use from the continuation of activities at the current levels of operations because activities would continue to be compatible with existing land use designations on the TTR and primary land uses on the Nevada Test and Training Range.	Same as under the No Action Alternative.	Same as under the No Action Alternative.	There would be no impact on land use from the continuation of activities at the current levels of operations because activities would continue to be compatible with existing land use designations on the TTR and primary land uses on the Nevada Test and Training Range.
	Airspace No new impacts were identified for airspace activities because these activities would be maintained at the current level of air traffic, navigational aid services, airspace structure, and coordinated and scheduled by the Nellis Air Traffic Control Facility.	*Airspace* Same as under the No Action Alternative.	*Airspace* Impacts would be slightly reduced compared to the No Action Alternative because of the discontinuation of fixed rocket and missile launches, cruise missile operations, and detonation of fuel-air explosives at the TTR, which would increase the restricted airspace availability for other military uses as coordinated and scheduled by the Nellis Air Traffic Control Facility.	*Airspace* No new impacts were identified for airspace activities because these activities would be maintained at the current level of air traffic, navigational aid services, airspace structure, and coordinated and scheduled by the Nellis Air Traffic Control Facility.
Infrastructure and Energy (for details go to Chapter 5, Sections 5.4.2.1 and 5.3.4.2)				
	Infrastructure would be maintained as needed to accommodate ongoing activities. No new buildings or facilities are planned.	Same as under the No Action Alternative.	Same as under the No Action Alternative.	Infrastructure would be maintained as needed to accommodate ongoing activities. No new buildings or facilities are planned.

	No Action Alternative	***Expanded Operations Alternative***	***Reduced Operations Alternative***	***Preferred Alternative***
Transportation [a] and Traffic (for details go to Chapter 5, Sections 5.4.3.1 and 5.4.3.2)				
TTR LLW/MLLW				
Incident-free truck transport				
worker risk (LCF)	0 (9×10^{-6})	0 (0.0005)	0 (9×10^{-6})	0 (0.0005)
population risk (LCF)	0 (1×10^{-6})	0 (0.0002)	0 (1×10^{-6})	0 (0.0002)
Transport accidents				
radiological risk (LCF)	0 (1×10^{-12})	0 (6×10^{-11})	0 (1×10^{-12})	0 (6×10^{-11})
nonradiological fatalities	0 (0.002)	0 (0.1)	0 (0.002)	0 (0.1)
Nonradiological waste transport fatalities	Nonradioactive material transports included in NNSS impacts.	Same as under the No Action Alternative.	Same as under the No Action Alternative.	Nonradioactive material transports included in NNSS impacts.
Traffic	Up to 2 additional truck trips per day from Environmental Restoration Program radioactive waste transport; minimal impacts on onsite and regional traffic conditions.	Up to 10 additional truck trips per day from Environmental Restoration radioactive waste transport; minimal impacts on onsite and regional traffic conditions.	Same as under the No Action Alternative.	Up to 10 additional truck trips per day from Environmental Restoration Program radioactive waste transport; minimal impacts on onsite and regional traffic conditions.
Socioeconomics (for details go to Chapter 5, Sections 5.4.4.1, 5.4.4.2, and 5.4.4.3)				
	No change in employment; therefore, no change in socioeconomic impacts.	Employment would decrease by 63 FTEs, which would increase the unemployment rate by about 0.01 percent in Clark County and about 1.64 percent in Nye County. Local spending would decrease and revenues for Clark and Nye Counties could decrease. This small decrease would have a negligible adverse impact on local economies. There would be no impact on public services.	Employment would decrease by 67 FTEs, which would increase the unemployment rate by about 0.01 percent in Clark County and about 1.76 percent in Nye County. Local spending would decrease and revenues for Clark and Nye Counties could decrease. This small decrease would have a negligible adverse impact on local economies. There would be no impact on public services.	Employment would decrease by 63 FTEs, which would increase the unemployment rate by about 0.01 percent in Clark County and about 1.64 percent in Nye County. Local spending would decrease and revenues for Clark and Nye Counties could decrease. This small decrease would have a negligible adverse impact on local economies. There would be no impact on public services.

	No Action Alternative	*Expanded Operations Alternative*	*Reduced Operations Alternative*	*Preferred Alternative*
Geology and Soils (for details go to Chapter 5, Sections 5.4.5.1, 5.4.5.2, and 5.4.5.3)				
National Security/Defense Mission	There would be localized impacts on soil and geology from tests using gravity weapons, joint test assemblies, and inert projectiles. Some soil contamination could occur. Work for Others – Some localized soil disturbance from a variety of site activities.	Same as under the No Action Alternative.	Same as under the No Action Alternative.	There would be localized impacts on soil and geology from tests using gravity weapons, joint test assemblies, and inert projectiles. Some soil contamination could occur. Work for Others – Some localized soil disturbance from a variety of site activities.
Environmental Management Mission	Environmental restoration – Possible disturbance of soil from environmental restoration of contaminated sites, including Clean Slate 1, 2, and 3 at TTR. Overall, however, environmental restoration would reduce or stabilize the inventory of legacy contamination.	Same as under the No Action Alternative, plus: Up to 11,000,000 cubic feet of soil could be removed during environmental restoration activities at the Clean Slate 1, 2, and 3 sites. Overall, however, environmental restoration would reduce or stabilize the inventory of legacy contamination.	Same as under the No Action Alternative.	Up to 11,000,000 cubic feet of soil could be removed during environmental restoration activities at the Clean Slate 1, 2, and 3 sites. Overall, however, environmental restoration would reduce or stabilize the inventory of legacy contamination.
Nondefense Mission	There would be no impacts on geological and soil resources.	Same as under the No Action Alternative.	Same as under the No Action Alternative.	There would be no impacts on geological and soil resources.
Hydrology (for details go to Chapter 5, Sections 5.4.6.1 and 5.4.5.2)				
Surface Water Resources				
National Security/Defense Mission	Gravity weapons drops and rocket and missile testing could cause alterations of natural drainage pathways and chemical contamination of ephemeral waters. Operation of ground-based remote control vehicles could cause sedimentation to ephemeral waters.	Same as under the No Action Alternative.	Same as under the No Action Alternative.	Gravity weapons drops and rocket and missile testing could cause alterations of natural drainage pathways and chemical contamination of ephemeral waters. Operation of ground-based remote control vehicles could cause sedimentation to ephemeral waters.
Environmental Management Mission	Environmental restoration projects could cause beneficial restoration of natural drainage pathways and adverse impacts of chemical contamination of and sedimentation to ephemeral waters.	Same as under the No Action Alternative.	Same as under the No Action Alternative.	Environmental restoration projects could cause beneficial restoration of natural drainage pathways and adverse impacts of chemical contamination of and sedimentation to ephemeral waters.
Nondefense Mission	No proposed activities would affect surface hydrology.	Same as under the No Action Alternative.	Same as under the No Action Alternative.	No proposed activities would affect surface hydrology.

	No Action Alternative	***Expanded Operations Alternative***	***Reduced Operations Alternative***	***Preferred Alternative***
Groundwater Resources				
	Proposed activities would not adversely affect groundwater quality or supply.	Same as under the No Action Alternative.	Potable water use would decrease by 50 percent compared to current use because several testing activities would cease.	Proposed activities would not adversely affect groundwater quality or supply.
Biological Resources (for details go to Chapter 5, Section 5.4.7.1)				
	All work would occur in previously disturbed areas and there would be no additional impacts on biological resources.	Same as under the No Action Alternative.	Same as under the No Action Alternative.	All work would occur in previously disturbed areas and there would be no additional impacts on biological resources.
Air Quality and Climate (for details go to Chapter 5, Sections 5.4.8.1, 5.4.8.2, and 5.4.8.3)				
Annual Average Operational Emission in 2015 (tons per year) [b]				
PM_{10}	<4.0	<3.8	<3.8	<3.8
$PM_{2.5}$	<4.0	<3.8	<3.8	<3.8
CO	<10.8	<6.1	<5.8	<6.1
NO_x	<17.1	<14.8	<14.7	<14.8
SO_2	<0.93	<0.92	<0.92	<0.92
VOC	<1.4	<1.1	<1.1	<1.1
Lead	<0.010	<0.010	<0.010	<0.010
Hazardous air pollutants	<1.1	<1.1	<1.1	<1.1
CO_2-equivalent	3,652	1,790	1,671	1,790
Radiological Air Quality	No activities are expected to produce radiation beyond those documented for 2008 baseline conditions.	Remediation activities would likely result in increased suspended particulates and higher radiological air emissions relative to those observed in the 2008 baseline conditions. Monitoring would be performed to assess the potential for offsite impacts and the need for mitigating action.	Same as under the No Action Alternative.	Remediation activities would likely result in increased suspended particulates and higher radiological air emissions relative to those observed in the 2008 baseline conditions. Monitoring would be performed to assess the potential for offsite impacts and the need for mitigating action.
Visual Resources (for details go to Chapter 5, Sections 5.4.9.1, 5.4.9.2, and 5.4.9.3)				
	No impacts on visual resources.	Same as under the No Action Alternative.	Same as under the No Action Alternative.	No impacts on visual resources.

	No Action Alternative	*Expanded Operations Alternative*	*Reduced Operations Alternative*	*Preferred Alternative*
Cultural Resources (for details go to Chapter 5, Section 5.4.10)				
	All work would occur in previously disturbed areas. DOE/NNSA would consult with the State Historic Preservation Officer prior to environmental restoration of the Clean Slate 1, 2, and 3 sites because they are considered historically significant.	Same as under the No Action Alternative.	Same as under the No Action Alternative.	All work would occur in previously disturbed areas. DOE/NNSA would consult with the State Historic Preservation Officer prior to environmental restoration of the Clean Slate 1, 2, and 3 sites because they are considered historically significant.
Waste Management [e] (for details go to Chapter 5, Section 5.4.11)				
LLW	200,000 cubic feet generated by Environmental Restoration Program activities would be disposed within available capacity at the NNSS Area 5 RWMC.	11,000,000 cubic feet generated by Environmental Restoration Program activities would be disposed within available capacity at the NNSS Area 5 RWMC and Area 3 RWMS.	Same as under the No Action Alternative.	11,000,000 cubic feet generated by Environmental Restoration Program activities would be disposed within available capacity at the NNSS Area 5 RWMC and Area 3 RWMS.
Hazardous waste	About 4,500 cubic feet of hazardous waste would be generated over the next 10 years that would be transported to permitted offsite facilities to be recycled, treated, and/or disposed within available capacity.	Same as under the No Action Alternative.	Same as under the No Action Alternative.	About 4,500 cubic feet of hazardous waste would be generated over the next 10 years that would be transported to permitted offsite facilities to be recycled, treated, and/or disposed within available capacity.
Solid waste	33,000 cubic feet disposed at onsite landfills within available capacity. An additional 61,000 cubic feet recycled or disposed at the NNSS or other offsite facilities within available capacity.	16,000 cubic feet disposed at onsite landfills within available capacity. An additional 61,000 cubic feet recycled or disposed at the NNSS or other offsite facilities within available capacity.	15,000 cubic feet disposed at onsite landfills within available capacity. An additional 61,000 cubic feet recycled or disposed at the NNSS or other offsite facilities within available capacity.	16,000 cubic feet disposed at onsite landfills within available capacity. An additional 61,000 cubic feet recycled or disposed at the NNSS or other offsite facilities within available capacity.

		No Action Alternative	*Expanded Operations Alternative*	*Reduced Operations Alternative*	*Preferred Alternative*
Human Health (for details go to Chapter 5, Sections 5.4.12.1 and 5.4.12.2)					
Annual Radiological Impacts of Normal Operations due to Legacy Soil Contamination					
Offsite Population	Dose (person-rem) Risk (LCFs)	<1 $<6 \times 10^{-4}$	Same as under the No Action Alternative.	Same as under the No Action Alternative.	<1 $<6 \times 10^{-4}$
MEI	Dose (millirem) Risk (LCFs)	0.024 1.4×10^{-8}			0.024 1.4×10^{-8}
Annual Industrial Accident Incidence Rate					
Noise Impacts					
	Workers	Mitigated through worker protection practices.	Same as under the No Action Alternative.	Same as under the No Action Alternative.	Mitigated through worker protection practices.
	Public	Large noises and traffic noise mitigated due to remoteness of site and distance to receptors.	Same as under the No Action Alternative, plus: Minimal increase from higher level of traffic	Same as under the No Action Alternative, except: No large noises – fuel-air explosive experiments would not occur.	Large noises and traffic noise mitigated due to remoteness of site and distance to receptors.
Facility Accidents – Dose Consequence and Annual Risk [c] *Highest Risk Accident (Aircraft crash and fire into multiple containers of contaminated soil - estimated frequency 1 in 590,000 per year)*					
Offsite Population	Dose (person-rem) Risk (LCFs per year)	0.012 1×10^{-11}	Same as under the No Action Alternative.	Same as under the No Action Alternative.	0.012 1×10^{-11}
MEI	Dose (rem) Risk (LCFs per year)	0.00034 3×10^{-13}			0.00034 3×10^{-13}
Noninvolved Worker	Dose (rem) Risk (LCFs per year)	1.5 2×10^{-9}			1.5 2×10^{-9}

Annual Industrial Accident Incidence Rate

	No Action TRC	No Action DART	Expanded TRC	Expanded DART	Reduced TRC	Reduced DART	Preferred TRC	Preferred DART
Tonopah Test Range Industrial – Site Operations	1.6	0.7	0.7	0.3	0.6	0.3	0.7	0.3

	No Action Alternative	*Expanded Operations Alternative*	*Reduced Operations Alternative*	*Preferred Alternative*
Environmental Justice				
	Impacts on low-income and minority populations would be identical to those of the general population. Therefore, no disproportionately high and adverse impacts on minority or low-income populations are expected.			Impacts on low-income and minority populations would be identical to those of the general population. Therefore, no disproportionately high and adverse impacts on minority or low-income populations are expected.

CO = carbon monoxide; CO_2-equivalent = carbon dioxide-equivalent; DART = days away, restrictive, or transferred; FTE = full-time equivalent; LCF = latent cancer fatality; LLW = low-level radioactive waste; MEI = maximally exposed individual; MLLW = mixed low-level radioactive waste; NNSA = National Nuclear Security Administration; NNSS = Nevada National Security Site; NO_x = nitrogen oxides; PM_n = particulate matter with an aerodynamic diameter of *n* micrometers or less; rem = roentgen equivalent man; RWMC = Radioactive Waste Management Complex; RWMS = Radioactive Waste Management Site; SO_2 = sulfur dioxide; TRC = total recordable cases; TTR = Tonopah Test Range; VOC = volatile organic compound.

[a] The reported radiological risks are the projected number of LCFs in the population and are therefore presented as whole numbers. The calculated value is shown in parentheses.

[b] The emissions under the Expanded Operations would be less than the levels projected under the No Action Alternative because certain site support functions would be transferred from DOE/NNSA to the U.S. Air Force, resulting in fewer DOE/NNSA and DOE/NNSA contractor employees at the TTR.

[c] The risk is the annual increased likelihood of an LCF in the MEI or noninvolved worker or the increased likelihood of a single LCF occurring in the offsite population, accounting for the estimated probability (frequency) of the accident occurring.

3.6 Alternatives Eliminated from Detailed Study

This section identifies the alternatives that were considered but eliminated from detailed study and provides a brief explanation of the reason for elimination.

3.6.1 Discontinue Operations at the Nevada National Security Site

In its *1996 NTS EIS*, DOE considered cessation of all operations at the NNSS and placing all facilities into a cold standby status (Discontinue Operations Alternative) and considered discontinuing all Defense mission-related and most Work for Others Program activities at the NNSS (Alternate Use of Withdrawn Lands Alternative). In its December 9, 1996, Record of Decision (ROD) (61 *Federal Register* [FR] 65551), DOE decided that it would implement the Expanded Use Alternative for all activities other than LLW and MLLW management, which was to continue under the Continue Current Operations Alternative. DOE later decided to implement the Expanded Use Alternative for LLW and MLLW management at the NNSS (65 FR 10061).

Because discontinuing operations at the NNSS was previously considered but rejected by DOE in 1996 and because there is a continuing need for the NNSS for National Security/Defense Mission programs, closing the NNSS or discontinuing National Security/Defense Mission programs, projects, and activities are considered unreasonable alternatives.

Ceasing operations at the NNSS would result in a loss of support for a number of missions and other activities that are critical to national security, including Stockpile Stewardship and Management, Nonproliferation and Counterterrorism, and Homeland Security. In addition, as the only U.S. nuclear weapons testing facility, the NNSS must be available to conduct an underground nuclear test if so directed by the President. Because these activities are vital to national security and are among the major components of the missions assigned to the NNSS by DOE/NNSA, discontinuing operations at the NNSS would not achieve the purpose and need stated in Chapter 1.

3.6.2 Transfer the Nevada National Security Site to Another Agency

One organization provided a scoping comment that suggested that the NNSS should be transferred "out of NNSA control and, indeed, out of the 'active' nuclear weapons complex altogether" (a curatorship alternative). The comment cited statements by the President, United Nations resolutions, the Comprehensive Test Ban Treaty, and U.S. initiatives to strengthen the Nonproliferation Treaty as support for considering such an alternative. Although the United States has not ratified the Comprehensive Test Ban Treaty, since 1992, it has observed a moratorium on underground nuclear testing. However, there have been no new policies or legislative direction to abandon the capability to conduct an underground nuclear test if extraordinary events jeopardize the supreme national interests, which, if the United States were a signatory, would be allowed by Article IX of the Comprehensive Test Ban Treaty. The *Final Complex Transformation Supplemental Programmatic Environmental Impact Statement* (DOE/EIS-0236S4) (DOE 2008l) addressed alternatives for consolidating Nuclear Weapons Complex facilities and activities. Thus, closure of the NNSS and/or transfer of responsibility to another organization as part of a larger plan to consolidate the Nuclear Weapons Complex are not being considered in this SWEIS.

3.6.3 Prepare a Programmatic Environmental Impact Statement

In scoping comments for this *NNSS SWEIS*, the Nevada Attorney General opined that a programmatic EIS should be prepared for the NNSS. DOE defines a site-wide NEPA document as "a broad scope EIS or EA that is programmatic in nature and identifies and assesses the individual and cumulative impacts of ongoing and reasonably foreseeable future actions at a DOE site." Although this *NNSS SWEIS* is "programmatic in nature" with regard to DOE/NNSA facilities and activities in the State of Nevada, it would not provide the basis for a DOE programmatic decision, but would provide the basis for site-specific implementation of programmatic decisions that have already been made in existing programmatic EISs and other NEPA documents. Those EISs and other NEPA documents include the *Final Programmatic Environmental Impact Statement for Stockpile Stewardship and Management* (DOE 1996d); *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste* (DOE 1997); *Complex Transformation SPEIS* (DOE 2008l); and the *Final Environmental Impact Statement for the Proposed Relocation of Technical Area 18 Capabilities and Materials at the Los Alamos National Laboratory* (DOE 2002h), as well as a number of project-specific environmental assessments. With regard to this *NNSS SWEIS*, DOE NEPA regulations (10 CFR 1021.330(c)) require large, multiple-facility DOE sites, such as the NNSS, to prepare SWEISs. This *NNSS SWEIS* addresses the full range of missions, programs, capabilities, projects, and activities under the purview of DOE/NNSA in Nevada. Where project information is sufficiently specific, the analyses are similarly specific and will support implementing decisions by DOE/NNSA. Where project information is insufficient to support an implementing decision, or if there are statutory or regulatory uncertainties, a more programmatic description is provided and implementation would require an appropriate level of additional NEPA review.

3.6.4 Renewable Energy Alternative

DOE/NNSA announced in its Notice of Intent for this SWEIS (74 FR 36691) that it would address a Renewable Energy Alternative. During the scoping meetings, several suggestions were made to include renewable energy in each of the alternatives addressed in this SWEIS. DOE/NNSA recognizes the need to incorporate, as appropriate, conservation and renewable energy planning as part of the activities it undertakes at the NNSS. Therefore, the Renewable Energy Alternative was not addressed as a separate alternative, but was made part of each of the alternatives addressed in detail in this SWEIS.

3.6.5 1996 Record of Decision-Based No Action Alternative

As indicated in its Notice of Intent to prepare this SWEIS, dated July 24, 2009 (74 FR 36691), DOE/NNSA initially defined the No Action Alternative as "the continued implementation of the *1996 NTS EIS* ROD, and the amendment to the ROD for the *1996 NTS EIS* (65 FR 10061 at 10065) at DOE/NNSA sites in Nevada over the next 10 years." The Notice of Intent also stated that No Action would "include the implementation of other decisions supported by separate NEPA analyses completed since the issuance of the *1996 NTS EIS*" as well as "actions analyzed in eight environmental assessments and their associated Findings of No Significant Impacts, as well as actions categorically excluded from the preparation of either an EA or EIS." The original No Action Alternative considered for analysis in this SWEIS would have addressed significantly higher numbers of many DOE/NNSA activities, based on levels of activities analyzed in the *1996 NTS EIS*. As development of this SWEIS progressed, it became apparent that those potential levels of activities were unrealistically high in some cases. For this reason, DOE/NNSA decided to base the analysis for the No Action Alternative in this SWEIS on actual levels of operations known to have occurred since 1996. For instance, the *1996 NTS EIS* analyzed 1,100 potential dynamic plutonium experiments over a 10-year period. Under the No Action Alternative, this SWEIS considers up to 10 such experiments per year, or 100 over the next 10 years. Chapter 1, Table 1–1 provides a comparison of the Expanded Use Alternative from the *1996 NTS EIS* and the No Action Alternative in this *NNSS SWEIS*.

CHAPTER 4
AFFECTED ENVIRONMENT

4.0 AFFECTED ENVIRONMENT

This chapter describes the existing environmental conditions of the Nevada National Security Site (NNSS) (formerly known as the Nevada Test Site), the Remote Sensing Laboratory (RSL) at Nellis Air Force Base, the North Las Vegas Facility (NLVF), and the Tonopah Test Range (TTR). During the preparation of this *Site-Wide Environmental Impact Statement for the Continued Operation of the Department of Energy/National Nuclear Security Administration Nevada National Security Site and Off-Site Locations in the State of Nevada (NNSS SWEIS)*, the most up-to-date and accurate information available was used to describe existing environments, facilities, activities, and projects. This information serves as a baseline from which to identify and evaluate environmental changes resulting from the proposed alternatives. The baseline conditions, for the purpose of analysis, are the conditions that currently exist.

The environmental resources discussed in this chapter include land use, infrastructure and energy, transportation and traffic, socioeconomics, geology and soils, hydrology, biological resources, air quality and climate, visual resources, cultural resources, waste management, human health and safety, and environmental justice. For some environmental resource areas, the regions of influence (ROIs) are limited to the areas contained within each U.S. Department of Energy/National Nuclear Security Administration (DOE/NNSA) jurisdictional boundary. For other environmental resource areas, such as transportation and air quality, the ROIs are larger and include all of southern Nevada, as well as portions of Utah, Arizona, and California.

4.1 Nevada National Security Site

This section describes the existing environmental conditions found at the NNSS, a unique national resource managed by the DOE/NNSA Nevada Site Office (NSO) that is located approximately 57 miles from the intersection of Interstate 15 and U.S. Route 95 in Las Vegas, Nevada. The NNSS covers approximately 1,360 square miles (larger than the state of Rhode Island) and is one of the largest restricted access areas in the United States. The NNSS is surrounded by thousands of additional acres of land withdrawn from the public domain for use as a protected wildlife range and a military gunnery range, creating an unpopulated land area of nearly 6,500 square miles.

DOE/NNSA consulted with American Indian tribes and groups that have cultural affiliation with the NNSS to obtain input for this site-wide environmental impact statement (SWEIS). American Indian input regarding natural and cultural resources at the NNSS was provided by the American Indian Writers Subgroup of the Consolidated Group of Tribes and Organizations (CGTO) and may be found in shaded text boxes throughout this chapter identified with a CGTO feather icon.

4.1.1 Land Use

The NNSS is located about 57 miles northwest of downtown Las Vegas in the remote desert and mountainous terrain of southern Nye County, Nevada, at the southern end of the Great Basin. The Federal Government (primarily the U.S. Bureau of Land Management [BLM], the U.S. Department of Defense [DoD], DOE/NNSA, and the U.S. Forest Service [USFS]) manages more than 85 percent of the land in Nevada, and 93 percent in Nye County (DOE 2008g). Approximately 22 percent of the total land area in Nye County, including the NNSS, is designated for federally restricted access for U.S. Government activities.

The NNSS consists of sparsely vegetated basins or flats—Jackass Flats in the southwestern quadrant, Frenchman Flat in the southeastern quadrant, and Yucca Flat in the northwestern quadrant—separated by low mountains that dominate the western and southern sides of the site. Frenchman Flat and Yucca Flat each contain a large playa (the flat-floored bottom of a desert basin that may contain water after a seasonally high runoff). The northeastern quadrant of the site comprises mountains with a pinyon-juniper and sagebrush forest separated by canyons. The dominant mountains in this quadrant are Rainier Mesa near the center of the northern border and Pahute Mesa in the northwestern region of the site (DOE 2002f; Wills and Ostler 2001).

The NNSS is controlled by DOE/NNSA and is the largest and most extensive of DOE/NNSA's sites in terms of the complexity of its facilities, buildings, and infrastructure, and its land area. Although the NNSS is under DOE/NNSA management, DoD and other customers use the site for National Security/Defense and Nondefense Mission-related experiments, training, and research. Chapters 2 and 3 of this SWEIS describe in more detail the missions, levels of operation, and clients that use the NNSS. Numerous offices, laboratories, and support buildings are located throughout the NNSS to assist in these missions.

In 1998, the DOE Nevada Operations Office (now the DOE/NNSA NSO) prepared a Resource Management Plan for the NNSS, as specified in the Record of Decision (ROD) (65 *Federal Register* [FR] 10061) for the 1996 *Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada* (*1996 NTS EIS*). The goals for managing the NNSS resources (both natural and manmade) were developed in consideration of the balance between the primary mission of the NNSS, economic development, and the limits of ecological sustainability. While the principles of the Resource Management Plan have been retained, the primary planning document for new facilities and programs throughout the DOE complex is the Ten-Year Site Plan. Ten-year site plans are required by DOE Order 430.1B, *Real Property Asset Management* (DOE 2008e), and the NNSS Ten-Year Site Plan is used as an integrated planning tool to help develop an efficient and responsive infrastructure that effectively supports the DOE/NNSA NSO's missions.

4.1.1.1 Adjacent Land Use

The lands adjacent to the NNSS include the Nevada Test and Training Range (formerly Nellis Air Force Range), Desert National Wildlife Refuge, and Nye County. The NNSS is located within Nye County, which comprises communities widely separated by distance and which, in 2008, had a population of 43,600 people (USCB 2008b). The nearest community to the NNSS is Amargosa Valley, located about 2 miles south of the NNSS, with a population of 1,400. Additional nearby communities include Indian Springs (about 16 miles southeast of the NNSS, population 1,400); Beatty (about 17 miles west of the NNSS, population 800); Pahrump (about 26 miles south of the NNSS, population 38,200); and Alamo (about 42 miles northeast of the NNSS, population 460). There are other urban and residential land uses outside of and adjacent to the NNSS in the Pahrump Valley (about 22 miles southwest of the NNSS), which is the largest populated area near the NNSS (NV State Demographer's Office 2008). Las Vegas is the closest major metropolitan area (about 57 overland miles southeast of the NNSS, population 564,484) (USCB 2008b).

Nevada Test and Training Range. The Nevada Test and Training Range surrounds the NNSS to the north, east, and west, and is managed by the U.S. Air Force (USAF). It provides a safe and secure remote desert location to test equipment and train military personnel. Testing and training activities occurring on the Nevada Test and Training Range include armament and high-hazard testing (aerial gunnery, rocketry, electronic warfare), tactical maneuvering training, and equipment and tactics development and training. The Nevada Test and Training Range also provides a 3-million-acre security and safety buffer area for activities occurring on the NNSS because it is withdrawn from public use and has limited public access.

Desert Wildlife National Refuge. The Desert National Wildlife Refuge, administered by the U.S. Fish and Wildlife Service (USFWS), is located mostly within the southeastern section of the Nevada Test and Training Range, along the eastern border of the NNSS. The refuge was established in 1936 with the primary objective being the sustainability of the desert bighorn sheep and its habitat. The portion of the refuge that is within the Nevada Test and Training Range is closed to public access. This results in approximately 5,470 acres of additional remote, unpopulated land area surrounding the NNSS, withdrawn from public domain and use (USFWS 2009b).

Bureau of Land Management Land. BLM manages lands adjacent to the NNSS to the south and southwest. BLM is responsible for carrying out numerous programs for the management and conservation of public lands and resources throughout Nevada. Land uses occurring on BLM-managed lands include agriculture, energy and mineral extraction, livestock grazing, and recreation. These lands also provide resources for fish and wildlife habitat (including wild horses and burros); wilderness areas; and archaeological, paleontological, and historic sites. A small portion of the Nevada Wild Horse Range, one of the many herd management areas within Nevada, overlaps the northwestern corner of the NNSS. BLM is responsible for managing the wild horse population under the Wild Free-Roaming Horses and Burros Act of 1971; however, access to the range is coordinated through DOE/NNSA.

Nye County. Primary land uses in Nye County occurring in close proximity to the NNSS include mining, grazing, agriculture, and recreation. Section 4.1.5.3 describes soils, including the status of prime farmland soils at the NNSS. **Figure 4–1** depicts land ownership and uses surrounding the NNSS.

BLM has identified seven solar energy study areas in Nevada. The closest study area to the NNSS is in Amargosa Valley, located south and west of the NNSS's southwestern corner, along the U.S. Route 95 corridor between Beatty and Pahrump. Lands identified as solar energy study areas have excellent solar resources and suitable slope, as well as proximity to roads and transmission lines or designated corridors, and include at least 2,000 acres of BLM-administered public lands. Sensitive lands, wilderness, and other high-conservation-value lands, as well as lands with conflicting uses, were excluded from consideration as solar study areas. BLM published a Notice of Intent in the *Federal Register* on July 13, 2009, announcing the development of an environmental impact statement for the Amargosa Farm Road Solar Energy Project. An application for a 4,350-acre right-of-way on public lands was submitted to BLM for two 224-megawatt, dry-cooled solar power generation facilities, as well as thermal storage tanks. This document is expected to be finalized after publication of this SWEIS.

DOE and BLM have issued the final programmatic environmental impact statement that evaluates utility-scale solar energy development, to develop and implement agency-specific programs that would establish policies and mitigation strategies for solar energy projects, and to amend relevant BLM land use plans with the intent of establishing a new BLM solar energy development program.

4.1.1.2 Historical Nevada National Security Site Development and Current Land Use

Historical Nevada National Security Site Development. Until the mid-1900s, the land on which the NNSS would be established provided traditional, ceremonial, and recreational areas for American Indians. The first European Americans known to traverse what is now the NNSS were emigrants on their way to California in 1849. Short-lived periods of mining and ranching occurred in this region. Military use of the area began in 1940 and, since that time, the NNSS has remained associated with national security and defense activities (DOE 2002f). Section 4.1.10 includes a more detailed description of the history of the NNSS.

There are 19 historic mining districts on the NNSS, as described in the *1996 NTS EIS*. These mining districts would be of interest for economic mining if the NNSS were opened for public access; however, the NNSS has been closed for commercial mineral development since the 1940s (DOE 1996c).

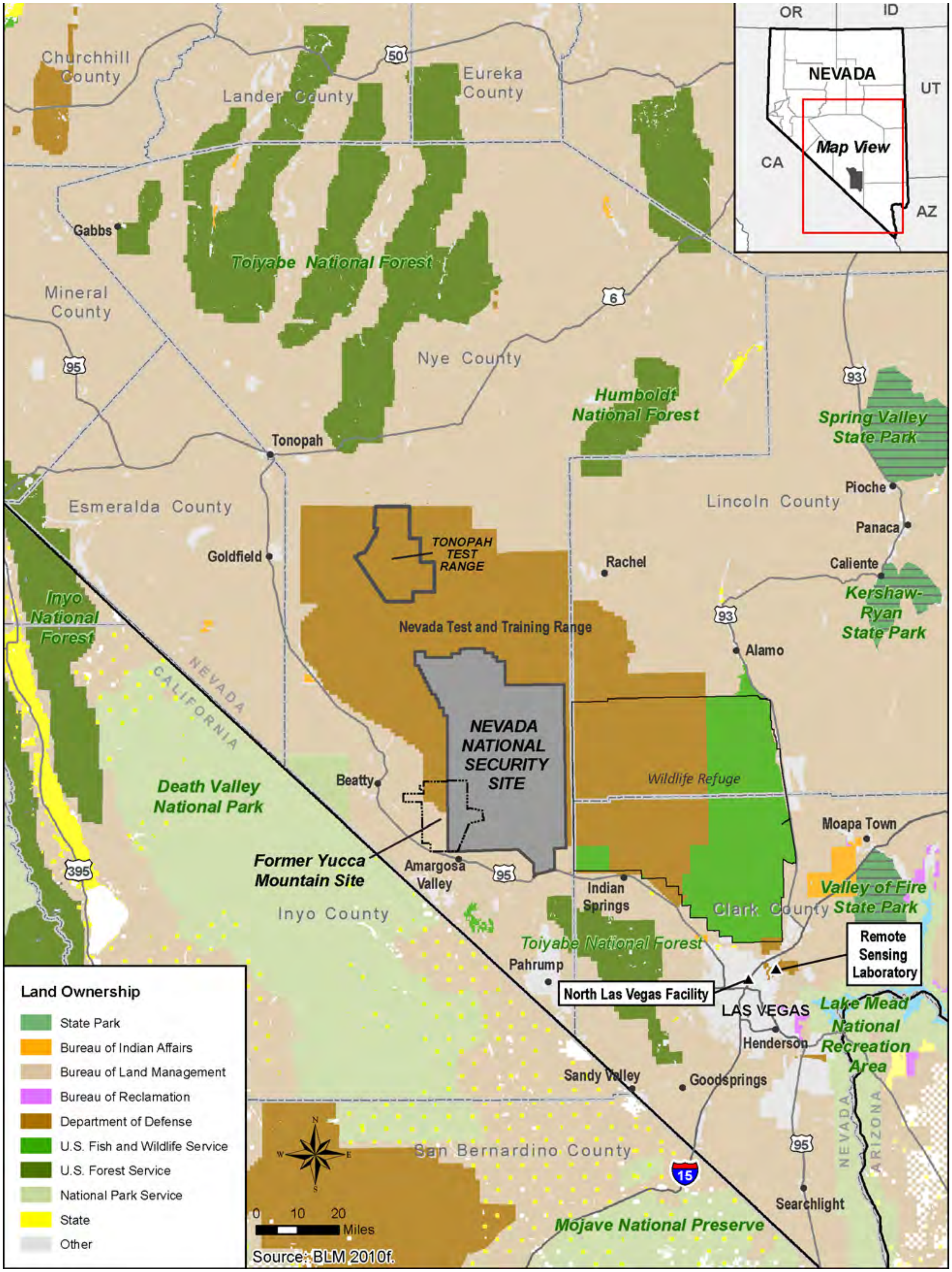

Figure 4–1 Location of Nevada National Security Site and Offsite Locations in the State of Nevada

The first atmospheric nuclear test detonation at the NNSS took place in 1951 on Area 5 of Frenchman Flat. Atmospheric detonations associated with nuclear testing continued through the 1950s until international test ban negotiations culminated in the Limited Test Ban Treaty of 1963, which banned atmospheric testing, but continued to allow underground testing. Nuclear testing occurred at the NNSS for over 40 years until the President declared a moratorium on nuclear weapons testing in October 1992. During the same time that the NNSS was being used for testing nuclear weapons, tests and experiments under the Plowshare Program were conducted there to support and promote peaceful uses of nuclear detonations. Testing and activities associated with these other projects continued until the mid-1970s. These weapons effects experiments have left behind damaged or demolished military hardware, as well as everyday structures and artifacts of domestic life, such as a bank vault, a train trestle, an underground parking garage, and houses built of various materials. Hundreds of saucer-like craters, formed by the subsidence of the ground above an underground test, are located throughout the areas where these detonations occurred.

Plowshare Program

Beginning in 1961, the Plowshare Program was a research development activity, consisting of 35 individual nuclear detonations, established to explore a wide variety of peaceful uses for the inexpensive energy available from nuclear explosions. The majority of detonations that took place at the Nevada National Security Site occurred in the Yucca Flat region.

Peaceful applications utilizing the explosive energy from aboveground detonations that were explored include rock-moving exercises to facilitate the construction of canals, harbors, and dams and aid in the construction of highway and railroad corridors through mountainous areas. Underground engineering applications that were explored include stimulation of natural gas production and formation of underground natural gas and petroleum storage reserves.

Despite great expectations, many projects within the Plowshare Program did not progress past the planning phase. A lack of confidence that projects could be completed at less cost than by conventional means and insufficient public and congressional support led to the program's termination.

Inaccessible to the public, Mercury (formerly called Base Camp Mercury), the "town" located at the entrance to the NNSS, is about 5 miles north of U.S. Route 95. Development of this built-up area increased after 1951, when it served as a base camp area providing basic facilities for personnel involved with NNSS operations, reaching its peak usage by the end of the 1960s. Mercury served, and continues to serve, as the center of administrative services and activities for the NNSS. It provides a variety of structures and services, including office space, laboratory facilities, fire and medical facilities, and overnight living quarters for personnel (DOE 2007a). Mercury is described in more detail in Chapter 2 of this SWEIS.

The NNSS is divided into numbered operational areas to facilitate management; communications; and distribution, use, and control of resources. Chapter 2, Table 2–1, of this SWEIS describes these operational areas and identifies where atmospheric and underground nuclear testing previously occurred.

Current DOE/NNSA Use. The NNSS currently supports work under three missions: (1) National Security/Defense, (2) Environmental Management, and (3) Nondefense. Further details are included in Chapter 2 of this SWEIS. Since the cessation of nuclear testing in 1992 and the subsequent creation of the Stockpile Stewardship and Management Program, DOE/NNSA has consolidated working environments and disposed many excess facilities. As of 2008, the NNSS has 486 buildings, 113 trailers, a 340-mile onsite network of paved roads, and over 300 miles of unpaved roads within its 880,000 acres (DOE 2008i). Most of the experimental facilities and infrastructure are concentrated along the main roadway thoroughfare (Mercury Highway); the majority of maintenance, support, and development activities also are located along this corridor.

Current Military Use. Military organizations use portions of the NNSS for land area exercises and training involving navigation, maneuvering through obstacles, mission rehearsal, and related tactics. The remote areas of the NNSS also provide these organizations with the ability to perform classified exercises.

Existing facilities at the NNSS that resemble real-world chemical, water, and nuclear plant facilities are used by DoD for training scenarios and test beds for sensors for both counterproliferation exercises and defensive security force training. The geology, geography, and tunnel complexes of the NNSS provide unique training venues for DoD and other Federal agencies because these features replicate real-world interests.

Public Use. Access to the NNSS is restricted and limited to public bus tours. Tours must be scheduled in advance. Timber Mountain Caldera, a unique volcanic feature listed as a National Natural Landmark by the National Park System, is located on both the NNSS and USAF-managed Nevada Test and Training Range lands. The U.S. National Park Service manages the Timber Mountain Caldera site, except for portions within the NNSS that are managed by DOE/NNSA. Access to this site through portions located within the NNSS is coordinated by DOE/NNSA.

Under Executive Order 13007, *Indian Sacred Sites*, Federal land agencies are directed, to the extent practical, to allow access to and ceremonial use of American Indian sacred sites by American Indian religious practitioners (DOE 2008f).

Land Use—American Indian Perspective

The Nevada National Security Site (NNSS) area is part of the traditional Holy Lands of the Western Shoshone, Southern Paiute, and Owens Valley Paiute and Shoshone peoples. We rely on these lands for medicinal purposes, religious activities and ceremonies, food, recreational use, and integral places described in traditional narratives and religious ceremonies.

Indian people know these lands contain not only archaeological remains left by our ancestors but also natural resources and geologic formations in the region, such as plants, animals, water sources and minerals; natural landforms that mark important locations for keeping our history alive and for teaching our children about our culture. We use traditional sites in the NNSS region to make tools, stone artifacts, and ceremonial objects; many sites are also associated with traditional healing ceremonies and power places.

For many centuries, the NNSS area has been a central place in the lives of American Indian tribes, continuously used by these tribes from antiquity to contemporary times. Until the mid-1900s, traditional festivals involving religious and secular activities attracted American Indian people to the area from as far as San Bernardino, California. Similarly, groups came to the area from a broad region during the hunting season and used animal and plant resources that were crucial for their survival and cultural practices.

Several areas in the NNSS region are recognized as traditionally or spiritually important. For example, Fortymile Canyon is an important crossroad where trails from such distant places as Owens Valley, Death Valley, and the Avawatz Mountain come together. Black Cone, in Crater Flats is an important religious site that is considered to be an entry to the underworld. Prow Pass continues to be an important ceremonial site and, because of this religious significance, tribal representatives recommend that the U.S. Department of Energy (DOE) avoid affecting this area. Oasis Valley was historically an important area for trade, and continues to be a place recognized for ceremonial use. Other areas are considered important based on the abundance of artifacts, traditional-use plants and animals, rock art, and possible burial sites. Despite the current physical separation of tribes from the NNSS and neighboring lands, we continue to recognize the meaningful role of these lands in our culture and continued survival.

The Consolidated Group of Tribes and Organizations (CGTO) maintains we have Creation-based rights to protect, use, and have access to lands of the NNSS and the immediate area. These rights were established at Creation and persist forever. Despite the loss of many traditional lands on the NNSS to pollution and reduced access, Indian people have neither lost our ancestral ties nor have we forgotten our responsibilities in caring for it. As one elder noted, *"Land is to be respected. It sustains us economically, spiritually, and socially."*

During the past decade, representatives of the CGTO have visited portions of the NNSS and have identified places, spiritual trails, and cultural landscapes of traditional and contemporary cultural significance. Because this is a public document, the exact locations of these areas will not be revealed; however, they do include a burial cave, a Native American Graves Protection and Repatriation Act (NAGPRA) reburial area, and a local trail and ceremonial landscape near a large water tank. These actions by DOE are considered positive steps towards facilitating co-stewardship arrangements between DOE and the CGTO to help co-manage important Indian resources of the NNSS and to regain balance.

See Appendix C for more details.

4.1.1.3 Public Land Orders and Withdrawals

The NNSS comprises several separate land transfers from other Federal agencies to DOE/NNSA, as well as land from a legislative withdrawal. The NNSS is federally owned, access-controlled, and withdrawn from public settlement, location, or entry. Withdrawal of land from public use also excludes public mining and mineral leasing.

Public lands may be withdrawn and reserved for military training and testing in support of the Nation's national defense requirements. Lands designated as withdrawn are typically withdrawn from all forms of appropriation under public land laws. The term "withdrawal," as defined by the Federal Land Policy and Management Act of 1976, as amended in 2001 (Public Law [P.L.] 92-579), means withholding an area of Federal land from settlement, sale, location, or entry, under some or all of the general land laws, for the purpose of (1) limiting activities under those laws to maintain other public values in the area; (2) reserving the area for a particular public purpose or program; or (3) transferring jurisdiction of an area of Federal land, other than "property" governed by the Federal Property and Administrative Services Act, as amended (40 *United States Code* [U.S.C.] 472), from one department, bureau, or agency to another department, bureau, or agency.

The following three administrative land withdrawals (public land orders) by the Secretary of the Interior and one legislative withdrawal by Congress, provide the jurisdictional basis for DOE/NNSA's stewardship and management of the lands constituting the NNSS:

Public Land Order 805. Public Land Order 805, issued on February 12, 1952, reserved approximately 435,000 acres of land for use by the Atomic Energy Commission as a weapons testing site.

Public Land Order 2568. Public Land Order 2568, issued on December 19, 1961, transferred 318,000 acres of land previously reserved for the USAF to the jurisdiction of the Atomic Energy Commission for use in connection with the NNSS for test facilities, roads, and safety distances.

Public Land Order 3759. Public Land Order 3759, issued on August 3, 1965, reserved 21,108 acres of land for placement under the jurisdiction of the Atomic Energy Commission for use in connection with the NNSS.

Military Lands Withdrawal Act of 1999, Public Law 106-65. Enacted on October 5, 1999, this act renewed the withdrawal of lands known as "Pahute Mesa" that are an integral part of the NNSS and provided the site of nuclear weapons testing activities. Pursuant to the act, these lands were transferred from DoD to DOE/NNSA, thus aligning jurisdictional responsibilities consistent with DOE/NNSA's retention of environmental, safety, and health responsibilities at the NNSS. Use of this area by DOE/NNSA was previously covered under a Memorandum of Understanding with the USAF.

Figure 4–2 depicts the current NNSS boundary and the boundary prior to 1999.

Area 5 Land Transfer. As part of an April 1997 settlement agreement between the State of Nevada and DOE/NNSA, consultation with the U.S. Department of Interior, which oversees BLM, was initiated concerning the status of existing land withdrawals with regard to low-level radioactive waste (LLW) storage and disposal. This consultation process concluded in November 2009, when DOE/NNSA formally accepted permanent custody of and accountability for the 740-acre Area 5 Radioactive Waste Management Complex (RWMC).

Yucca Mountain Project. In 1994, the DOE Nevada Operations Office (now the DOE/NNSA NSO) entered into a management agreement with the Yucca Mountain Site Characterization Office for use of about 58,000 acres of NNSS land for site characterization activities related to the Yucca Mountain Project. Under this agreement, the Yucca Mountain Project was responsible for meeting the same environmental requirements that apply to the NNSS independent of, but in coordination with, DOE/NNSA.

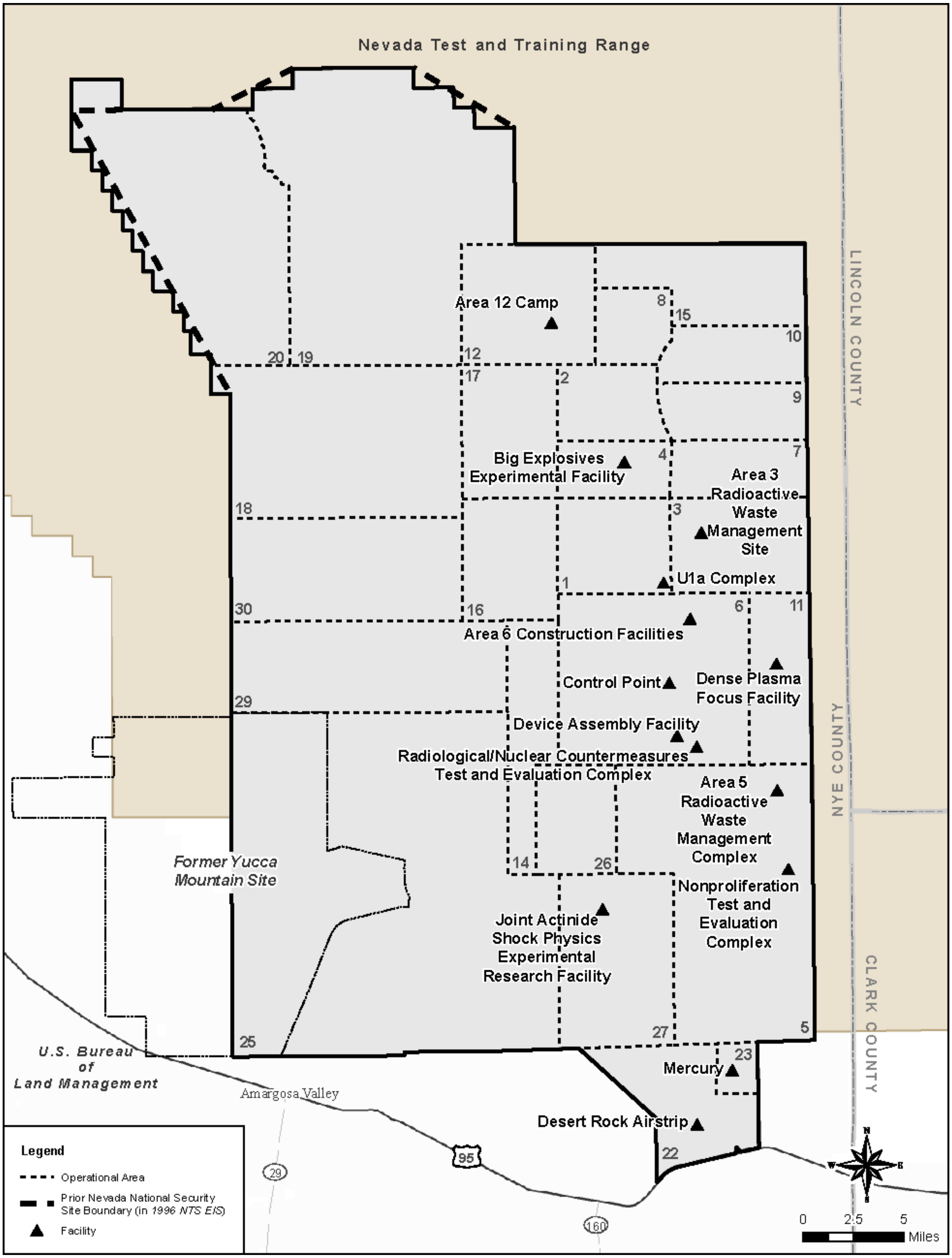

Figure 4–2 Nevada National Security Site Boundary Resulting from the Military Lands Withdrawal Act of 1999 (Public Law 106-65)

DOE's portion of *The Budget of the United States Government Fiscal Year 2011* states, "The Administration has determined that Yucca Mountain, Nevada, is not a workable option for a nuclear waste repository and will discontinue its program to construct a repository at the mountain in 2010. The Department will carry out its responsibilities under the Nuclear Waste Policy Act within the Office of Nuclear Energy as it develops a new nuclear waste management strategy."

4.1.1.4 Land Use Designations

Existing land use on the NNSS is divided into seven zone designations that support the three NNSS missions: National Security/Defense, Environmental Management, and Nondefense.

These land use zone designations, which are described in **Table 4–1**, include previously disturbed areas, areas with desirable slope and soil conditions for construction, and areas that have mission requirements such as remoteness and space for safety and security reasons. The areas within the land use zones may be sensitive to development for mission, environmental, or cultural reasons, and certain areas are protected from certain uses; however, these zones may host activities not normally associated with the particular zone designation, pending compatibility with existing activities or other factors that would affect collocation of activities, including the health and safety of personnel or avoidance of environmentally sensitive areas. Additionally, DOE/NNSA considers all zone designations compatible with environmental restoration activities.

Most of the experimental facilities are consolidated along a central corridor leading to Mercury Highway (the main thoroughfare on the NNSS). To help simplify the distribution, use, and control of resources, the NNSS is also divided into 26 numbered operational areas. The zone designations generally encompass portions of one or more NNSS areas and are depicted in **Figure 4–3**. Chapter 2, Table 2–1, describes the historical use of the NNSS operational areas, and Section 2.1.1 describes the major facilities. Section 4.1.2 describes the facilities located within each of the numbered areas, and Section 4.1.11 describes waste management activities and support facilities in detail.

4.1.1.5 Airspace

Approximately 40 percent of the airspace within Nevada is military "special use" airspace. Airspace in Nevada is managed in a manner that best serves the competing needs of commercial, general, military, and DOE/NNSA's aviation interests. The Federal Aviation Administration (FAA) is responsible for the overall management of airspace and has established different airspace designations that are designed to protect aircraft flying to or from an airport, transiting between airports, or operating within special use areas identified for defense-related purposes. Flight rules and air traffic control procedures have been established to govern how aircraft must operate within each type of designated airspace.

FAA regulates military operations in the National Airspace System through the implementation of FAA Order JO 7400.2G, *Procedures for Handling Airspace Matters*, and FAA Handbook 7610.4J, *Special Military Operations*. The latter was jointly developed by DoD and FAA to establish policy, criteria, and specific procedures for air traffic control planning, coordination, and services during defense activities and special military operations.

Special Use Airspace

Airspace where activities must be confined because of their nature or where limitations are imposed upon aircraft operations that are not part of those activities, or both. This airspace includes restricted airspace, military operations areas, and controlled firing areas.

Restricted Airspace

An area of airspace in which the controlling authority has determined that air traffic must be restricted, if not continually prohibited. It denotes the existence of unusual, often invisible, hazards to aircraft such as artillery firing, aerial gunnery, or guided missiles.

Table 4–1 Description of the Nevada National Security Site Land Use Zone Designations

Zone Designation	***Description of Zone Designation***	***Acres of Zone Designation on the NNSS***	***Operational Area within Zone Designation***
Defense Industrial Zone	Land area designated for stockpile stewardship experiments and operations to maintain confidence in the safety and reliability of the stockpile without underground nuclear testing. Activities include exercises, operations, and experiments (including subcritical experiments involving special nuclear materials). The land area is located around critical assembly areas and is dedicated to defense-related activities.	41,700 acres	Area 27; portions of Areas 6 and 5
Nuclear Test Zone	Land area reserved for underground hydrodynamic tests, dynamic experiments, and underground nuclear weapons and weapons effects tests. This zone includes compatible defense and nondefense research, development, and testing activities. The emplacement hole inventory, underground alcove areas where radioactive materials are tested (designed such that radioactive materials will not reach aboveground environments), is located within this zone.	224,000 acres	Areas 7, 8, 9, 10, 19, and 20; portions of Areas 6 and 11
Nuclear and High Explosives Test Zone	Land area designated for additional underground and aboveground high-explosive tests or experiments. This zone includes compatible defense and nondefense research, development, and testing activities.	103,800 acres	Areas 1, 2, 3, 4, 12, and 16
Radioactive Waste Management Zone	Land area designated for the shallow land burial of low-level and mixed low-level radioactive wastes.	820 acres	Portions of Areas 3 and 5
Research, Test, and Experiment Zone	Land area designated for small-scale research, development projects, pilot projects, and outdoor tests and experiments related to development, quality assurance, or reliability of materials and equipment under controlled conditions. This zone contains compatible defense and nondefense research, development, and testing projects and activities.	76,200 acres	Areas 14 and 26; portions of Areas 5 and 25
Reserved Zone	Controlled-access land area that provides a buffer between nondefense research, development, and testing activities. The Reserved Zone includes areas and facilities that provide widespread flexible support for diverse short-term nondefense research, testing, and experimentation. This land area is also used for short-duration exercises and training, such as Nuclear Emergency Search Team and Federal Radiological Monitoring and Assessment Center training and land navigation exercises and training.	410,100 acres (includes acreage from the former Yucca Mountain Project Zone)	Areas 15, 17, 18, 29, and 30; portions of Areas 5, 6, 11, 22, 23, and 25
Renewable Energy Zone	Land area and infrastructure reserved for future solar power development, light industrial equipment, and commercial manufacturing capability.	11,900 acres	Portions of Areas 22, 23, and 25

NNSS = Nevada National Security Site.

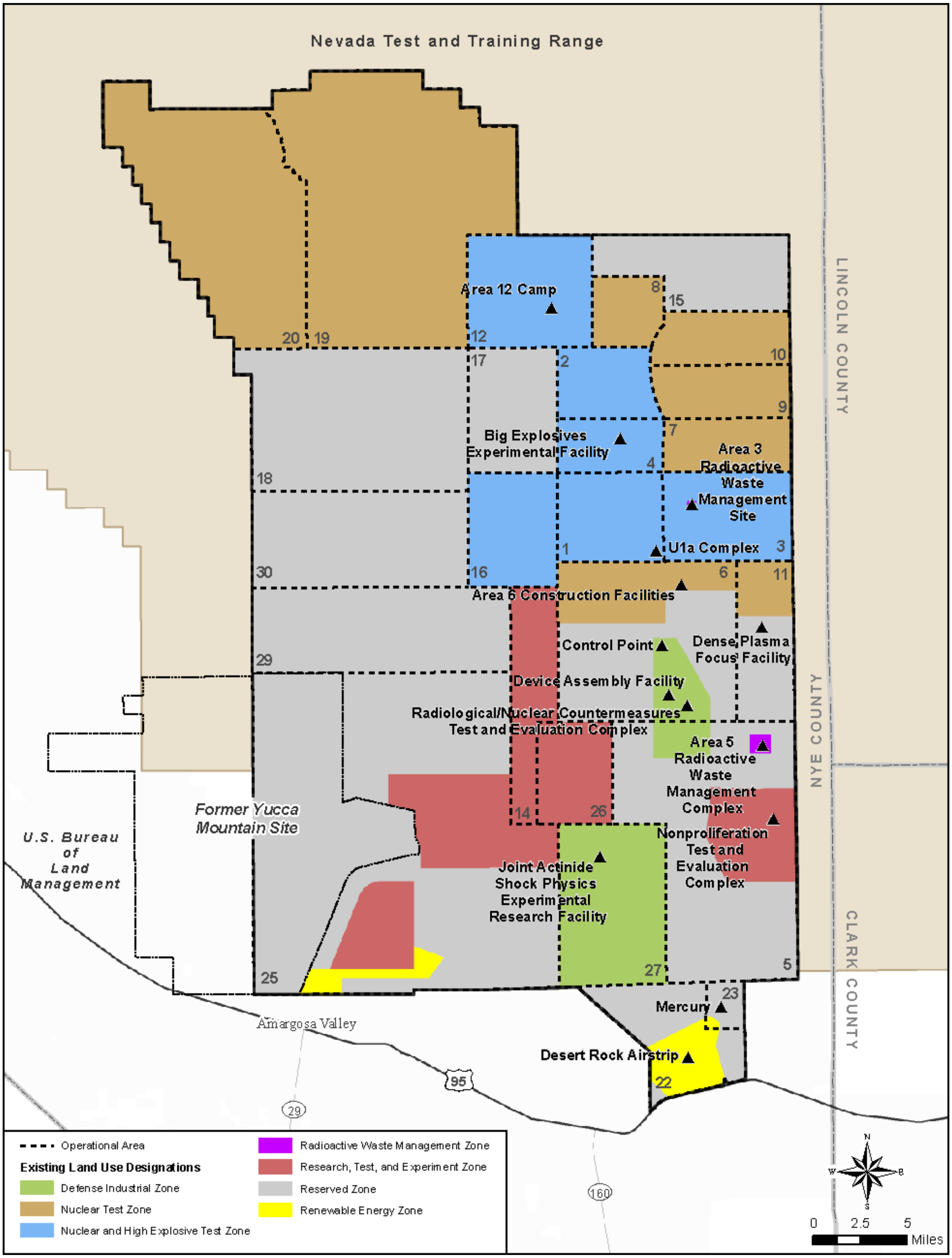

Figure 4–3 Existing Land Use Zones and Major Facilities on the Nevada National Security Site

The airspace above the NNSS was withdrawn and designated as Restricted Area 4808 (R-4808), special use airspace, by FAA and DOE/NNSA. The restricted area within this airspace is used by DOE/NNSA, which has established that this parcel of airspace is used by DOE/NNSA 24 hours a day, 365 days per year, and is not accessible by the public, except under certain conditions. R-4808 (the airspace above the NNSS and the northeastern portions of the Nevada Test and Training Range) and R-4809 (the airspace above the TTR) are managed by DOE/NNSA and are never authorized for use by civilian aircraft, except under conditions such as flights in direct support of a project at or proposed for the NNSS, meeting minimum security requirements, being scheduled in the airspace by DOE/NNSA, and other project-dependent conditions. The restricted airspace surrounding the NNSS to the north, east, and west is controlled by the Nevada Test and Training Range (DOE/NV 1998b).

Airspace associated with the NNSS and its vicinity is shown in **Figure 4–4**. The NNSS airspace is part of the Nevada Test and Training Range, which includes four restricted areas, the desert military operating areas/air traffic control assigned airspace, two low-altitude tactical navigation areas, 29 military training routes (established to provide low-altitude and high-speed training, allowing the military to conduct training for combat tactics), and three refueling routes (DOE 1996c). The NNSS contains four airstrips and seven helipads, located in Areas 6, 12, 22, 23, and 25.

4.1.2 Infrastructure and Energy

4.1.2.1 Infrastructure and Utilities

This section discusses the buildings and transportation infrastructure and potable water, wastewater, and communications utilities. Further transportation-related information is discussed in Section 4.1.3. Solid waste collection and landfills are discussed in Section 4.1.11. Energy systems distribution, use, and demand (electricity, natural gas, and liquid fuels) are discussed in Section 4.1.2.2. Discussions of NNSS and outside community support services, including law enforcement and security, fire protection, and health care, are presented in Section 4.1.4.

4.1.2.1.1 Infrastructure

Facilities. As of November 2009, there were 486 buildings and 113 trailers that support activities at the NNSS. **Table 4–2** presents the building floor space maintained at the NNSS, as well as the building floor space for leased properties off site, delineated by their respective functions, including administration, storage, industrial and production processes; research and development; services; and other uses (e.g., hangars, guard stations, and dormitories). As of November 2009, NNSS floor space totaled 2,231,602 square feet and offsite floor space totaled 214,071 square feet (NNSA/NSO 2009b). Most of these facilities and the supporting infrastructure at the NNSS are 30 to 50 years old and are rapidly deteriorating (DOE 2008f; NSTec 2009e).

DOE/NNSA ensures that existing facilities' maintenance and operation practices, as well as all new construction and renovation projects, conform to the requirements of Executive Order 13423, *Strengthening Federal Environmental, Energy, and Transportation Management* (72 FR 3919), and Executive Order 13514, *Federal Leadership in Environmental, Energy, and Economic Performance* (74 FR 52117), signed by President Obama on October 5, 2009, which expands on Executive Order 13423. In accordance with DOE Order 436.1, *Departmental Sustainability*, DOE/NNSA prepares an annual Site Sustainability Plan, which identifies performance goals and accomplishments in meeting High Performance and Sustainable Building Guidance of the Interagency Sustainability Working Group (ISWG 2008).

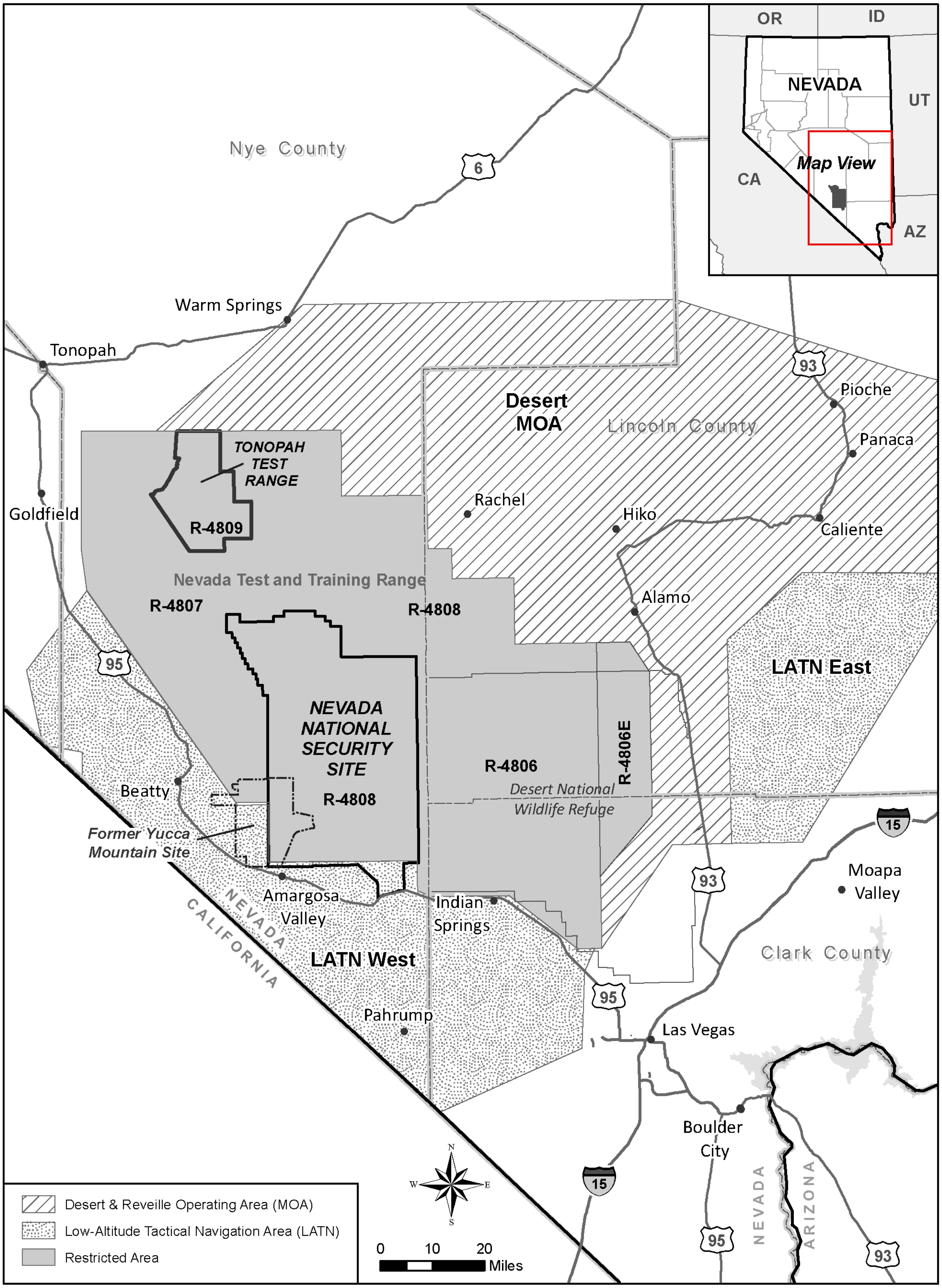

Figure 4–4 Airspace Within the Vicinity of the Nevada National Security Site

Table 4–2 Nevada National Security Site Building Floor Space by Function

Function	*Floor Space (square feet)*	*Offsite Leased Floor Space (square feet)*
Administrative	383,336	117,263
Storage	332,877	1,104
Industrial and Production Processes	359,980	8,253
Research and Development	486,405	87,451
Service Buildings	413,948	0
Other	255,056	0
TOTAL	2,231,602	214,071

Source: NNSA/NSO 2009b.

Transportation Systems. The NNSS is accessible and navigable by vehicles via a network of paved and unpaved roads, accompanied by parking areas. The onsite road network consists of approximately 340 miles of paved roads, including 195 miles considered mission essential, and over 300 miles of unpaved roads.

The primary paved roads in the southern part of the NNSS include Mercury Highway, Jackass Flats Road, Cane Spring Road, and Lathrop Wells Road. Mercury Highway is the primary access route to the NNSS from U.S. Route 95. Mercury Bypass is well constructed and runs from just north of gate 100 to north of Mercury. This 26-foot-wide road was built to enable the rerouting of all traffic with a forward area destination.

The primary paved roads on the northern part of the NNSS are Pahute Mesa Road, Buckboard Mesa Road, and Tippipah Highway. The areas served by these roads are Pahute Mesa, Buckboard Mesa, and Rainier Mesa, respectively. Pahute Mesa Road from Yucca Flat to the Area 20 camp is typical of hot-mix paved roads on the NNSS. At the higher elevations, the road is winding and crosses rugged terrain that may be hazardous under winter conditions.

Three basic types of roads have evolved over the years at the NNSS to support direct mission and mission support requirements: major transport routes, e.g., Mercury Highway, constructed of asphalt concrete suitable for sustained highway loads and speeds; spur roads of shorter length to specific activity locations, e.g., Road 5-01 Radioactive Waste Management Site, generally consisting of multiple applications of oil and chip suitable for use at reduced speeds and loads; and unpaved routes, e.g., Fortymile Canyon Road, graded and passable at low speed suitable for construction or maintenance vehicles.

Determining the level of road serviceability required to meet operational demands on the NNSS is a solid basis for establishing design, construction, maintenance, and safety criteria. The following hierarchy has been established to evaluate existing and proposed roadways:

- Level I – Roads that provide safe access to heavily used areas at highway speeds (currently 55 miles per hour); basic emergency response; and critical personnel and material movement routes. Level I roads handle the entire spectrum of vehicular traffic encountered at the NNSS.
- Level II – Roads that provide access to more-remote areas and/or complete loop access to most used areas. Highway speed and load capabilities are important. Roads facilitate periodic operations, construction, and maintenance, and provide a bypass during selected operations. Level II roads are primarily program-specific and receive all types of vehicular traffic except for tour buses and heavy construction machinery.
- Level III – Roads that maintain established access to specific active programmatic, campaign, or Directed Stockpile Work sites. Level III roads are limited in capacity and serviceability.
- Level IV – Unpaved roads that provide more direct and efficient access to selected locations or direct access to established isolated activities. Level IV roads are not routinely used.

Using this hierarchy of roads, **Table 4–3** presents roads assigned to each level.

Table 4–3 Roads Assigned to Each Level of Hierarchy Established on the Nevada National Security Site

Level 1	**Road Segment/Classification [a]**
Mercury Highway	U.S. 95 to BJY Intersection (RA)1
Mercury Bypass	South Turnout to North Turnout (RF)
Rainier Mesa Road	BJY Intersection to Area 12 Camp (RA)
Tippipah Highway	Mercury Highway to Area 12 Camp (RA)
Cane Spring Road	Mercury Highway to 27-01 Road (RC)
5-01 Road	Mercury Highway to Area 5 RWMC site (RC)
3-03 Road	Mercury Highway to Area 3 RWMS site (RC)
Level II	**Road Segment/Classification [a]**
Stockade Wash Road	A-12 Camp to Pahute Mesa Road (RC)
Buckboard Mesa Road	18-03 Road to Pahute Mesa Road North (RF)
Cane Spring Road 27-01	Road to Jackass Flats Road (RC)
Jackass Flats Road (South)	Mercury Bypass to 27-01 Road (RC)
27-01 Road	Cane Spring Road to Jackass Flats Road (RC)
Pahute Mesa Road	Mercury Highway to Stockade Wash Road (RA)
Tweezer Road	Mercury Highway to Construction Area (RF)
18-03 Road/Airport Road	Pahute Mesa Road to Buckboard Mesa Road (RC)
Level III	**Road Segment/Classification [a]**
Jackass Flats Road (North)	27-01 Road to Cane Spring Road (RC)
Pahute Mesa Road	Stockade Wash Road to Buckboard Mesa Road N (RF)
4-04 Road	Rainier Mesa Road to BEEF site (RF)
Level IV	**Road Segment/Classification [a]**
Mercury Highway	Old BJY Intersection to Gate 700 (RA)
Lathrop Wells Road	Cane Spring Road to NNSS boundary (RA) (Gate 510)
Desert Rock Road	Mercury Highway to Desert Rock Airport (RF)
Airport Road (Area 18)	18-03 Road to Pahute Mesa Airport (RF)
5-07 Road	Mercury Highway to 5-01 Road (RF)
5-06 Road	5-01 Road to Spill Test Facility (RF)
Tunnel Access Roads	Multiple spurs (RF)
Other existing paved, gravel, or graded roads	

BEEF = Big Explosives Experimental Facility; RWMC = Area 5 Radioactive Waste Management Complex; RWMS = Area 3 Radioactive Waste Management Site.

[a] Comparison with Nevada state road classifications is shown: Rural Arterial (RA); Rural Connector (RC); Rural Feeder (RF).

Source: FY 2007 Utility Management Plan, Table 2-1.

With the exception of Mercury Highway, the 340 miles of paved and 300 miles of unpaved roads were not designed or intended for use at the loads and speeds of today's traffic, e.g., 55 miles per hour. While numerous repairs and safety improvements to various segments have allowed continuous operations along most NNSS roadways, portions of the paved road system are currently substandard (DOE 2008i). Approximately 15 miles of roadway (amount usually determined by funding) are oiled and chipped each year to prevent deterioration and provide safe road surfaces. Based on this level of effort, each of the 340 miles of paved road can only be treated every 22 years. However, in 2010, a major Mercury Highway road improvement project was completed on the entire length of the road.

Traffic conditions on NNSS roads are discussed in Section 4.1.3.

Parking for government and private vehicles is available at most buildings on the NNSS; and paved parking areas are available for commuter buses at support facilities in Areas 6, 12, 23, and 25. Collectively, the NNSS has approximately 1 square mile of paved land comprising parking areas. A bus fleet operation is used to transport personnel to and from the NNSS and Las Vegas/Pahrump, Nevada. These buses are operated by a private firm under subcontract to DOE/NNSA (NNSA/NSO 2009c). There are no operational railroads that access the NNSS.

The NNSS transportation-related infrastructure also includes the following air facilities:

Pahute Airstrip. This airstrip is located in Area 18 and has a paved runway and a secondary support facility. It is currently limited to helicopter use due to runway deterioration.

Desert Rock Airport. Located in Area 22, this airport has a paved runway with radio-activated lights, an administrative/control building, aircraft parking areas, and other ancillary features. It is unmanned, but operational, and its use is controlled by DOE/NNSA.

Yucca Lake Airstrip. This airstrip is located in Area 6 and has a secondary support facility and an unpaved runway that is subject to flooding following local storms.

Area 6 Aerial Operations Facility. Located in Area 6, this is an unmanned aerial system research and development facility. It has a paved runway, taxiways, and aircraft parking areas, as well as hangars, shops, and administrative buildings.

Helipads. Helipads with windsocks, fire extinguishers, and painted markings are located in seven locations across the NNSS.

All roads, parking areas, and air facilities at the NNSS are maintained for mission-related uses.

4.1.2.1.2 Utilities

The utility systems discussed in this section include the potable water supply, wastewater collection and treatment, and communication systems.

Water Supply. The NNSS water systems provide potable, fire-protection, construction, and wildlife preservation water throughout the expanse of the installation. Water production and distribution systems have been in place at the NNSS for over 50 years, serving work populations of up to 10,000 workers.

Drinking water needs are met by deep-well groundwater draws from two major aquifers (the volcanic and the alluvial aquifers) that are not influenced by surface waters. In addition, groundwater is withdrawn from the carbonate, volcanic, and alluvial aquifers for nonpotable, construction, and fire protection purposes.

The NNSS comprehensive water production and distribution system consists of three permitted public water systems (PWSs), two wildlife preservation reservoirs, and two isolated environmental sampling wells (DOE 2008l).

The three discrete PWSs permitted by the Nevada Division of Environmental Protection (NDEP) to provide potable water to the NNSS are served by six wells (Well 4/4a, Well 5b/5c, Well 8, Well 16D, Well C-1, and Well J-12). The transmission and distribution systems include mains, valves, hydrants, booster pump stations, pump suction tanks, and reservoir storage tanks. Each PWS extends to the point of the service connection. Two tanker trucks used to haul potable water from the permitted wells to remote work sites are also permitted, but are not considered PWSs (NSTec 2010d).

The NNSS water system is spread over four distinct water service areas and consists of eight water systems; two wildlife preservation reservoirs; numerous water storage tanks, fillstands, and construction water open pit reservoirs, as well as approximately 140 miles of pipeline located throughout the site

(DOE 2008l). These water service areas are discussed in detail below in relation to their location and the areas they support.

Water Service Area A. Encompasses Areas 19 and 20. System capabilities within this service area have been abandoned for more than a decade. There are two wells in this area (Wells 19c and 20), both of which are out of service and have monitoring casing to prevent vandalism or contamination (DOE/NV 2008c).

Water Service Area B. Encompasses Areas 2, 4, 7, 8, 9, 10, 12, 15, 17, and 18. PWS NV0004099 serves Area 12. Well 2, which is within this service area, is out of service and is locked to prevent vandalism or contamination. Well 8 provides water to Area 12 and supplies water to the construction water open pit reservoir system. Water Service Area B also includes one pumping station and two water storage tanks (DOE 2009f; DOE/NV 2008c).

Water Service Area C. Encompasses Areas 1, 3, 5, 6, 11, 22, 23, 26, and 27. PWS NV0000360 serves Areas 5, 6, 22, and 23. Five active wells provide water in this service area (Wells C-1, 4, 4a, 5b, and 5c). Fillstand A-6 is used to supply potable water via water trucks to the Joint Actinide Shock Physics Experimental Research Facility (JASPER), Area 12, and the Big Explosives Experimental Facility (BEEF). Water Service Area C also includes five pumping stations and nine water storage tanks (DOE 2009f; DOE/NV 2008c).

Water Service Area D. Encompasses Areas 14, 16, 25, 29, and 30. PWS NV0004098 serves Area 25. It consists of two active wells (Wells J12 and 16d). Water Service Area D also includes three pumping stations and 12 water storage tanks (DOE 2009f; DOE/NV 2008c).

Water is currently hauled into Areas 26 and 27 by truck. There are four elevated tanks in Area 26 that store construction water and one tank in Area 27 that stores fire protection and potable water (DOE/NV 2008c).

The annual maximum production capacity of the site's potable supply wells (based on equipment capacity) is approximately 2.1 billion gallons per year, although the combined sustainable yield of the groundwater basins is substantially lower, and the sustainable yield of each basin is considered in groundwater withdrawals. Section 4.1.6.2 and Chapter 5, Section 5.1.6.2, provide additional information on groundwater wells, basins, and sustainable yields.

Water Conservation. DOE/NNSA is currently implementing programs to maximize compliance with Executive Order 13423, *Strengthening Federal Environmental, Energy, and Transportation Management*, as detailed in the Annual Site Sustainability Plan required by DOE Order 436.1, *Departmental Sustainability,* and in the annual Executable Energy Plans. One of the goals of these plans is to reduce the use of energy and water in DOE/NNSA facilities by advancing water conservation (NSTec 2011c).

According to DOE/NNSA's Energy Executable Plan of December 2008, the goal is to reduce potable water consumption by no less than 16 percent from the 2007 level by 2015. This reflects an average reduction in water consumption of approximately 2 percent per year. To accomplish this goal, the NNSS began saving water through several water conservation measures and best management practices for water efficiency. Examples include the installation of WaterSense™ products (including toilets and urinals, faucets and showerheads, boiler systems, and other water uses), xeric landscaping, water-efficient irrigation, system audits and leak repairs, use of nonpotable water for dust suppression when possible, and institution of 4-day workweeks (NSTec 2011c). Potable water consumption for the NNSS is presented in **Table 4–4** (see Section 4.1.6.2 for further information on water usage at the NNSS).

Gray water recycling was deemed cost-prohibitive at the NNSS due to the quantity of flow and lack of redistribution means. Gray water is sometimes used for dust control; however, depending on the extent of treatment, there are restrictions on how the water may be used (NSTec 2008b).

Table 4–4 Potable Water Consumption for the Nevada National Security Site by Year

Year	*Potable Water Consumption (gallons, approximate)*
2005	182,650,000
2006	221,250,000
2007	225,150,000
2008	172,550,000
2009	190,000,000
2010	185,765,000
2011	184,073,000

Source: NSTec 2010c; Rudolph 2012.

Wastewater Collection and Treatment Systems. The NNSS sanitary sewer system consists of approximately 100 linear miles of cast iron or polyvinylchloride mains and service laterals. Domestic and industrial wastewater is treated using either sewage treatment lagoon systems or septic tanks with leach field systems.

In fiscal year (FY) 2003, due to insufficient flow in the lagoons, to remain compliant with Nevada regulations, DOE/NNSA placed 8 of the 10 sewage lagoon systems in inactive status and installed new septic systems that allowed the lagoons to be bypassed. Only the Area 23 (Mercury) and Area 6 (Yucca Lake Complex) lagoon systems remain operative (NSTec 2010g). These two active lagoons operate under NDEP Water Pollution Control General Permit GNEV93001, with design flow capacities of 73,407 gallons per day (Area 23, Mercury) and 10,850 gallons per day (Area 6, Yucca Lake Complex) (NDEP 2005). The current rate of wastewater production for the two operating lagoons is presented in **Table 4–5**.

Table 4–5 Wastewater Production for the Mercury and Yucca Lake Lagoons at the Nevada National Security Site by Year

Year	*Wastewater Production (average gallons per day)*		*Total Treated in Lagoon Systems (average gallons per day)*
	Mercury Sewage Lagoon System	*Yucca Lake Sewage Lagoon System*	
2005	44,510	8,229	52,739
2006	42,124	9,219	51,343
2007	42,367	7,427	49,794
2008	32,588	1,084	33,672
2009	26,550	1,049	27,599
Permit capacity	73,407	10,850	84,257
Percentage of lagoon capacity used in 2009	36%	10%	33%

Source: NSTec 2010g.

Sludge removed from the wastewater treatment systems is disposed in the Area 23 sanitary landfill or the Hydrocarbon Disposal Site in Area 6, depending on the hydrocarbon content (DOE 2008f).

Installation of new septic tank systems to supplement the NNSS's wastewater treatment capacity enabled the NNSS to meet current site needs and comply with state regulations (DOE 2008f). There are currently 23 permitted septic tank systems at the NNSS (NSTec 2010h). Each septic tank has a capacity for handling 5,000 gallons of wastewater per day. Seven of the septic tanks are maintained by the National Security Technologies, LLC, Department of Water and Waste, and the remaining units are maintained by the individual facilities with which they are connected. Collectively, the 23 septic systems provide a capacity for treating 115,000 gallons of wastewater per day. The currently permitted septic systems at the NNSS and the approximate number of people they serve per workday are presented in **Table 4–6**.

Table 4–6 Nevada National Security Site Septic Tank Locations and Capacities for 2010

Permit Number	*Location*	*Capacity* [a] *(gallons)*	*Number of People Served per Workday*
NY-1054	Area 3, Waste Management Office	5,000	10
NY-1069	Area 18	5,000	1
NY-1076	Area 6, Art Hangar	5,000	20
NY-1077	Area 27, Baker	5,000	10
NY-1106	Area 5, NPTEC	5,000	20
NY-1079	Area 12 (U12G)	5,000	1
NY-1080	Area 23, 1103	5,000	20
NY-1081	Area 6, CP-70	5,000	0
NY-1082	Area 22, 22-1	5,000	5
NY-1083	Area 5, RWMC	5,000	20
NY-1084	Area 6, DAF	5,000	40
NY-1085	Area 25, Central Support Area	5,000	0
NY-1086	Area 25, RCP	5,000	0
NY-1087	Area 27, Able	5,000	15
NY-1089	Area 12, Camp	5,000	2
NY-1090	Area 6, LANL Construction	5,000	10
NY-1091	Area 23, Gate 100	5,000	150
NY-1103	Area 22, DRA	5,000	1
NY-1110-HAA-A	Area 12, 12-910	5,000	1
NY-1112	Area 1, U1a	5,000	40
NY-1113	Area 1, 1-121	5,000	1
NY-1124	Commercial individual sewage disposal system NNSS Area 6 permit to operate	5,000	–
NY-1128	Commercial individual sewage disposal system NNSS Area 6 Yucca Lake Project permit to construct	5,000	–
Total capacity		**115,000**	**367**
Demand	**Assuming 20 gpd per person,[b] total treatment demand**	**7,340**	**6% of collective capacity**

DAF = Device Assembly Facility; gpd = gallons per day; LANL = Los Alamos National Laboratory; NNSS = Nevada National Security Site; NPTEC = Nonproliferation Test and Evaluation Complex; RWMC = Area 5 Radioactive Waste Management Complex.

[a] Source: NSTec 2010h.

[b] Liu and Liptak 1997; CMU 2004.

DOE/NNSA assumes that a typical wastewater generation rate for the NNSS would be approximately 20 gallons per day, based on the upper limits of an average flow rate for an office setting (7 to 16 gallons per day) and a school with cafeteria setting (10 to 20 gallons per day) (Liu and Liptak 1997). This estimate is further confirmed by a study done at Carnegie Mellon University that calculated per capita water use in 2004 for the NNSS at 20.81 gallons per day (CMU 2004).

As shown in Table 4–6, the septic tank systems at the NNSS are currently being used at approximately 6 percent of their collective capacity. As shown in **Table 4–7**, the population at the NNSS is currently using approximately 17 percent of the collective total capacity of wastewater treatment at the NNSS (the capacity of the two lagoons and 23 septic tanks).

Areas not serviced by a permanent wastewater system are provided with portable sanitary units. The portable sanitary units are serviced regularly, and the wastewater is discharged to a permitted onsite treatment system (DOE 2008f).

Table 4–7 Estimated Total Wastewater Treatment Capacity at the Nevada National Security Site

Wastewater Treatment System	*Capacity (gallons per day)*
Lagoons: Mercury and Yucca Lake Systems [a]	84,257
Septic Systems [b]	115,000
Total NNSS Capacity	199,257
Total Wastewater Generation [c]	34,000
Percentage of Capacity Used	17%

NNSS = Nevada National Security Site.
[a] Based on NDEP permit design flow capacity.
[b] Based on 23 septic systems at 5,000 gallons per day each.
[c] Based on 20 gallons per day of wastewater per person for the current population of 1,700 persons.

Communication Systems. Communication systems cover not only the entire area of the NNSS, but also reach far beyond its boundaries. The NNSS telecommunications/information technology infrastructure is composed of fiber optic and copper cabling and microwave systems. The distribution architecture is composed of approximately 205 miles of fiber optic cabling, thousands of circuit miles of legacy copper telecommunications cabling, and seven major microwave links. The systems include telephone network, data transmission, and storage systems, as well as video, radio, and mail systems. Parts of the NNSS telecommunications/information infrastructure are technologically dated and have been degraded in many locations (DOE 2008f).

4.1.2.2 Energy

Electrical power and liquid fuels are necessary for the continued operations of the NNSS, RSL, NLVF, and the TTR. These sources provide energy to support the buildings, vehicles, and operations at the facilities.

4.1.2.2.1 Electrical Energy

Electrical service at the NNSS is supplied by two power sources: (1) NV Energy (previously Nevada Power) and (2) the Valley Electric Association (DOE 2008f). It is distributed to the site by an onsite 138-kilovolt transmission loop that supplies eight substations, one switching center, and one 138-kilovolt radial. The power distribution involves an extensive 34.5-kilovolt system, and short 69-kilovolt and 12-kilovolt systems. These voltages are transformed to a 4.16-kilovolt distribution voltage, and then subsequently to 480–208/120-volt working levels. The NNSS is served by approximately 600 miles of transmission and distribution lines (NSTec 2008b).

The electrical capacity at the NNSS is approximately 45 megawatts, and the current load is approximately 20 megawatts. From 2003 through 2006, electrical usage at the NNSS ranged from 57,000 to 95,000 megawatt-hours, averaging 81,000 megawatt-hours with a peak load usage of 27 megawatts (DOE 2008f). Electrical usage at the NNSS during FY 2009 was 84,577 megawatt-hours. Utility use in areas surrounding the NNSS is holding steady; the NNSS capacity should remain at 45 megawatts in the foreseeable future (NNSA/NSO 2010a).

4.1.2.2.2 Natural Gas

There is no infrastructure for natural gas supply at the NNSS.

4.1.2.2.3 Liquid Fuels

The NNSS uses various types of liquid fuel for its energy needs. Red dye fuel oil is used to heat many buildings and facilities (though numerous oil-fired boilers have been replaced with electric boilers). Unleaded gasoline, diesel fuel, and biofuels (such as ethanol/E85 and biodiesel) are used to power its vehicle fleet and equipment. **Table 4–8** presents liquid fuel usage at the NNSS in 2009 by type.

Table 4–8 Fuel Usage in Fiscal Year 2009 at the Nevada National Security Site

Fuel Type	Quantity (gallons)
#2 Red Dye Fuel Oil for Heating	66,433
Unleaded Gasoline	426,964
Ethanol/E85	216,616
#2 Diesel	64,844
Biodiesel	343,191

Source: NNSA/NSO 2010b.

The NNSS has two service stations, each with the capacity to store 10,000 gallons of unleaded gasoline and 9,500 gallons of biodiesel. E85 fueling stations are located near these NNSS gasoline/biodiesel service stations. The NNSS currently has a secure source for daily delivery of E85 fuel and currently has no need for a large onsite stored reserve.

The bulk storage tanks in Area 6 are capable of storing approximately 100,000 gallons of biodiesel and 40,000 gallons of unleaded gasoline (DOE 2008l). Both tanks are filled and maintained to support four weeks of biodiesel consumption and two weeks of unleaded fuel consumption in case of a fuel shortage (NSTec 2009e).

The trend over the last several years has been a decline in petroleum-based fuel usage. The majority of the NNSS fleet currently operates on alternative fuels. The NNSS uses E85 fuel for alternative-fuel vehicles and B-20 biodiesel for all diesel vehicles and off-road equipment. As of December 2008, the NNSS had 548 alternative-fuel vehicles that are E85-capable, equal to 94 percent of the NNSS vehicle fleet. The NNSS requires its fleet to operate all alternative-fuel vehicles on alternative fuels to the maximum extent practicable.

4.1.2.2.4 Conservation and Renewable Energy

The Federal Energy Policy Act of 2005 (EPACT 2005, Section 203(a) [42 U.S.C. 15,853 (a)]) requires DOE to reduce the use and cost of energy at its facilities by advancing energy efficiency, water conservation, and renewable energy sources. As a result, DOE/NNSA has implemented various energy and water conservation practices and is working toward maximizing installation of onsite renewable energy projects at the NNSS where technically and economically feasible.

NNSA has met the requirements for installing electrical meters (as set forth in Section 103 of the Energy Policy Act of 2005) for 90 percent of the electricity used by NNSS and NLVF (NSTec 2011c). The metering allows DOE/NNSA to better track its use of electricity to help improve its ability to identify conservation opportunities.

As part of energy conservation efforts under Energy Saving Performance Contract funding, some NNSS buildings have been retrofitted with low-energy light fixtures and programmable thermostats. Several onsite renewable energy projects have been implemented at the NNSS, including: (1) solar lighting installed for pedestrian footpaths, (2) solar light post in front of the cafeteria, (3) solar-powered monitoring stations, (4) solar-powered low-volume continuous air sampling systems, and (5) solar-powered pedestrian crosswalk lighting (NSTec 2008b).

4.1.3 Transportation and Traffic

This section addresses baseline transportation conditions with respect to onsite and regional traffic, including transportation of materials and wastes. "Onsite traffic" relates to the roadway network within site boundaries; "regional traffic" relates to the roadway network surrounding the site.

4.1.3.1 Onsite Transportation

Access to the NNSS is restricted; guard stations are located at entrances, as well as at other locations throughout the site. The main entrance to the NNSS, Gate 100, is located on Mercury Highway, which originates at U.S. Route 95. Although there are access points at other locations, their use is restricted and they are usually barricaded. Vehicles accessing the NNSS are generally limited to the main entrance. Other existing roadways, some of which are unpaved, provide access or exit routes in cases of emergency or for special purposes.

The NNSS has 640 miles of roadways: 340 miles of paved roads and 300 miles of unpaved roads (DOE 2007c). The paved roads are considered primary roads; most are two-way, two-lane roads with speed limits of 55 miles per hour, unless posted otherwise. The speed limit in developed areas is 20 miles per hour. The maximum speed limit on dirt roads is 35 miles per hour. The majority of the paved roadway network was constructed prior to 1965 and is considered to be in substandard condition, requiring extensive and effective remedial reconstruction, rehabilitation, and resurfacing actions (DOE 2009f). The unpaved portion of the roadway system is composed of graded gravel roads and jeep trails. The NNSS also has numerous unpaved test- or experiment-related roads that are no longer used after a test or experiment is completed.

Figure 4–5 depicts the NNSS's onsite roadway network, which can be considered in terms of a southern network and a northern network. The primary paved roads in the southern part of the NNSS include Mercury Highway, Jackass Flats Road, Cane Spring Road, and Lathrop Wells Road. Mercury Highway is the primary access route to the NNSS from U.S. Route 95. South of Gate 100, Mercury Highway is a two-lane highway. At the gate, it widens to multiple lanes to facilitate entry through the guard station. North of the gate, the highway narrows to a two-lane highway and remains a two-lane highway northward to the transition to Rainier Mesa Road. Most of Mercury Highway is 26 feet wide (13 feet wide per travel lane), but the shoulders vary from 4 to 6 feet wide. Mercury Bypass runs from just north of Gate 100 to north of Mercury. This 26-foot-wide road was built to divert traffic around Mercury to outlying areas of the NNSS.

The primary roads in the northern part of the NNSS include Mercury Highway, Pahute Mesa Road, Buckboard Mesa Road, Stockade Wash Road, Rainier Mesa Road, and Tippipah Highway. The areas served by these roads are Buckboard Mesa, Pahute Mesa, and Rainier Mesa.

Mercury Highway is the main thoroughfare within the NNSS and handles most of the traffic volume at the site. The highway runs approximately 37 miles from the southern border of the NNSS to its intersection with Rainier Mesa Road. A 1999 traffic study estimated that approximately 1,500 vehicle trips were made through the main access gate at the NNSS per day. Peak hours were from 6:00 to 7:00 a.m. and from 5:00 to 6:00 p.m., Monday through Thursday (because most personnel work 4 days per week) (PBS&J 1999). The study also revealed that the mix of vehicles accessing the main gate was approximately 90 percent automobiles, 7 percent trucks, and 3 percent buses. In the northern roadway network, approximately 700 vehicle trips on Mercury Highway occurred per day, of which about 81 percent were automobiles, 15 percent were trucks, and 4 percent were buses. The study determined that the highway was operating at adequate capacity, but that overall surface conditions were suboptimal and could pose traffic safety concerns (PBS&J 1999). In 2010, a major Mercury Highway road improvement project was completed along the entire length of the road. Recent vehicle counts just north of the Mercury interchange at U.S. Route 95 indicate that the total volume of vehicles accessing the NNSS increased 29 percent between 1999 and 2008 (NDOT 2008a, Nye County). NNSS employment data indicate that the number of onsite employees was approximately 1,300 in 1999 and 1,700 in 2008, representing a 31 percent increase over this timeframe (NNSA 2000, 2008; DOE 2002g). Therefore, because of the similar increases in traffic levels and NNSS personnel, DOE/NNSA assumed that the number of onsite employees is a reasonable indicator of traffic levels at the NNSS and that current number of onsite vehicle trips per day has also increased by approximately 30 percent since the 1999 traffic study. Major roadway improvements and maintenance work on Mercury Highway and Rainier Mesa Road have occurred over the last decade and are ongoing.

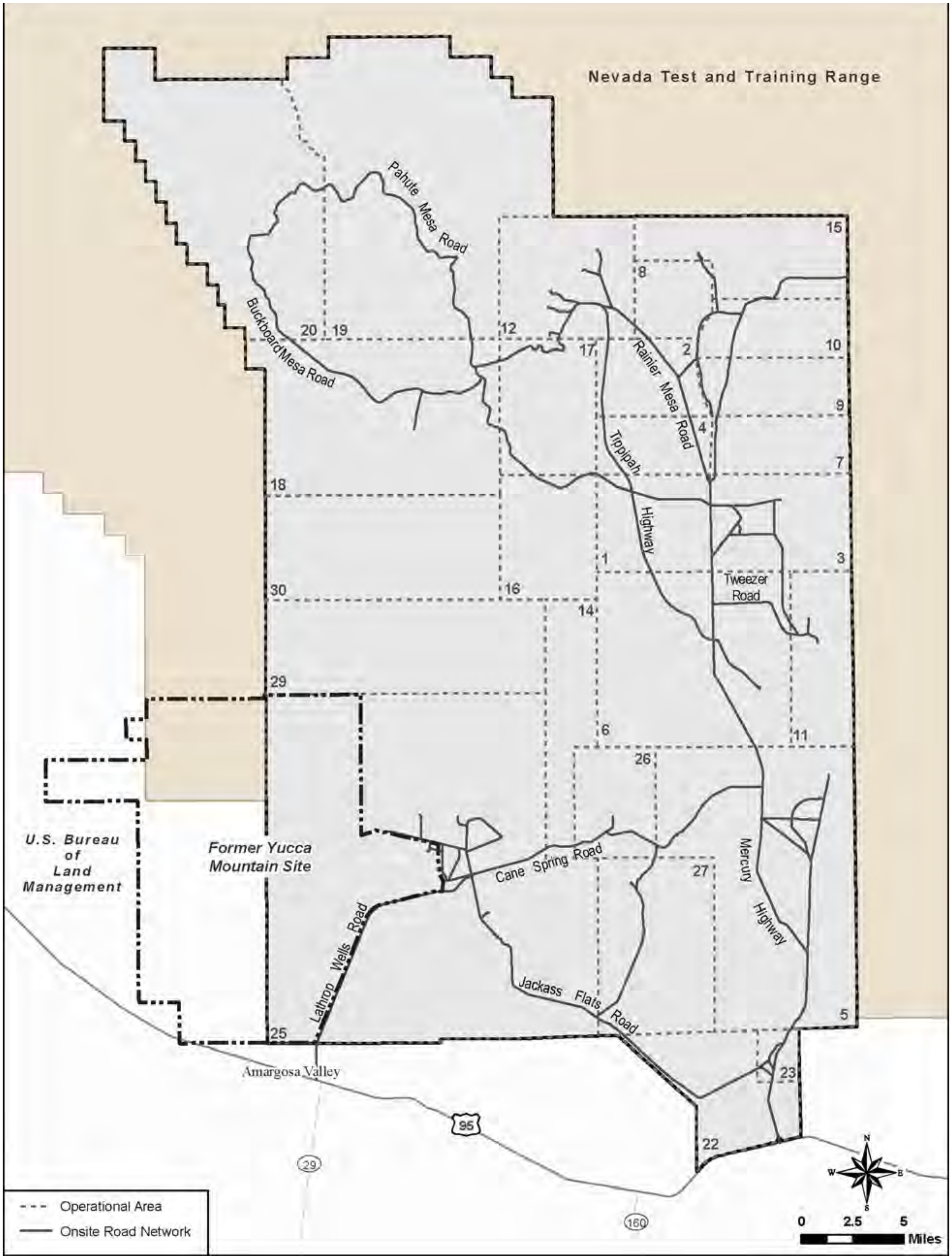

Figure 4–5 Nevada National Security Site Transportation System

Transportation facilities related to the onsite roadway network include bus parking and commuter-vehicle parking areas. At least 50 percent of NNSS employees commute to the site by bus, but the privately owned vehicles of commuting personnel still contribute to the majority of traffic accessing the NNSS (NSTec 2010a). Commuter buses provide daily passenger service to the NNSS from Las Vegas via U.S. Route 95 and from Pahrump via Nevada State Route 160 and U.S. Route 95. The number of buses entering and exiting the NNSS on a daily basis varies, depending on the onsite activities in progress. Currently, there are 15 buses serving the Las Vegas area and 2 buses serving the town of Pahrump. These buses have dedicated routes to the following locations: Mercury, the Area 6 Device Assembly Facility (DAF), the Control Point in Area 6, the Area 6 Construction Facilities, and Area 5 (when projects are being conducted in the area). Parking for government and private commuter vehicles is available at most buildings on the NNSS.

4.1.3.2 Regional Transportation

4.1.3.2.1 Regional Transportation System

The NNSS is located in a region served by a network of U.S., interstate, and state highways. A significant portion of the commuter and truck traffic associated with the NNSS (approximately 95 percent) arrives via U.S. Route 95 from the Las Vegas area (DOE 2008l). Although the transport of materials and waste includes a nationwide system, the ROI for the regional, nonradiological traffic analysis presented in this SWEIS primarily covers the major roadways within Nye and Clark Counties that are most frequently used by personnel and visitors of the NNSS and by vehicles transporting nonradioactive and radioactive materials and waste to or from the NNSS. **Figure 4–6** presents the major roadways in the southern Nevada region, including those serving RSL, NLVF, and the TTR (discussed in subsequent sections of this chapter), and highlights the major transportation routes for shipments of radioactive materials and waste to and from the NNSS. **Figure 4–7** shows the road network in the vicinity of Las Vegas and highlights the major transportation route used for shipments of radioactive materials and waste.

Interstate 15 is the major transportation artery in the Las Vegas area. It is a north–south highway that passes to the south of the NNSS, connecting San Diego, California, to Salt Lake City, Utah, and continuing northward. In southern Nevada, this interstate highway is generally a four-lane divided highway, except in the Las Vegas metropolitan area, where it expands to six lanes. The 53-mile Las Vegas Beltway (also known as Interstate 215 and Clark County Route 215) encircles all but the east side of Las Vegas. Interstate 40 is a major east–west highway approximately 100 miles south of Las Vegas. Interstate 80 and U.S. Route 50 are major east–west highways to the north of the NNSS. Interstate 80 passes about 250 miles north of the NNSS, and U.S. Route 50 passes about 150 miles north.

U.S. Route 95 is a major north–south roadway extending from the Mexican border north to the Canadian border. U.S. Route 95 is a four-lane road between Las Vegas and the interchange with Mercury Highway (the highway leading onto the NNSS) and a two-lane road as it continues north. The interchange of U.S. Route 95 and Interstate 15, also referred to as the "Spaghetti Bowl," has undergone some recent construction to improve traffic flow. U.S. Route 93 is a major north–south, two-lane roadway that enters Nevada south of Lake Mead, and then extends through Las Vegas to the Canadian border, intersecting U.S. Route 50 east of Ely, Nevada, and Interstate 80 near the town of Wells, Nevada. U.S. Route 6 is an east–west, two-lane roadway to the north of the NNSS that links U.S. Routes 93 and 95.

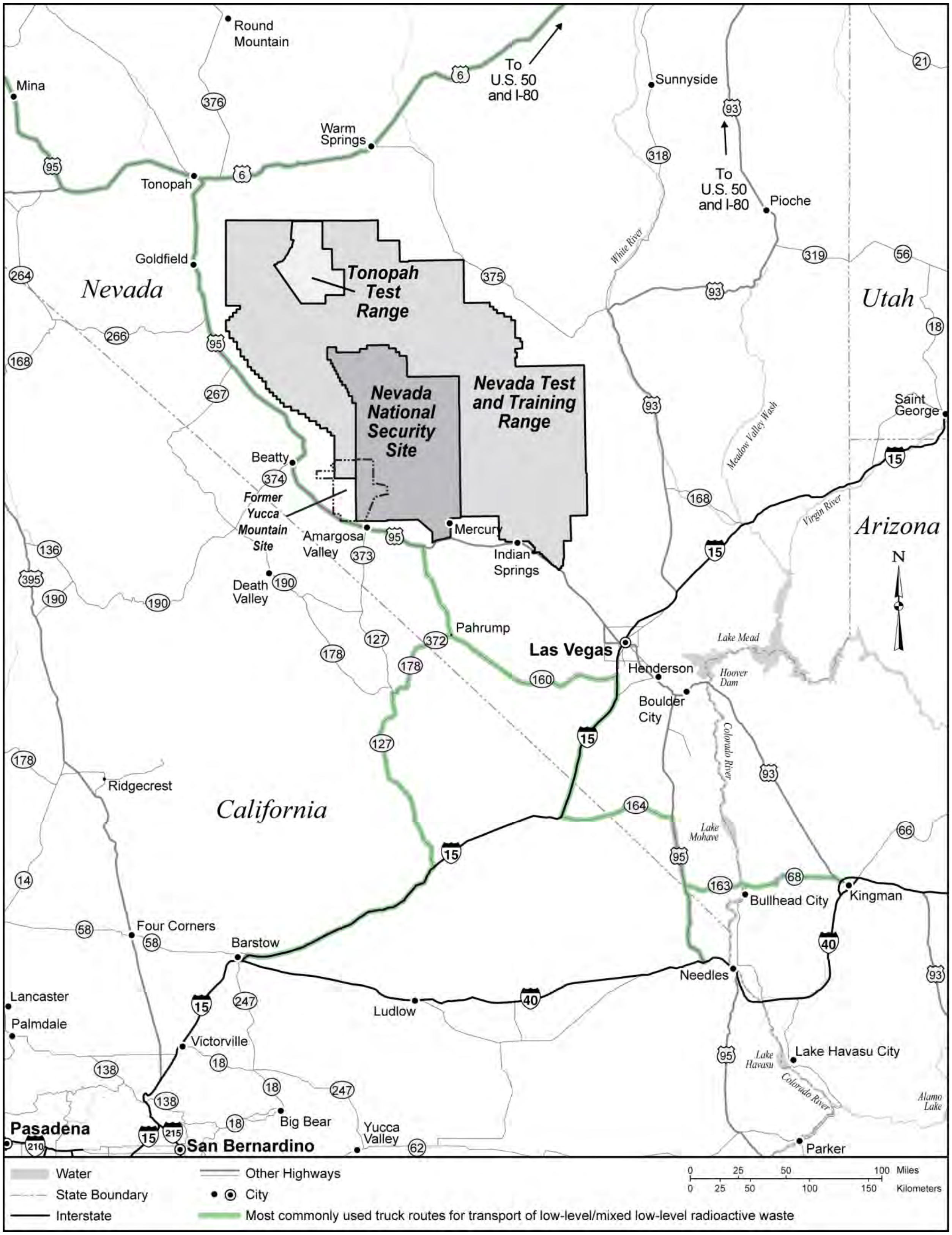

Figure 4–6 Regional Transportation Routes Surrounding the Nevada National Security Site

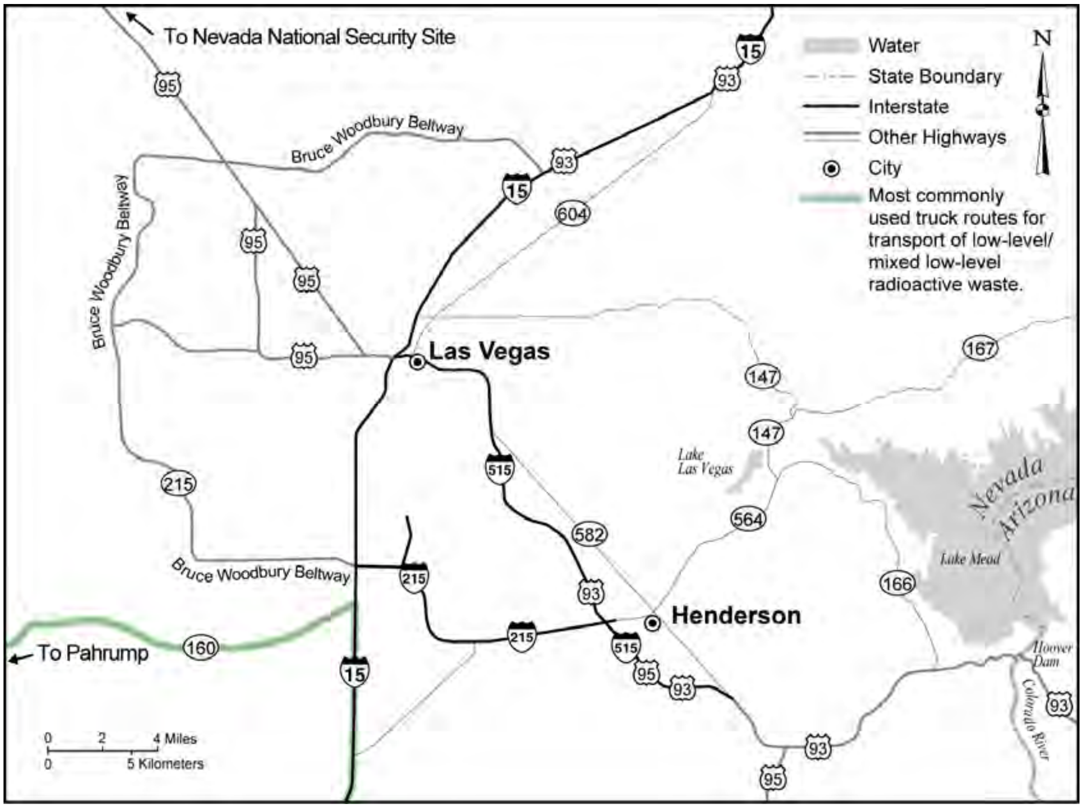

Figure 4–7 Transportation Routes Within the Las Vegas Metropolitan Area

The DOE/NNSA NSO has historically avoided shipping LLW and mixed low-level radioactive waste (MLLW) using the Interstate 15/U.S. Route 95 interchange, based on a verbal commitment from DOE/NNSA. This informal commitment was made at a time when the major highway infrastructure, specifically Interstate 15 and U.S. Route 95, was unable to safely handle the rapidly growing volume of traffic. Since the mid-2000s, U.S. Route 95 has been widened and expanded overpasses have been built to accommodate traffic much more safely. In addition, the Las Vegas Beltway, which extends around approximately three-quarters of the valley, was built at the far edges of Las Vegas to further reduce traffic loads on Interstate 15 and U.S. Route 95. In addition, a bypass bridge has been constructed adjacent to Hoover Dam. This bridge opened to all traffic in October 2010. Trucks transporting waste on Interstate 15 from the south avoid traveling through Las Vegas by taking Nevada State Route 160 to its intersection with U.S. Route 95. Radioactive waste being transported from points north of Las Vegas avoids Interstate 15 in Nevada by using U.S. Route 50, traveling west to U.S. Route 6 and then south on U.S. Route 95. As a result of DOE/NNSA's informal commitment, more-circuitous routes are used for the transport of radioactive materials and wastes. The following combinations of routes are most commonly used to ship radioactive materials and wastes to and from the NNSS (NNSA/NSO 2009a):

- From southern California: Interstate 15 to California State Route 127, to California State Route 127, to California State Route 178, to Nevada State Route 372, to Nevada State Route 160, to U.S. Route 95
- From the east via Interstate 40: Interstate 40 to U.S. Route 95, to Nevada State Route 164, to Interstate 15, to Nevada State Route 160, to U.S. Route 95 or Interstate 40, to U.S. Route 93, to Arizona State Route 68, to Nevada State Route 163, to U.S. Route 95, to Nevada State Route 164, to Interstate 15, to Nevada State Route 160, to U.S. Route 95

- From the east via Interstate 80: Interstate 80 to U.S. Route 93 (Alternate), to U.S. Route 93, to U.S. Route 6, to U.S. Route 95
- From the west via Interstate 80: Interstate 80 to U.S. Route 50 (Alternate), to U.S. Route 50, to U.S. Route 95
- From the east via U.S. Route 50: U.S. Route 50 to U.S. Route 6/50, to U.S. Route 6, to U.S. Route 95

There is no direct railroad access at the NNSS. An east–west rail line passes through northern Nevada, roughly paralleling Interstate 80. Another rail line extends northward through Barstow, California, and through Las Vegas and Caliente, Nevada, into Utah. Further south is a rail line through Arizona and California. Any materials or wastes that are destined for the NNSS and are initially transported by rail are offloaded at an intermodal site in Parker, Arizona, and placed onto trucks to complete the trip (NNSA/NSO 2009a).

Nonradioactive materials transported to and from the NNSS include construction materials and equipment that support site operations. Radioactive materials include source, special nuclear material, or other equipment that support research and development activities. Radioactive wastes transported to or from the NNSS include LLW, MLLW, and transuranic (TRU) waste (NNSA/NSO 2009a). DOE/NNSA received approximately 20,000 truck shipments of LLW and MLLW from 1997 through 2010. TRU waste is no longer transported to the NNSS; however, it is transported from the NNSS to the Waste Isolation Pilot Plant (WIPP) near Carlsbad, New Mexico, for disposal or to Idaho National Laboratory for processing prior to disposal at WIPP (NNSA/NSO 2007).

4.1.3.2.2 Traffic Volumes and Level of Service Analysis

Population and economic growth in Nevada over the past couple of decades have significantly increased demands on the state's major roads and highways, especially in the Las Vegas metropolitan area. In 2007, Nevada was ranked fourth in the Nation in terms of its share of congested urban interstates and other highways or freeways, with 59 percent of the state's urban highways carrying a level of traffic that is likely to result in significant delays during peak travel hours (TRIP 2009). Between 1991 and 2001, daily vehicle miles traveled increased by 53 percent in Clark County, which experienced the greatest amount of population growth of any metropolitan area in the country over this timeframe (NDOT 2003).

Traffic volumes on Mercury Highway at a location 0.2 miles north of the Mercury interchange are available from the Nevada Department of Transportation and are considered representative of the average daily traffic volumes generated by the NNSS because this highway serves as the main roadway onto the site. **Table 4–9** presents the annual average daily traffic volumes for this location from 1999 through 2008. According to these data, traffic volumes moderately increased (by approximately 30 percent) over this 10-year period.

Table 4–9 Annual Average Daily Traffic Volumes, 1999–2008

Location	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*
Main Access Road to the Nevada National Security Site	855	1,000	960	960	960	1,250	1,350	1,250	1,100	1,100

Source: NDOT 2008a, Nye County.

The level of service is a measurement typically used by traffic professionals to gauge the adequacy of transportation facilities. All references to levels of service in this section are defined by the *2000 Highway Capacity Manual* published by the Transportation Research Board (TRB 2000). For analysis purposes, the manual defines six categories of level of service that reflect the level of traffic congestion and qualify the operating conditions of an intersection (CMPO 2006). The six levels are given letter designations ranging from "A" to "F," with "A" representing the best operating conditions (free flow, little delay) and "F" the worst (congestion, long delays). For this analysis, the quantitative value that is computed and used to categorize the roadway (based on average daily traffic volumes and roadway characteristics) is the volume-to-capacity ratio. The level-of-service designations for associated ratio values are presented in **Table 4–10**.

Table 4–10 Level-of-Service and Volume-to-Capacity Criteria

Level of Service	*Operating Conditions*	*Criteria (Volume-to-Capacity)*		
		Freeway [a]	*Multilane Highway* [b]	*Two-Lane Highway* [c]
A	Very short delays; progression is extremely favorable.	0 – 0.35	0 – 0.33	0 – 0.12
B	Progression, short delay times.	0.36 – 0.54	0.34 – 0.50	0.13 – 0.24
C	Number of vehicles stopping is significant, although many still pass through the intersection without being required to stop.	0.55 – 0.77	0.51 – 0.65	0.25 – 0.39
D	Many vehicles must stop, and the proportion of vehicles not stopping declines.	0.78 – 0.93	0.66 – 0.80	0.40 – 0.62
E	Poor progression, and/or high volume-to-capacity ratios; considered by many agencies to be the limit of acceptable delay.	0.94 – 1.00	0.81 – 1.00	0.63 – 1.00
F	Intersection oversaturation; high volume-to-capacity ratios; poor progression and long delays; considered to be unacceptable to most drivers.	> 1.00	> 1.00	> 1.00

[a] A divided highway with full control of access and two or more lanes for the exclusive use of traffic in each direction.
[b] An undivided highway with four or more lanes (includes both directions); may be divided with medians with two-way left-turn lanes.
[c] A two-lane, undivided highway.

Major roadways in the Las Vegas metropolitan area, including segments of Interstate 15, Nevada State Route 160, and U.S. Route 95, typically experience high levels of traffic congestion (TRIP 2007). Many portions of these roadways within the city are operating at a level of service of E or F because of the heavy traffic volumes, especially during peak commuting hours.

Outside the Las Vegas metropolitan area, traffic within the ROI is generally considered light and free flowing. **Table 4–11** shows the daily traffic volumes and volume-to-capacity ratios during peak hour conditions, with corresponding levels of service, on the key regional and local roadways in the ROI. The NNSS contribution to the existing traffic congestion in the Las Vegas metropolitan area is considered minor compared to the city's existing traffic volumes, as presented in Table 4–11. Daily traffic volumes were projected to the year 2020 to provide a baseline comparison for future traffic conditions in terms of the potential impacts discussed in Chapter 5. These projected volumes take into account population growth (assuming approximately an annual traffic volume of 5 percent) (NV State Demographer's Office 2008) and are provided in Table 4–11.

Daily traffic volumes were projected to the year 2020 to provide a baseline comparison for future traffic conditions in terms of the potential impacts discussed in Chapter 5. These projected volumes take into account population growth (assuming an approximate annual traffic volume of 5 percent) (NV State Demographer's Office 2008) and are provided in Table 4–11.

Table 4–11 Traffic Volumes and Levels of Service on Key Roads During Peak Hour Conditions

Route	Location	Number of Lanes	2008 (current baseline)			2020 [a] (future baseline)		
			Annual Average Daily Traffic	Volume-to-Capacity Ratio During Peak Hour	Level of Service During Peak Hour	Annual Average Daily Traffic	Volume-to-Capacity Ratio During Peak Hour	Level of Service During Peak Hour
Nye County								
U.S. Route 6	0.3 miles east of Warm Springs Road	2	220	0.01	A	358	0.02	A
	200 feet west of Warm Springs Road	2	300	0.02	A	489	0.03	A
	0.2 miles east of Nevada State Route 376 (Tonopah-Austin Road)	2	590	0.03	A	961	0.06	A
	0.2 miles west of Nevada State Route 376	2	1,100	0.06	A	1,792	0.11	A
Nevada State Route 373	0.5 miles south of U.S. Route 95	2	910	0.05	A	1,482	0.09	A
Nevada State Route 372	0.8 miles west of Nevada State Route 160	4	12,000	0.35	B	19,547	0.57	C
	0.1 miles east of Nevada–California state line	2	820	0.05	A	1,336	0.09	A
U.S. Route 95	In Tonopah, 100 feet south of Bryan Ave	4	6,900	0.27	A	11,239	0.43	B
	500 feet north of Cemetery Road, north of Tonopah	2	4,200	0.32	C	6,841	0.53	D
	0.2 miles south of U.S. Route 6 in Tonopah	4	5,400	0.21	A	8,796	0.34	B
	9 miles south of Scotty's Junction (State Route 267)	2	2,300	0.14	B	3,746	0.22	B
	1 mile north of Beatty (State Route 374)	2	2,500	0.15	B	4,072	0.24	B
	0.2 miles west of Amargosa Valley (State Route 373)	2	2,600	0.15	B	4,235	0.25	C
	1.5 miles east of Amargosa (State Route 373)	2	2,900	0.17	B	4,724	0.28	C
	4 miles west of Mercury Interchange	2	2,900	0.17	B	4,724	0.28	C
Mercury Highway	0.2 miles north of Mercury Interchange on U.S. Route 95	2	1,100	0.07	A	1,100	0.07	A

Route	Location	Number of Lanes	2008 (current baseline)			2020 [a] (future baseline)		
			Annual Average Daily Traffic	*Volume-to-Capacity Ratio During Peak Hour*	*Level of Service During Peak Hour*	*Annual Average Daily Traffic*	*Volume-to-Capacity Ratio During Peak Hour*	*Level of Service During Peak Hour*
Nevada State Route 160	0.1 miles south of U.S. Route 95	2	1,000	0.06	A	1,629	0.10	A
	7.7 miles north of Nevada State Route 372	2	1,600	0.09	A	2,606	0.15	B
	0.1 miles north of Nevada State Route 372 (near Pahrump)	4	23,000	0.68	D	37,465	1.10	F
	200 feet south of Nevada State Route 372 (near Pahrump)	4	21,000	0.62	C	34,207	1.01	F
	0.3 miles north of the Clark–Nye county line	4	8,900	0.26	A	14,497	0.43	B
Clark County								
Nevada State Route 160	12 miles west of Interstate 15	2	8,100	0.32	C	10,886	0.43	D
	4 miles west of Interstate 15	4	22,000	0.49	B	29,566	0.66	D
	200 feet west of Interstate 15	8	36,000	0.35	B	48,381	0.47	B
U.S. Route 95	9.25 miles north of Indian Springs	4	3,600	0.07	A	4,838	0.09	A
	4 miles east of Indian Springs	4	6,400	0.13	A	8,601	0.17	A
	0.5 miles south of Snow Mountain Interchange (in northwest Las Vegas)	4	9,200	0.18	A	12,364	0.24	A
	0.4 miles north of Ann Road Interchange (in northwest Las Vegas)	6	84,000	1.1	F	112,889	1.48	F
	0.5 miles west of Interstate 15 (between Rancho Drive and Martin Luther King Boulevard)	10	212,000	1.66	F	284,910	2.23	F
	0.5 miles east of Interstate 15 (between Las Vegas Boulevard and Main Street)	8	176,000	1.73	F	236,529	2.32	F
	Between Russell Road and Sunset Road (in southwest Las Vegas)	6	111,000	1.45	F	149,175	1.95	F
	0.8 miles north of Nevada State Route 163 (west of Bullhead City)	2	8,100	0.32	A	10,886	0.43	B
	1 mile south of Nevada State Route 163 (Nevada–California state line)	2	3,200	0.13	B	4,301	0.17	B

Route	Location	Number of Lines	2008 (current baseline)			2020 [a] (future baseline)		
			Annual Average Daily Traffic	Volume-to-Capacity Ratio During Peak Hour	Level of Service During Peak Hour	Annual Average Daily Traffic	Volume-to-Capacity Ratio During Peak Hour	Level of Service During Peak Hour
Interstate 215	Between Green Valley Parkway and Valle Verde Drive (in southwest Las Vegas)	8	142,000	1.39	F	190,836	1.87	F
	Between Decatur Boulevard and Interstate 15 (in central-south Las Vegas)	8	151,000	1.48	F	202,931	1.99	F
	0.2 miles north of State Route 159 (in central-west Las Vegas)	4	46,000	0.90	E	61,820	1.21	F
Losee Road	0.3 miles south of Cheyenne Avenue (north of NLVF)	4	15,000	0.38	B	20,159	0.52	C
	0.2 miles south of Carey Avenue (south of NLVF)	4	17,000	0.44	B	22,847	0.59	C
Las Vegas Boulevard	0.3 miles south of Nellis Boulevard (west of RSL)	4	13,000	0.33	A	17,471	0.45	B
Nellis Boulevard	300 feet north of Cheyenne Avenue (west of RSL)	6	27,000	0.46	B	36,286	0.62	C
Nevada State Route 164	1.1 miles west of U.S. Route 95 (west of Searchlight)	4	690	0.03	A	927	0.04	A
Interstate 15	At the Nevada–California state line	4	38,000	0.75	C	51,069	1.00	E
	5 miles north of Interstate 215 (in south-central Las Vegas)	8	263,000	2.58	F	353,450	3.47	F
	1 mile north of Interstate 515 (in central Las Vegas)	10	147,000	1.15	F	197,556	1.55	F
	5 miles north of Interstate 515 (near central Las Vegas)	8	72,000	0.71	C	96,762	0.95	E
	5.5 miles north of Interstate 515 (in north-central Las Vegas)	4	34,000	0.67	C	45,693	0.90	D
	North of West Mesquite Interchange (Nevada–Utah state line)	4	19,000	0.37	B	25,534	0.50	B

NLVF = North Las Vegas Facility; RSL = Remote Sensing Laboratory.
[a] 2008 traffic volumes were projected to the year 2020 (represents future baseline conditions), assuming an annual increase in traffic volumes of 5 percent for Nye County and Clark County (NV State Demographer's Office 2008).
Source: NDOT 2008a, Nye County; NDOT 2008b, Clark County; NDOT 2010.

4.1.4 Socioeconomics

4.1.4.1 Region of Influence

The ROI is defined as both the area in which the principal direct and secondary socioeconomic effects of site action are likely to occur and the area expected to be of the most consequence for local jurisdictions. The socioeconomic information presented in this SWEIS discusses current conditions in an ROI comprising Nye and Clark Counties, Nevada. This ROI includes most of the residential distribution of the employees of DOE/NNSA, its contractor personnel, and supporting government agencies.

Within this ROI, there are also several American Indian reservations, tribal enterprises, tribally controlled schools, tribal police departments, and tribal emergency response units (DOE 1996c). The following reservations are located within the designated ROI: Duckwater Shoshone Tribe, Las Vegas Paiute Tribe, Moapa Paiute Tribe, and Yomba Shoshone Tribe. In addition, there are tribes that are located geographically outside the ROI, but are potentially affected by NNSS activities. One of these tribes, the Timbisha Shoshone Tribe, based in Death Valley, California, is located closer to the NNSS than many towns in northern Nye County. As a consequence of this proximity, the people of the Timbisha Shoshone Tribe are a part of the social and economic ROI of the NNSS. For example, students from the Timbisha Shoshone Tribe attend public school in Beatty, Nevada, whereas many Shoshone students from Tacopa, California, attend school in Pahrump, Nevada. Timbisha tribal members both work and shop in Clark and Nye Counties. The Pahrump Paiute Tribe, located in Pahrump Valley, is composed of American Indian people who have been historically recognized by Federal and state agencies to be both qualified to receive services as American Indian people and a group that is seeking Federal acknowledgment.

4.1.4.2 Economic Activity

Economic activity impacts in the ROI of Clark and Nye Counties were analyzed separately for each county. The differences in size, economies, and contributions would produce a misleading analysis if both were analyzed as one aggregate area. For example, in 2008, Nye County accounted for 1.4 percent of total Nevada employment, contrasted with Clark County, which accounted for 71.6 percent of total Nevada employment (USCB 2008b).

Clark County. Between 2000 and 2008, total employment in Clark County increased an average of 13.3 percent annually (USCB 2008b).

Clark County, which covers an area of 7,927 square miles, is located in southern Nevada and is composed of large expanses of unincorporated land and five incorporated cities (DOE 1996c). These are Las Vegas, North Las Vegas, Henderson, Boulder City, and Mesquite. By 2008, total employment in Clark County had increased to 890,221, representing an average annual increase of 5.0 percent from the 2000 figure of 637,339 (USCB 2000, 2008b). Between 2000 and 2008, average annual employment growth in Nevada was 4.1 percent, higher than the United States' average of 1.3 percent.

In 2008, per capita income was $28,138 (USCB 2008b). The unemployment rate in Clark County in 2008 was 6.0 percent, the same as that of the state (6.0 percent) and slightly lower than the national unemployment rate of 6.4 percent. However, as of August 2010, the unemployment rate was 14.7 percent, up 8.7 percent from November 2008.

The largest employment sector in Clark County in 2010 comprised arts, entertainment, recreation, accommodation, and food services (28 percent) (USCB 2010a). Educational services, health care, and social assistance accounted for 12.5 percent of employment. Retail trade; professional, scientific, and management; construction; and finance, insurance, and real estate accounted for 11.2 percent, 10.8 percent, 9.4 percent, and 6.8 percent of employment, respectively. The remaining 20.5 percent was divided among the following sectors: transportation, warehousing, and utilities (4.8 percent); other services (4.2 percent); public administration (3.9 percent); manufacturing (3.4 percent); wholesale trade (2.2 percent); information (1.7 percent); and agricultural, forestry, fishing and hunting, and mining (0.3 percent). Employers of the largest workforces in the region are listed in **Table 4–12**.

Table 4–12 Clark County's Largest Employers

Employer	*Number of Employees*
Clark County School District	30,000 – 39,999
Wynn Las Vegas, LLC	10,000 – 19,999
Wal-Mart Stores, Inc.	9,500 – 9,999
The Venetian Casino Resort	8,000 – 8,499
Clark County	7,500 – 7,999
MGM Grand Hotel/Casino	7,500 – 7,999
Bellagio, LLC	7,500 – 7,999
Aria Resort & Casino, LLC	7,000 – 7,499
Mandalay Bay Resort & Casino	6,500 – 6,999
Desert Palace, Inc.	5,500 – 5,999
Rio Properties, LLC	4,500 – 4,999
Nevada Property 1, LLC – Cosmopolitan	4,000 – 4,499
GNS Corporation – Mirage	4,000 – 4,499
University Medical Center of Southern Nevada	3,500 – 3,999
Flamingo Las Vegas	3,500 – 3,999
Smith's Food & Drug Centers, Inc.	3,000 – 3,499
Ramparts, Inc. – Luxor	2,500 – 2,999
City of Las Vegas	2,500 – 2,999
Southwest Airlines	2,500 – 2,999
Harrah's Las Vegas	2,500 – 2,999

LLC = Limited Liability Corporation.
Source: DETR 2011a.

Nye County. Nye County, located northwest of Clark County, covers an area of approximately 18,064 square miles (46,786 square kilometers) (DOE 1996c, 4-54). The Federal Government controls 93 percent of the land area. Mining, Federal installations, tourist and recreation attractions, and grazing allotments all occur largely on public land in Nye County.

Nye County comprises communities that are widely separated by distance, each with a distinct and independent economic base (DOE 1996c, 4-54). The NNSS and the TTR have been operating in Nye County for many decades. Federal facilities have provided employment for Nye County residents and a minor amount of procurement for local business. The economy in each community depends on different private companies and, in some cases, different industries. Because the communities are widely separated by distance, economic links between communities are limited. Metropolitan economies generally absorb a significant portion of business and residential purchases. Rural economies, such as Nye County, however, often leak large portions of both business and residential purchases to larger communities, resulting in economic loss and a different set of economic development needs from those of more-urban areas.

Nye County's strategy to increase economic development opportunities from Federal facilities is to engage the appropriate divisions of DOE/NNSA in a formal set of interactions (DOE 1996c, 4-54). Nye County has identified the need for a qualified workforce and business base to fulfill Federal requirements. To this end, Nye County has developed programs to inform local businesses of Federal procurement opportunities and continuing formal and informal interaction with appropriate Federal agencies. One example of this proactive approach is Nye County's status as a cooperating agency in the development of this *NNSS SWEIS*.

Between 2000 and 2008, total employment in Nye County increased an average of 4.3 percent annually (USCB 2000, 2008b). In 2008, per capita income in Nye County was $21,071 (USCB 2008b). The unemployment rate for Nye County in 2008 was 5 percent, lower than the state's (6 percent) and the Nation's (6.4 percent). However, as of August 2010, the unemployment rate was 17.2 percent, up 12.2 percent from 2008.

The largest employment sector in Nye County in 2010 comprised arts, entertainment, recreation, accommodation, and food services (19.0 percent) (USCB 2010b). Educational services, health care, and social assistance accounted for 15.1 percent. Construction accounted for 13.9 percent. Retail trade; agriculture, forestry, fishing and hunting, and mining; and professional, scientific, and management accounted for 10.4 percent, 8 percent, and 7.4 percent, respectively. The remaining 22.1 percent was divided among the following sectors: transportation, warehousing, and utilities (6.3 percent); public administration (6.3 percent); finance, insurance, and real estate (4.3 percent); other services (4.2 percent); manufacturing (2.2 percent); information (1.8 percent); and wholesale trade (1.3 percent). Employers of the largest workforces in the region are listed in **Table 4–13**.

Table 4–13 Nye County's Largest Employers

Employer	*Number of Employees*
Bechtel Nevada Corporation	1,000 – 1,499
Nye County School District	800 – 899
Smoky Valley Mining Division	800 – 899
Nye County	600 – 699
Wackenhut Services, Inc.	300 – 399
Wal-Mart Supercenter	300 – 399
Golden Pahrump Nugget, LLC	300 – 399
CCA of Tennessee, LLC	200 – 299
Flamingo Paradise Gaming, LLC	200 – 299
Desert View Regional Medical	100 – 199
Aces High Management, LLC	100 – 199
Home Depot USA, Inc.	100 – 199
State of Nevada	100 – 199
Smith's Food & Drug Centers, Inc.	100 – 199
Front Sight Management, Inc.	90 – 99
Premier Magnesia, LLC	90 – 99
Healthcare Partners of Nevada	80 – 89
Lockheed Martin Corporation	80 – 89
Valley Electric Association	70 – 79
U.S. Postal Service	70 – 79

LLC = Limited Liability Corporation.
Source: DETR 2011b.

Table 4–14 shows employment numbers for the NNSS, NLVF, RSL, and the TTR.

Table 4–14 Onsite Employment

	NNSS		*NLVF*	*RSL*	*TTR*	*Total*
	NNSS Only	*Including Contract Employees for Solar Plant*				
No Action	1,699	1,849	1,442	132	106	3,379

NLVF = North Las Vegas Facility; NNSS = Nevada National Security Site; RSL = Remote Sensing Laboratory; TTR = Tonopah Test Range.

4.1.4.3 Population

Clark County. In 2008, Clark County's total population was 1,821,359, an increase of 445,594 individuals, or approximately 32.4 percent, from 1,375,765 in 2000 (USCB 2000, 2008b). This increase was equivalent to an annual average growth of approximately 4.0 percent for the county over the 2000 to 2008 period. By comparison, the average annual growth was approximately 3.4 percent for Nevada and nearly 1 percent for the United States between 2000 and 2008. Most recently, however, there has been a small decrease in population. Clark County decreased 0.8 percent from a high of 1,967,716 in mid-2008 to 1,952,040 in mid-2009 (NSBDC 2010).

The population of the city of Las Vegas totaled 564,484 in 2008, an increase of 18 percent from the 2000 level of 478,434 (USCB 2000, 2008b). The average annual growth of 2.2 percent for the 2000 to 2008 period was below the county level. In 2000, the city of Las Vegas accounted for 34.8 percent of Clark County's population; in 2008, the city accounted for 31.0 percent of the total population in Clark County.

The population of the city of North Las Vegas was 115,488 in 2008, an increase of 78.9 percent from the 2000 level (USCB 2000, 2008b). The average annual growth of 9.9 percent for the 2000 to 2008 period was well above the county level. In 2008, the city of North Las Vegas accounted for 11.3 percent of Clark County's population, an increase from 2000, when the city accounted for 8.4 percent of the total population in Clark County. These data indicate a trend toward outward expansion of the Las Vegas metropolitan area.

Nye County. In 2008, the population for Nye County was 43,555, an increase of 11,070, or 34.1 percent, from the 2000 level (USCB 2000, 2008b). This overall increase is equivalent to an annual average growth for Nye County of about 4.3 percent over the 2000 to 2008 period; the average annual population growth in Nevada was about 3.4 percent, and in the United States, 1 percent. Most recently, however, there has been a small decrease in population. Nye County decreased 2.1 percent from a high of 47,370 in mid-2008 to 46,360 in mid-2009 (NSBDC 2010).

Pahrump is the largest and most rapidly growing community in Nye County. The 2008 population for the town of Pahrump was 36,390, up 47.7 percent from 24,631 in 2000 (USCB 2000, 2008b). The average annual growth was 6.0 percent for the 2000 to 2008 period. In 2008, Pahrump accounted for 83.5 percent of the population in Nye County.

The 2000 (2008 population data were not available) population in the town of Tonopah was 2,627, down from 3,810 in 1990 (USCB 2000, 2008b). In 2000, Tonopah accounted for 23.7 percent of the population in Nye County.

The 2000 (2008 population data were not available) population in Beatty was 1,154, down from 1,652 in 1990 (USCB 2000, 2008b). In 2008, Beatty accounted for only 2.6 percent of the population in Nye County.

4.1.4.4 Housing

Clark County. In 2008, the housing stock in Clark County consisted of 784,892 units, an increase of 234,113 units, or 42.5 percent, over the 2000 total of 550,799 (USCB 2000, 2008b). Between 2000 and 2008, Clark County housing unit vacancies increased from 47,546 units, or 8.5 percent of the housing stock, in 2000 to 208,275 vacant units, or 13.8 percent of the housing stock, in 2008. According to the Case-Shiller Home Price Index, single-family home prices in Las Vegas were down 28 percent in 2009, and off 46 percent from the peak in August 2006. Prices continue to fall because of an excess supply of housing. According to an April 2009 analysis, the number of excess single-family homes is over 7,000. Multifamily housing, condominiums, and townhouses are also overbuilt, with excess supply topping 7,800 units. Others estimate an excess supply of nearly 35,000 units (UNLV 2009).

An excess supply of residential real estate has caused permitting activity to come to a standstill (UNLV 2009). The number of building permits issued annually in Clark County rose sharply in the mid-2000s, with a peak of 39,015 permits issued in 2005. In 2008, the number of permits dropped, with only 24,596 issued. Monthly permitting from January to October 2009 averaged 508 units per month. Building permits issued in a given year may not represent the actual number of units built; however, they indicate the level of new residential development in the county.

In 2008, the housing stock in the city of Las Vegas consisted of 236,730 units, an increase of 46,006, or 24.1 percent, over the 2000 total of 190,724 (USCB 2000, 2008b). Between 2000 and 2008, housing unit vacancies in the city of Las Vegas increased from 13,974 units, or 7.3 percent of the housing stock, to 29,005 units, or 12.3 percent of the housing stock.

Nye County. In 2008, the housing stock in Nye County consisted of 16,592 units, an increase of 658 units, or 4.1 percent, over the 2000 total of 15,934 (USCB 2000, 2008b). Between 2000 and 2008, Nye County housing unit vacancies increased from 2,625 units, or 16.5 percent of the housing stock, to 3,202 units, or 19.3 percent of the housing stock. The vacancy rate does not reflect substandard units or houses held for occasional and recreational use.

4.1.4.5 Public Finance

The financial characteristics of Clark and Nye Counties are presented in this section. For many jurisdictions discussed, ad valorem taxes are a major source of revenue. These are taxes levied on the assessed valuation of real property. "Assessed valuation" is a valuation set upon real estate as a basis for levying taxes. Thirty-five percent of the taxable value placed on real property is used as the basis for levying property taxes in most Nevada jurisdictions.

Nevada has one of the most liberal tax structures in the Nation from a tax planning perspective. Nevada has no personal state income tax, unitary tax, corporate income tax, inventory tax, estate and/or gift tax, franchise tax, or inheritance tax.

Clark County. Clark County, incorporated in 1909, is governed by a Board of County Commissioners and a county manager (DOE 1996c). The seven members of the board are elected by each district to serve staggered four-year terms. Within the county are 5 incorporated cities, including Las Vegas, which is the county seat, and 13 unincorporated towns. County services include the county recorder, assessor, treasurer, social services, airport, hospital, and criminal justice. In addition, the county provides a full range of local services, such as fire, police, road maintenance and construction, animal control, building inspection, and water and sewage systems to county residents living in unincorporated areas.

In Clark County, the sales tax rate is 8.100 percent (NV Energy 2010a). The 2009 to 2010 average countywide property tax rate was 3.1849 percent. The formula for calculating real property tax is as follows:

$$\text{Taxable Value} \times 0.35 = \text{Assessed Value}$$
$$\text{Assessed Value} \times \text{Tax Rate} = \text{Total Real Property Tax}$$

In 2008, the county's primary revenue sources for government activities were ad valorem taxes ($799,257,814), consolidated taxes ($489,752,501), and sales and use taxes ($265,477,538) (Clark County 2008). These three revenue sources accounted for 25 percent, 15 percent, and 8 percent, respectively, or a total of 48 percent, of government activities revenues. The remaining 52 percent of revenue in Clark County came from interest income, franchise fees, fuel taxes, motor vehicle privilege taxes, room taxes, and other taxes. The county's total expenses were $4,205,515,941. Government activities constituted $2,506,782,626 of total expenses; the largest functional expenses were public safety ($1,082,216,327) and public works ($467,845,743). Business-type activities contributed $1,698,733,315 to total expenses; the largest components were hospital ($589,797,799), water ($431,929,066), and airport ($495,754,402).

Nye County. Nye County is governed by a Board of County Commissioners and a county manager. In Nye County, the sales tax rate is 7.100 percent (NV Energy 2010b). The 2009 to 2010 average countywide property tax rate was 3.1621 percent. The formula for calculating real property tax is the same as that for Clark County.

In 2008, the county's primary revenue sources for government activities were intergovernmental resources ($37,626,930), property taxes ($20,186,445), and miscellaneous ($8,268,727) (Nye County School District 2009). The county's total expenses were $70,843,657. Government activities constituted $20,347,092 of total expenses; the largest functional expenses were public safety ($18,861,475), capital projects ($9,123,301), and public works ($8,287,225).

4.1.4.6 Public Services

The key public services examined in this analysis are public education, police protection, fire protection, and health care. Providers of these services in the ROI are public school districts, police and fire departments, and hospitals and clinics. Existing conditions for each major public service are determined by student-to-teacher ratios at primary and secondary public schools and by the ratio of employees (sworn officers, professional firefighters, and health care personnel) to the serviced population.

4.1.4.6.1 Public Education

Higher Education. The University of Nevada, Las Vegas, was officially established in 1957 (UNLV 2010). More than 220 undergraduate, masters, and doctoral degree programs are offered to a student body of 28,605. The university has on-campus research facilities, including the Desert Biology Research Center, Center for Business and Economic Research, Nuclear Waste Transportation Research Center, and Parent/Family Wellness Center. The Desert Research Institute, a separate division of the University and Community College System of Nevada, was founded in 1959 as an international center for environmental research. The University of Nevada Medical School trains medical students and resident physicians at the University Medical Center, where the school is located. The Harry Reid Center is an environmental studies organization located on campus and operated by the university.

Clark County School District. The Clark County School District includes all of Clark County, which covers 7,910 square miles and includes the metropolitan Las Vegas area, all outlying communities, and rural areas (Clark County School District 2009). During the 2009–2010 school year, the district operated 350 schools: 212 elementary schools, 58 middle schools, 46 high schools, 25 alternative schools, and 9 special needs schools. The district operates one of the Nation's largest school construction and modernization programs. In fall 2009, the district opened 3 new elementary schools and 3 high schools. The student-to-teacher ratio is 21:1.

Nye County School District. During the 2009–2010 school year, the district operated 18 schools: 7 elementary schools, 3 elementary/middle schools, 1 middle school, 1 middle school/high school, 3 high schools; 1 combined K–12 (kindergarten through 12th grade) school; 1 combined 6th–12th grade school; and one tribally controlled school that is kindergarten through 8th grade (Nye County School District 2009). Some 426 certified personnel were employed by the district in the 2009–2010 school year, and the district had a 2008 enrollment of 6,348 students. The approximate average student-to-teacher ratio for the Nye County School District was 18.6:1.

American Indian Education. Under Federal and tribal law, American Indian children can be educated in tribally controlled, federally certified schools located on American Indian reservations (DOE 1996c). Federal funds are available for the education of American Indian children through the Indian Education Act. Compensation from the Federal Government is provided to any school district that enters into a cooperative agreement with federally recognized tribes regarding a public, private, or tribally controlled school.

In Nye County, there is one tribally controlled elementary school, which is operated by the Duckwater Shoshone Tribe. In 2009, the school had 16 students enrolled from preschool to 8th grade (Nye County School District 2009).

A tribally operated Head Start Program is located on the Moapa Paiute Indian Reservation (DOE 1996c). The program is open to all eligible preschool students, including both American Indian and non–American Indian students from nearby communities. This program is funded through the Inter-Tribal Council of Nevada, which operates Head Start Programs elsewhere in Nevada. American Indian students also attend public schools that are not tribally controlled.

4.1.4.6.2 Police Protection

Police protection in the ROI is provided by the Las Vegas Metropolitan Police Department, the North Las Vegas Police Department, and the Nye County Sheriff's Office, with stations at Tonopah, Pahrump, Beatty, Mercury, and Amargosa Valley. Each station provides law enforcement services in conjunction with other law enforcement agencies, including the Nevada Highway Patrol.

Las Vegas Metropolitan Police Department. The department is headed by the elected sheriff of Clark County. In addition to patrolling the city of Las Vegas, the department provides service for rural areas of the county. The department maintains 3,542 sworn personnel for a level of service of 6.27 personnel per 1,000 people (Castle 2010). There are 15 training personnel and 8 civilian crime prevention specialists, which include community relations, crime prevention, and Drug Abuse Resistance Education (DARE) officers. Some 2,200 vehicles (650 patrol cars), including four-wheel vehicles, motorcycles, and search and rescue vehicles, are used by the department. The holding facility capacity for the Clark County Detention Center is 2,984; the capacity of the Las Vegas Detention Center, operated by the City of Las Vegas, is 1,200.

North Las Vegas Police Department. The North Las Vegas Police Department was founded in 1946 with an original jurisdiction covering almost 4 square miles and approximately 3,000 people (NLVPD 2010). It now services 100.44 square miles and a population of approximately 221,003. The North Las Vegas Police Department, which consists of the police department and the detention center, currently employs a total of 739 employees, including 458 commissioned personnel and 281 civilian personnel. The commissioned staff consists of 310 police personnel and 148 detention personnel. The civilian staff consists of 265 full-time employees and 16 part-time employees, as well as 123 crossing guards employed on a part-time basis (whose numbers are not included in total of civilian personnel). Statistics show that there are 1.33 officers per 1,000 residents.

Nye County Sheriff's Office. The Nye County Sheriff's Office, whose main office is located in Tonopah, serves the entire county and supports substations located in Pahrump, Mercury, Amargosa Valley, Beatty, Smoky Valley, and Gabbs (Becht 2010).

There are 87 total patrol personnel, including administrative staff, 4 DARE/school resource officers, 3 assistant sheriffs, and 1 person specifically assigned to training (Becht 2010). In addition, there are approximately 106 vehicles, including detention transport vehicles and other specialty vehicles (SWAT [special weapons and tactics], Mobile Command Post, etc.)

Based on population estimates, current staffing levels are roughly 1.15 officers per 1,000 members of the population (Becht 2010).

There are 7 sworn detention personnel and 151 bed spaces for prisoners (Becht 2010).

Onsite Law Enforcement. Civilian law enforcement at the NNSS is provided under a contract with the Nye County Sheriff's Department. Officers work out of a substation located in Mercury. Nellis Air Force Base Security Forces respond to RSL when called. The Police Services portion of the current Inter-Service Support Agreement between DOE/NNSA and Nellis Air Force Base, dated January 2006, reads, "In the event of an emergency, Nellis Security Forces response will be limited to securing the exterior of the facility only." Law enforcement for the TTR is also provided by the Nye County Sheriff's Department, and law enforcement at NLVF is provided by the North Las Vegas Police Department.

Onsite Security. Security enforcement is the responsibility of WSI, a private contractor. The NNSS is a controlled-access area and WSI provides site-wide protective services according to the guidelines established by the DOE/NNSA NSO.

4.1.4.6.3 Fire Protection

Fire protection for the ROI is provided by the Clark County Fire Department, Las Vegas Fire Department, and several volunteer fire departments in Nye County (including Tonopah, Pahrump, Beatty, and Amargosa Valley).

Clark County Fire Department. The Clark County Fire Department is divided into two sections: urban and rural (DOE 1996c). The urban fire stations are located in areas that are not cities and do not have their own fire departments. The rural fire stations are manned by volunteer firefighters and are discussed in the subsection on volunteer fire departments below.

In 2008, the Clark County Fire Department provided service to a population of 861,546 in an area covering 7,420 square miles (CCFD 2008). The Clark County Fire Department operates out of 27 paid fire stations and 13 volunteer fire stations. With 650 paid firefighters, 350 volunteer firefighters, 58 inspectors/investigators, and 50 support employees, the department provides a level of service equal to 1.28 firefighters per 1,000 people.

Las Vegas Fire and Rescue. Las Vegas Fire and Rescue has 18 fire stations that protect an area of 133.2 square miles and a population of 607,876 residents (Szymanski 2010). The department uses 19 engines, 6 ladder trucks, 20 emergency medical service rescue units, 3 battalion chief units, 1 heavy rescue unit, 1 hazardous material unit, 1 Chemical-Biological-Radiological-Explosives-Nuclear unit, 1 air/light resource unit, 1 3,000-gallon water tender, and 1 mobile command post. The department has 681 employees, including 12 battalion chiefs, 87 captains, 91 engineers, 126 firefighter/paramedics, and 179 firefighters. Last year, the department responded to nearly 85,000 incidents. Las Vegas Fire and Rescue is both an accredited and an ISO [International Organization for Standardization] Class One department.

City of North Las Vegas Fire Department. The North Las Vegas Fire Department is staffed by 234 uniformed and civilian employees who serve in divisions such as Administration, Fire Operations, Homeland Security and Special Operations, Business and Support Services, Community Life Safety, and Code Enforcement (NLVFD 2010). Personnel provide emergency services response, advanced life support, emergency management, department training and record-keeping, fire prevention, inspection, fire protection enforcement, fire investigations, code compliance, public information, and public education, as well as administrative services. The North Las Vegas Fire Department provides all-hazard 24-hour emergency response service from eight fire stations using seven engines, two trucks, six advanced life-support rescue units, and two battalion chief units. The department provides fire engineering and inspection services, along with a complete public education program. All "first-out" emergency vehicles provide medical services at the advanced-care (paramedic) level.

In 2007, the North Las Vegas Fire Department responded to 23,679 emergency incidents, resulting in 29,009 unit responses, and conducted 3,816 plan reviews, 10,930 fire and business inspections, and 122 fire investigations (NLVFD 2010). Public education activities reached over 62,000 citizens at 226 public events. The Tactical Medic Program started operations on April 18, 2007, and made 68 deployments in 2007 and 54 deployments in the first 4 months of 2008, all in support of the North Las Vegas Police Department. Additionally, 30 members of the North Las Vegas Fire Department are active participants in the Federal Emergency Management Agency's Nevada Urban Search and Rescue Task Force 1. Technical rescue and hazardous material response programs are currently under development.

Volunteer Fire Departments. Nye County's main hub for coordinating volunteer fire protection is Station 51, located in Pahrump, Nevada. Station 51 is the home of a quick response fire/HAZMAT [hazardous materials]/EMS [emergency medical services] station, and it also functions as the Southern Emergency Operations Center for the southern part of the county. Station 51 consists of 3 paid staff and approximately 20 volunteers. Equipment for Station 51 consists of Engine 51, Engine 52, Brush 51, Rescue 51, HAZMAT 51, Tender 51, Medic 51, Command 51, Command 52, two quads, a trailer containing decontamination supplies, a mass casualty trailer, a mobile command post, and a disaster supplies bus.

Station 11 is located in Tonopah, Nevada, and is the base for the Tonopah Volunteer Fire Department, Tonopah Volunteer Ambulance Service, and Emergency Services Northern Office and serves as the Emergency Operations Center for the northern part of the county. Station 11's volunteer fire department consists of approximately 20 volunteers and no paid staff. Equipment for Station 11 consists of Engine 11, Engine 12, Rescue 11, Ladder 11, Command 11, and a four-by-four utility terrain vehicle with a patient rescue trailer. The Tonopah Volunteer Ambulance Service, an intermediate-level service, has approximately 15 volunteers, and its equipment consists of Medic 11, Medic 12, a mass casualty trailer, and a disaster response trailer. The Emergency Services Department has 2 paid staff members at this location.

Station 21 is located in Round Mountain/Smoky Valley, Nevada, and is the base for the Round Mountain Volunteer Fire Department. A staff of approximately 14 volunteers and 1 paid member respond to fire and rescue calls from this station. Station 21 is also the home of the Northern HAZMAT Team. Equipment includes Engine 21, Engine 22, HAZMAT 21, Rescue 21, Command 21, and a trailer containing decontamination supplies. The Smoky Valley Volunteer Ambulance Service is an intermediate-level service with approximately 16 volunteers. Equipment includes Medic 21 and Medic 22.

Station 31 is located in Beatty, Nevada, and is the base for the Beatty Volunteer Fire Department and Beatty Volunteer Ambulance Service. Approximately 12 volunteers serve on the fire department and there is 1 paid station superintendent/responder. Equipment includes Engine 31, Engine 32, Rescue 31, Tender 31, Ladder 31, a quad, and Command 31. The Beatty Volunteer Ambulance Service consists of approximately 10 volunteers, who respond at an intermediate level. Equipment includes Medic 31, Medic 32, a mass casualty trailer, and a Point of Distribution trailer.

Station 61 is located in Manhattan, Nevada, and is the base for the Manhattan Volunteer Fire Department. Approximately eight volunteers serve on the department. Equipment includes Engine 61 and Rescue 61.

Station 71 is located in Gabbs, Nevada, and is the base for the Gabbs Volunteer Fire Department and the Gabbs Volunteer Ambulance Service. Approximately six volunteers serve on the fire department. Equipment includes Engine 71 and Rescue 71. The Ambulance Service has approximately eight volunteers and the equipment includes Medic 71 and Medic 72.

Station 81 is located in Belmont, Nevada, and is the base for the Belmont Community Emergency Response Team (CERT). Approximately 10 volunteers serve on the CERT team. Equipment includes CERT 81, CERT 82, and a mobile fire attack trailer.

Station 91 is located in Duckwater/Currant Creek, Nevada, and is the base for the volunteer fire department. Approximately eight volunteers serve on the fire department. Equipment includes Engine 91, Command 91, and a mobile fire attack trailer.

Each station has dedicated mutual aid areas and Station 51 provides mutual aid to Southern Inyo County in California, Clark County, BLM, USFWS, the NNSS, throughout Nye County, and anywhere dispatched, as determined by the director of emergency services. The NNSS Fire/HAZMAT/EMS Team provides mutual aid to Nye County in Crystal, Nevada, and along the transportation corridor leading to Amargosa.

The Pahrump Valley Fire Department is a combination career and volunteer department with 22 career positions (RCI 2005). According to a 2004 study, 22 volunteers were reported at the time of the assessment (RCI 2005). Seven career firefighters are on duty each day. Four fire stations are associated with the Pahrump Valley Volunteer Fire Department. Two fire stations are staffed on a 24-hour basis with career personnel; one is manned by a combination of career and volunteer personnel; and one is manned by volunteers and houses reserve equipment.

Equipment consists of one command car, four engines (plus one reserve engine), six medics, three tenders, two brushes, one tower ladder, one rescue unit, two attack units, and one hazardous material response unit.

Onsite Fire Protection. The fire protection capacity of the NNSS is structured to accommodate current mission requirements, and a self-contained firefighting department is responsible for suppression and prevention. Other services include rescue, hazardous material response, training of fire personnel, fire prevention inspection, installation of all fire extinguishers at the NNSS, and fire-prevention awareness programs. NNSS Fire and Rescue operates out of two fire stations; one is in Mercury, and a newly constructed station in Area 6 provides rapid response to emergencies in the forward areas of the NNSS (DOE 2009f).

4.1.4.6.4 Health Care

Health care services within the ROI include 15 full-service hospitals located in Clark and Nye Counties. These facilities provide a wide array of medical services, including physical examinations; treatment of illness; emergency, intensive, and coronary care; internal medicine; x-ray and laboratory; infertility, obstetrics, and gynecology; neonatal intensive care; inpatient and outpatient surgery; pharmaceuticals; optometry; dental; respiratory therapy; and skilled nursing and long-term care. Services provided by three special service hospitals include psychiatric, chemical dependency, and mental health treatment. In addition, the Clark County Health District provides public health services and coordinates the EMS system. The following information pertains to hospitals and medical facilities within the ROI.

Boulder City Hospital is a nonprofit, 20-bed acute-care critical access hospital and a 47-bed skilled nursing facility located in Boulder City, Nevada (Boulder City Hospital 2010). It has a medical staff of nearly 200 physicians, representing nearly 26 specialties.

Centennial Hills Hospital and Medical Center opened in January 2008 and is located in northwest Las Vegas. It provides 171 beds, including a 41-bed Emergency Department, 25-bed Women's Center, 6-bed Level II Nursery, 32-bed Intensive Care Unit, and 108 medical/surgical beds. It also provides a wide range of medical services and procedures (Centennial Hills Hospital 2011).

Mountainview Hospital is a short-term hospital located in Las Vegas, Nevada (NV Energy 2010c). It has 235 beds and two specialty units: adult and pediatric (191 beds) and intensive care (36 beds).

Desert Springs Hospital is a 351-bed, acute-care facility located in southeast Las Vegas that has been providing for the health care needs of Las Vegas residents since 1971 (NV Energy 2010c). The hospital provides 24-hour emergency services, including a fast-track area in the emergency room to treat less-acute patients and comprehensive cardiology services. New facilities include a maternity center featuring labor, delivery, recovery, and postpartum suites; a third catheterization laboratory; and a 107,000-square-foot medical office building and outpatient surgery facility.

Lake Mead Hospital Medical Center has served the North Las Vegas Community since 1960 (NV Energy 2010c). The facility now has 198 licensed beds. The medical staff consists of over 800 specialists and primary care physicians.

Mike O'Callaghan Federal Hospital is a joint venture between the U.S. Department of Veterans Affairs and DoD (99th Medical Group Hospital, Nellis Air Force Base) (NV Energy 2010c). It is situated on a 49-acre site adjacent to Nellis Air Force Base, approximately 11 miles northeast of downtown Las Vegas.

The facility has 114 beds, 52 of which are designated for Department of Veterans Affairs use: 36 for medical/surgical, 14 for psychiatric, and 2 for intensive care/coronary care.

St. Rose Dominican Hospital is a system of three acute-care facilities in southern Nevada: the Rose de Lima Campus in Henderson (opened in 1947), the Siena Campus in Henderson (opened in 2000), and the San Martín Campus in southwest Las Vegas (opened in 2006). Combined, the three campuses offer more than 500 patient beds and have a collective staff of nearly 3,000 employees.

Southern Hills Hospital, located in southwest Las Vegas and opened in 2004, is a full-service hospital. There are a total of 139 beds. Services include an accredited Chest Pain Center, certified Primary Stroke Center, the Nevada Neurosciences Institute, children's services, Emergency Department, and maternity services (Southern Hills Hospital 2011).

Spring Valley Hospital Medical Center opened in October 2003 and is a full-service acute care facility. It has 231 beds, including 105 medical/surgical beds, 22 rehabilitation beds, 18 intensive care beds, 21 intermediate care beds, 12 chest pain observations beds, 28 women's center beds, 9 Level II nursery beds, and 18 Level III Neonatal Intensive Care Unit beds (Spring Valley Hospital 2011).

Summerlin Hospital Medical Center features 169 licensed beds, all of which are private patient rooms (NV Energy 2010c). The acute-care facility has adjoining facilities for outpatient services such as surgery, a laboratory, and radiology, as well as two medical office buildings.

Sunrise Hospital and Medical Center is located in Las Vegas (Healthgrades 2010). This short-term hospital has 610 beds and three specialty units, including adult and pediatric (436 beds), intensive care (92 beds), and surgical intensive care (10 beds).

University Medical Center, which is affiliated with the University of Nevada School of Medicine, is the premier teaching hospital in the state. The medical center serves the medical needs of southern Nevada and parts of California, Utah, and Arizona, as well as those of millions of visitors to Las Vegas.

Valley Hospital Medical Center, founded in 1972, is a licensed, 409-bed, full-service acute-care hospital located in the heart of Las Vegas that serves the greater Las Vegas area and the surrounding rural communities of southern Nevada (NV Energy 2010c).

The Desert View Regional Medical Center, located in Pahrump, Nevada, opened April 27, 2006. It is a short-term acute-care hospital with 24 private rooms, expandable to 50 beds, a 24-hour emergency room, two surgical suites; diagnostic imaging; physical therapy; delivery suites and a nursery; a diagnostic sleep center; and a decontamination room.

Nye Region Medical Center is located in Tonopah (NV Energy 2010c). It has 44 beds, one physician, and three nurses.

Onsite Health Care. An eight-bed dispensary in Mercury serves as a clinic for the NNSS. Facilities include rooms for emergency care; examination and treatment; and x-ray and associated darkroom equipment, offices, and storage. First-aid stations are located near field activities for quick treatment of personnel.

4.1.5 Geology and Soils

This section presents an analysis of the regional geology and soil environment, including descriptions of the physiography, stratigraphy, structural geology, seismicity, volcanism, and mineralogy of the NNSS and the surrounding region. Although construction, facility operations, and surface and subsurface tests have reworked localized areas of soils and bedrock, the condition of the regional geology and soils remains largely unchanged. This section provides an updated review of the geology and soils in the affected environment as presented in Chapter 4, Section 4.1.4, of the *1996 NTS EIS*.

Beginning in 1951, shortly after the establishment of the NNSS, geologic studies were commissioned for the site. Initially used to support nuclear testing in the 1950s and 1960s, the surface and subsurface geologic surveys were gradually expanded and then compiled into a series of databases now used to create a comprehensive knowledge of the region. Geologic mapping, site-wide geophysical surveys, exploratory drilling and testing, fault mapping, and detailed geotechnical studies have all contributed to the wide-ranging knowledge of the area's geology. The results of the military and academic investigations have been described in a Geological Society of America Memoir in 1968 (Eckel 1968), and updated with new groundwater studies (Laczniak et al. 1996; Sweetkind et al. 2010), and geology reports on the Yucca Mountain area (Stuckless and Levich 2007). The Annual NNSS Environmental Report summarizes the general geologic knowledge at the site, which has remained consistent from 2008 through 2011 (DOE/NV 2009d, 2011). Because of continuous investigations, the NNSS is considered geologically one of the most well-researched regions in the United States (DOE 1996a).

4.1.5.1 Physiography

The NNSS is located in the southern part of the Great Basin, the northernmost subprovince of the Basin and Range Physiographic Province. This region is characterized by north–south-trending, linear mountain ranges that are separated by broad sediment-filled basins. The mountain ranges, formed by tilted, fault-bounded blocks of bedrock, can extend as much as 50 miles in length and 15 miles in width. Extensive fault zones, including the Walker Lane shear zone, its subsidiary, the Las Vegas shear zone, and the southwestern Nevada volcanic field, also affect the area topography. The Walker Lane shear zone transverses the TTR from the north to the southeast and gradually merges with the Las Vegas shear zone, which borders the southern edge of the NNSS (Faulds and Henry 2008). The flat uplands of the northwest NNSS, including the Pahute and Rainier Mesas, are composed of volcanic units of the southwestern Nevada volcanic field. Vertical relief at the NNSS varies from 3,280 feet above sea level at Frenchman Flat and Jackass Flats to 7,216 and 7,675 feet above sea level on Pahute and Rainier Mesas, respectively.

The Great Basin Subprovince is an internally draining basin with no outlet to the Pacific Ocean. Two deserts, the Mojave Desert and the Great Basin Desert, are located within the Great Basin Subprovince and are characterized by their arid conditions and landforms formed by wind and water. The northern section of the NNSS is located in the Great Basin Desert; the southern third is located in the Mojave Desert, with transitional valleys in between. The topography of the region includes rugged mountain and mesas with steep sides. Eroded material from the ranges collects on alluvial fans that extend into the valley floors. The sediments in the alluvial fans and valleys are typically composed of coarse to fine alluvial debris (boulders, cobbles, sand, silt, and clay).

Yucca Flat and Frenchman Flat are topographically closed valleys. In the lowest portions of these valleys, water from snowmelt and other runoff from higher elevations collects during wet seasons. The collected water contains fine sediments and dissolved solids, including salts. As the water evaporates, these fine sediments and evaporite salts are left behind to form a playa. Jackass Flats is topographically open and drains via Fortymile Wash to the south off the NNSS.

Past actions by DOE, particularly underground nuclear testing, have significantly altered the topography at the NNSS. Yucca Flat and, to a much lesser extent, Pahute and Rainier Mesas are pockmarked with craters from surface explosions and collapsed test cavities. Buckboard Mesa, Shoshone Mountain, Dome Mountain, and Frenchman Flat also exhibit evidence of past tests. Other excavations on the NNSS include blasting for road construction, excavation of aggregate material (e.g., sand and gravel), flood and drainage control, and historical mining tunnels and shafts.

4.1.5.2 Regional Geology

The NNSS is located in a region of complex stratigraphic and structural elements that combines volcanic uplands and calderas, Basin-and-Range faulted bedrock, Mesozoic thrust faults, and modern alluvial basins. All of these features overlay a basement complex of highly deformed Proterozoic- and Paleozoic-age sedimentary and metasedimentary rocks. Approximately 40 percent of the NNSS surface is alluvium-filled basins; 40 percent is Tertiary-age volcanic rocks; and 20 percent is Paleozoic- and

Precambrian-age sedimentary rocks (DOE/NV 2011). **Figure 4–8** presents a simplified map of the geologic units expressed at the surface. **Table 4–15** presents a description and age of the geologic units found at the NNSS. A detailed compilation of the rock units at the NNSS can be found in Slate et al. (1999).

The regional tectonic history is complex, and the geologic record reflects a history of deposition of marine sediments, compressional deformation, erosion, and volcanic activity that spans an interval of hundreds of millions of years. During the late Paleozoic era, the region was a stable continental shelf, periodically covered by shallow seas that gradually deepened westward. Thick layers of limestone, dolomite, shale, and sandstone deposited in the Cambrian through the early Devonian periods are present on the NNSS. In the late Devonian era, uplift west and north of the NNSS resulted in the seas retreating, erosion, and deposition of Mississippian sandstones and shales in a foreland basin (Poole and Sandberg 1991).

Major east–west compression and deformation occurred during an event called the Sevier orogeny, which produced regional thrusts, folds, and strike-slip faults. As a result of the thrust faulting, sheets of older Paleozoic sedimentary rocks were thrust over younger rocks. Erosion continued through the early Tertiary period. This erosion was interrupted in the Miocene by episodes of silicic volcanism, emplacement of granitic rocks, and extensional deformation as widespread normal faults and local strike-slip faulting. Crustal extension in this region has continued for the last 20 million years but at diminished rates in the Pliocene and Quaternary (DOE 1996c). Extensional deformation accompanied by local strike-slip faulting formed large basins in the east (Yucca Flat, Frenchman Flat) and the south (Jackass Flats) of the NNSS; this deformation exposed Paleozoic and Mesozoic rocks in the ranges flanking the basins of Yucca and Frenchman Flat. The valleys subsequently filled with coarse gravels and sands eroded from the mountain ranges, which are layered with finer grains that were reworked by wind and water. Crustal extension is continuing today, and is recorded by instrumentally located earthquakes and the presence of local fault scarps in Quaternary alluvial deposits.

Most of the uplands along the western edge of the NNSS and the TTR are covered by middle Tertiary-age volcanic rocks that are part of the southwestern Nevada volcanic field (Sawyer et al. 1994). This volcanic field includes a broad volcanic plateau underlain by tuffs and lavas that erupted from multiple caldera complexes in the area. At least 17 ash-flow tuff sequences have been associated with eruptions from seven major, overlapping caldera complexes (Byers et al. 1989; DOE 1996c; DOE/NV 2011). Most of the calderas were formed from large-volume eruptions approximately 16 to 7.5 million years ago, while the youngest caldera-forming events most likely occurred about 7.5 million years ago, forming the Stonewall Caldera (DOE 1996c). These eruptions deposited high silica deposits of ash, tuff, and lava. The multiple layers of ash-flow tuff and lava are seen exposed today in the complex Tertiary volcanic sequences and mountain ranges. Approximately 8 million years ago, volcanic activity in the area transitioned to low-volume, nonexplosive eruptions of basalt scoria and lava. The volcanic activity is marked by basaltic scoria cones and associated lava flows at Crater Flat and Frenchman Flat. Since the last major eruptions about 7.5 million years ago, only scattered, short-duration volcanic activity has occurred in Nevada (DOE 1996c). The waning tectonism and transition to small-volume basaltic volcanism indicate that future large-scale volcanic activity is not expected at the NNSS (DOE 1996c).

There are over 300 described Tertiary volcanic units at the NNSS (DOE/NV 2011; Warren et al. 2000, 2003), although limited units are often grouped into larger, more-extensive units. Due to the large number of volcanic units and multiple caldera sources, the volcanic stratigraphy has been subsequently revised and updated with additional research. Byers et al. (1989) presents a detailed review of the past studies and the evolution of concepts on calderas of the southwestern Nevada volcanic field from 1960 to 1988; this work was updated by Sawyer et al. (1994). The revised stratigraphy was used to generate complex hydrogeologic models for use in analyzing the movement of groundwater near testing locations in support of the Underground Test Area (UGTA) Project.

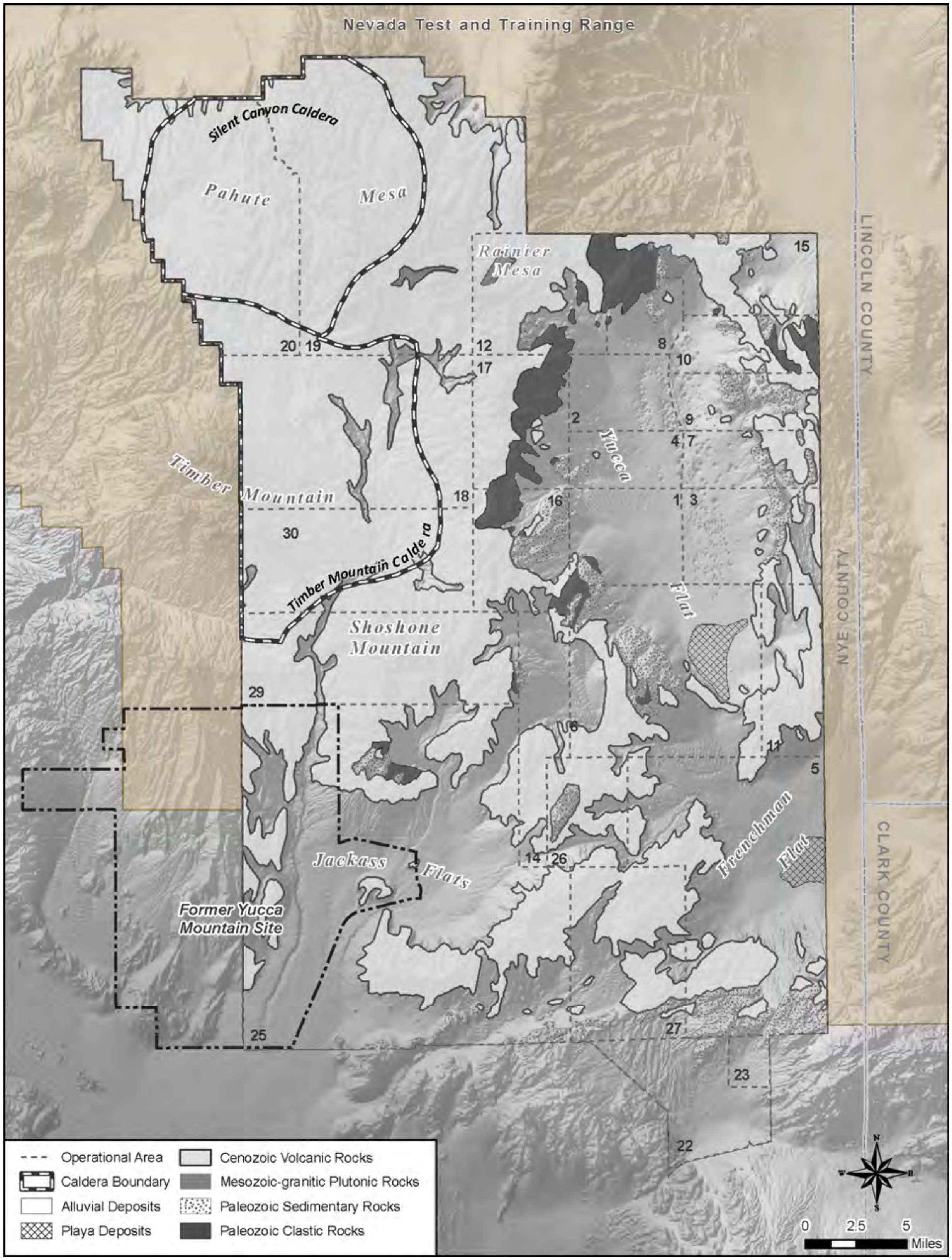

Figure 4–8 Simplified Map of the Geologic Units

Table 4–15 Summary Stratigraphy of the Nevada National Security Site

Era	*Period*	*Series*	*Group*	*Map Units*	*Description*	*Thickness*	*Example Location*
Cenozoic	Quaternary	Holocene – Present Day	Surficial & Volcanic Deposits	Young Alluvial Deposits	Intermixed gravel, sand, and silt, unconsolidated to poorly consolidated, poorly to moderately well-sorted, locally cross-bedded.	32.8 feet	Fortymile Wash
				Playa	Silt, fine sand and clay, poorly to moderately well-consolidated, calcareous, moderately well-sorted. Ocasionally saline.	65.6 feet	Yucca Flat, Frenchman Flat
		Early Holocene/ Pleistocene		Intermediate Alluvial Deposits	Intermixed and interbedded gravel, sand, and silt. Clasts are light and pinkish gray, with variable sorting and cross-beds. Moderately to densely packed pavement.	Up to 98.4 feet	Yucca Flat, Frenchman Flat
		Pleistocene		Youngest Basalt	Isolated black and reddish-brown cinder cones, lava flows, feeder.	Variable	Crater Flat
		Middle to early Pleistocene/ Pliocene		Old Alluvial Deposits	Intermixed and interbedded gravel, sand and silt, light brownish gray to light gray. Generally poorly sorted and moderately cemented with carbonate.	Greater than 131 feet	Yucca Flat, Frenchman Flat, Jackass Flat
	Tertiary (Miocene)	Miocene	Thirsty Canyon Group	Gold Flat Tuff, Pahute Mesa and Rocket Wash Tuffs, Basalt of Thirsty Mountain, Stonewall Flat Tuff	Ash-flow tuff, basalt lava flows and nonwelded tuff from the Black Mountain caldera. Multiple sequences of tuff formations from sequential volcanic eruptions. High-alkali feldspar and low-plagioclase minerals present in tuff.	Greater than 1,640 feet	Pahute Mesa, Buckboard Mesa
			Timber Mountain Group	Ammonia Tanks Tuff, Rainier Mesa Tuff	Rhyolite ash-flow tuff, subordinate rhyolite lava flows and volcanic domes, with related intracaldera breccias. Volcanic rocks erupted from the Timber Mountain caldera complex. Contains an abundance of quartz phenocrysts in rhyolite and iron-magnetic minerals in upper layers. Also contains some thin basaltic lava flows.	Greater than 1,640 feet	Timber Mountain Caldera Complex, Pahute Mesa
			Paintbrush Group	Paintbrush Tuff, Wahmonie Formation	Alkali rhyolite nonwelded tuff and lava flows erupted form Claim Canyon caldera. Biotite, hornblende, and some clinopyroxene present in sequence through the group. Rhyolite lava flows and related nonwelded tuff.	3,608 feet	West of Frenchman Flat, Shoshone Mountain, Yucca Mountain
			Crater Flat Group	Prow Pass Tuff, Bullfrog Tuff	Assemblage of ash-flow tuff and related lava flows and airfall tuffs.	Variable	South of Timber Mountain

Era	***Period***	***Series***	***Group***	***Map Units***	***Description***	***Thickness***	***Example Location***
			Belted Range Group	Grouse Canyon Tuff, Tunnel Formation, Comedites of Quartet Dome and Split Range	Voluminous assemblage of peralkine ash-flow tuff and related lava flows and air fall tuff. The source calderas were buried under later eruptions.	Greater than 1,640 feet	Pahute Mesa, Belted Range
		Oligocene/ Cretaceous		Gabbro dikes	Dark-green hornblende gabbro and diorite dikes that cut pre-Tertiary rocks. Medium-grained texture, with plagioclase, hornblende, clinopyroxene, and biotite as the component minerals.	Variable	Northern margin of Yucca Flats
		Upper		Granitic intrusion	Medium-grained intrusive rocks, hornblende-biotite granodiorite, quartz monzonite. Includes Climax stock.	Variable	Northern edge of Yucca Flat
Mesozoic	Cretaceous	Lower		Tippipah Limestone	Light to medium gray and light brown well-bedded marine limestone, calcareous mudstone, and minor chert pebble conglomerate. Forms ledges easily.	4,101 feet	West of Yucca Flat
Paleozoic	Permian	–		Eleana Formation	Chert-rich sandstone and pebble conglomerate, siliceous siltstone.		
	Penn.	–					
	Miss.	Upper and Middle		Guilmette Formation	Thick-bedded finely to coarsely crystalline marine limestone. Contains sandy limestone and thick beds of quartz sandstone; quartzite beds are brecciated.	1,148 feet	Shoshone Mountain
	Devonian	Upper, Middle, Lower		Slope-facies carbonate	Dark gray limestone, dolomite, silty carbonate rocks, well-bedded, locally laminated, debris-flow deposits. Locally fossiliferous.	Variable	Eastern Rainier Mesa
		Middle		Simonson Dolomite	Bedded dolomite and local sandy dolomite. Includes silty and cherty dolomite at base. Fossils present.	984 feet	
		Lower		Sevy Dolomite and Laketown Dolomite	Thick-bedded dolomite, beds of quartz, commonly brecciated. Base is well-bedded, locally cherty, with fossils present.	3,166 feet	West of Yucca Flat
		Lower Devonian/ Upper Silurian		Lone Mountain Dolomite	Varying color dolomite with increased bedding at base. Sparse fossils.	1,607 feet	Yucca Mountain
	Silurian	Upper		Lone Mountain Dolomite Ely Springs Dolomite	Varying color dolomite with increased bedding at base. Sparse fossils. Two major units: Upper is gray dolostone with silty and clay-rich dolostone, and a thin sandy zone. Lower is fine-grained, cherty dolomite.	Upper: 1,607 feet Lower: 164 to 492 feet	Yucca Mountain
	Ordovician	Middle		Eureka Quartzite	Two major parts. Upper is white, very fine medium-grained sandstone and quartzite. Lower is varicolored, medium-grained quartzite interval with thin limestone and dolomite.	246 to 475 feet	

Era	Period	Series	Group	Map Units	Description	Thickness	Example Location
		Middle to Lower	Pogonip Group	Antelope Valley Limestone, Ninemile Formation	Medium, well-bedded silty limestone, dolomite, with chert and siltstone.Various invertebrate fossils present.	3,444 feet	
	Cambrian	Upper		Nopah Formation	Poorly to well-bedded carbonates with shale and siltstones. Includes Dunderberg Shale Member. Invertebrate fossils present.	2,362 feet	
		Upper to Middle		Bonanza King Formation	Well-bedded dolomite and limestone with a banded appearance.	4,199 feet	East of Yucca Flat
		Middle to Lower		Carrara Formation	Heterogeneous sequence of shales, siltstone, sandstone, limestone and silty limestone. Clastic rocks at base, silty limestone beds at top. Stromatolith, trilobite fossils present.	1,148 to 1,541 feet	
		Lower		Zabriskie Quartzite	Resistant, massive, white quartz, pink quartz, and red quartz sandstone.	98.4 to 1,148 feet	
		Late		Wood Canyon Formation	Quartz sandstone, mica and quartz sandstone, clay-rich sandstones, and magnesium carbonates; may be slightly metamorphosed. Includes Stirling Quartzite.	2,296 to 3,772 feet	North of Rainier Mesa
				Stirling Quartzite	Medium to thick-bedded, commonly laminated, fine-grained quartz sandstone, mica quartz sandstone, interbedded with pebbly sandstone. Also limestone and dolostone. Locally metamorphosed.	4,921 feet	
Proterozoic	Precambrian	–		Johnnie Formation	Thick-bedded, few cross-beds, locally pebbly quartz sandstone, with laminated mica siltstone, limestone, and calcareous siltstone.	2,952 to 6,561 feet	
				Metamorphic and intrusive rocks	Light-gray and brown biotite schist, biotite-hornblende schist, and biotite-epidote schist intruded by gneissic monzogranite. Some aplite and pegmatite dikes, quartzofeldspathic gneiss and buiotite schist, minor metaconglomerate, and marble also present.	Bedrock	Gold Flat, Funeral Mountains

Source: Slate et al. 1999.

Soils form in the youngest geologic material at the NNSS, the late Tertiary and Quaternary alluvial, colluvial, spring, lake, playa, and eolian (windblown) deposits. The unconsolidated sediments are formed by erosion of Paleozoic and Tertiary volcanic materials from the surrounding ranges that are deposited in the alluvial fans formed at the basin margins. The alluvial fans consist of interbedded gravel, sand, and silt that vary in their cementation. Valleys that only have internal drainage often collect shallow water after seasonal storms and snowmelt in the spring. As the water evaporates, it leaves stratified lake bed sediments and precipitated salts. The resulting playa sediments are typically bedded sand, silt, or clay. The playa typically looks like a dry lake bed that may contain water after a seasonally high runoff. Sand and silt from the playas can be eroded, transported by wind, and subsequently reworked by moving water. However, most sediments remain stable as long as they are not disturbed.

4.1.5.2.1 Site-Specific Geology

The oldest bedrock at the NNSS is the Paleozoic and Proterozoic sedimentary rock, which includes dolomite, limestone, quartzite, and mudstones (see Table 4–15). The carbonate section of the sedimentary rocks often forms the primary regional aquifer and a "basement" for the Great Basin's hydrology (DOE/NV 2011). The Paleozoic and Precambrian rocks have been subjected to thrust and extensional faulting, as described in Section 4.1.5.2.2. The rocks were formed from marine sediments and have a thickness of up to 32,800 feet (DOE/NV 2011).

The oldest formations of the Proterozoic basement consist of approximately 9,800 feet of lower Cambrian and Proterozoic quartzite and siltstones (DOE 1996c). Above these formations is approximately 15,100 feet of Cambrian through Devonian dolomite, interbedded limestone, and thin but persistent shale and quartzite layers. The youngest of the basement rocks is the Missippippian Eleana formation, which outcrops along the western edge of the Yucca Flat basins, and the Pennsylvanian limestone, which overlies the Eleana formation. In western Yucca Flat, east of the Eleana Range, the Paleozoic-age carbonate rocks have been thrust over the Eleana formation. More information on the basement formations at the NNSS is presented in several publications (Cole 1997; Cole and Cashman 1999; Trexler et al. 2003; Slate et al. 1999).

There are two outcroppings of Mesozoic intrusive rocks at the NNSS; both are granitic masses. The Gold Meadows Stock crops out north of Rainier Mesa, and the Climax Stock is located at the extreme north end of Yucca Flat (DOE/NV 2011). Three underground tests were performed within the Climax Stock. The stock is a granitic rock (quartz monzonite and granodiorite) of Late Cretaceous age that intruded into the Paleozoic sediments.

Pahute and Rainier Mesas are high volcanic plateaus dissected by modern drainages. The mesas are located in the northern portion of the southwestern Nevada volcanic field. Their Tertiary ash-flow tuffs were derived from the Timber Mountain–Oasis Valley caldera complex and the Silent Canyon and Black Mountain calderas. Pahute Mesa was formed from an overlapping complex of fault-controlled calderas, while the laterally extensive tabular outflow sheets of welded tuff covered the surrounding area. During faulting and uplift, the softer pre-Tertiary material was exposed, while the welded tuffs and lava flows resisted erosion. The result was flat-topped mesas with steep sides adjacent to down-dropped valleys. The Timber Mountain caldera, located to the southwest of Pahute and Rainier Mesas, is listed as a national natural landmark by the National Park Service (DOE 1996c).

There are two buried calderas at Pahute Mesa; drill hole and geophysical data indicate that their morphology may be largely controlled by the Basin and Range faults (Warren et al. 2000). All of the tests at Pahute and Rainier Mesas were underground tests that occurred within the Tertiary volcanic rocks and did not penetrate the pre-Tertiary bedrock.

Other historical testing locations are located at Buckboard Mesa, Dome Mountain, and Shoshone Mountain. Buckboard Mesa is located along the northeastern edge of Timber Mountain, while Dome Mountain is a foothill to the southeast. These two sites within the Timber Mountain caldera complex have similar geologic characteristics, including a thick sequence of volcanic rocks that also includes rhyolitic lavas and ash-flow tuffs; volcanic-derived sediments, including sandstone and conglomerate; and basalts. Radial fracturing and faulting typical of a caldera are present at both of these sites. Shoshone Mountain is located southeast of Timber Mountain. The mountain is capped by a unit called rhyolite of Shoshone Mountain, and lithic ridge tuff. North of Shoshone Mountain, the Paleozoic sandstone and conglomerate of Eleana formation and carbonates of the Tippipah limestone are exposed. Quartzite of the Guilmette formation is also present in the area.

Yucca Flat and Frenchman Flat are alluvium- and tuff-filled valleys bounded by mountain ranges with Paleozoic sedimentary and Tertiary volcanic rocks. Thick layers of sand and gravel have collected at the base of these valleys. At Yucca Flat, subsurface gravity surveys using isostatic gravity data from surface stations have estimated the thickness of the alluvial deposits to be up to 8,200 feet (Phelps et al. 1999). From the edge of the mountain ranges, coarse-grained deposits in alluvial fans grade laterally to clay deposits at playas in the lowest part of the valleys. Some windblown sand and silt may also collect at the basin troughs.

4.1.5.2.2 Structural History

As a result of the depositional periods interrupted by tectonic upheaval, the structural record in the region is complex. Geologic structures, such as faults and folds, strongly affect the regional hydrology. Groundwater predominantly travels through cooling joints and fractures, often enhanced proximal to faults. Other structures such as caldera faults or normal faults modify surface drainage and erosion patterns.

Five types of structural features occur in the region around the NNSS: (1) thrust faults (e.g., Belted Range thrusts); (2) normal faults (e.g., the Yucca and West Greeley faults); (3) transverse faults and structural zones (e.g., the Rock Valley fault, Walker Lane shear zone); (4) calderas (e.g., the Timber Mountain and Silent Canyon caldera complexes); and (5) detachment faults (e.g., the Fluorspar Canyon–Bullfrog Hills detachment fault).

The Belted Range thrust fault is the principal pre-Tertiary structure in the NNSS region and, therefore, only affects the pre-Tertiary rocks in the area. The fault can be traced or inferred from Bare Mountain, just south of the southwest corner of the NNSS, to the northern Belted Range north of the NNSS, a distance of more than 81 miles (DOE/NV 2011). The Belted Range thrust fault is an eastward thrust, which generally places late Proterozoic–early Cambrian rocks over rocks as young as the Mississippian Period. Several overlapping thrust faults occur east of the main thrust fault. Deformation related to the Belted Range thrust fault occurred sometime between 100 and 250 million years ago.

Normal faults associated with the formation of the Basin and Range mountain sequence are the most recent structural elements. The high-angle faults cut across Paleozoic volcanic, Precambrian sedimentary rocks, and early Cenozoic volcanic formations. Most of the faults in the region are northwest–northeast-striking and high angle (DOE/NV 2011). Good examples of normal faults at the NNSS are found at Yucca and Frenchman Flats. In Yucca Flat, the faults generally trend north–south; in Frenchman Flat, the faults generally strike west–southwest in the south, curving northward in the northern portion of the valley. Evidence of normal faulting is also visible in the Tertiary tuffs of Pahute and Rainier Mesas (e.g., the West Greeley fault) (DOE/NV 2011). Shoshone Mountain has normal faults that also have a strike-slip component.

The Walker Lane shear zone trends northwest to southeast of the TTR along the western edge of the NNSS (DOE 1996c). The Walker Lane shear zone is a major strike-slip fault zone that extends several hundred miles to merge with the Las Vegas shear zone. To the west of the Walker Lane shear zone and northwest of the NNSS is a series of volcanic centers, including Goldfield, Cactus Range, Stonewall Mountain, and Mount Helen (DOE 1996c).

4.1.5.2.3 Faulting and Seismic Activity

As seismic activity still occurs in the Basin and Range Physiographic Province, there have been earthquakes in the recent past around the NNSS. In addition, historical nuclear testing has generated ground motion and triggered seismic activity that could be felt miles away from the testing sites. Seismic activity in the Great Basin tends to be concentrated towards the west and, to a lesser extent, the east margins of the basin (USGS 2010a). Seismic activity in the NNSS region was described by Vortman (1991). The analysis determined that, from 1868 to 1991, 11,988 seismic events were recorded within 120 miles of the NNSS. Of these events, 8,161 were naturally occurring and 3,827 were induced by humans (DOE 1996c). This is a minimum count of events because placement of seismic instruments capable of detecting low-magnitude events in the region began after testing in 1951. Other studies of Great Basin earthquakes have compared the regional stress field to earthquake occurrence and surface fault expression (Rodgers et al. 1987; Gomberg 1991; Smith et al. 2001). These studies correlated some earthquakes with faults with surface expression, although they also identified many other moderate-size earthquakes that could not be associated with mapped faults (e.g., Smith et al. 1991).

The southern Great Basin contains many Quaternary fault traces, but few indications of movement in the last 10,000 years. Quaternary faults are identified by the presence of discontinuous scarps in volcanic material or in the alluvial sediment in valleys. The Spotted Range–Mine Mountain structural zone appears to be the only currently active fault system within the site. The Spotted Range–Mine Mountain structural zone is the revised name for the Cane Spring and Rock Valley fault zones that were described in the *1996 NTS EIS*. These faults are located in southwestern Frenchman Flat and have a generally northeast strike and a left-lateral slip (Anderson 1998a). The Mine Mountain fault is also associated with the Spotted Range–Mine Mountain structural zone and trends northeast–southwest, but is located along the southwestern edge of Yucca Flat, east of Shoshone Mountain (Anderson 1998b).

Small earthquakes have occurred at or near the Spotted Range–Mine Mountain structural zone; although no surface displacements were associated with them (Carr 1974; DOE 1996c). The last earthquake with a magnitude over 5.0 was near Little Skull Mountain in 1992. The shallow 5.6-magnitude earthquake was associated with the Spotted Range–Mine Mountain structural zone and was potentially caused by a 7.5-magnitude earthquake near Landers, California (DOE 1996c). This earthquake was notable because it damaged several of the NNSS facilities that were built prior to revised building codes. Since 1992, several smaller earthquakes ranging between magnitudes of 3.0 to 4.0 have occurred near Little Skull Mountain, Frenchman Flat, and Calico Hills, all in the southern portions of the NNSS. The largest of these earthquakes had a magnitude of 4.0 in 1997, south of Calico Hills; earthquakes with magnitudes of 4.5 and 4.8 occurred in January 1999 in Frenchman Flat; and a 4.6-magnitude earthquake occurred southwest of Skull Mountain in 2002 (USGS 2010b).

Yucca Flat is bisected by a fault scarp called Yucca Fault, which stretches approximately north–south. Several investigations of the scarp height and sediment ages indicate that most of the recent movement occurred between 10,000 and 130,000 years ago. There is also evidence that southern sections of the fault were displaced by testing activities (Anderson 1998c). Testing in Yucca Flat during the 1970s and 1980s generated manmade earthquakes with magnitudes between 4.0 and 6.0 (Rodgers et al. 2005).

The Bare Mountain fault forms the border on the eastern side of Bare Mountain and the western edge of Crater Flat, and is the southernmost portion of the Walker Lane shear zone. The fault strikes generally north, and dips to the east-southeast. Trenches along the fault found that surface movement along the fault has likely not occurred within 130,000 years, although when movement did occur in the southern portion, it occurred in multiple locations at once (Anderson 1998d).

There are two fault systems in the Yucca Mountain property: the eastern area, which contains the Soltario Canyon, Iron Ridge, Stagecoach Road, Paintbrush Canyon, and Bow Ridge faults; and the western area, which contains the Black Cone, northern and southern Crater Flat, Windy Wash and Fatigue Wash faults (Anderson 1998e, 1998f). The faults within the fault sequences have a braided appearance, with clockwise movement along northerly striking fault lines, and extensional displacement. The Yucca Mountain eastern group shows movement within the late Quaternary (less than 130,000 years), while the western group cuts across Holocene and latest Pleistocene deposits, which would indicate movement within the last 15,000 years (Anderson 1998e, 1998f).

Sandia National Laboratories developed a program for recording surface and subsurface motions resulting from underground nuclear explosions (DOE 1996c). Test-induced ground motion is affected by several factors: (1) the yield of the device; (2) ground-coupling at the source of the explosion, which is a function of the test design, depth of the device, local geology, and stratigraphy; (3) geological complexity along the ground wave path; and (4) the topography and geology at the location receiving ground motion (DOE 1996c). There is always some variation or unknown associated with estimating these factors; however, because of the long history of conducting nuclear weapon tests, ground motion predictions for tests at the NNSS have become increasingly accurate.

DOE policy is to design, construct, and operate its facilities so that workers, the general public, and the environment are protected from the impacts of natural phenomena hazards (including seismic events) on DOE facilities. Executive Order 12699, *Safety of Federal and Federally Assisted or Regulated New Building Construction* requires new buildings owned by the Federal government to be designed and constructed in accordance with appropriate seismic design and construction standards. DOE Order 420.1B, *Facility Safety*, and DOE G-420.1-2, *Guide for the Mitigation of Natural Phenomena Hazards for DOE Nuclear Facilities and Nonnuclear Facilities*, require that structures, systems, and components at DOE facilities be designed to withstand the effects of natural phenomena hazards using a graded approach. The graded approach is implemented by five performance categories requiring natural phenomena hazard protection, with Performance Category 0 for those structures, systems, and components requiring no natural phenomena hazard protection and Performance Category 4 for those structures, systems, and components requiring protection from the release of hazardous material similar to that provided by commercial nuclear power plants. For each performance category, DOE Standard 1020-2002, *Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities*, provides natural phenomena hazard design, evaluation, and construction requirements. DOE Standard 1023-95, *Natural Phenomena Hazards Assessment Criteria*, provides general and detailed criteria for establishing adequate design-basis load levels for DOE structures, systems, and components. DOE seismic design criteria also meet the requirements of the International Building Code (ICC 2009).

Seismic waves from nuclear explosions are believed to relieve tectonic stress, as seen by the aftershocks and movement along some Quaternary faults around the testing zones (DOE 1996c; Rodgers et al. 1991). The Yucca Fault and Carpetbag Fault, in Yucca Flat, showed indications of reactivation (Frizzell and Shulters 1990) by vertical and lateral displacement as a result of past nuclear detonations in Yucca Flat, though most of this movement is believed to be due to differential compaction of the porous alluvium over the existing buried fault scarp.

As a result of the ongoing moratorium on nuclear testing, the last underground nuclear tests at the NNSS occurred in 1992. The only architectural damage in surrounding communities resulting from underground nuclear testing occurred with test yields over 100 kilotons (DOE 1996c). For the period of time between the enactment of the Threshold Test Ban Treaty and the last underground nuclear test, only a few reports of very minor test-related damage were received (DOE 1996c). For communities farther than 30 miles from the test location, only multiple-story buildings would be affected by the larger tests, should testing resume (DOE 1996c).

4.1.5.2.4 Geotechnical Hazards

There are several geotechnical hazards at the NNSS and the TTR that may present a small risk to structures and roads. The main hazards include slope, soil, and ground instability. Areas near rugged topography and cliffs, combined with ground motion from earthquakes or nuclear tests (should testing resume), present an increased risk for slope stability hazards. However, most existing structures at the NNSS were built in locations with a lower potential for geotechnical hazards.

Many soils in Nevada contain clay minerals (e.g., montmorillonite) that swell when wet (DOE 1996c). Soils with a volume change of 3 percent or less when wet have low limitations when used for construction. Soils that swell from 3 to 6 percent of their volume have moderate limitations, while soils that swell greater than 6 percent of their dry volume have high limitations. Soils with moderate-to-high limitations due to shrink-swell properties could affect the stability of structures.

In general, ground stability is adversely affected by the presence of weathered or fractured bedrock, a high percentage of void space in the soil, lack of vegetation, freeze-thaw sequences, soil erosion from wind or flowing water, or ground motion. Knowledge of the subsurface activities is also important, as underground nuclear tests may have rubble chimneys that did not reach the surface, but would pose a hazard for any construction or other activity; these areas on the NNSS are known and are fenced and controlled.

Some soil processes enhance ground stability. Development of a pebble pavement as soil is stripped away by erosion, as well as accumulation of calcium carbonate minerals in subsurface horizons, can provide additional stability to certain structures. These areas are also less likely to be reworked by surface flow, so the soil column would be more comprehensive (Friesen 1992).

4.1.5.2.5 Geologic Resources

Potential geologic resources around the NNSS include mineral mining, aggregate, oil and natural gas, and geothermal resources. The availability of the resources has not changed significantly since the publication of the *1996 NTS EIS*.

For more than 100 years, sections of the southern Great Basin have produced amounts of base and precious metals, particularly gold, silver, copper, lead, zinc, tungsten, and uranium (Kral 1951). At the NNSS, there are four historic mining districts (SAIC/DRI 1991). These mining districts would be of interest for economic mining if the NNSS were open for public access. However, the NNSS has been closed to commercial mineral development since the 1940s (SAIC/DRI 1991).

Gold, silver, copper, lead, zinc, and mercury are present in the region around the NNSS. Gold and silver deposits are mined in the Goldfield mining district to the northwest of the Nevada Test and Training Range. Silver may still be present in the Oak Spring District, located at the north end of Yucca Flat; a significant amount of silver has been taken from the Groom mine (BLM 1979) located on the Nevada Test and Training Range, northeast of the NNSS. Economic quantities of copper, lead, and zinc have also been extracted from the Groom mine (SAIC/DRI 1991). On NNSS property, gold or silver deposits may be present in the Wahmonie District, located on the south-central NNSS, although prospecting in the 1930s found few ore deposits (SAIC/DRI 1991; NPS 2000).

In the 1950s and 1960s, commercial tungsten mining occurred at the Oak Spring District, which indicates that the NNSS has a moderate potential for economic tungsten deposits (SAIC/DRI 1991). Iron, in the form of magnetite, is also present in the region; however, there is a low potential for its commercial ores at the NNSS (Sherlock et al. 1996). Aggregate materials are typically mined from alluvial fans that border the region's mountain ranges. There are sufficient aggregate resources in the region to support foreseeable future demand from construction (DOE 1996c).

Uranium resources may be present in the northwestern part of the Nevada Test and Training Range (BLM 1979). Zeolitized rocks are common in the NNSS region. The widespread occurrence of zeolite deposits in the region suggests a low-to-moderate potential for development (SAIC/DRI 1991). Barite is known to occur in the Mine Mountain District, specifically in veins associated with quartz and mercury, antimony, and lead mineralization. However, barite veins at the NNSS are small and impure and do not represent a potential barite resource (SAIC/DRI 1991). Fluorite was reported to be present in the Calico Hills area, although little is known about the occurrence of fluorite, and its resource potential is assumed to be low to moderate (SAIC/DRI 1991).

The northeastern and southwestern portions of the NNSS and the Nevada Test and Training Range have a theoretical potential for hydrocarbon resources, as the rock type, age, and thermal maturity all contribute to a potential for pockets of oil or gas reserves (Grow et al. 1994). The northeastern and southern sections of the NNSS and Nevada Test and Training Range have potential for oil and gas, while the southern portion of the NNSS and southeastern portion of the Nevada Test and Training Range have a potential for gas. The presence of oil deposits at Railroad Valley, about 50 miles north of the NNSS, has led some researchers to hypothesize that large petroleum deposits could also be present under similar conditions at the site (Chamberlain 1991). However, Trexler et al. (1996) states that the likeliest formation (Chainman shale) is less extensive than previously thought, and may have lost as much as 80 percent of the original hydrocarbon content from migration. Other investigations (SAIC/DRI 1991; Garside et al. 1988) have also determined that large-scale hydrocarbon resources would be very unlikely because there are few laterally extensive carbon-bearing formations, the thermal maturity of the region is just within acceptability, and the large fault complexes throughout the NNSS are likely to have fractured the confining bedrock. No surface occurrences of oil, gas, coal, tar, sand, or oil shale at the NNSS have been reported, and numerous boreholes drilled at the site have not revealed any hydrocarbon shows within the likeliest formations (DOE 1996c). There are also no oil or gas wells at the NNSS (Hess and Johnson 1996).

4.1.5.2.6 Geothermal Resources

The extensional forces that create seismicity in the Basin and Range Province have also thinned the crust so that the upward flow of heat from the mantle warms the shallow bedrock. Increased heat flow through aquifer-bearing bedrock creates hot springs that could be amenable for use with a geothermal plant facility. Hot springs are not present at the NNSS; however, several are located west of the NNSS (Coolbaugh et al. 2005). If downhole temperatures near Yucca Mountain are representative (120 degrees Fahrenheit [°F] to 140 °F), groundwater temperatures in the region may be insufficient for some types of commercial power development (DOE 1988). However, a 1994 preliminary assessment of the geothermal potential of the NNSS found good potential for development of a moderate-temperature geothermal resource. This resource potential was judged suitable for development of a binary geothermal power plant (HRCES 1994).

An Enhanced Geothermal System, a type of binary geothermal power-generating technology, would use steam created in bedrock to turn electricity-generating turbines. The bedrock would need to be at least 356 ºF to heat the steam. An open system could use steam from hot-water-bearing bedrock (wet), while a closed system could use heat from bedrock that does not contain an aquifer (dry). In a review of geothermal resources, DOE/NNSA determined that several locations at the NNSS appear to have the heat potential to support an Enhanced Geothermal System (Brown 2009). Hot-water-bearing bedrock is located outside the NNSS at East Yucca Flat, Wahmonie Volcanic Center, Crater Flat, and Oasis Valley. The hot dry rock areas include Halfpint Range, Climax Mine, Gold Meadows, the Timber Mountain Caldera Complex, and Calico Hills.

4.1.5.3 Soils

There are few soil surveys for the NNSS and surrounding areas because the site was established as a nuclear weapons testing site prior to the nationwide soil survey program. Radioactivity and nuclear testing have also resulted in restricted ready access to some parts of the NNSS. Soil surveys internal to the NNSS have been conducted at locations of interest, particularly those associated with the Yucca Mountain site, new facility construction sites, and onsite waste disposal sites. However, most of the soil characterization is limited to a series of geotechnical descriptions for a particular construction project, rather than a regional soil analysis. These documents are used for internal uses and permit applications. A great deal of research at the NNSS has been focused on defining areas of contamination at testing locations and the movement of contaminants through the soil column.

Soils at the NNSS are similar to those throughout southern Nevada. Most of the soils form on the alluvial fans and valley floors, with thin soils forming on mesa and mountain surfaces. The most common soils at the NNSS are aridisols and entisols. The amount of development these soils have undergone depends on their age, their parent materials, and particularly their geomorphic position. Entisols generally form on steep mountain slopes where erosion is active. Aridisols tend to be older and form on more-stable fans and terraces (DOE 1996c). Evaporate deposits found in playas tend to develop in aridisols. The parent materials for most of these soils are mixed alluvial sediments that were eroded from the surrounding ranges. The soil texture generally grades from coarse-grained soil close to the mountain fronts to fine-grained sediments in playas at the bottom of valleys. This gradation can be seen in cross sections at Yucca Flat and Frenchman Flat. Overall, most of the soils are reasonably young, with low leaching, and retain their structures from when the parent materials were deposited.

Underlying the surface of more well-developed soils is a layer of caliche (calcium carbonate minerals precipitated from evaporating carbonate-saturated groundwater). The saltiness of the soils increases toward the center of internal drainage basins because snowmelt, rainfall, and groundwater tend to collect, concentrate, and then evaporate. The highest level of soluble salts at the NNSS can be found in the soil horizons at Frenchman Flat (DOE 1996c).

The soils at the NNSS are highly susceptible to erosion by wind and water. Although finer-grained soils on steep slopes are more easily erodible, mineral composition and topography can also affect the movement of topsoil. Because the NNSS has not undergone a comprehensive soil survey review, locations of soils that are easily erodible have not been identified.

Approximately 7,800 acres of surface and near-surface soils at the NNSS, the TTR, and the Nevada Test and Training Range contaminated from nuclear testing activities at a level requiring use restrictions are addressed by the DOE/NNSA NSO Environmental Restoration Program. These include about 6,006 acres on the NNSS, 571 acres on the TTR, and 1,222 acres on the Nevada Test and Training Range. The soils were contaminated by radioactive isotopes expelled from open air testing at Yucca Flat, Frenchman Flat, Plutonium Valley (Area 11), and other areas around the NNSS, the TTR, and the Nevada Test and Training Range. Section 4.1.5.4.1 provides a more detailed description of the soil contamination and isotopes at the NNSS and the surrounding areas.

Prime Farmland soils have not been identified at the NNSS and surrounding areas. However, agriculture production in Nevada often requires irrigation, so soil suitability for irrigation could be used as a proxy for soils with a potential to be classified as Prime Farmland. Previous maps by the Division of Water Resources show that the lowest elevations of Yucca Flat, Frenchman Flat, and Jackass Flats would be the most suitable at the NNSS for water retention (Rush 1974). Other soils at the NNSS tend to be too thin or too permeable to be effectively irrigated. In Yucca Flat, the cobbly, stony soils have moderately low water-holding capability, while Frenchman Flat and Jackass Flats have severe limitations with low water-holding capabilities. These areas tend to flood and drain, rather than retain groundwater directly below the surface (DOE 1996c).

4.1.5.4 Radiological Sources as a Result of Testing

4.1.5.4.1 Soils

There are approximately 143 releases of radioactivity onto surface and near-surface soils as a direct result of past nuclear weapons testing on the NNSS, the TTR, and the Nevada Test and Training Range (DOE/NV 2011). The impacts from radioactive contamination have been considerable and, in some cases, significant. The areas of greatest soil contamination were the locations of atmospheric testing of nuclear weapons, safety tests, and shallow borehole tests. Additional surface contamination occurred from crater tests and deep underground testing. This section describes the results of past tests and the remaining contamination in the soils.

DOE/NNSA is managing contaminated sites in accordance with the Federal Facility Agreement and Consent Order (FFACO), in conjunction with the State of Nevada. A variety of corrective actions are used to remediate soil contamination, including soil removal and "closure in place," in which the site is fenced, warnings are posted, and access is restricted (DOE/NV 2011). As of December 31, 2010, 18 sites have been approved for closure in accordance with the FFACO by the State of Nevada (DOE/NV 2011).

Under the FFACO, the goal of the Environmental Restoration Program is to characterize, monitor, and remediate identified contaminated areas, facilities, soils, and groundwater at the NNSS and its associated facilities. Within the Environmental Restoration Program, the Soils Project is responsible for the corrective action units (CAUs) that consist of surface and shallow subsurface contamination from nuclear experiments or testing on the NNSS, the TTR, and the Nevada Test and Training Range. **Figures 4–9** and **4–10** depict all Environmental Restoration Program corrective action sites (CASs) (i.e., sub-units of CAUs) for the Soils, Industrial Sites, and UGTA Projects on the NNSS, TTR, and Nevada Test and Training Range. Figure 4–9 depicts CASs that have been closed under the FFACO and Figure 4–10, CASs that that are not yet closed.

The Soils Project implements air monitoring and radiological surveying of affected soils and implements comprehensive remediation and/or monitoring plans. The Soils Project includes surface and near-surface releases from atmospheric testing, safety experiments, hydronuclear experiments, nuclear rocket engine tests, Plowshare excavation tests, and subsurface nuclear tests with corresponding surface releases (Bechtel Nevada 1998a). The tests that generated radiological soil contamination are described below.

A total of 105 atmospheric tests were conducted on the NNSS and Nevada Test and Training Range from 1951 to 1963, when the Limited Test Ban Treaty was signed (DOE 1996c). The majority of atmospheric tests were conducted at Yucca Flat and Frenchman Flat on the NNSS. Atmospheric weapons testing included weapons dropped by planes, detonated from towers, suspended from balloons, or detonated on the ground surface (DOE 1996c). Depending on the proximity of the explosion to the ground surface and the size of the yield, surface disturbances from atmospheric testing varied widely.

Radioactivity from atmospheric tests was dispersed by three primary mechanisms: (1) throwout, (2) base surge, and (3) fallout (DOE 1996c). Throwout occurs immediately after the initial detonation, when large volumes of rock and soils are thrown outward. Base surge follows as the throwout laterally expands and begins to settle. Fallout consists of the finest particles that remain suspended and mixed with the radioactive weapon residues before gradually being deposited on the ground surface. Fallout can be transported away from the test location because it can remain suspended for several hours after a test. Soil contaminated with radioactive fallout can also be transported limited distances through resuspension by wind. The extent and distribution of contamination from an atmospheric test are quite variable depending on the height of detonation, the yield and type of device, the nature of the ground surface, the mass of the inert material surrounding the device, and the weather conditions during and after the test (DOE 1988).

Various isotopes, including strontium, cesium, barium, hydrogen-3 (tritium), and iodine, form during a nuclear detonation. Most of these isotopes have short half-lives; however, strontium-90 and cesium-137 have half-lives of 28 and 30 years, respectively, so they are retained longer in the soil (Glasstone and Dolan 1977). Because most of the isotopes released during the atmospheric tests rapidly decayed, most of the radioactivity was reduced within the first 12 hours after detonation (OTA 1989). Americium, plutonium, cobalt, cesium, strontium, and europium are the primary radioactive isotopes still present in the soils from historical atmospheric testing. The surface radiation concentration in soils is concentrated near ground zero in the areas where atmospheric testing occurred (Frenchman Flats, Yucca Flat, and Buckboard Mesa) (DOE 1996c). McArthur estimated that, in Frenchman Flat, 20 curies of radioactivity remain at or near the soil surface (McArthur 1991). In Areas 2 and 4, approximately 11.0 and 10.4 curies of cesium-137 were measured at the Kepler and Shasta ground zero locations, respectively (McArthur and Kordas 1985). In Yucca Flat and Buckboard Mesa, some of the radioactivity in soils may also be attributed to underground testing in the area; however, it is likely that the majority is connected to atmospheric testing (DOE 1996c).

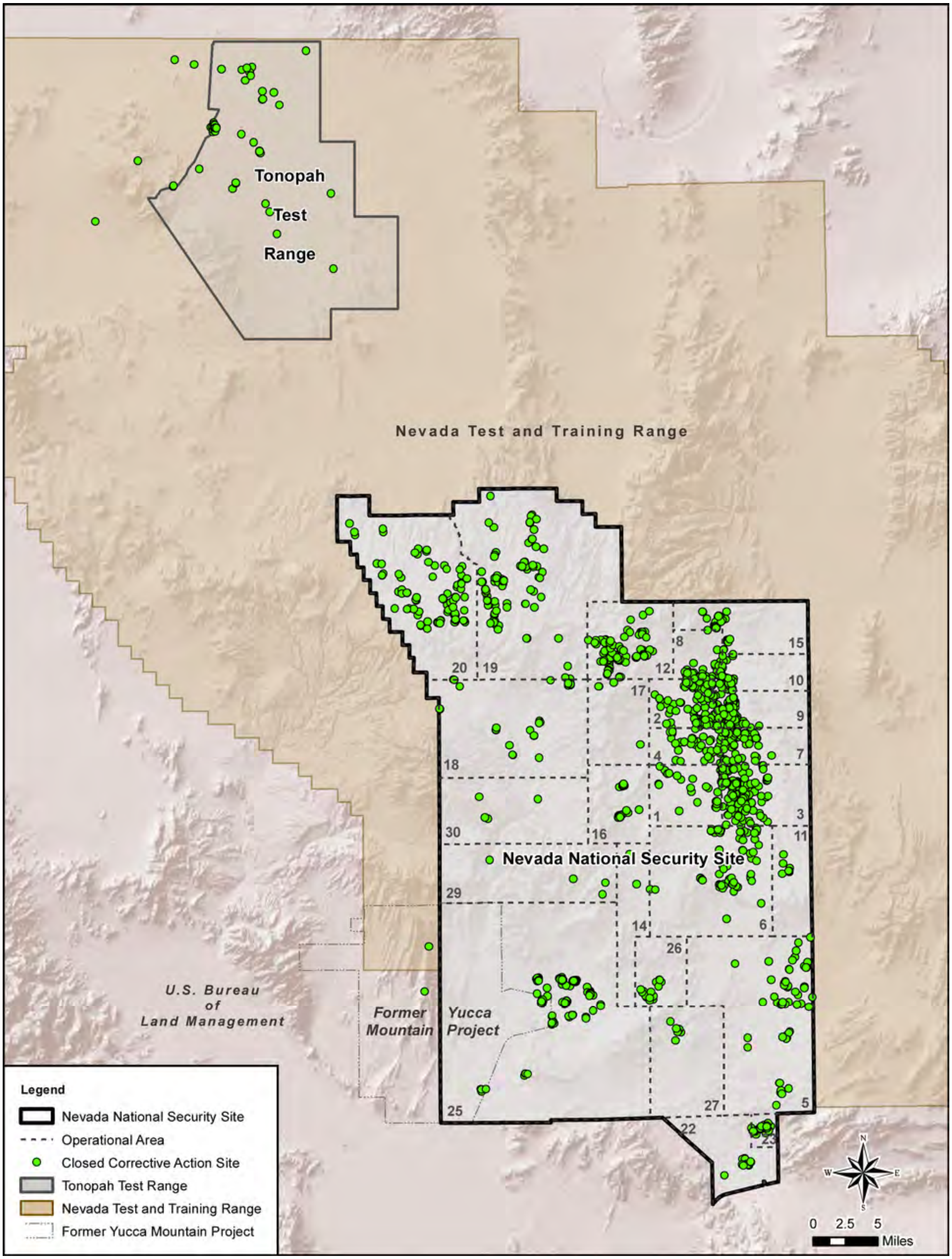

Figure 4–9 Location of Corrective Action Sites on the Nevada National Security Site, Tonopah Test Range, and Nevada Test and Training Range that are Closed under the Federal Facility Agreement and Consent Order

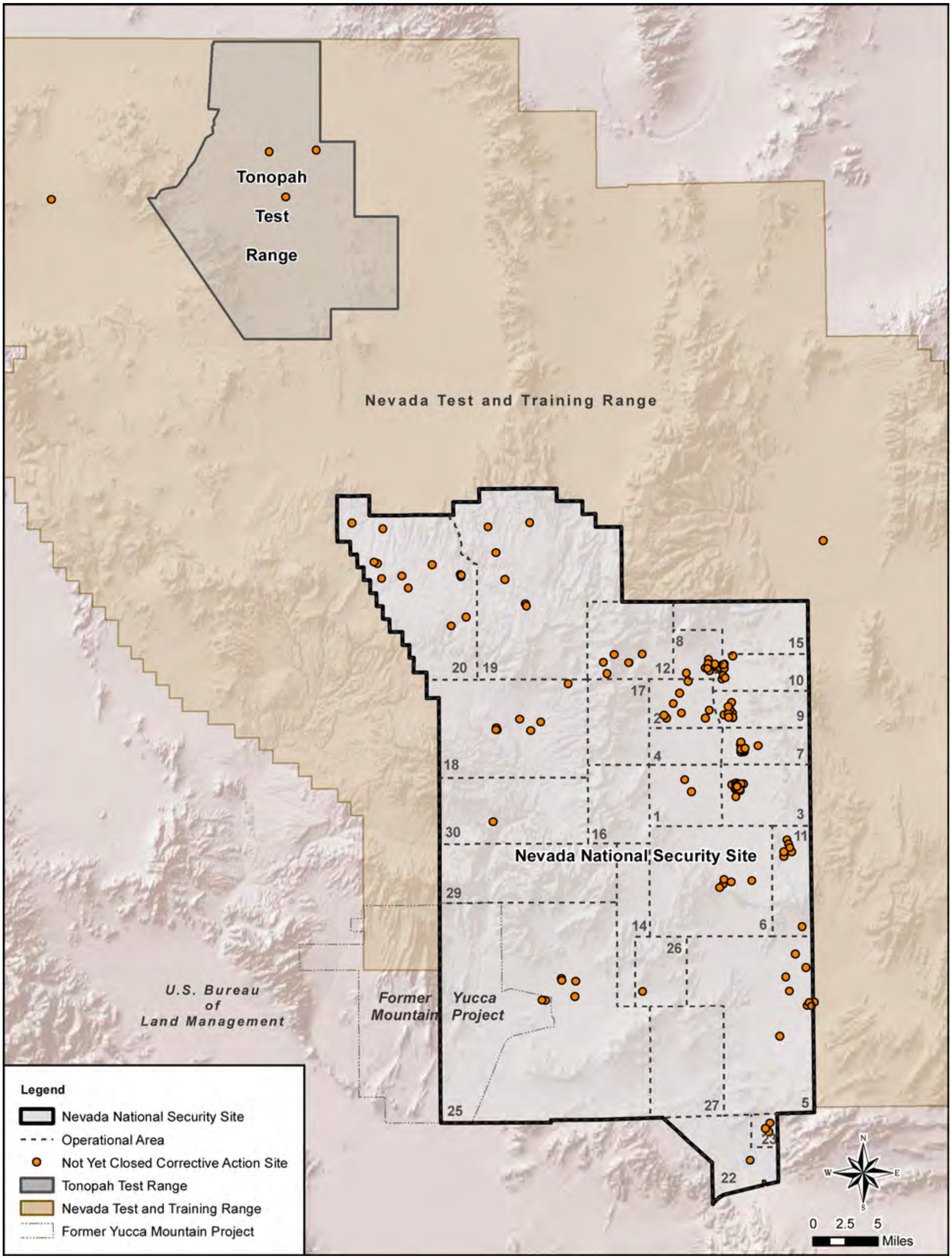

Figure 4–10 Location of Corrective Action Sites on the Nevada National Security Site, Tonopah Test Range, and Nevada Test and Training Range that are not yet Closed under the Federal Facility Agreement and Consent Order

As shown in **Figure 4–11**, areas of surface soil contamination on the NNSS have been identified, fenced, and/or posted as Radiation Areas and Contamination Areas, in accordance with the *Nevada Test Site Radiation Control Manual* (DOE/NV 2012c). The aggregated area of these contaminated areas is about 6,006 acres, or less than 1 percent of the overall area of the NNSS. A decay-corrected estimate of the total surface source term at the NNSS is about 1,614 curies as of January 2012 (Kidman 2012); however, there is a substantial level of uncertainty in this source term with a range as low as 820 and as high as 3,300 curies. Access to these contaminated areas is controlled.

Fifteen subsurface nuclear tests with corresponding surface releases were conducted on the NNSS between 1958 and 1972. In each of these tests, radioactivity from the subsurface detonation was released to surface soils around their ground zeros. While these releases consisted mostly of short-lived noble gases, cesium is the major long-lived source of radioactive dose at these sites.

Between 1955 and 1963, 27 safety experiments with surface or near-surface releases were conducted on the NNSS and the Nevada Test and Training Range, including the TTR. These safety experiments used mixtures of plutonium and uranium that were subjected to detonations of conventional explosives. Safety experiments at the NNSS were performed in Yucca Flat (Areas 3, 7, 8, and 9); Plutonium Valley (Area 11); Rainier Mesa (Area 12); and in the Nevada Test and Training Range (including the TTR) to the northeast and northwest of the NNSS. Although most tests had no nuclear yield, the explosions spread mostly plutonium, uranium, and americium.

Figures 4–12, **4–13**, and **4–14**, respectively, show the Double Tracks site; the Clean Slate 1, 2, and 3 sites; and the Project 57 site. DOE/NNSA has conducted interim remediation on the Double Tracks and Clean Slate 1 sites to remove all radioactive contamination that exceeds 400 picocuries per gram. The Clean Slate 2 and 3 and Project 57 sites have not yet been remediated. In addition to these sites, the Small Boy test resulted in an area of radioactive contamination extending from the northeastern portions of Area 5 east onto the Nevada Test and Training Range, as shown in Figure 4–11. Soils sites on the Nevada Test and Training Range, including the TTR, are expected to be remediated to an action level that is mutually agreed upon by DOE/NNSA, the USAF, and NDEP.

In addition to explosive tests, a series of activities was conducted at the Nuclear Rocket Development Station in Areas 25 and 26. From 1959 through 1973, the area was used for a series of experiments involving an open-air nuclear reactor, nuclear engine, and nuclear furnace tests, as well as for the High Energy Neutron Reactions Experiment (DOE 1996c). Equipment and facilities remain from some of these locations. Some limited areas of contaminated soils are also present. The total inventory of isotopes remaining in the soils in this area of the NNSS has been estimated to be about 1 curie (McArthur 1991). The primary soil contaminants in this area are isotopes of strontium, cesium, cobalt, and europium (DOE 1996c). Cleanup of contaminated soils resulting from nuclear rocket and related testing is addressed as part of the Environmental Management Mission under the Environmental Restoration Program (FFACO 2008).

At the end of 2010, two Soil Site corrective action sites were closed, leaving 110 CAS that remain to be closed (DOE/NV 2011).

4.1.5.4.2 Subsurface

Underground nuclear tests at Yucca Flat and Frenchman Flat were detonated primarily in alluvium or in the volcanic rocks. A few tests were detonated in the underlying carbonate rocks beneath the northern Yucca Flat during the early years of the testing program (DOE 1996c; OTA 1989). Testing near or below the water table was common in both the Yucca Flat weapons test basin and Frenchman Flat test area.

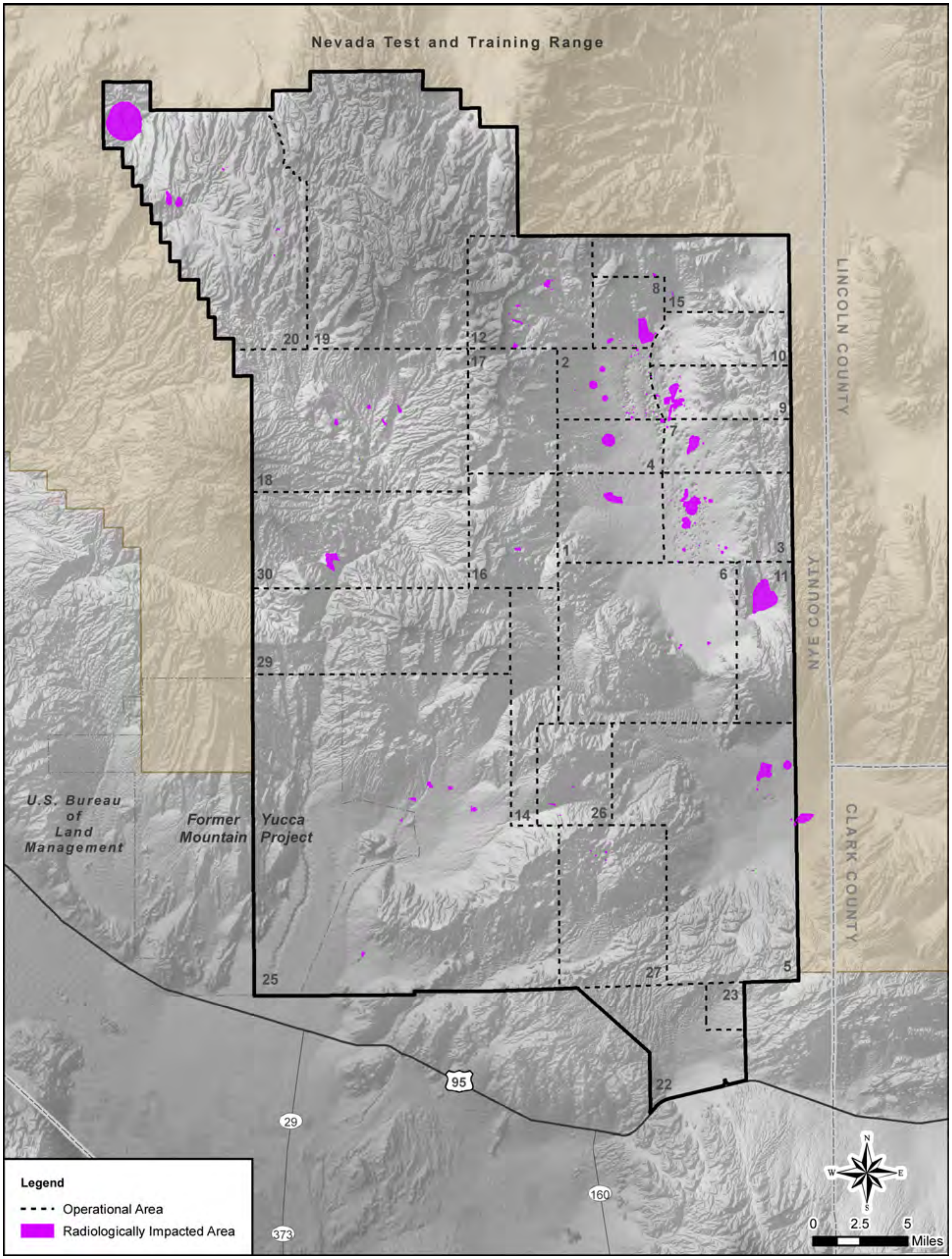

Figure 4–11 Areas on the Nevada National Security Site that are Fenced and/or Posted as Radiation Areas and/or Contamination Areas in Accordance with *Nevada Test Site Radiation Control Manual* (DOE/NV/25946-801, Revision 1, February 2010)

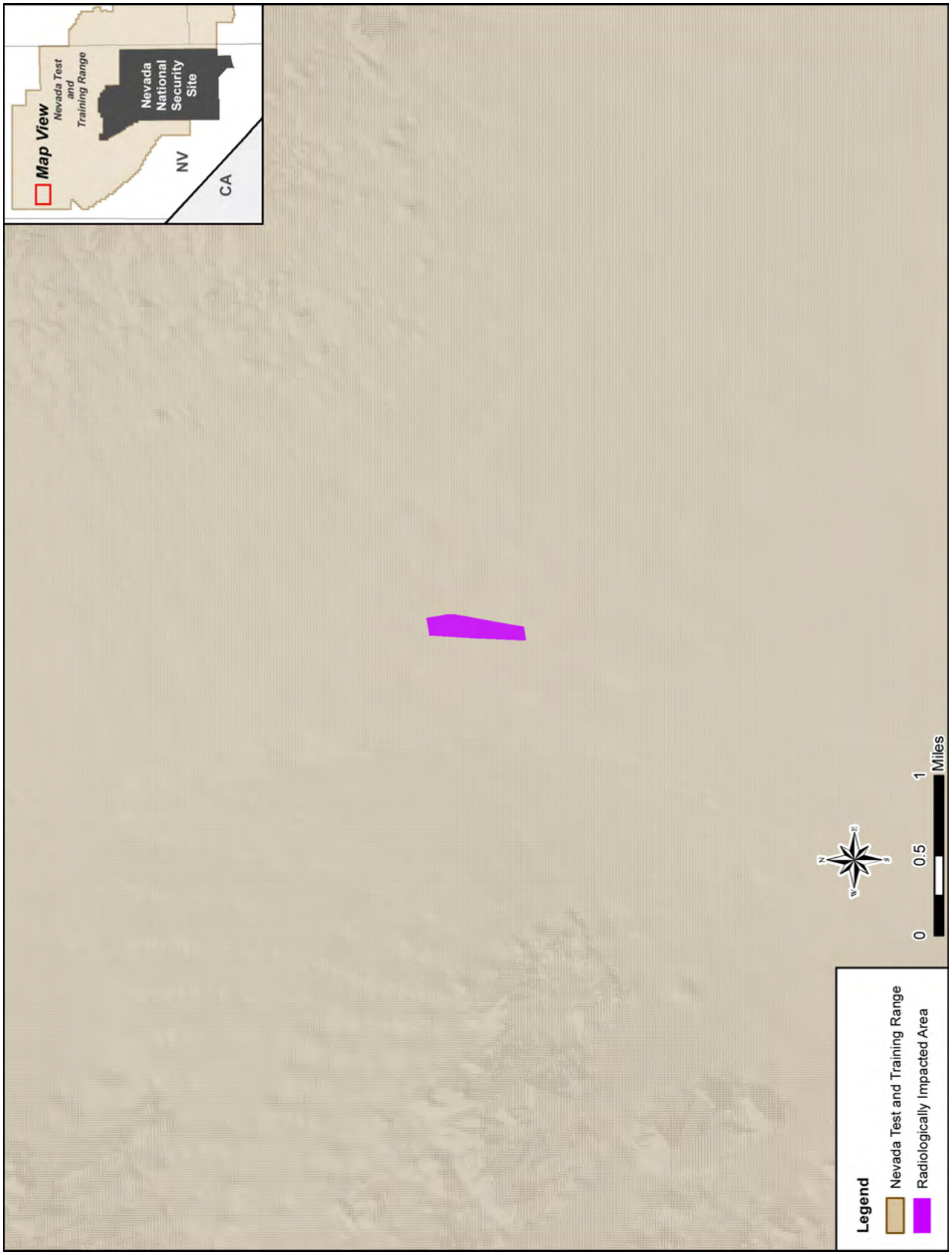

Figure 4–12 Areas on the Nevada Test and Training Range that are Fenced and/or Posted as Radiation Areas and/or Contamination Areas in Accordance with *Nevada Test Site Radiation Control Manual* (DOE/NV/25946-801, Revision 1, February 2010): the Double Tracks Site

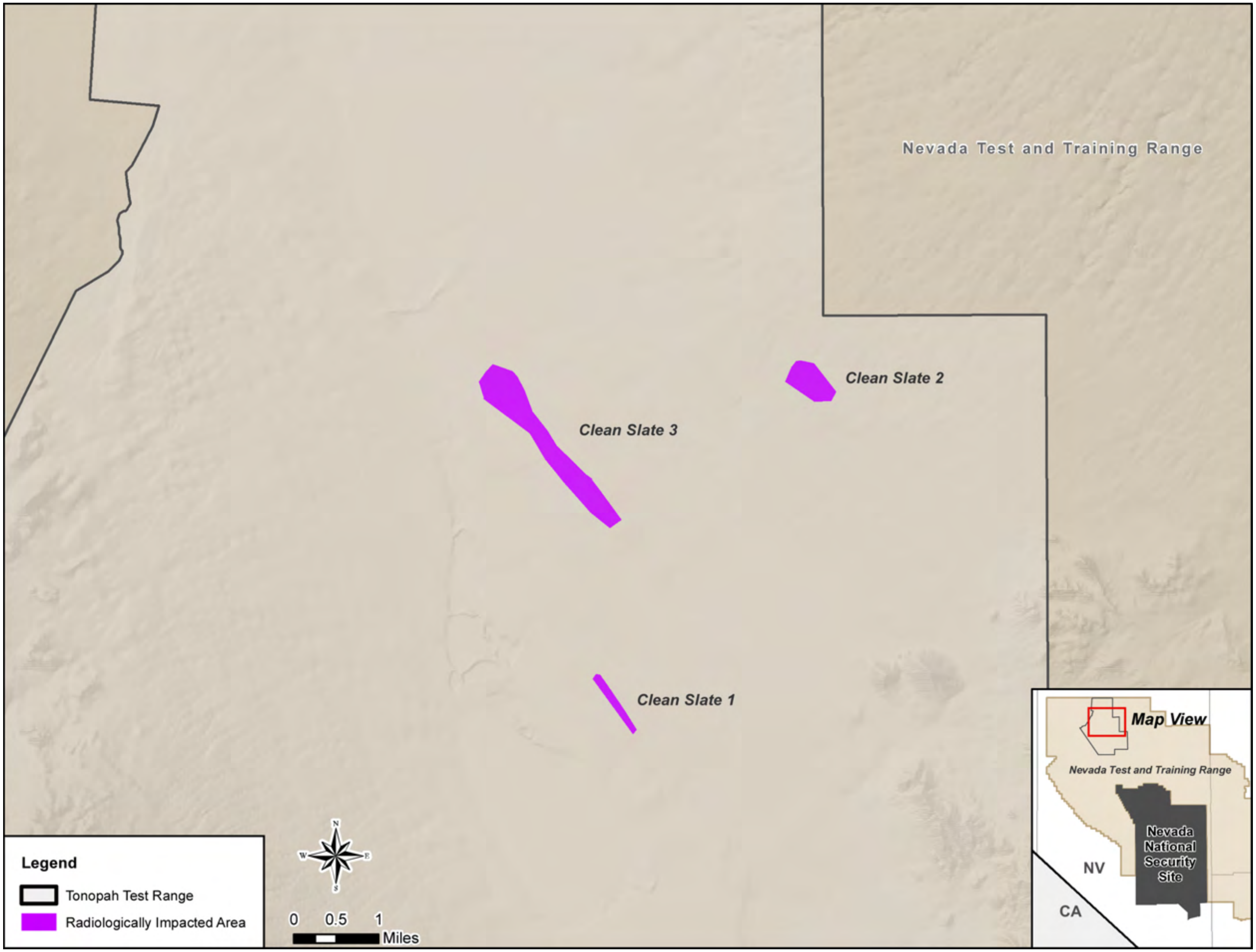

Figure 4–13 Areas on the Nevada Test and Training Range that are Fenced and/or Posted as Radiation Areas and/or Contamination Areas in Accordance with *Nevada Test Site Radiation Control Manual* (DOE/NV/25946-801, Revision 1, February 2010): Clean Slate 1, 2, and 3 Sites on the Tonopah Test Range

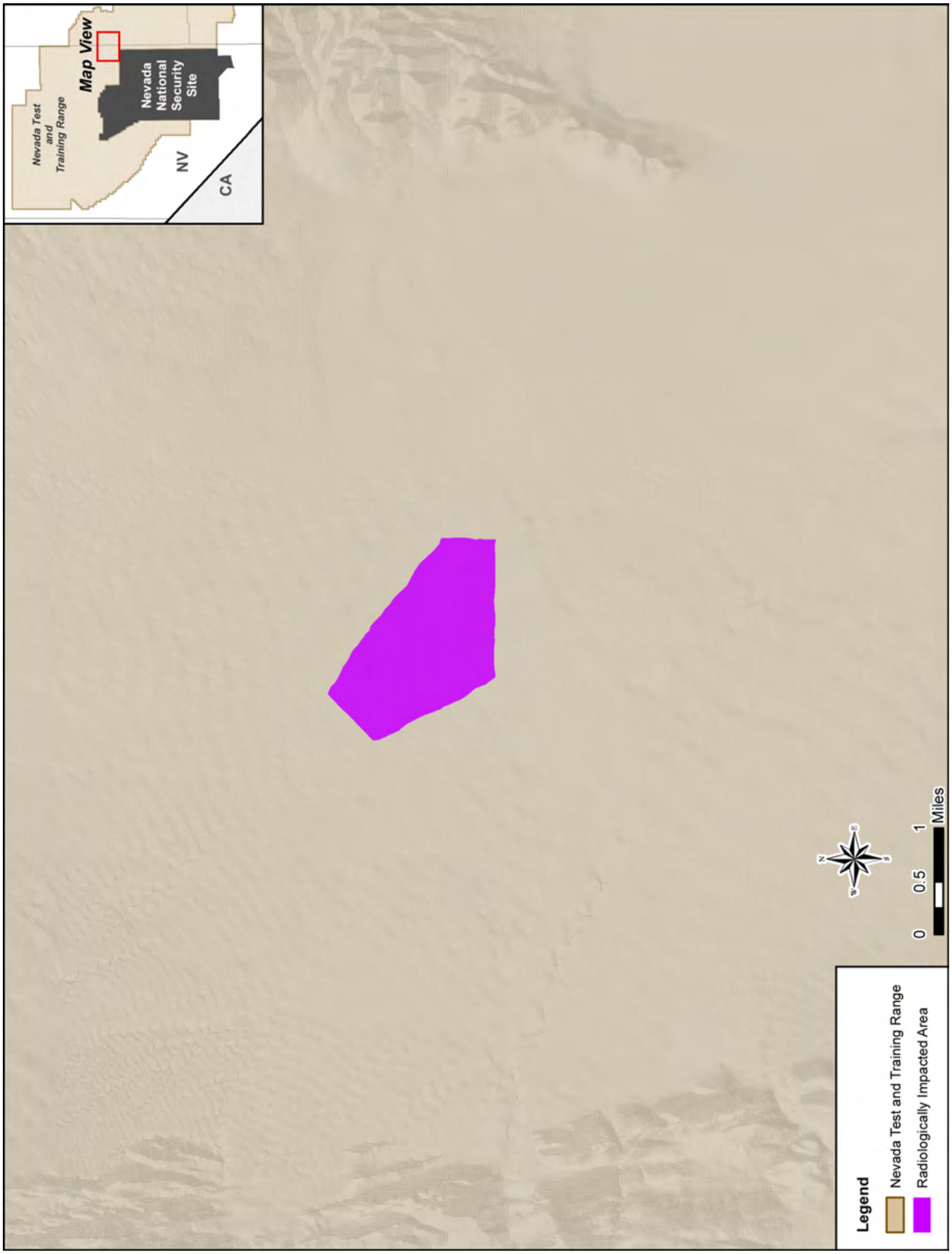

Figure 4–14 Areas on the Nevada Test and Training Range that are Fenced and/or Posted as Radiation Areas and/or Contamination Areas in Accordance with *Nevada Test Site Radiation Control Manual* (DOE/NV/25946-801, Revision 1, February 2010): Project 57 Site

A total of 828 underground nuclear tests were conducted at the NNSS. This resulted in pockets of radiological contamination in the bedrock in underground nuclear testing areas at the subsurface and in the near vicinity of the testing locations. Underground testing is broken down into three main categories: (1) shallow borehole tests, (2) deep vertical tests, and (3) tunnel tests. This section presents the condition of the bedrock as a result of the tests.

From 1960 through 1968, shallow borehole tests were used to test a variety of explosives. "Shallow borehole tests" refer to the tests performed within 200 feet of the surface. Some of these were related to the safety experiments; others were conducted as part of Project Plowshare. Project Plowshare used nuclear detonations to determine whether the explosions could be used for large-scale excavations, such as creating harbors and canals. As a result, some large ejection craters were created at the NNSS, such as the Sedan Crater in Area 10 at the northern end of Yucca Flat and Buggy in Area 18. The Sedan Crater, a 1,280-foot-diameter crater, was generated from a 104-kiloton nuclear device detonated 635 feet underground. McArthur estimated that the remaining inventory of surficial radioactivity at the Sedan Crater is 344 curies (McArthur 1991). The craters contain radioactivity injected from the initial detonation that is being slowly covered as surrounding material is eroded into the craters. The total estimate for all releases from shallow borehole tests to the surficial soil horizon at the NNSS is 2,000 curies (DOE 1996c).

Deep vertical tests occurred at Frenchman Flat, Yucca Flat, Pahute Mesa, and Rainier Mesa. The tunnel complexes at Rainier Mesa and Shoshone Mountain were also used for horizontal tests. Radiological contamination, disruption of the geologic media, and seismic waves (i.e., ground motion) are other major impacts of underground nuclear testing. Some of the tests generated shock waves equivalent to 5.0-magnitude and 7.0-magnitude earthquakes, which were felt for miles outside of the NNSS with no permanent effects.

Following a deep underground nuclear detonation, a pocket of vaporized bedrock is almost instantaneously formed, which quickly fractures and propels a shock wave out from the test site. As the gases cool, molten rock begins to collect and solidify on the cavity sidewalls and settles in a puddle at the bottom of the cavity. When gas pressure decreases to the point that it can no longer support the overlying rock and soil, the cavity may collapse, forming a chimney upward above the cavity. The collapse of the overburden in the chimney occurs until the vertical stress is equalized or the chimney reaches the surface (DOE 1996c). The result is a saucer-like collapse crater. The collapse crater differs from the shallow borehole tests because the crater collapses inward, with no ejecta striations. The complete process usually occurs within a few hours after detonation. A more complete description of underground nuclear test phenomena is contained in Appendix H.

Yucca Flat is pockmarked with subsidence craters formed by deep vertical underground tests. The crater sizes range in diameter from 200 to 1,500 feet, and in depth from a few feet to 200 feet. The size of the crater depends on the depth of the test, the properties of the geologic units, and the explosive energy yield. The creation of craters is the principal visible consequence from underground nuclear testing. The seismic waves created by underground nuclear detonations also created pressure ridges, small displacement faults that occurred as the detonation created upward pressure initially and then released it. Young faults, such as the Yucca Fault in Yucca Flat, showed some signs of reactivation as a result of the bedrock equalizing to the new stress field around the testing area.

Some cratering occurred on Pahute Mesa due to underground tests; however, the greater competency of the volcanic tuffs and lavas prevented large-scale cratering. Some surface fracturing occurred on Pahute and Rainier Mesas. The amount of fracturing in a given test location is predictable, based on test parameters and the host bedrock. Site selection factors that were essential to both containment and the integrity of the test data ensured that failures within the test areas did not occur.

The fracturing of the rock in the near-test environment may have resulted in some alteration of the natural permeability of the rocks underlying portions of the NNSS. The shock wave and compressive forces from the tests can increase the permeability of the rock by creating more fractures near the test, but can also decrease the permeability by opening and closing fractures at greater distances from the test (DOE 1996c). The bedrock is generally unchanged beyond three cavity radii of the detonation site. At further distances, some fractures may open and then close because of the stress differential as the shock wave passes through. The process of opening and subsequent closing of existing rock fractures could reduce the permeability of the rock by reducing the fracture aperture.

Just as surface and atmospheric tests increased the radioactivity of the soils at the surface, underground nuclear tests created pockets of radioactive contamination around the detonation site. The amount of radiation in these pockets has to be estimated because, unlike surface tests, the detonation site is surrounded by fractured and unfractured bedrock. Immediately after the detonation, the amount of radiation spikes, then reduces as the isotopes with short half-lives decay. Most investigators have concluded that much of the radioactivity released during an underground detonation, exclusive of tritium, remains in the melt glass in the original cavity, especially the refractory isotope species; the more-volatile nuclides tend to condense on the chimney rubble (Borg et al. 1976). Refractory species include plutonium, rare earth elements, zirconium, and alkaline earth elements; volatile species include alkali metals, ruthenium, uranium, antimony, tellurium, and iodine. The most mobile isotopes are the gaseous species, including argon, krypton, tritium, and xenon, which tend to rise through the chimney and may ultimately seep out to the surface (DOE 1996c). The total amount of radioactivity released into the underground environment during a test is called the radiological source term. The source term includes both short- and long-half-life isotopes. The estimated radiological source term from all deep underground tests reported in the *1996 NTS EIS* was 300 million curies (DOE 1996c). In 2001, scientists at Los Alamos and Lawrence Livermore National Laboratories estimated the underground source term beneath the NNSS, decay-corrected to September 23, 1992, to be about 132 million curies (Bowen et al. 2001). Of the 132 million curies, approximately 95 percent (125 million curies) was estimated to be tritium, which has a half-life of about 12.3 years. As of September 2012, radioactive decay will have reduced the tritium component of the underground source term to about 23 million curies.

Geology and Soil—American Indian Perspective

CGTO

When visiting Area 5 of the Nevada National Security Site (NNSS) in 2009, Indian people observed several traditional use minerals. In particular, Indian people have observed the presence of: (1) Chalcedony, (2) Obsidian, (3) Yellow Chert (otherwise known as Jasper), (4) Black Chert, (5) Pumice, (6) Quartz Crystal, and (7) Rhyolite Tuff. Other traditional use minerals are known to exist in other areas throughout the NNSS.

Minerals are culturally important and have significant roles in many aspects of Indian life. For example, the Chalcedony would have made an attractive offering, which could be acquired here and then left at the vision quest or medicine site located to the north on top of a volcano like Scrugham Peak. Upon return, traditional Indian people would bring offerings back to where we acquired offerings.

Obsidian is a glass-like stone produced by volcanoes. Indian people used a green volcanic glass during curing ceremonies that involved bleeding the patient. Volcanic glass found below Scrugham Peak was used in the first arrow making lessons for young men. Such lessons were held in small rock shelters found along the base of the basalt flow that constitutes Buckboard Mesa. Obsidian flakes were placed before important rock art panels as offering to the spirits that lived on the other side of the passageway provided by the panel. Small obsidian stones, commonly called Apache Tears, have been found on the face of Shoshone Mountain in southern Nevada. This massive deposit of obsidian stones is interpreted by Indian people as being provided by the mountain as both a spiritual backdrop and a location rationale for vision quests.

Volcanic rocks are used in a wide range of ceremonial activities. Indian women enhance the quality of breast milk by squirting it on heated rocks. They are used for medicine society sweat lodge meetings. Indian people call some volcanic rocks "grandfather stones," a designation that reflects reverence as well as wisdom. Such rocks are sought in special places of power and carried over long distances to serve as the heated stones in sweat lodges.

See Appendix C for more details.

4.1.6 Hydrology

4.1.6.1 Surface Water

The NNSS lies within the Basin and Range Physiographic Province and the Great Basin, which is a closed hydrographic basin from which no surface water leaves, except by evaporation. Much of Nevada is contained within the Great Basin, including the NNSS, the TTR, and all but the southern corner of the Nevada Test and Training Range. Consistent with the Great Basin, the internal drainage of regional hydrographic basins is controlled by topography (USAF 1999). The Great Basin comprises numerous smaller hydrographic basins; parts of nine different smaller basins occur within the boundaries of the NNSS. The basins that cover the greatest amount of land area on the NNSS include (1) Fortymile Canyon (the Buckboard Mesa and Jackass Flats Subdivisions), (2) Yucca Flat, (3) Rock Valley, and (4) Frenchman Flat. Hydrographic basins on the NNSS that are less extensive in land area include portions of Gold Flat, Kawich Valley, Emigrant Valley, Mercury Valley, and Oasis Valley (see **Figure 4–15**).

The similarity of physical environmental attributes throughout the region allows for a general discussion of surface-water features and characteristics of the NNSS, the TTR, and the Nevada Test and Training Range, as well as offsite features of importance in close proximity. Thus, the surface-water section begins with a brief discussion of regional conditions before focusing on the NNSS.

Surface-Water Features. None of the streams in the region perennially contains water. Thus, streams are ephemeral and are fed by runoff from snowmelt and precipitation during storm events. Storms are most common in winter and occur occasionally in fall and spring; localized thunderstorms often occur in the summer. Much of the runoff quickly infiltrates into rock fractures or into the dry soils. Some runoff is carried down alluvial fans in arroyos, and some drains onto playas where it may stand for weeks as a lake (DOE 1988). These usually dry playas illustrate a perennial water deficit that has been characteristic of southern Nevada since about 1850 (Forester et al. 1999).

The Amargosa River, in the Amargosa Desert, is the main ephemeral stream feature in the region, though it is normally dry, and lies approximately 20 miles southwest of the NNSS at its closest point. The Amargosa River continues to Death Valley, California (DOE 1988).

Springs are the only perennial surface-water sources throughout the region. Most perennial surface discharges from springs occur as pools at some large springs. In most instances, discharged spring water travels only a short distance from the source before evaporating or infiltrating the ground. Springs, seeps, and marsh areas of the region discharge from less than one to several thousand gallons of water per minute. In larger springs, discharges are typically several tens to several hundreds of gallons per minute. The largest discharge is at Crystal Pool in Ash Meadows, approximately 15 miles south of the NNSS southern boundary (DOE 1988). A small lake, locally known as Crystal Reservoir, with a storage capacity of 1,489 acre-feet, is present in Ash Meadows. Water for the reservoir is supplied by a flume from Crystal Pool (Giampaoli 1986).

NNSS-Specific Conditions. There are no important perennial or intermittent streams on the NNSS. During infrequent runoff events, ephemeral channel systems in the western half and southernmost parts of the NNSS carry runoff beyond the NNSS boundaries. Fortymile Canyon is the largest drainage system, draining to the Amargosa River approximately 20 miles southwest of the NNSS boundary. The main tributary in the Fortymile Canyon system is Fortymile Wash. On the NNSS, Fortymile Canyon and its ephemeral tributaries consist of well-defined canyons; however, the canyon splits into several tributaries beyond the NNSS boundary (DOE 1996a).

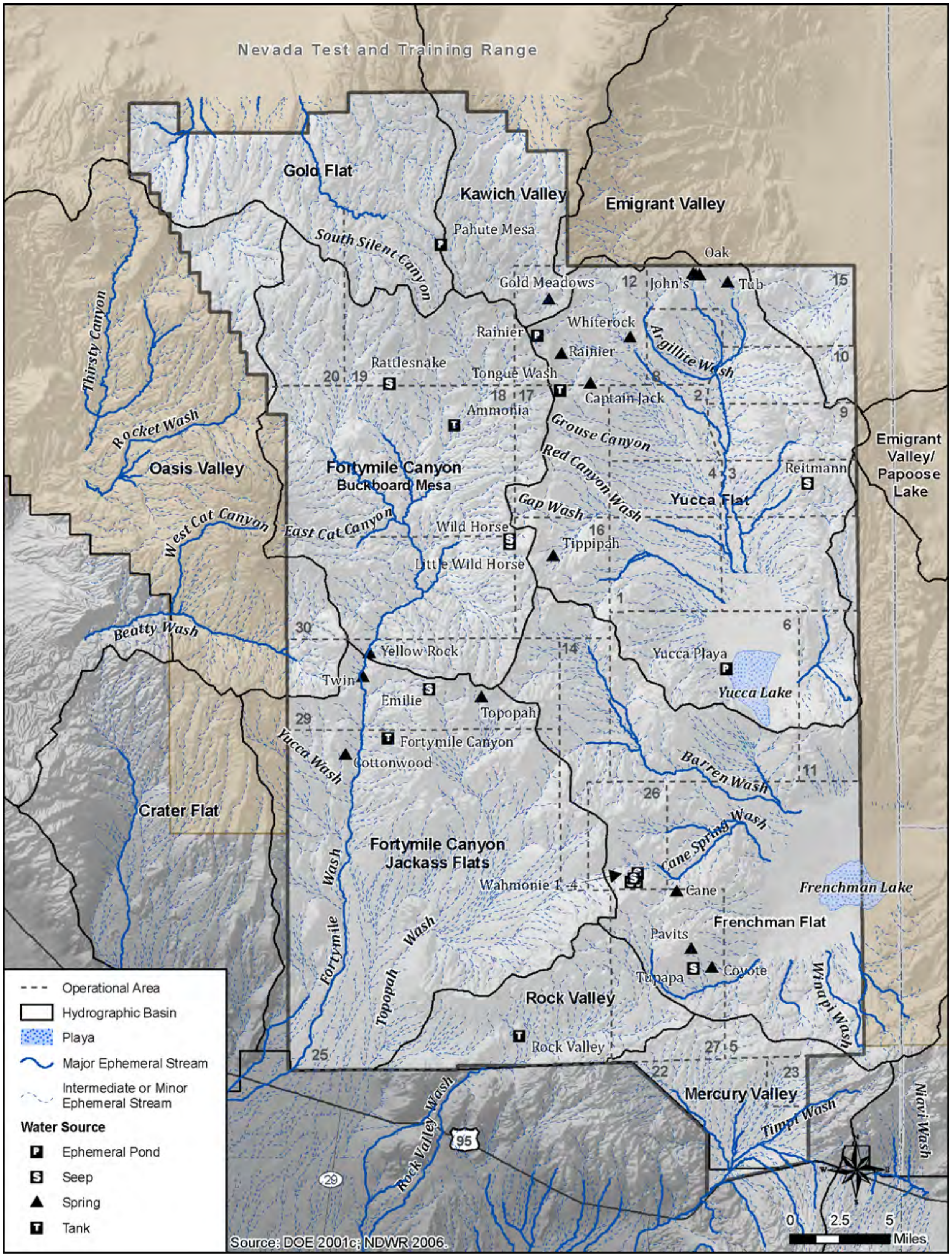

Figure 4–15 Hydrographic Basins and Surface-Water Features on the Nevada National Security Site

There are two other major NNSS drainages that discharge to the Amargosa River: (1) Topopah Wash and (2) Rock Valley. Topopah Wash originates in the Jackass Flats Subdivision of Fortymile Canyon in the south-central portion of the NNSS and trends southwesterly. Rock Valley drains from the southernmost portion of the NNSS westward (see Figure 4–15). Both of these drainage systems are dry throughout most years (DOE 1996a).

In general, ephemeral surface flows on the NNSS are infrequent, with no flow in some years, while in other years, flows may occur for only a few days (DOE 1996a). For example, stream flows measured in Fortymile Wash near the NNSS boundary (approximately 3 miles northwest of the intersection of Lathrop Wells Road and U.S. Route 95) for the water years of 2002 through 2004 (a water year runs from October 1 through September 30) showed no flow at all in 2002 and 2004 (USGS 2002, 2004). In 2003, a discharge of less than 0.1 cubic feet per second was recorded as the yearly maximum and the flow was not sufficient to measure a water height (USGS 2003). Recordable flow events do occur in Fortymile Wash periodically. The most notable of these occurred during March 11–13, 1995, when U.S. Route 95 was closed due to water flowing over the road. The peak discharge at the aforementioned stream flow gauging station during this event was 1,200 cubic feet per second. Historically, stream flow has occurred throughout the Fortymile Wash channel system in January and February 1969, March 1983, July and August 1984, and March 1995, with several other periods where flow occurred in portions of the overall system (Savard 1998). Although these washes contain water infrequently, when they do contain water, they provide many of the beneficial functions that surface-water resources typically provide, such as providing habitat for desert species and serving as flood control features.

There are several "tanks" on the NNSS, which are natural rock depressions that capture surface runoff. There are little data available on the hydrologic characteristics of the tanks. During a study conducted in 1997, the maximum surface areas of individual tanks on site measured approximately 160 square feet with maximum water depths of approximately 3 feet. In addition, there are three ephemeral ponds on the NNSS: (1) Yucca Playa Pond, (2) Pahute Mesa Pond, and (3) Rainier Pond. Yucca Playa Pond occurs in a low spot on the west side of Yucca Lake Playa, where water collects naturally from playa drainage (Hansen et al. 1997). Pahute Mesa Pond occurs in the northern portion of the NNSS near the boundary between Gold Flat and Kawich Valley. Pahute Mesa Pond typically contains water for short periods following summer rain events (DOE/NV 2011). Rainier Pond was discovered in 2009 (see Figure 4–15).

In areas where underground nuclear tests have occurred, ground surface disturbances and craters have altered natural drainage paths. Some craters have captured nearby drainage and headward erosion of drainage channels has occurred. In some areas of the NNSS, the natural drainage system has been completely altered by the craters (DOE 1996a). The majority of past underground nuclear tests and associated craters are concentrated in the following NNSS locations: Areas 2, 3, 4, 6, 7, 8, 9, 10, and 15. Areas 5, 11, 12, 16, 19, and 20 have been affected as well.

There are 26 known springs and seeps on the NNSS (DOE/NV 1999; Hansen et al. 1997), although some are dry for most of the year (see Figure 4–15). Additionally, 143 manmade impoundments (plastic-lined and earthen sumps) currently exist at the NNSS, but similar to natural water sources, not all of the manmade impoundments contain water year-round.

Records of Wells, Test Holes, and Springs in the Nevada Test Site and Surrounding Area (Moore 1961) provides data on discharges from eight springs on the NNSS and one spring approximately 10 miles north of the NNSS on the Nevada Test and Training Range (i.e., Indian Springs) sampled from 1957 to 1960. The largest two of the nine springs in the study located on the NNSS discharged more than 1 gallon per minute (Cane Spring, 2 to 3 gallons per minute; Whiterock Spring, 1 to 2 gallons per minute); all others discharged less than 1 gallon per minute. *Nevada Test Site Wetlands Assessment* (Hansen et al. 1997, Table 5-1) provides more-recent data (1996 to 1997) on 20 NNSS springs and seeps that indicate a general lowering of discharge rates since the early 1960s. Discharge rates ranged from 0.0 to 0.8 gallons per minute, with the greatest values measured at Cane Spring (0.8 gallons per minute), Tippipah Spring

(0.7 gallons per minute), and Whiterock Spring (0.5 gallons per minute). All others discharged less than 0.5 gallons per minute, with several exhibiting no discharge (i.e., Coyote, Gold Meadows, Pavits, and Rainier Springs, as well as Tupapa Seep and Wahmonie Seeps 2 and 3).

The Clean Water Act prohibits the discharge of pollutants (including dredged or fill material) into "waters of the United States," except as authorized by a permit. Joint guidance by the U.S. Environmental Protection Agency (EPA) and the U.S. Army Corps of Engineers, issued in response to a June 2006 Supreme Court decision, provides new guidelines for determining whether tributaries and wetlands are waters of the United States and are regulated under the Clean Water Act (EPA and Army 2007). Based on the new guidance, no wetlands at the NNSS are expected to qualify as waters of the United States (DOE/NV 2009d) due to a lack of surface hydrologic connections to navigable waterways or their tributaries, though certain tributaries on the NNSS may qualify (e.g., Fortymile Wash). If an activity is proposed that may affect a tributary or wetland that is potentially a water of the United States, a site-specific evaluation by the U.S. Army Corps of Engineers would be determinative in terms of jurisdictional status. **Table 4–16** provides a summary of the general characteristics of potential wetland areas known to exist on the NNSS. Some of the wetland areas have not yet been studied thoroughly due to their remote nature and, in some instances, their relatively recent discovery.

Table 4–16 General Characteristics of Potential Wetland Areas on the Nevada National Security Site

Potential Wetland Area	***Area of Surface Water (square feet)*** [a]	***Dominant Vegetation*** [b]	***Wildlife Types Observed***
Ammonia Tanks	323	Louisiana sagewort (*Artemisia ludoviciana*)	Mammals and upland game birds
Cane Spring	43	Goodding's willow (*Salix gooddingii*) Baltic rush (*Juncus balticus*) Basin wildrye (*Leymus cinereus*) Willow dock (*Rumex salicifolia*)	Mammals, upland game birds, migratory waterfowl, raptors, and passerine birds
Captain Jack Spring	75	Seep monkeyflower (*Mimulus guttatas*) Willow dock (*Rumex salicifolia*) Water speedwell (*Veronica anagallis-aquatica*)	Mammals, upland game birds, raptors, and passerine birds
Carrie Spring	22	N/A	N/A
Cottonwood Spring	969	Fremont's cottonwood (*Populus fremontii*)	Mammals
Coyote Spring	0	Inland saltgrass (*Distichlis spicata*)	Mammals
Emilie Seep	N/A	N/A	N/A
Fortymile Canyon Tanks	86	None identified	Mammals and raptors
Gold Meadows Spring	0	Baltic rush (*Juncus balticus*)	Mammals, upland game birds, raptors, and passerine birds
John's Spring	54	Clustered field sedge (*Carex praegracilis*) Seep monkeyflower (*Mimulus guttatas*)	Mammals and passerine birds
Little Wild Horse Seep	22	N/A	Mammals and passerine birds
Oak Spring	11	Sandbar willow (*Salix exigua*) Basin wildrye (*Leymus cinereus*)	Mammals, upland game birds, and passerine birds
Pahute Mesa Pond	24,488	N/A	Mammals
Pavits Spring	0	None identified	Mammals and upland game birds
Rainier Pond	N/A	N/A	N/A
Rainier Spring	0	Basin wildrye (*Leymus cinereus*)	None
Rattlesnake Seep	32	N/A	N/A
Reitmann Seep	16	Parish's spikerush (*Eleocharis parishii*) Annual rabbitsfoot grass (*Polypogon monspeliensis*)	Mammals, upland game birds, raptors, and passerine birds
Rock Valley Tank	1	Foxtail brome (*Bromus rubens*)	Mammals

Potential Wetland Area	***Area of Surface Water (square feet)*** [a]	***Dominant Vegetation*** [b]	***Wildlife Types Observed***
Tippipah Spring	2,045	Baltic rush (*Juncus balticus*) Annual rabbitsfoot grass (*Polypogon monspeliensis*) Biennial cinquefoil (*Potentilla biennis*) Water speedwell (*Veronica anagallis-aquatica*)	Mammals, upland game birds, raptors, and passerine birds
Tongue Wash Tank	48	None identified	Mammals, upland game birds, and passerine birds
Topopah Spring	86	Baltic rush (*Juncus balticus*) Rocky Mountain rush (*Juncus saximontanus*) Sandberg bluegrass (*Poa secunda*) Louisiana sagewort (*Artemisia ludoviciana*) Willow dock (*Rumex salicifolius*) Water speedwell (*Veronica anagallis-aquatica*)	Mammals, upland game birds, raptors, and passerine birds
Tub Spring	1	Skunkbush sumac (*Rhus trilobata*)	Mammals, upland game birds, and passerine birds
Tupapa Seep	0	Cheatgrass (*Bromus tectorum*) Foxtail barley (*Hordeum jubatum*)	Mammals and passerine birds
Twin Spring	22	Southern cattail (*Typha domingensis*)	Mammals and upland game birds
Wahmonie Seep 1	54	Emory's baccharis (*Baccharis emoryii*) Rubber rabbitbrush (*Ericamaerica nauseosa*) Baltic rush (*Juncus balticus*) Basin wildrye (*Leymus cinereus*) Water speedwell (*Veronica anagallis-aquatica*)	Mammals, upland game birds, and passerine birds
Wahmonie Seep 2	3	Emory's baccharis (*Baccharis emoryii*)	Mammals
Wahmonie Seep 3	0	Emory's baccharis (*Baccharis emoryii*) Foxtail brome (*Bromus rubens*) Louisiana sagewort (*Artemisia ludoviciana*)	Mammals
Wahmonie Seep 4	377	N/A	Mammals
Whiterock Spring	1	Sandbar willow (*Salix exigua*) Baltic rush (*Juncus balticus*)	Mammals, upland game birds, raptors, and passerine birds
Wild Horse Seep	22	N/A	Mammals
Yellow Rock Spring	323	Skunkbush sumac (*Rhus trilobata*) Cheatgrass (*Bromus tectorum*)	Mammals
Yucca Playa Pond	246,816	Saltceder (*Tamarix ramosissima*)	Mammals, upland game birds, migratory waterfowl, and raptors

N/A = information not available.
[a] Maximum inundated area recorded at time of survey (1996, 1999, 2000, or 2009).
[b] Dominant vegetation defined as 10 percent or greater absolute cover.
Source: Bechtel Nevada 1999, 2000b; Hanson et al. 1997; NSTec 2010j.

Surface-Water Characteristics. There is no known human consumption of surface water on the NNSS. In fact, no public water supplies are drawn from springs in the Amargosa Valley, which is located downgradient from the NNSS along the primary pathway for surface-water flow. The closest surface-water supply used for public consumption is Lake Mead (NDEP 2010c), which is located approximately 100 miles southeast of the NNSS and supplies a large portion of the water demand of metropolitan Las Vegas.

Little data on the characteristics of water in the region are available because all streams in the region are ephemeral. *Records of Wells, Test Holes, and Springs in the Nevada Test Site and Surrounding Area* (Moore 1961) presented results on chemical analyses for eight springs on the NNSS (see **Table 4–17**). More-recent (1996 to 1997), but less extensive data are provided in **Table 4–18**.

Table 4–17 Chemical Analyses of Water from Springs on the Nevada National Security Site (1957 – 1959)

Spring Name	***Cane***	***Cane***	***Topopah***	***Topopah***	***Tippipah***	***Tippipah***	***Rainier***	***Captain Jack***	***White-rock***	***White-rock***	***White-rock***	***White-rock***	***Oak***	***Butte***	***Indian***
Date of Collection	***9/19/57***	***3/24/58***	***9/17/57***	***3/25/58***	***9/17/57***	***3/24/58***	***9/18/57***	***5/1/59***	***4/5/57***	***9/18/57***	***3/21/58***	***5/19/59***	***4/28/58***	***4/30/59***	***5/1/58***
°F	66	64	70	53	53	54	61	56	56	59	48	67	55	52	50
pH	7.9	8.0	6.9	6.9	7.7	7.4	8.3	6.9	6.9	7.1	7.2	8.8	7.5	7.1	7.2
Specific Conductance in Microohms at 25 °C	425	403	291	114	207	192	346	188	215	222	197	219	241	260	358
Silica (ppm)	64	63	71	50	53	50	65	43	80	52	119	48	57	64	61
Aluminum (ppm)	0	0	0.2	0.3	0.6	0	0.2	0.6	1.1	0.1	0.8	0.7	0.1	0.1	0.1
Iron (ppm)	0.1	0	0.08	0.44	0.31	0.23	0.04	0.95	0.62	0.03	0.44	0.3	0	0.13	0.08
Manganese (ppm)	0[a]	0	0	0	0	0	0[a]	0[a]	0	0	0.4 [a]	0	0[a]	0	0
Calcium (ppm)	32	30	20	7.2	4.8	4.8	7.2	3.2	4.8	4.0	6.4	4.8	18	16	42
Magnesium (ppm)	9.2	9.2	3.9	1.0	0.1	0	1.0	0	0	0.2	0	0	4.9	3.9	7.8
Strontium (ppm)	0	<0.1	0	<0.1	0	<0.1	0.2	<0.2	0	0	<0.1	<0.2	<0.1	<0.2	<0.2
Sodium (ppm)	37	36	19	14	40	37	66	47	39	42	35	39	22	31	17
Potassium (ppm)	7.8	7.6	18	6.4	3.0	3.2	4.0	2.2	5.4	5.4	7.4	4.0	6.4	4.0	4.8
Bicarbonate (ppm)	163	152	147	48	88	81	158	95	72	78	66	50	116	118	148
Carbonate (ppm)	0	0	0	0	0	0	2.0	0	0	0	0	13	0	0	0
Sulfate (ppm)	28	30	11	15	16	19	18	25	23	29	32	23	14	14	36
Chloride (ppm)	20	19	6.0	3.0	7.2	6.0	14	4.0	11	8.0	6.0	9.0	9.0	11	12
Fluoride (ppm)	0.5	0.7	0.7	0.3	0.2	0.3	0.6	0.4	0.4	0.4	0.6	0.6	0.3	0.4	0.4
Nitrate (ppm)	19	18	0.1	2.0	4.6	4.2	0.6	0	4.9	4.8	4.8	1.9	0	0	0
Phosphate (ppm)	0.25	0	10	0.9	0.45	0.4	2.2	1.2	0.5	0.65	0.45	0.55	0.1	0.21	0
Total Dissolved Solids (sum) [a]	298	288	222	123	172	164	256	172	204	184	243	167	189	202	254
Hardness (as calcium carbonate) Total (ppm)	118	113	66	22	12	12	22	8.0	12	11	16	12	65	56	137
Hardness (as calcium carbonate) Non-carbonate (ppm)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16
Percent Sodium	399	399	322	50	84	83	84	90	82	84	75	83	40	52	211

°C = degrees Celsius; °F = degrees Fahrenheit; ppm = parts per million; pH = a measure of acidity or basicity.
[a] In solution at time of analysis.
Source: Moore 1961, Table 5.

Table 4–18 Water Quality Measurements of Natural Water Sources on the Nevada National Security Site (June 1996 – February 1997)

Surface-Water Feature	*Date Sampled*	*Location (microhabitat)*	*Water Temperature (°C)*	*Dissolved Oxygen (parts per million)*	*pH*	*Total Dissolved Solids (parts per million)*	*Electrical Conductivity (µS)*
Cane Spring	6/19/96	cave pool	19.4 [a]	6.2 [a]	7.7 [a]	190 [a]	–
	9/09/96	cave pool	17.4	6.0	7.1	207	406
	11/13/96	cave pool	15.7	8.4	7.2	209	424
	6/19/96	flow box	28.0 [a]	0.7 [a]	7.3 [a]	248 [a]	–
	9/09/96	flow box	22.2	2.6	7.0	227	453
	11/13/96	flow box	9.2	6.7	7.3	256	525
Captain Jack Spring	6/19/96	spring pool	19.0 [a]	5.5[a]	7.1 [a]	90 [a]	–
	9/10/96	spring pool	16.8	4.9	7.3	959	193
Cottonwood Spring	1/08/97	spring pool	7.4	3.5	7.1	54	107
Reitmann Seep	6/19/96	spring pool	30.0 [a]	–	9.2 [a]	379 [a]	–
	7/24/96	spring pool	28.4	2.1	7.7	346	–
	9/10/96	spring pool	31.5	8.1	8.8	336	669
	11/22/96	spring pool	12.4	2.7	7.4	287	557
Tippipah Spring	6/18/96	open channel pool	18.6 [a]	1.2	6.8	114	–
	9/03/96	open channel pool	18.5	1.0	6.7	135	267
	11/15/96	open channel pool	13.7	4.6	7.2	119	243
	9/03/96	cave pool	15.3	6.7	7.0	114	227
	11/22/96	cave pool	14.3	7.8	7.1	106	212
Topopah Spring	6/20/96	spring pool	14.9 [a]	3.8	7.5	66	–
	9/09/96	spring pool	20.0	2.7	6.7	69	139
Tub Spring	6/24/96	guzzler can	26.0 [a]	–	7.6	147	–
	9/10/96	guzzler can	26.5	6.0	7.5	146	294
Twin Spring	1/08/97	spring pool	16.8	1.0	7.0	137	271
Wahmonie Seep 1	6/20/96	wash pool	17.8 [a]	1.8	7.5 [a]	259	–
Whiterock Spring	6/18/96	flow box	16.8	8.1 [a]	7.0	124	–
	9/03/96	flow box	18.7	6.6	7.2	139	277
	9/03/96	west cave pool	15.6	5.8	7.4	142	276
Yucca Playa Pond	1/07/97	pond	1.7	13.6	8.1	162	328

°C = degrees Celsius; µS = microsiemen; pH = a measure of acidity or basicity.
[a] Values represent single readings. All other values are an average of three readings.
Note: "–" indicates no data collected.
Source: Hansen et al. 1997, Table 5-2.

Prior to 1998, natural springs on the NNSS were tested annually for radiological constituents. In 1998, in accordance with the Routine Radiological Environmental Monitoring (RREM) Plan, this sampling was discontinued because the onsite springs are fed by locally derived or "perched" groundwater (i.e., groundwater in a saturated zone of material separated from other groundwater bodies by a relatively impervious zone) (Hansen et al. 1997; Moore 1961) that is not hydrologically connected to any of the aquifers that may be affected by underground nuclear tests (Bechtel Nevada 1998a; DOE/NV 1999). In 1996 and 1997, seven natural springs on site were sampled because only seven had enough water to provide a sample. The sampled springs were (1) Rainier Mesa Spring, (2) Oak Spring, (3) Whiterock Spring, (4) Captain Jack Spring, (5) Tippipah Spring, (6) Topopah Spring, and (7) Cane Spring. In 1996, the average gross beta concentration of the sampled springs was 9.2×10^{-9} microcuries per milliliter, and in 1997 it was 9.8×10^{-9} microcuries per milliliter. These average values represent approximately 23 to 25 percent of the EPA Derived Concentration Guide for exposure to the public (based on a strontium-90 value for drinking water of 4 millirem effective dose equivalent). Although these values are much lower than the Derived Concentration Guide, it is important to note that spring water is not used for human consumption on the NNSS (DOE/NV 1997b, Table 5.11; 1998c, Table 5.6). It is also important to note that this radiation is due to elements that naturally exist in the volcanic geologic medium (e.g., uranium and potassium-40).

Flood Hazards. Flash flooding occurs on the NNSS in response to heavy precipitation events, especially during summer thunderstorms. The runoff from these storms is typically of short duration; however, the storms do result in large peak discharge rates. Flood hazards for DOE/NNSA facilities and activities are most likely associated with flooding in alluvial fans and playas. Throughout the NNSS, there is the potential for sheetflow or channelized flow through arroyos to cause localized flooding. In addition, a rise in any standing water on a playa creates a potential flood hazard. However, because of the size of the NNSS, no comprehensive floodplain analysis has been conducted to delineate the 100- and 500-year floodplains (Cohn 2010).

Playas in the Yucca Flat weapons test basin and Frenchman Flat in the eastern and southeastern parts of the NNSS, respectively, collect and dissipate runoff from their respective hydrographic basins. Control Point and News Knob arroyos (informal names), and Gap Wash, Red Canyon Wash, Tongue Wash, and the Aqueduct arroyos in the Yucca Flat weapons test basin pose a potential flood hazard to existing facilities (DOE 1996a). The Control Point and News Knob arroyos have been assessed for flood hazards (Miller et al. 1994).

Arroyos in Frenchman Flat that pose a potential flood hazard to existing facilities include Barren Wash, Scarp Canyon, Nye Canyon, and Cane Spring (DOE 1996a). There is a 100-year flood hazard area along the southwest corner of the Area 5 RWMC associated with Barren Wash (Schmeltzer et al. 1993). Areas prone to flooding surround Fortymile Wash, a major tributary of Fortymile Canyon. Topopah Wash runs southwesterly across the Jackass Flats Subdivision of Fortymile Canyon from Jackass Divide in the south-central part of the NNSS (DOE 1996a). The 100-year flood-prone areas of Topopah Wash and its tributaries would closely parallel most stream channels with few occurrences of out-of-bank flooding, though 500-year flood events would overtop the banks of all tributaries (not including Topopah Wash itself) and maximum flood events would inundate the entire area (Christensen and Spahr 1980). The Fortymile Canyon Hydrographic Basin poses a flood hazard to offsite areas (SAIC/DRI 1991). Arroyos trending southward from Red Mountain pose a potential flood hazard to sewage lagoons that service Mercury (DOE 1996a).

Water Discharges and Regulatory Compliance. Industrial discharges on the NNSS are limited to two operating sewage lagoon systems: (1) Area 6 Yucca Lake and (2) Area 23 Mercury (these lagoon systems also receive domestic wastewater). The Area 6 Yucca Lake system consists of two primary lagoons and two secondary lagoons. All lagoons in the Area 6 Yucca Lake system are lined with compacted native soils that meet State of Nevada requirements for hydraulic conductivity (3.937×10^{-8} inches per second). The Area 23 Mercury system consists of one primary lagoon, a secondary lagoon, and an infiltration basin. The primary and secondary lagoons in the Area 23 Mercury system have a geosynthetic clay liner and a high-density polyethylene liner. The lining of the ponds allows the Area 23 lagoons to operate as a fully contained, evaporative, nondischarging system (DOE/NV 2011).

These Area 6 Yucca Lake and Area 23 Mercury lagoon systems are operated under a State of Nevada Water Pollution Control General Permit (Permit number: GNEV93001). Through 2008, this permit required annual monitoring of gross alpha, gross beta, and tritium radioactivity. The permit was revised on November 20, 2008, and annual monitoring requirements changed; the lagoons are now sampled for gross alpha, gross beta, and tritium radioactivity, as well as 29 organic and inorganic contaminants only in the event of specific or accidental discharges of potential contaminants (DOE/NV 2009d). There were no such discharges in 2010 (DOE/NV 2011). For the influent water, quarterly monitoring of 5-day biochemical oxygen demand, total suspended solids, and pH (a measure of acidity or basicity) continue to be permit requirements (DOE/NV 2009d). **Table 4–19** provides results of 2008 gross alpha, gross beta, and tritium sampling of the active lagoon systems. No concentrations exceeded permit limitations; tritium concentrations did not reach the sample-specific minimum detectable concentration levels.

Table 4–19 Annual Radiological Results for Sewage Lagoon Effluent (2008)

Monitoring Location	*Gross Alpha ± Uncertainty* [a]	*Gross Beta ± Uncertainty* [a]	*Tritium ± Uncertainty* [a]
	(minimum detectable concentration) (picocuries per liter)		
Area 6 Yucca Lake	4.7 ± 1.3 (1.3) [b]	23.8 ± 4.1 (2.0) [b]	136 ± 225 (370)
Area 23 Mercury	3.8 ± 1.3 (1.5) [b]	27.7 ± 5.0 (3.3) [b]	35 ± 222 (370)
Permit Limit	15	50	20,000

[a] ± 2 standard deviations.
[b] Results are considered detected (i.e., results greater than the sample-specific minimum detectable concentration).
Note: Samples taken July 8, 2008.
Source: DOE/NV 2009d, Table 4-5.

Table 4–20 provides results of 2008 nonradiological water toxicity sampling of the active lagoon systems. The vast majority of potential contaminants were below the laboratory's detection limits; no exceedances of permit limitations occurred.

Table 4–20 Annual Nonradiological Toxicity Analysis Results of Sewage Lagoon Pond Water (2008)

Contaminant	*Permit Limit (ppm)*	*Area 6 Yucca Lake (ppm)*	*Area 23 Mercury (ppm)*
Benzene	0.5	ND	ND
Carbon Tetrachloride	0.5	ND	ND
Chlorobenzene	100	ND	ND
Chloroform	6.0	ND	ND
Cresol (total)	200	ND	ND
2,4-D	10	ND	ND
1,4-Dichlorobenzene	7.5	ND	ND
1,2-Dichloroethane	0.5	ND	ND
1,1-Dichloroethylene	0.7	ND	ND
2,4-Dinitrotoluene	0.13	ND	ND
Hexachlorobenzene	0.13	ND	ND
Hexachlorobutadiene	0.5	ND	ND
Hexachloroethane	3.0	ND	ND
Methylethyl Ketone	200	ND	ND
Nitrobenzene	2.0	ND	ND
Pentachlorophenol	100	ND	ND
Pyridine	5.0	ND	ND
Trichloroethylene	0.5	ND	ND

Contaminant	*Permit Limit (ppm)*	*Area 6 Yucca Lake (ppm)*	*Area 23 Mercury (ppm)*
2,4,5-Trichlorophenol	400	ND	ND
2,4,6-Trichlorophenol	2.0	ND	ND
Vinyl Chloride	0.2	ND	ND
Arsenic	5.0	ND	ND
Barium	100	0.0411	0.0631
Cadmium	1.0	ND	ND
Chromium	5.0	ND	ND
Lead	5.0	ND	ND
Mercury	0.2	ND	ND
Selenium	1.0	ND	ND
Silver	5.0	0.0060	0.0085

ND = Not detected (results were below the laboratory's minimum detection limits); ppm = parts per million.
Note: Samples taken in July 2008.
Source: DOE/NV 2009d, Table 4-10.

Table 4–21 provides 2010 water quality analysis results for sewage lagoon influent waters. No exceedances of permit limitations occurred (DOE/NV 2011).

Table 4–21 Annual Water Quality Results for Sewage Lagoon Influent Waters (2010)

Parameter	*Unit*	*Permit Limit*	*Minimum and Maximum Values from Quarterly Samples*	
			Area 6 Yucca Lake	*Area 23 Mercury*
BOD_5	ppm	No Limit	136 – 233	183 – 361
BOD_5 Mean Daily Load	lbs/d	19.09 (Area 6 Yucca Lake) 254.41 (Area 23 Mercury)	0.53 – 3.59	32.67 – 65.74
Total Suspended Solids	ppm	No Limit	145 – 290	160 – 350
pH	S.U.	6.0 – 9.0	8.20 – 8.70	8.00 – 8.50

BOD_5 = 5-day biochemical oxygen demand; lbs/d = pounds per day; pH = a measure of acidity or basicity; ppm = parts per million; S.U. = standard units of pH.
Source: DOE/NV 2011, Table 5-10.

E-Tunnel is a complex of tunnels and drifts in Area 12 that were constructed for underground testing of nuclear devices. Perched groundwater percolating through the pores and fractures of the volcanic tuffs constituting Rainier Mesa encounters radiological artifacts of nuclear experiments, as well as naturally occurring radiological constituents; some of that water exits through the E-Tunnel portal. Attempts were made to eliminate the discharge by plugging the tunnel, which were unsuccessful; therefore, disposal of this water has been performed via infiltration/evaporation in five unlined primary holding ponds, directing most of the effluent toward the groundwater regime. The NNSS manages and operates the E-Tunnel Waste Water Disposal System (ETDS) in Area 12 under a water pollution control permit issued by the NDEP Bureau of Federal Facilities (Permit number: NEV 96021). The permit governs the management of radionuclide-contaminated wastewater that drains from the E-Tunnel portal into the five holding ponds. The permit requires ETDS discharge waters to be monitored every 12 months for certain radiological and nonradiological parameters. In addition, monthly monitoring is required for flow rate, pH, temperature, specific conductance, total volume, and the structural integrity of the holding ponds. **Table 4–22** provides results of 2010 gross alpha, gross beta, and tritium sampling of the ETDS discharge water. Tritium concentrations were about 50 percent of the limit allowed under the permit. The discharge water was also within gross alpha/beta permit limits (DOE/NV 2011). Gross beta values represent radiation from both human-influenced (e.g., tritium) and naturally occurring sources (e.g., radium-228).

Table 4–22 Radiological Results for E-Tunnel Waste Water Disposal System Discharge Water Samples (2010)

Radiological Parameter	*Permit Limit (picocuries per liter)*	*Measured Value (picocuries per liter)*
Tritium	1,000,000	505,000 ± 77,100
Gross Alpha	35.1	8.0 ± 1.6
Gross Beta	101	37.7 ± 6.1

Note: Samples taken in October 2010.
Source: DOE/NV 2011, Table 5-6.

Table 4–23 shows the results of the 2010 water quality sampling of the ETDS holding ponds for nonradiological parameters that are required to be monitored under the water pollution control permit. All measurements were within permit limits and specifications for the annual sample. Most monthly measurements were also within permit limits except for specific conductance at the ETDS discharge point. Specific conductance is a measure of how well water can conduct an electrical current. Monthly specific conductance measurements were 379.0, 369.7, 385.7, 395.7, 371.5, 391.7, 380.2, 389.0, 388.2, and 393.3 microsiemens per centimeter in February, March, April, May, June, August, September, October, November, and December, respectively. These are all below the lower permit limit of 400 microsiemens per centimeter. NDEP determined that specific conductance measurements should continue to be collected after evaluating NNSS's study of this parameter. NDEP suspended the permit requirement for follow-on monitoring and will re-evaluate the permit limits for specific conductance when the permit is renewed in 2013 (DOE/NV 2011).

Table 4–23 Nonradiological Results for E-Tunnel Waste Water Disposal System Discharge Water Samples (2010)

Nonradiological Parameter	*Permit Limit*	*Measured Value*
Cadmium (ppm)	0.045	<0.001
Chloride (ppm)	360	9.43
Chromium (ppm)	0.09	<0.003
Copper (ppm)	1.2	0.00152 [a]
Fluoride (ppm)	3.6	0.25
Iron (ppm)	5.0	2.42
Lead (ppm)	0.014	0.00164 [a]
Magnesium (ppm)	135	1.28
Manganese (ppm)	0.25	0.027
Mercury (ppm)	0.0018	<0.0002
Nitrogen (as nitrate) (ppm)	9	1.27
Selenium (ppm)	0.045	<0.01
Sulfate (ppm)	450	16.9
Zinc (ppm)	4.5	0.0308
pH (S.U.)	6.0 – 9.0	7.21
Specific conductance (µS/cm)	400 – 500	389

pH = a measure of acidity or basicity; ppm = parts per million; S.U. = standard units of pH; µS/cm = microsiemens per centimeter.
[a] Estimated quantity based on the laboratory's minimum detection limit.
Source: DOE/NV 2011, Table 5-11.

4.1.6.2 Groundwater

This section is an overview of the general hydrogeologic setting and characteristics of groundwater underlying the NNSS. Water-resource features, including supply wells and monitoring wells used for access to groundwater, are described in relation to the hydrographic areas in which they lie.

Important characteristics of groundwater systems include recharge zones (areas where water infiltrates from the surface and reaches the saturated zone), discharge points (locations where groundwater reaches the surface), unsaturated zones (the portion of the groundwater system above the water table), saturated zones (the portion of the groundwater system below the water table), aquitards (confining units), and aquifers (water-bearing layers of rock that provide water in usable quantities). In combination, these characteristics define the quantity and quality of the available groundwater.

Hydrogeologic Setting. The NNSS is located within the southern portion of the Great Basin, occupying approximately 0.7 percent of the Great Basin. The Great Basin is a closed hydrographic province (a basin with no external drainage, from which water is lost only by evapotranspiration) with no outlet to the Pacific Ocean. It comprises many hydrographic basins (areas in which surface runoff collects and from which it is carried by a drainage system, such as a river and its tributaries). Hydrographic basins are mapped on the basis of topographic divides and are used by the State of Nevada for the purposes of water appropriation and management. The NNSS lies within a portion of 10 hydrographic basins (Mercury Valley, Rock Valley, Yucca Flat, Frenchman Flat, Buckboard Mesa, Jackass Flats, Oasis Valley, Gold Flat, Kawich Valley, and Emigrant Valley; see **Figure 4–16**).

> **Acre-foot**: The volume of water that will cover an area of 1 acre to a depth of 1 foot; 1 acre-foot is equivalent to 325,851 gallons.

The perennial yield for the 10 hydrographic basins partly or wholly located within the NNSS, as shown in **Table 4–24**, is estimated at 33,050 acre-feet per year. The perennial yield is an estimate of the quantity of groundwater that can be withdrawn from a basin on an annual basis without depleting the reservoir (Scott et al. 1971). The perennial yield values used by the Nevada State Engineer were applied for purposes of analysis to all basins. The values used by the Nevada State Engineer for most basins are conservative estimates (considering only recharge through precipitation in a basin), and are based upon a series of reports dating to 1970 and earlier. The term sustainable yield, as used in this *NNSS SWEIS*, means the quantity of groundwater that can be withdrawn in the future from a basin without depleting the reservoir, considering any resources (water rights) already committed to other users. Sustainable yield is effectively the value of a basin's perennial yield minus any existing annual withdrawals.

For Frenchman Flat, the Nevada State Engineer has previously estimated a perennial yield of only 100 acre-feet per year (NDWR 2010a). However, this yield is based upon previous assumptions that little or no groundwater recharge from precipitation occurred in Basin 160. More-recent studies suggest that in-basin recharge does occur in Basin 160, and that perennial yield values are much higher than 100 acre-feet per year. DOE/NNSA has extensively studied the groundwater recharge in Frenchman Flat, using a model from the UGTA program, two U.S. Geological Survey (USGS) models (Hevesi et al. 2003), and two Desert Research Institute models (Russell and Minor 2002). All of these models provide revised estimates of precipitation-driven recharge (and thus perennial yield) of Frenchman Flat using more-rigorous analytical methods and more-recent data. As an example, the UGTA model (yields an estimate of 1,070 acre-feet per year) for Frenchman Flat and the USGS and Desert Research Institute models provide perennial yield estimates of 1,830 and 1,320 acre-feet per year, respectively.

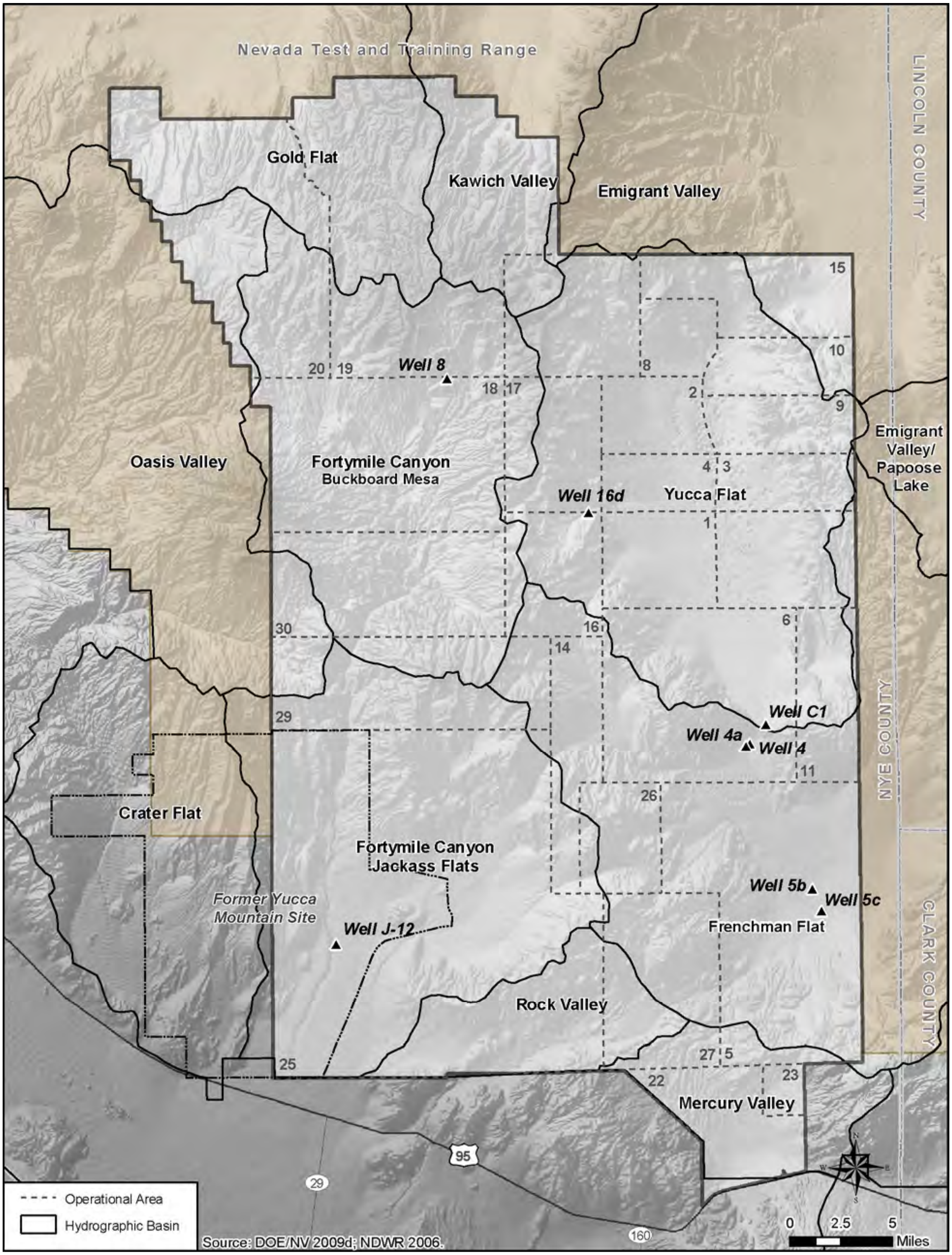

Figure 4–16 Hydrographic Basins at the Nevada National Security Site

Table 4–24 Perennial Yield of Hydrographic Basins at the Nevada National Security Site

Hydrographic Basin	*Hydrographic Basin Number*	*Perennial Yield (acre-feet per year)* [a]	*Total Committed Groundwater Resources (acre-feet per year)* [a, b]	*Sustainable Yield (acre-feet per year)*
Mercury Valley	225	8,000	0	8,000
Rock Valley	226	8,000	0	8,000
Yucca Flat	159	350	0	350
Frenchman Flat	160	100	0	100
Fortymile Canyon, Buckboard Mesa Subdivision	227 [b]	3,600	0	3,600
Fortymile Canyon, Jackass Flats Subdivision	227 [a]	4,000	56	3,944
Oasis Valley	228	2,000	1,727	273
Gold Flat	147	1,900	95	1,805
Kawich Valley	157	2,200	8	2,192
Emigrant Valley	158	2,900	12	2,888
Total	N/A	33,050	1,898	31,152

[a] Source: NDWR 2010a.
[b] Represents water rights appropriated to non-DOE/NNSA users off the NNSS.

The eight water supply wells currently used at the NNSS are located within the Fortymile Canyon Buckboard Mesa and Jackass Flats Subdivisions, Yucca Flat, and Frenchman Flat. These four hydrographic basins have a combined perennial yield of 8,050 acre-feet per year. Total water withdrawals at the NNSS between 2005 and 2009 ranged from 530 to 691 acre-feet per year, as shown later in this section in Table 4–27.

Groundwater beneath the NNSS exists within three groundwater subbasins (a subbasin is defined as the area that contributes water to a major surface discharge area), as shown in **Figure 4–17**. The eastern half of the NNSS is located within the Ash Meadows subbasin, where groundwater flows toward the Ash Meadows discharge area downgradient of the NNSS. The Ash Meadows discharge area contains the sensitive Ash Meadows National Wildlife Refuge. Within the northeast corner of this refuge lies Devils Hole, which is home to the Devils Hole pupfish, an endangered species (see Section 4.1.7 for more information regarding Devils Hole). In 1976, the Supreme Court ruled that the Devils Hole pupfish had prior water rights and that a minimum level of water must be preserved to ensure its protection (United States v Cappaert, 426 U.S. 128 [1976]). This decision resulted in the prohibition of any development that could lower the water level in Devils Hole. The western half of the site lies largely within the Alkali Flat Furnace Creek Ranch subbasin, which flows toward the Alkali Flat Furnace Creek Ranch discharge area, and a small section of the northwest corner of the site is located within the Pahute Mesa Oasis Valley subbasin, which flows toward the Pahute Mesa Oasis Valley discharge area. As displayed above, these three subbasins are named for their downgradient discharge areas. As all three discharge areas are located off site, any activity that may affect groundwater on the NNSS has the potential to affect groundwater off the NNSS.

The NNSS is located within the Death Valley regional groundwater flow system extending from central Nevada north of the NNSS to Death Valley. The Death Valley system encompasses approximately 16,000 square miles of the Great Basin (Belcher et al. 2010). It is very complex, involving many aquifers and aquitards, which vary in their characteristics and presence over distance.

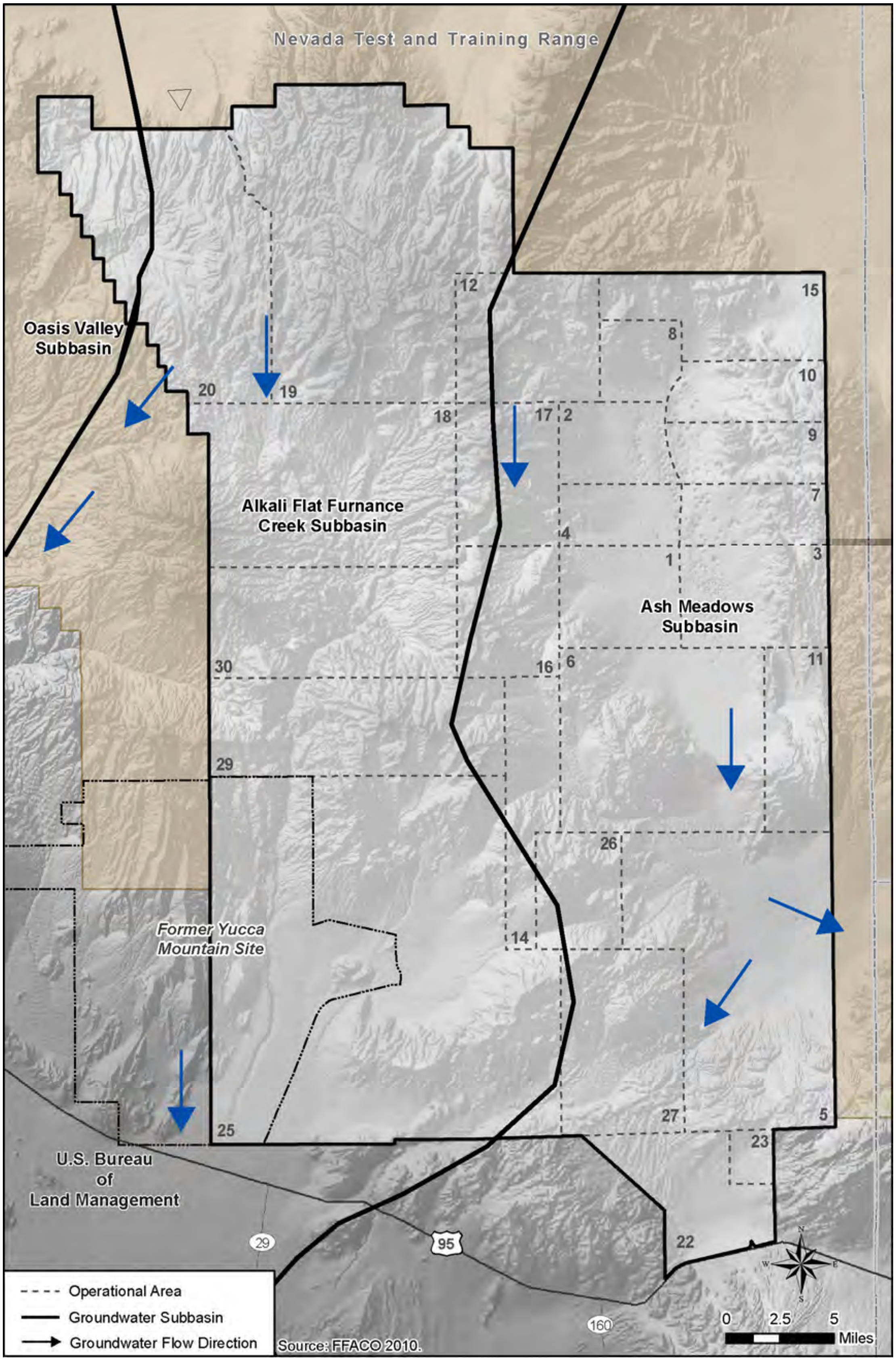

Figure 4–17 Groundwater Subbasins and Flow at the Nevada National Security Site

The principal hydrogeologic water-bearing units of the Death Valley regional groundwater flow system are grouped into three types of aquifers: (1) basin-fill alluvium (or alluvial aquifers), (2) volcanic aquifers, and (3) carbonate aquifers. An alluvial aquifer is in a permeable body of sand, silt, gravel, or other detrital material deposited primarily by running water. Volcanic and carbonate aquifers are permeable units of volcanic rocks and marine carbonate (limestone or dolomite) rock, respectively. The mountainous area that makes up the north-central portion of the NNSS is upheld by volcanic rocks associated with the Timber Mountain caldera complex and includes multiple volcanic aquifers associated with areas of fractured rock. The valley or basin areas in the region contain alluvial aquifers. Together, these volcanic and alluvial aquifers are referred to as "Cenozoic aquifers" because the rocks and sediments in which they occur are of Cenozoic geologic age. The rocks containing the carbonate aquifers are older (Paleozoic age) and regionally extensive, generally occurring at large depths below the Cenozoic aquifers. The major aquifers beneath the NNSS are the Lower Carbonate aquifer system and the Cenozoic aquifer system.

Hydrogeologic Terms

Aquifer: A permeable water-bearing unit of rock or sediment that yields water in a usable quantity to a well or spring.

Artesian: Where water in a lower aquifer is under pressure in relation to an overlying confining unit; when intersected by a well, the water will rise in the borehole to a level above the top of the aquifer.

Saturated zone: The area below the water table where all spaces (fractures and rock pores) are completely filled with water.

Aquitard (or confining unit): A rock or sediment unit of relatively low permeability that retards the movement of water in or out of adjacent aquifers.

Caldera: A near-circular volcanic feature formed by the collapse of rocks overlying a magma chamber from rapid emptying of the chamber during large-volume eruptions.

The Lower Carbonate aquifer system is found primarily in the eastern and southern part of the NNSS and is not present in all areas. The Cenozoic aquifer system is found beneath the main valleys, such as Yucca and Frenchman Flats, and caldera areas, including Pahute Mesa and Timber Mountain.

There is limited hydraulic connection between groundwater in the Lower Carbonate aquifer system and the Cenozoic aquifers (alluvial and volcanic) in many areas, controlled by the location and properties of low-permeability aquitards (see Section 4.1.5 for a discussion of geology and soils). Aquifer types are subdivided into regional and local aquifers dependent on their hydrologic connection to the regional groundwater flow system (Fenelon et al. 2010); in many locations, the alluvial and volcanic form local aquifers where they are separated from the Lower Carbonate aquifer system by volcanic confining units.

Table 4–25 shows the hydraulic parameters of the major aquifers found beneath the NNSS. Hydraulic conductivity is a measure of the ability of the hydrogeologic unit to transmit water, and effective porosity is that portion of the void space within a geologic unit through which groundwater moves (DOE/NV 1997a). The product of hydraulic conductivity and aquifer thickness is transmissivity. Transmissivity is the rate at which groundwater flows through a unit width of an aquifer under a unit hydraulic gradient. As displayed below, the Lower Carbonate aquifer is the most transmissive aquifer below the NNSS; therefore, it controls regional groundwater flow and the possible transport of contaminants. The mean hydraulic conductivity of the alluvial aquifer is lower than the Lower Carbonate aquifer and overlaps with the hydraulic conductivity of the volcanic aquifers. Local conductivity estimates for fractured volcanic rock can be high and approach the conductivity of the Lower Carbonate aquifer, but there is significant lateral variability in rock properties of the volcanic rocks. Mean conductivity of volcanic rocks averaged on a basin-wide scale can be lower than the conductivity of the alluvial aquifer. Their ability to transmit water is lower than that of the Lower Carbonate aquifer. Alluvial and volcanic aquifers are highly variable throughout the region and are assumed to be discontinuous. In most instances, the alluvial aquifer is confined to the basin in which it resides by surrounding mountain ranges. In general, these two aquifers only influence regional flow in localized areas.

Table 4–25 Hydraulic Parameters of the Major Aquifers Below the Nevada National Security Site

Aquifer	*Hydraulic Conductivity*		*Effective Porosity Range (percent)*
	Mean (meters per day)	*Range (meters per day)*	
Alluvial Aquifer	8.44	0.00005–83	31–35
Volcanic Aquifer	1.18	0.0003–12	0.00001–0.006
Carbonate Aquifer	31.71	0.0008–1,570	0.0006–10

Source: DOE/NV 1997a.

Groundwater flow at the NNSS is complex due to the discontinuous nature of the volcanic aquifers (discussed above) and due to major high-angle Basin and Range faults and other features such as caldera structural margins that can juxtapose rocks of contrasting hydraulic conductivity. Groundwater flow through these units is largely controlled by faults and fractures. Groundwater flows generally south and southwest on the NNSS. The flow system extends from the water table to a depth below ground surface that may exceed 4,900 feet where the transmissivity of the rocks becomes much smaller (DOE 1996a). The rates of groundwater flow through the hydrogeologic units are highly variable. The current understanding of groundwater flow at the NNSS is derived from work by Winogard and Thordarson (1975), which was summarized and updated by Laczniak et al. (1996) and Fenelon et al. (2010), and continues to be further developed by the UGTA Project hydrogeologic modeling team. In general, average flow rates over broad areas were estimated by Winogard and Thordarson (1975) to range from 7 to 660 feet per year, but rates can be much higher or lower over short distances in certain geologic settings.

Depth to Groundwater. The depth to groundwater at the NNSS varies from approximately 30 feet at Fortymile Wash to more than 700 feet in Frenchman Flat, to greater than 1,500 feet in portions of Yucca Flat, to finally more than 2,000 feet under the upland portions of Pahute Mesa. Perched groundwater (isolated lenses of water lying above the regional groundwater level) is known to occur in some parts of the NNSS, mainly in the volcanic rocks of Rainier Mesa. The greatest depth to water at the NNSS was measured near Tippipah Point in the central part of the NNSS at 4,093 feet (DOE 2008l; DOE/NV 1997a).

Groundwater Recharge and Discharge. The Death Valley groundwater flow system is recharged by underflow from upgradient areas, as well as precipitation in the higher elevations of the northern and eastern mountain ranges, while discharge areas such as Death Valley and the Amargosa Valley occur primarily in the south and southwest low-lying valleys.

Groundwater recharge includes the water contribution from precipitation and from interbasin underflow from upgradient areas. There are various processes that inhibit recharge of the groundwater from precipitation in arid areas. Therefore, depending on the type of soil, amount of vegetation, evaporation, and subsurface geology, only a fraction of precipitation contributes to recharge. The majority of precipitation recharge on the NNSS is limited to higher elevations, where precipitation is greatest and originates over upland areas of Pahute Mesa, Timber Mountain, and the Belted Range (see Section 4.1.8 for more information regarding precipitation and evaporation at the NNSS). However, total recharge (i.e., all of the water that moves into an aquifer) at the NNSS is dominated by subsurface, lateral regional flow, or interbasin flow. The estimated underflow onto the NNSS from adjacent areas ranges from 38,000 to 44,000 acre-feet per year. Total recharge for the NNSS regional groundwater flow system from both precipitation and lateral interbasin flow has been estimated at 69,097 acre-feet per year (DOE/NNSA/NSO 2008).

Groundwater discharge within the NNSS is minor, consisting of natural discharge at small springs found in mountainous regions that drain perched water within near-surface volcanic rocks and withdrawals at water supply wells. No direct discharge from the regional groundwater flow system occurs on the NNSS. Springs at the NNSS are located well above the regional water table level and have very low discharge rates, ranging from 0.22 to 35 gallons per minute (see Section 4.1.6.1 for more information regarding the location of springs) (DOE/NNSA/NSO 2008). Discharge to these onsite springs is small when compared to the discharge of groundwater from the NNSS to Rock Valley and the Amargosa Desert, which totals an estimated 42,000 acre-feet per year (DOE 1996a).

Groundwater Supply. Groundwater is the only local source of potable water on the NNSS. Drinking water needs, as well as water required for nonpotable, construction, and fire protection purposes, are met by groundwater drawn from deep wells installed in the carbonate, volcanic, and alluvial aquifers.

Water production and distribution systems have been in place at the NNSS for over 50 years. Currently, the NNSS has three permitted PWSs served by six wells (Wells 4/4a, 5b/5c, 8, 16D, C-1, and J-12) (NSTec 2010d). Two of the PWSs are non-transient, non-community PWSs (NV0004099 and NV0000360) that operate under permit numbers NY-0360-12NTNC and NY-4099-12NTNC, respectively. The third PWS is a transient system (NV0004098) and operates under permit number NY-4098-12NTNC. See **Table 4–26** for a list of these wells and their associated characteristics (e.g., depth and pumping rate). All three systems are regulated under the Safe Drinking Water Act (DOE/NV 2008c). The transmission and distribution systems include mains, valves, hydrants, booster pump stations, pump suction tanks, and reservoir storage tanks. Potable water is hauled to support facilities not connected to the potable water system in two permitted water-hauling trucks; however, these are not considered part of the PWS (NSTec 2010d). The NNSS drinking water systems currently meet all applicable regulatory standards.

Water System Terms

Public Water System: A system that provides water for human consumption that has at least 15 service connections or serves at least 25 individuals daily at least 60 days out of the year. Public water systems are further categorized into three different types: community, non-transient non-community, and transient non-community.

Community Water System: A public water system that serves at least 15 service connections used by year-round residents or regularly serves at least 25 year-round residents.

Non-Transient Non-Community Water System: A public water system that regularly serves at least 25 of the same nonresident persons per day for more than 6 months per year. Examples of such systems are those serving the same individuals (industrial workers, school children) on a daily basis even though those individuals do not reside at that location.

Transient Non-Community Water System: A non-community public water system that does not serve 25 of the same nonresident persons per day for more than 6 months per year. Examples of such systems include a restaurant or convenience store with fewer than 25 permanent nonresident staff, but the number of people served exceeds 25.

Table 4–26 Nevada National Security Site Supply Well Characteristics

Well Name	*Aquifer*	*Years Active*	*Depth to Water (feet)*	*Well Depth (feet)*	*Hydrographic Basin*	*Pumping Rate (millions of gallons per year)*	
						Maximum	*Average*
Well 4	Volcanic	1983–Present	837	1,479	Frenchman Flat (160)	192	36
Well 4a	Volcanic	1993–Present	838	–	Frenchman Flat (160)	72	54
Well 5b	Alluvial	1951–Present	687	900	Frenchman Flat (160)	88	31
Well 5c	Alluvial	1954–Present	702	1,187	Frenchman Flat (160)	73	37
Well 8	Volcanic	1963–Present	1,087	5,490	Fortymile Canyon, Buckboard Mesa Subdivision (227b)	121	34
Well J-12	Volcanic	1957–Present	740	1,139	Fortymile Canyon, Jackass Flats Subdivision (227a)	61	21
Well 16d	Carbonate	1981–Present	752	3,000	Yucca Flat (159)	52	30
Well C-1	Carbonate	1962–Present	1,544	1,707	Yucca Flat (159)	76	25

Source: DOE/NNSA/NSO 2008.

The NNSS water system is spread over four distinct water service areas and consists of eight water systems, two wildlife preservation reservoirs, numerous water storage tanks, fillstands, and construction water open pit reservoirs, as well as approximately 140 miles of pipeline located throughout the site (DOE 2008l). These water service areas are discussed in detail below in relation to their location and the areas they support. The water service areas are also displayed in **Figure 4–18**.

Water Service Area A. Encompasses Areas 19 and 20. System capabilities within this service area have been abandoned for more than a decade. There are two wells in this area (Wells 19c and 20), both of which are out of service and have monitoring casings to prevent vandalism or contamination (DOE/NV 2008c).

Water Service Area B. Encompasses Areas 2, 4, 7, 8, 9, 10, 12, 15, 17, and 18. PWS NV0004099 serves Area 12. Well 2, which is within this service area, is out of service and has a monitoring casing to prevent vandalism or contamination. Well 8 provides water to Area 12 and supplies water to the construction water open pit reservoir system. Water Service Area B also includes one pumping station and two water storage tanks (DOE 2009f; DOE/NV 2008c).

Water Service Area C. Encompasses Areas 1, 3, 5, 6, 11, 22, 23, 26, and 27. PWS NV0000360 serves Areas 5, 6, 22, and 23. Five active wells provide water in this service area (Wells C-1, 4, 4a, 5b, and 5c). Fillstand A-6 is used to supply potable water via water trucks to JASPER, Area 12, and BEEF. Water Service Area C also includes five pumping stations and nine water storage tanks (DOE 2009f; DOE/NV 2008c).

Water Service Area D. Encompasses Areas 14, 16, 25, 29, and 30. PWS NV0004098 serves Area 25. It consists of two active wells (Wells J12 and 16d). Well 16d is a nonpotable well that serves the batch plant. Water Service Area D also includes three pumping stations and 12 water storage tanks (DOE 2009f; DOE/NV 2008c).

In 2010, a new water well (Well J-14) was designed and drilled in Area 25. Well J-14 and its associated water pipeline were permitted in 2011 as a part of the Area 25 PWS, which is located in Water Service Area D (Radack 2012). Well J-14 was designed to relieve water pressure on the PWS's existing long water transmission line (DOE/NV 2011).

Water is currently hauled into Areas 26 and 27 (Water Service Area C) by truck from Area 25 (Water Service Area D). There are four elevated tanks in Area 26 that store construction water and one tank in Area 27 that stores fire protection and potable water (DOE/NV 2008c).

Since the 1992 moratorium on underground nuclear testing, there has been a significant reduction in personnel and operational activities at the NNSS, and the amount of water consumed at the NNSS has dropped significantly. In 2005, the NNSS installed water volume meters on the active water wells that contribute to the water distribution system; in 2009, the NNSS installed meters on the fillstand locations.

Between 2005 and 2009, total annual water usage from active wells ranged from approximately 173 million to 225 million gallons (from 531 to 690 acre-feet, see **Table 4–27**) (NSTec 2010c), which is significantly less than the peak usage of 3,375 acre-feet per year in 1989 (DOE 1996a). When comparing historic pumping levels in Frenchman Flat to the State Engineer's perennial yield estimate of Frenchman Flat (100 acre-feet per year), the NNSS appears to be overdrawing water by a large percentage (see **Table 4–28**). However, based upon more-recent data derived from USGS studies, the water levels in Frenchman Flat have remained static and have not shown a downward trend of water drawdown, even during peak water usage at the NNSS in 1989. This suggests that the perennial yield of Frenchman Flat is significantly higher than 100 acre-feet per year, and more likely in the range of yields calculated by other DOE/NNSA and USGS models.

In general, water usage at the NNSS has declined since 1989 and the volume of water produced from characterization wells is minor, totaling typically less than 2 acre-feet per well (DOE/NNSA/NSO 2008).

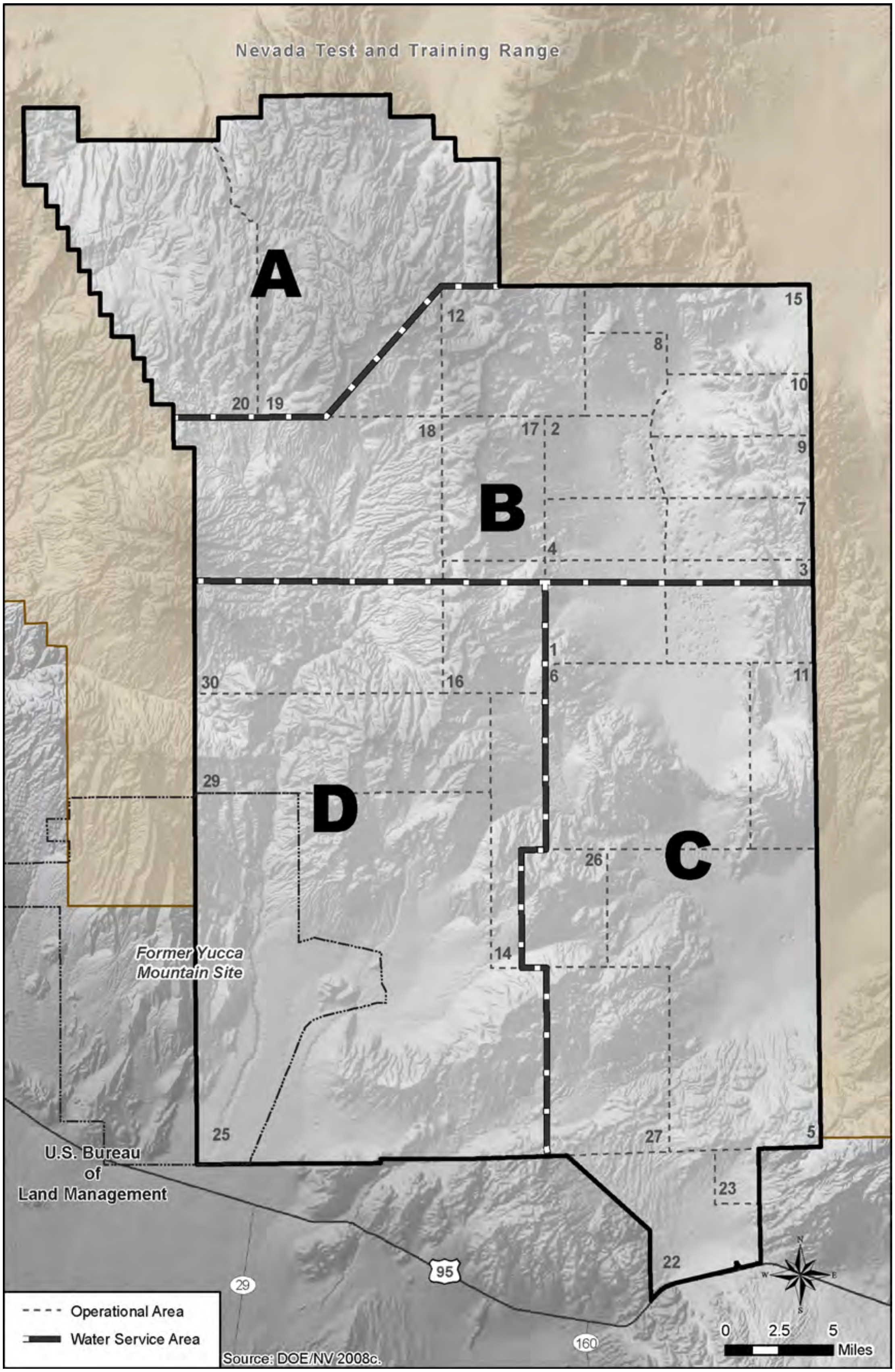

Figure 4–18 Water Service Areas at the Nevada National Security Site

Table 4–27 Nevada National Security Site Well Withdrawal Totals (2005 through 2009)

Well Name	*2005 Use (gallons)*	*2006 Use (gallons)*	*2007 Use (gallons)*	*2008 Use (gallons)*	*2009 Use (gallons)*	*Total Use (gallons)*	*Percent of 2005–2009 Total Use*
Well 4	38,512,000	52,398,000	40,391,000	26,288,000	22,727,000	180,316,000	18.2
Well 4a	52,325,000	66,257,000	60,990,000	34,434,000	49,633,000	264,639,000	26.7
Well 5b	25,600,000	35,608,000	37,968,000	47,348,000	39,315,000	185,839,000	18.7
Well 5c	10,339,000	8,951,000	4,597,000	14,104,000	11,918,000	49,909,000	5.0
Well 8	11,432,000	8,575,000	15,132,000	12,056,000	13,285,000	60,480,000	6.1
Well J-12	13,919,000	14,440,000	23,403,000	10,004,000	5,651,000	67,417,000	6.8
Well 16d	22,818,000	26,505,000	21,393,000	5,800,000	26,104,000	102,620,000	10.3
Well C-1	7,707,000	8,515,000	21,268,000	22,508,000	21,375,000	81,373,000	8.2
Total use in gallons	182,652,000	221,249,000	225,142,000	172,542,000	190,008,000	992,593,000	
Total use in acre-feet	561	679	691	530	583	3,046	

Source: NSTec 2010c.

Table 4–28 Nevada National Security Site Nonpotable Fillstand Flow Totals for 2009

Fillstand Name	*Use*	*Months Used in 2009*	*Total Use (gallons)*	*Total Use (acre-feet)*
FS 5B	Nonpotable	January–December	6,261,100	19.2
FS A-12	Nonpotable	March–December	1,424,200	4.4
FS A-17	Nonpotable	April–December	3,393,100	10.4
FS A-25	Nonpotable	July–December	491,410	1.5
FS A-6 #1 and #2	Nonpotable	May–June	890,400	2.7
FS Birdwell	Nonpotable	March–December	4,917,800	15.1
FS C-1	Nonpotable	February–December	3,666,600	11.3
FS ETS	Nonpotable	February–March	1,277	0.004
FS J-13	Nonpotable	February–March	188,800	0.6
FS Mercury	Nonpotable	February–December	8,037,000	24.7
FS Wet and Wild	Nonpotable	February–December	864,700	2.7
Total Water Withdrawn From Fillstands in 2009			30,136,387	92.5

Source: NSTec 2010c.

The measured annual water usage from the active wells includes fillstand water withdrawals, which are used for nonpotable purposes such as dust suppression (NSTec 2010d). As meters were not installed on the fillstand locations until 2009, detailed information on the division of potable and nonpotable water use is only available for one calendar year. See Table 4–28 for a list of fillstands and corresponding water withdrawals for 2009 and **Table 4–29** for a breakdown of potable and nonpotable water use at the NNSS for 2009.

Table 4–29 Potable and Nonpotable Water Use at the Nevada National Security Site for 2009

	Gallons	*Acre-Feet*
Total Nonpotable Water Use in 2009	30,136,387	93
Total Potable Water Use in 2009	159,871,613	491
Total Water Use in 2009	190,008,000	583

Source: NSTec 2010c.

Table 4–30 provides a summary of historic water withdrawals from affected hydrographic basins at the NNSS from 2005 through 2009. Over 68 percent of the NNSS water withdrawals in this timeframe occurred in Frenchman Flat (Basin 160), with lesser contributions coming from Yucca Flat (Basin 159) and the Jackass Flats and Buckboard Mesa Subdivisions of Fortymile Canyon (Basins 227b and 227a). In terms of use of sustainable yield (perennial yield minus any rights already committed by the State Engineer to other users), Frenchman Flat was the most heavily used during this timeframe (375 to 501 percent of perennial yield used in any year), followed by Yucca Flat (25 to 42 percent in any year). The Jackass Flats and Buckboard Mesa Subdivisions of Fortymile Canyon showed very light use during this timeframe, never exceeding 2 percent of sustainable yield in any year.

Table 4–30 Summary of Water Withdrawals from Hydrographic Basins

Hydrographic Basin	*Sustainable Yield of the Basin (acre-feet per year)*	*NNSS Operational Water Wells by Basin*	*Percentage of Basin's Average Contribution to NNSS Water Supply 2005–2009*	*Range of Total Withdrawals, 2005–2009 (acre-feet per year)*	*Percentage of Perennial Yield Used, 2005–2009*
Frenchman Flat (160)	100	4, 4a, 5b, 5c	68.6%	375–501	375–501%
Fortymile Canyon, Buckboard Mesa Subdivision (227b)	3,600	8	6.1%	26–46	0.7–1.3%
Fortymile Canyon, Jackass Flats Subdivision (227a)	3,944	J-12	6.8%	17–72	0.4–1.8%
Yucca Flat (159)	350	C-1, 16d	18.5%	87–146	25–42%

NNSS = Nevada National Security Site.
Source: Derived from Tables 4–26, 4–28, 4–29.

Groundwater Monitoring and Quality. Water resources in and around the NNSS are monitored through the measurement of groundwater levels in wells and the quantity of water produced. USGS conducts the monitoring, maintains the databases, and reports the results annually in a statewide water resource summary. Over the long term, existing and new regional groundwater modeling will improve the understanding of water availability and planning. The groundwater at the NNSS is classified as Class II groundwater according to the EPA groundwater classification system, which means that it is currently or potentially could be a source of drinking water.

Water chemistry (see **Table 4–31**) varies from a sodium-potassium-bicarbonate type associated with volcanic aquifers, to a calcium-magnesium-bicarbonate type associated with carbonate aquifers, to a calcium-magnesium-sodium-bicarbonate type, which is a mixed type and may represent alluvial aquifers or the mixing of groundwater entering the Lower Carbonate aquifer from overlying volcanic units (DOE/NNSA/NSO 2008). Drinking water quality on the NNSS is monitored to assess compliance with primary and secondary drinking water standards according to the schedule set in applicable Federal and state laws, monitoring waivers, and permits issued by NDEP. The three PWSs and permitted water hauling trucks at the NNSS meet all of the primary and secondary drinking water standards (DOE/NV 2011). The trucks that are permitted to haul water to the PWSs are permitted by NDEP's Bureau of Safe Drinking Water, and the water they carry is subject to water quality standards for coliform bacteria (DOE/NV 2011).

The Safe Drinking Water Act Arsenic Rule amendment, approved in 2001, lowered the allowable maximum level of arsenic in drinking water to 10 parts per billion for PWSs (Congressional Research Service 2007) (note that the water chemistry data displayed in Table 4–31 were collected in 1993, before the Arsenic Rule amendment). Groundwater drawn from two wells serving the PWSs in Area 25 currently exceeds this limit. To maintain compliance with the Safe Drinking Water Act, the pumped groundwater is treated in a reverse osmosis system or a point-of-use treatment to remove the excess arsenic before being distributed for consumption (DOE 2007c).

Table 4–31 Potable Groundwater Chemistry Data on the Nevada National Security Site

Well Name	Calcium	Magnesium	Potassium	Sodium	Bicarbonate	Carbonate	Chloride	Fluoride	Nitrate	Sulfate	TDS
	(milligrams per liter)										
Well 4	23	8	5	51	168	<0.3	12	0.6	4.5	41	309
Well 4a	23	7	6	50	162	<0.3	12	0.7	4.4	42	306
Well 5b	7	2	12	96	180	<0.3	21	0.7	3.1	56	346
Well 5c	2	1	6	131	328	<1.2	10	0.9	1.7	29	422
Well 8	8	1	4	31	81	<0.3	8	0.7	1.3	15	164
Well J-12	14	2	5	42	119	<0.3	7	1.8	2.2	22	232
Well 16d	77	23	7	30	360	<0.3	11	0.5	0.1	58	404
Well C-1	73	28	14	123	601	<0.3	32	1.0	0.1	67	671

TDS = total dissolved solids.
Source: Navarro-Intera 2012.

There have been 828 underground nuclear tests conducted at the NNSS. Approximately one-third of these tests were detonated near or below the water table. Most of the NNSS underground nuclear detonations were conducted at Frenchman Flat, Yucca Flat, Pahute Mesa, and Rainier Mesa. This legacy of nuclear testing has resulted in groundwater contamination in areas now identified as CAUs in environmental studies. Between 30 and 38 percent of underground nuclear tests conducted at or below the water table have contaminated groundwater near underground nuclear test cavities. This groundwater is contaminated with 43 identified radionuclides, the most prevalent of which is tritium (Bowen et al. 2001). In a 2001 report, scientists from Los Alamos National Laboratory and Lawrence Livermore National Laboratory calculated the underground inventory of radionuclides resulting from underground nuclear testing at the NNSS between 1951 and 1992 (Bowen et al. 2001). That report estimated the remaining underground source term of radionuclides as of September 23, 1992, to be about 132 million curies; however, only a portion of this source term would be available as part of the hydrologic source term. The hydrologic source term is that portion of the overall underground source term that is available for transport in the groundwater. As mentioned above, nuclear tests were conducted close enough to the groundwater to potentially contribute to the hydrologic source term. Of the radionuclides produced by an underground nuclear detonation, only those that are readily soluble in water and/or are available to be transported (i.e., not encapsulated within the melt glass within the detonation cavity or otherwise immobile), may become part of the hydrologic source term.

Figure 4–19 shows the locations of underground nuclear tests and established CAU areas of potential groundwater contamination. This figure also illustrates the directions of predicted groundwater flow from the CAUs.

Several groups regularly test water at and surrounding the NNSS. There are approximately 120 active groundwater monitoring wells (see **Table 4–32** for a complete list of these wells used under the NNSS Environmental Restoration Program by the RREM Program and UGTA). The DOE/NNSA NSO's RREM Program samples more than 80 locations, which include wells, springs, and surface-water sites, to make sure radionuclide levels do not exceed Safe Drinking Water Act standards. The UGTA Project samples a network of deep wells to help determine where contaminants are present in groundwater, what direction these contaminants are moving, and how quickly. UGTA wells that are not designated as source term characterization wells are made available for monitoring under the RREM Program (DOE/NV 2011).

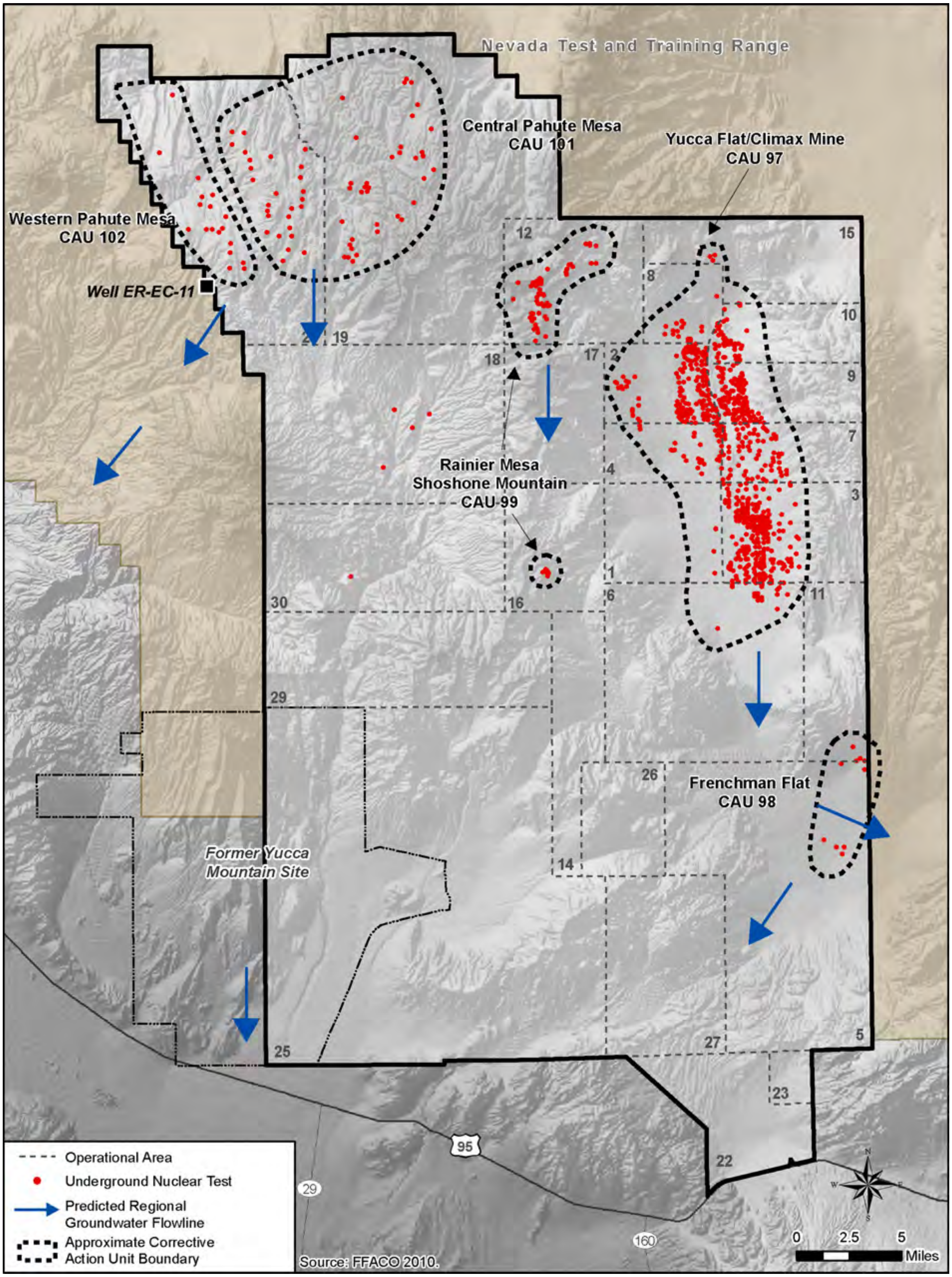

Figure 4–19 Underground Test Area Project Corrective Action Units and Underground Nuclear Test Locations at the Nevada National Security Site

Table 4–32 Groundwater Characterization and/or Monitoring Wells Used by the Underground Test Area Project and the Routine Radiological Environmental Monitoring Program on and near the Nevada National Security Site

UGTA Project Wells

Location	*Well Name*	*Depth (feet)*	*Primary Aquifer*
Area 2	ER-2-1	2,600	Timber Mountain lower vitric-tuff aquifer
	UE-2ce-WW	1,650	Lower carbonate aquifer-thrust plate
	U-2gg PSE 3A	2,383	Timber Mountain welded-tuff aquifer
			Timber Mountain lower-vitric tuff aquifer
Area 3	ER-3-1	2,807	Lower carbonate aquifer
	ER-3-2	3,000	Alluvial aquifer
			Timber Mountain upper vitric-tuff aquifer
			Timber Mountain welded-tuff aquifer
	UE-3e 4	2,300	Timber Mountain lower-vitric tuff aquifer
			Lower tuff confining unit
	U-3cn 5	3,030	Lower carbonate aquifer
	U-3cn PS 2	2,603	Lower tuff confining unit
Area 5	ER-5-3	2,606	Alluvial aquifer
			Timber Mountain welded-tuff aquifer
	ER-5-3-2	5,683	Lower carbonate aquifer
	ER-5-3-3	1,800	Alluvial aquifer
	ER-5-4	3,732	Alluvial aquifer
	ER-5-4-2	7,000	Lower tuff confining unit
	UE-5n	1,687	Alluvial aquifer
	RNM-1	1,302	Alluvial aquifer

Location	*Well Name*	*Depth (feet)*	*Primary Aquifer*
Area 7	ER-7-1	2,500	Lower carbonate aquifer
	U-7ba PS 1AS	2,333	Oak Spring Butte confining unit
	UE-7nS	2,205	Lower carbonate aquifer
	U-4t PS 3A	2,513	Lower tuff confining unit
	U-4u PS 2A	2,280	Lower tuff confining unit
Area 8	HTH-2	3,422	Lower carbonate aquifer
	UE-10j	2,613	Lower carbonate aquifer
	ER-8-1	2,863	Mesozoic granite confining unit
Area 12	ER-12-3	4,908	Lower carbonate aquifer-thrust plate
	ER-12-4	3,715	Lower carbonate aquifer-thrust plate
	ER-12-2	6,883	Oak Spring Butte confining Unit
			Redrock Valley aquifer
			Upper clastic confining unit
	ER-12-1	3,588	Upper clastic confining unit
			Lower carbonate aquifer
	U-12s	1,596	Mesozoic granite confining unit

Location	*Well Name*	*Depth (feet)*	*Primary Aquifer*
Area 20	ER-20-5-1	2,823	Topopah Spring aquifer
	ER-20-6-1	3,200	Calico Hills zeolitic composite unit
	ER-20-6-2	3,200	Calico Hills zeolitic composite unit
	ER-20-6-3	3,200	Calico Hills zeolitic composite unit
	ER-20-5-3	4,294	Calico Hills zeolitic composite unit
	ER-20-1	2,065	Tiva Canyon aquifer
	ER-20-2-1	2,524	Calico Hills zeolitic composite unit
	U-20n PS 1DD	4,520	Calico Hills zeolitic composite unit
	UE-20n 1	3,300	Calico Hills zeolitic composite unit
	ER-20-8	3,442	Tiva Canyon aquifer
			Topopah Spring aquifer
	ER-20-7	2,936	Lower Paintbrush confining unit
			Topopah Spring aquifer
			Calico Hills zeolitic composite unit
	ER-20-8-2	2,338	Scrugham Peak aquifer
	ER-20-4	2,499	Calico Hills zeolitic composite unit

Location	Well Name	Depth (feet)	Primary Aquifer
	RNM-2S	1,156	Alluvial aquifer
Area 6	ER-6-1	3,206	Lower carbonate aquifer
	ER-6-1 Sat 1	2,085	Lower carbonate aquifer
	ER-6-1-2	3,200	Lower carbonate aquifer
	ER-6-2	3,430	Lower carbonate aquifer-thrust plate
	UE-14b	3,680	Upper tuff confining unit
			Tiva Canyon aquifer
			Topapah Spring aquifer
			Topopah Spring aquifer
	ER-EC-11	4,148	Tiva Canyon aquifer
			Topopah Spring aquifer
	ER-EC-12	4,069	Tiva Canyon aquifer (two completion strings)
			Topopah Spring aquifer (two completion strings)
	ER-EC-2A	4,974	Fortymile Canyon composite unit
			Timber Mountain composite unit (two completion strings)
	PM-3	3,019	Upper Paintbrush confining unit
			Tiva Canyon Aquifer
			Lower Paintbrush confining unit
	ER-EC-5	2,500	Timber Mountain composite unit (three completion strings
			Fortymile Canyon

Location	Well Name	Depth (feet)	Primary Aquifer
Area 16	ER-16-1	4,566	Lower carbonate aquifer
Area 18	ER-18-2	2,500	Timber Mountain composite unit
Area 19	U-19ad PS 1A	2,609	Paintbrush lava-flow aquifer
	ER-19-1	3,595	Oak Spring Butte confining unit
			Redrock Valley aquifer
			Lower clastic confining unit-upper thrust plate
	U-19q PS 1D	4,991	Bullfrog confining unit
	U-19v PS 1D	4,113	Bullfrog confining unit
	ER-OV-01	180	Fortymile Canyon composite unit
	ER-OV-02	200	Alluvial aquifer
	ER-OV-03A	251	Detached volcanics aquifer
	ER-OV-03B	400	Alluvial aquifer
	ER-OV-04A	151	Alluvial aquifer
	ER-OV-03C	542	Timber Mountain composite unit
	ER-EC-7	1,386	Fortymile Canyon composite unit (two completion strings)

Location	Well Name	Depth (feet)	Primary Aquifer
	U-20 WW	3,268	Calico Hills zeolitic composite unit
Area 30	ER-30-1	1,426	Fortymile Canon composite unit
Offsite	ER-OV-03A2	821	Detached volcanic aquifer
	ER-OV-03A3	821	Detached volcanic aquifer
	ER-OV-03C2	321	Timber Mountain composite unit
	ER-OV-6A	536	Fortymile Canyon composite unit
	ER-OV-6A2	71	Fortymile Canyon composite unit
	ER-EC-4	3,487	Thirsty Canyon volcanic aquifer
			Timber Mountain upper welded tuff aquifer
	ER-EC-6	5,000	Benham aquifer
			Tiva Canyon aquifer
			Topopah Spring aquifer
			Crater Flat composite unit
	Ash-B	1,220	Alluvial aquifer
			Detached volcanic aquifer
	ER-OV-05	200	Alluvial aquifer
	ER-EC-1	5,000	Benham aquifer and Tiva Canyon aquifer

Location	Well Name	Depth (feet)	Primary Aquifer	Location	Well Name	Depth (feet)	Primary Aquifer	Location	Well Name	Depth (feet)	Primary Aquifer
	ER-EC-8		composite unit Timber Mountain composite unite (two completion strings)								
	ER-EC-13	3,000	Fortymile Canyon composite unit (four completion strings)								Topopah Spring aquifer
	ER-EC-15	3,254	Upper Paintbrush lava-flow aquifer Tiva Canyon aquifer Topopah Spring aquifer								Crater Flat composite unit
RREM Program Wells											
Area 1	UE-1q	2,600	Lower carbonate aquifer	Area 5 (cont.)	RNM-2S	1,156	Alluvial aquifer	Area 12 (cont.)	U-12e [a]	154	Lower tuff confining unit Oak Spring Butte confining unit
Area 3	ER-3-2	3,000	Alluvial aquifer Timber Mountain upper vitric-tuff aquifer Timber Mountain welded-tuff aquifer		UE5PW-1	839	Alluvial aquifer	Area 16	UE-16d WW	3,000	Upper carbonate aquifer
	UE-3e 4	2,300	Timber Mountain lower-vitric tuff aquifer Lower tuff confining unit		UE5PW-2	919	Alluvial aquifer	Area 17	HTH 1	4,206	Lower carbonate aquifer
	U-3cn5	3,030	Lower carbonate aquifer		UE5PW-3	955	Timber Mountain welded-tuff aquifer	Area 18	UE-18r	5,004	Timber Mountain composite unit
	U-3cn PS 2	2,603	Lower tuff confining unit	Area 6	WW C-1	1,707	Lower carbonate aquifer		WW 8	5,490	Belted Range aquifer
	WW A	1,870	Alluvial aquifer		WW 4	1,479	Timber Mountain welded-tuff aquifer	Area 19	ER-19-1	3,595	Oak Spring Butte confining unit Redrock Valley aquifer Lower clastic confining unit-upper thrust plate
Area 4	TW D	1,950	Lower carbonate aquifer		WW 4A	1,517	Timber Mountain welded-tuff aquifer		UE-19c WW	8,489	Belted Range aquifer Pie-Belted Range composite unit
Area 5	WW 5B	900	Alluvial aquifer	Area 7	UE-7nS	2,205	Lower carbonate aquifer		U-19v PS 1D	4,113	Bullfrog confining unit
	WW 5C	1,200	Alluvial aquifer		UE-4t	2,413	Lower tuff confining unit		U-19bh	2,148	Paintbrush lava-flow aquifer
	UE-5c WW	2,682	Alluvial aquifer		U-4t PS 3A	2,513	Lower tuff confining unit	Area 20	ER-20-5-1	2,823	Topopah Spring aquifer

Location	Well Name	Depth (feet)	Primary Aquifer	Location	Well Name	Depth (feet)	Primary Aquifer	Location	Well Name	Depth (feet)	Primary Aquifer
	UE-5n	1,687	Alluvial aquifer	Area 8	HTH-2	3,422	Lower carbonate aquifer		ER-20-6-1	3,200	Calico Hills zeolitic composite unit
	RNM-1	1,302	Alluvial aquifer	Area 12	ER-12-1	3,588	Upper clastic confining unit Lower carbonate aquifer		ER-20-6-2	3,200	Calico Hills zeolitic composite unit
Area 20 (cont.)	ER-20-1	2,065	Tiva Canyon aquifer	Offsite	Last Trail Ranch	237	Alluvial aquifer	Offsite (cont.)	ER-OV-03A	251	Detached volcanics aquifer
	ER-20-6-3	3,200	Calico Hills zeolitic composite unit		ER-OV-03C2	321	Alluvial aquifer Timber Mountain composite unit		ER-OV-04A	151	Alluvial aquifer
	ER-20-5-3	4,294	Calico Hills zeolitic composite unit		ER-OV-6A	536	Fortymile Canyon composite unit		ER-OV-03C	542	Alluvial aquifer Timber Mountain composite unit
	ER-20-1-2	2,524	Calico Hills zeolitic composite unit		Fire Hall 2 Well	230	Alluvial aquifer		Roger Bright Ranch		
	U-20n PS 1DDH	4,520	Calico Hills zeolitic composite unit		Peacock Ranch				School Well	320	
	PM-1	7,858	Belted Range aquifer		Spicer Ranch				Cind-R-Lite Mine	460	
	U-20 WW	3,268	Calico Hills zeolitic composite unit		Fairbanks Spring		Alluvial aquifer		Ash-B	1,220	Alluvial aquifer Detached volcanic aquifer
Area 22	Army 1 WW	1,946	Lower carbonate aquifer		Fuller Property				U.S. Ecology	575	
	SM-23-1	1,338	Lower carbonate aquifer		Longstreet Spring		Lower carbonate aquifer		Beatty Wtr Swr-Well3		
Area 25	UE-25p 1	5,923	Lower carbonate aquifer		PM-3	3,019	Upper Paintbrush confining unit Tiva Canyon aquifer Lower Paintbrush confining unit		ER-OV-05		Alluvial aquifer
	UE-25 WT 6	1,257	Yucca Mtn. Crater Flat Composite Unit		HTH 5	926	Lower clastic confining unit		Big Springs		Lower carbonate aquifer
	J-11 Prime	220	Topopah Spring aquifer		Tolicha Peak	2,005	Timber Mountain welded tuff aquifer		Crystal Pool		Lower carbonate aquifer
	J-12 WW	1,139	Topopah Spring aquifer		USW H-1/Inst	6,000	Yucca Mtn. Crater Flat Composite Unit		Revert Springs		
	J-13 WW	3,488	Topopah Spring aquifer		ER-OV-01	180	Fortymile Canyon composite unit				
	J-14 WW	1,775	Topopah Spring aquifer		ER-OV-02	200	Alluvial aquifer				

RREM = Routine Radiological Environmental Monitoring; UGTA = Underground Test Area.
[a] Tunnel Water Conduit Hole.
Source: BLM 2010l.

In addition to the RREM Program and the UGTA Project sampling efforts, the Community Environmental Monitoring Program (CEMP) performs independent, annual monitoring of 29 springs and water supplies in communities surrounding the NNSS (DOE/NNSA/NSO 2010). In 2008, CEMP offsite water sampling locations included 21 wells, 3 surface-water supply systems, and 4 springs. All water samples had levels of tritium either below laboratory detection limits or less than background levels of tritium in surface waters (25 to 35 picocuries per liter) (DOE/NV 2009d). Laboratory detection limits for tritium vary from less than 10 picocuries per liter to about 1,000 picocuries per liter dependent on methods of sample preparation and analytical techniques.

In a study published in 2006, Healing Ourselves and Mother Earth (HOME) conducted groundwater sampling and analysis in an attempt to develop an environmental/health baseline for helping to ascertain if contamination from the NNSS and the then-proposed Yucca Mountain site was approaching surrounding communities. HOME sampled eight wells and two springs located downgradient of the NNSS, the former proposed Yucca Mountain site, and U.S. Ecology's facility near Beatty, Nevada. The results of HOME's study showed analyte levels well within expected concentrations, and below EPA maximum contaminant levels, i.e., action levels. Some uranium and a low but positive reading for some trace metals were also expected, due to all the mineral deposits in the region. HOME also compared its data with that collected from the Nye County Early Warning Drilling Program and found that its data corroborated the results of Nye County, illustrating a wide variation in groundwater chemistry and radiation activity. HOME expressed concern that a possible consequence of the wide variation in gross alpha and beta readings in the data is that the profile of radioactive elements in the groundwater could vary, without triggering action for a more detailed analysis and the possibility of contamination from either the NNSS or Yucca Mountain site moving off site and into the water supply, without activating a warning system. HOME speculates that the variation in groundwater chemistry and radiation could be due to an as-yet-unidentified natural non-uniform binding mechanism in play with the naturally occurring radioisotopes that could affect the appearance and movement of contaminants coming from the NNSS or Yucca Mountain site.

Analytes Monitored by the RREM Program and UGTA Project. Tritium was the radioactive species created in the greatest quantities and is widely believed to be the most mobile in groundwater. Therefore, tritium is the primary target analyte for both the RREM Program and UGTA Project; every groundwater sample is analyzed for this radionuclide (DOE/NV 2011). For this reason, tritium is the primary radionuclide discussed in this SWEIS.

Both the RREM Program and UGTA Project analyze water samples for more than just tritium. The UGTA Project typically performs the following radioisotope analyses on groundwater samples:

- Tritium
- Carbon-14
- Chlorine-36
- Iodine-129
- Strontium-90
- Technetium-99
- Plutonium (-238 and -239/240)
- Gamma emitters* (typically report: actinium-228, aluminum-26, americium-241, antimony-125, beryllium-7, bismuth-212, bismuth-214, cesium-134, cesium-137, cobalt-58, cobalt-60, curium-243/244, europium-152, europium-154, europium-155, lead-212, lead-214, niobium-94, potassium-40, thallium-208, thorium-227, thorium-234, uranium-235)

The RREM Program typically performs the following radioisotope analyses on groundwater samples (quarterly to every 3 years, depending on the radioisotope):

- Tritium
- Carbon-14
- Strontium-90
- Technetium-99
- Plutonium (-238 and -239/240)
- Gamma emitters* (typically report: actinium-228, americium-241, antimony-125, cerium-144, cesium-134, cesium-137, cobalt-60, europium-152, europium-154, europium-155, lead-212, potassium-40, promethium-144, promethium-146, ruthenium-106, thorium-234, uranium-235, yttrium-88)

**Only the following gamma emitters reported by the RREM Program and UGTA Project are included in the radionuclide summary in Bowen et al. 2001 as products of underground nuclear weapons testing: aluminum-26, potassium-40, niobium-94, cesium-137, europium-152, europium-154, uranium-235, and americium-241; all others may be considered as naturally occurring.*

In 1992, Ernest A. Bryant from Los Alamos National Laboratory published *The Cambridge Migration Experiment: A Summary Report* (LA-12335-MS). The Cambric Experiment was a long-term (October 1974 through August 1991) experiment that consisted of first measuring the distribution of radioactive materials in water and rock in the vicinity of the 1965 Cambric underground nuclear test explosion and then inducing an artificial hydraulic gradient by pumping water from a nearby well (91 meters from the well used to characterize the initial source term). The water samples pumped from the test well were regularly analyzed for the presence of radioactive species that might have migrated from the explosion cavity. Among other things, the Cambric Experiment demonstrated that tritium migrates at about the same rate as groundwater relative to most other contaminants. Other radionuclides that exhibited migration with the groundwater during the Cambric Experiment included krypton-85 (a noble gas), chlorine-36, iodine-129, technetium-99, and ruthenium-106. As noted above, each of these, with the exception of krypton-85, is included in the list of radioisotopes analyzed by either the UGTA Project or RREM Program.

As reported by Kersting et al. (1998), groundwater samples taken at Well ER-20-5 in 1997 contained plutonium, apparently associated with colloids. Well ER-20-5 is located on the southwestern part of Pahute Mesa, about 4,265 feet south of the Benham underground nuclear test and 984 feet west of the Tybo underground nuclear test. Analysis of the plutonium in the groundwater samples demonstrated that it was from the Benham test, rather than the Tybo test. Kersting et al. noted, "this is the first time Pu has been shown to be transported by groundwater and for a significant distance." A low concentration of plutonium (0.42 picocuries per liter, which is well below the Safe Drinking Water Act EPA limit of 15 picocuries per liter) was found in samples taken from Well ER-20-5 #1 in 2004 (Eaton et al. 2007). In a study subsequent to the discovery of plutonium at Well EC-20-5, Smith et al. (2003) noted that general experience from the U.S. nuclear testing program based on radiochemical diagnostic data collected from a variety of test matrices suggests that only a small fraction (5 to 10 percent) of the total plutonium from an underground nuclear detonation would be available for transport in groundwater.

As evidenced by the above list of radiological analytes, DOE/NNSA has and will continue to track and report results of groundwater characterization and monitoring that demonstrates transport of any of the noted elements. Further, the data obtained from the ongoing groundwater characterization and monitoring are used in developing and refining the models used by DOE/NNSA and NDEP to site new characterization and monitoring wells and improve groundwater models.

Underground Test Area Project. The CAUs are investigated and monitored under the UGTA Project, which is the largest component of the NNSS Environmental Restoration Program, with the oversight of NDEP as part of the FFACO (DOE/NV 2010). The UGTA Project started in 1989 and is scheduled to be completed in 2027. This project evaluates the extent of radionuclide groundwater contamination due to past underground nuclear testing through hydrogeologic investigation and characterization, groundwater flow and transport modeling, and groundwater sampling and monitoring. The FFACO was amended in May 2011. Groundwater flow and transport models will be developed for each of the CAUs being evaluated under the UGTA Project to identify ensembles of contaminant boundaries where waters inside the boundaries exceed the radiological protection requirements of the Safe Drinking Water Act. The validity of the contaminant boundary forecasts will be tested through model evaluations that will lead to design and implementation of a long-term closure monitoring well network. The contaminant boundary evaluations provide the basis for establishing use-restriction areas and identifying a regulatory boundary by NDEP for protection of the health and safety of the public. Protection of the public is ensured through an in-depth approach that combines, for each CAU, model forecasts of contaminant transport over 1,000 years and long-term monitoring and institutional controls to restrict public access to contaminated groundwater (DOE/NV 2011).

Groundwater modeling for the UGTA Project is conducted in two steps. First, a regional three-dimensional groundwater flow model was developed for the Death Valley regional flow system to identify risks to the public, workers, and the environment (DOE/NV 1997a). Second, groundwater flow (boundary conditions) from this regional model is used in the development of CAU-scale groundwater flow and transport models. Individualized models are needed due to the complexity of geologic/hydrologic conditions within each CAU. These smaller-scale, site-specific groundwater models will be used to identify contaminant boundaries based on the maximum extent of contaminant migration over a 1,000-year time period. Results of the CAU-specific groundwater models will be used to develop a monitoring network, which augments current monitoring both on and off the NNSS. To ensure public health and safety, groundwater monitoring would continue until there is assurance that there is no remaining risk to public health and safety from groundwater contamination resulting from underground nuclear weapons testing.

CAU-specific groundwater flow and transport models have been completed for the Frenchman Flat CAU (Navarro Nevada Environmental Services 2010). The transport model included evaluations of ensembles of contaminant boundaries. The results of these models were reviewed and accepted by an external peer review panel (Navarro-Intera 2010a). The model results and peer review recommendations were accepted by NDEP, and the Frenchman Flat studies have moved into the model evaluation stage, the final stage before development of a long-term closure monitoring network. **Figure 4–20** shows the model-based estimation of the extent of groundwater contamination in the Frenchman Flat area over the next 1,000 years. As described above, depiction of groundwater contamination is based on the results of models that are being developed and refined. To date, the only UGTA CAU that has completed the Phase II investigation and the Phase II Transport Model is Frenchman Flat. Figure 4–20 depicts the area where there is a 95 percent certainty that groundwater contamination will exceed the Safe Drinking Water Act standards for radionuclides in the Frenchman Flat area over the next 1,000 years, as predicted by the Phase II Transport Model. The Central and Western Pahute Mesa CAUs have not completed Phase II milestones; therefore, a figure predicting groundwater contamination transport in Central and Western Pahute Mesa has not been included.

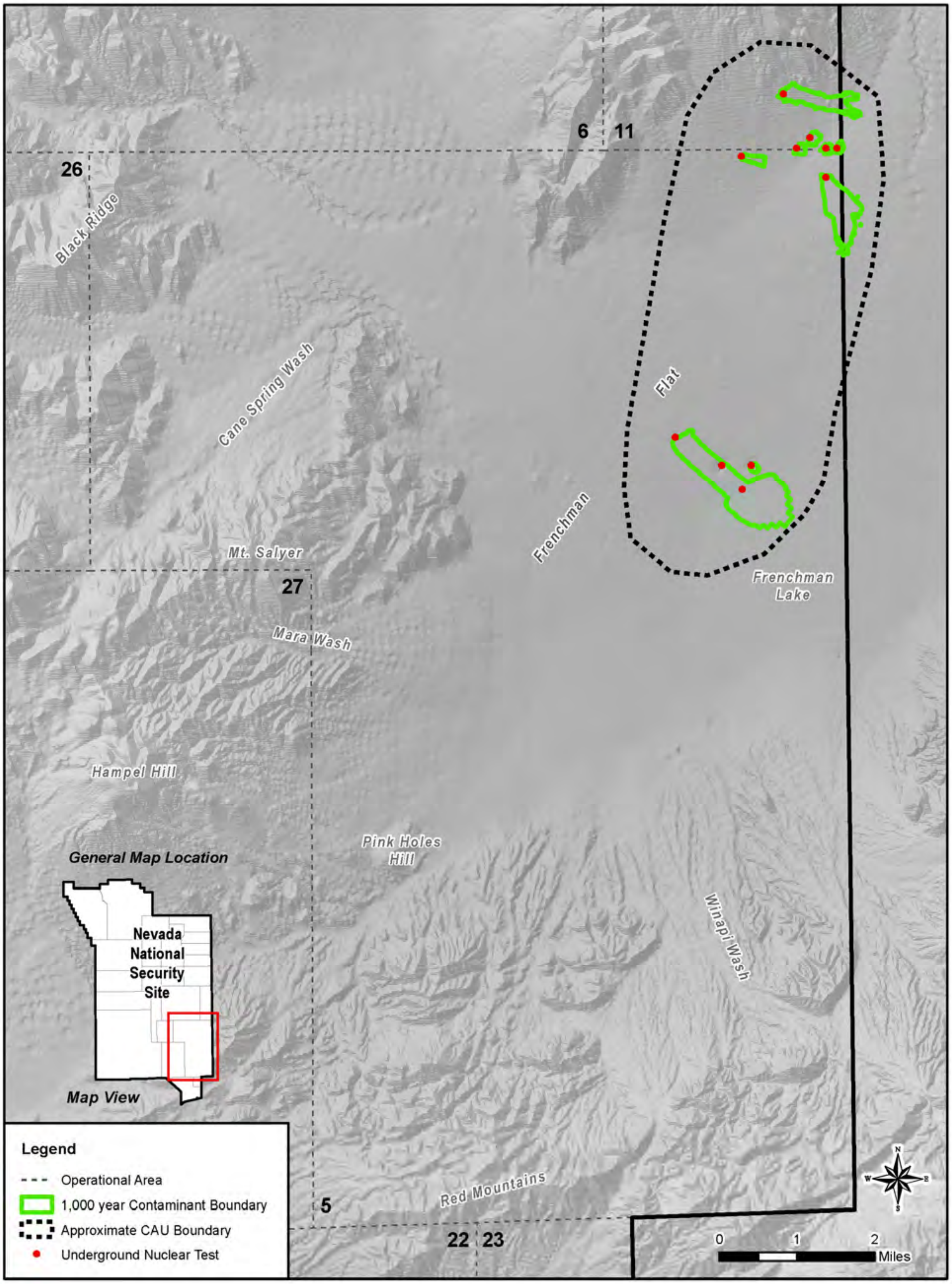

Figure 4–20 Modeled Extent of the Contaminant Boundary in the Frenchman Flat Corrective Action Unit in 1,000 Years

The UGTA Project has been routinely collecting groundwater samples from an average of six wells a year since 2000. The wells include new construction wells, existing on- and offsite monitoring wells (which may also be used under the RREM Program, along with post-shot/cavity wells). The post-shot/cavity wells are sampled as a part of the "hot well" sampling effort under the UGTA Project. Groundwater samples collected during the construction of new wells, as well as samples collected from existing on- and offsite monitoring wells generally did not display concentrations of tritium above the Safe Drinking Water Act standard of 20,000 picocuries per liter between 2000 and 2008. However, the samples taken under the hot well program consistently display tritium concentrations above the Safe Drinking Water Act standard. The hot well sampling effort supports DOE/NNSA's continuing effort to develop flow and transport models and design a long-term monitoring program for wells in or near underground nuclear test cavities. The program's objectives are to characterize the hydrologic source term and evaluate the effects of decay and potential migration of radionuclides through monitoring at or near the source (DOE/NV 2000c, 2001c, 2002b, 2003a, 2004a, 2005f, 2006a, 2007d, 2008a, 2009d, 2010). **Table 4–33** shows a summary of the hot well sampling effort and the associated tritium findings from 2003 to 2008. No post-shot/cavity well samples were taken between 2000 and 2003, nor were well samples taken between 2006 and 2008.

Table 4–33 "Hot Well" Tritium Analysis Summary Table (2003 to 2008)

Year Samples Taken	*Total Number of Samples Analyzed*	*Associated Underground Nuclear Test Cavity*	*Range of Results (picocuries per liter)*
2003	4	Gascon, Camembert, Almendro, and Cheshire	200,000 to 160,000,000
2004	4	Bilby, Chancellor, and Tybo	113,000 to 38,000,000
2005	1	Cheshire	37,000,000
2006–2008	0	–	–

Source: DOE/NV 2000c, 2001c, 2002b, 2003a, 2004a, 2005f, 2006a, 2007d, 2008a, 2009d.

A new well-drilling campaign, initiated in the summer of 2009 (as a part of Phase II characterization), identified the construction of nine additional wells over the next 3 years to gather additional data for developing groundwater models and contaminant boundary forecasts that would eventually aid in the implementation of a long-term monitoring network for the Pahute Mesa CAU (DOE/NV 2010). Three of the nine wells were drilled in 2009 (ER-EC-11, ER-20-8, and ER-20-7) in Pahute Mesa along the northwestern boundary of the NNSS, and the remaining six will also be located on or near Pahute Mesa. Well ER-EC-11 is located off site on USAF land, and Wells ER-20-8 and ER-20-7 are within the NNSS boundary. For the first time in October 2009, tritium was detected off site in Well ER-EC-11, located less than half a mile off the northwestern boundary of the NNSS and approximately 14 miles from the nearest public water source. The tritium level was found to be 13,180 picocuries per liter, which is below the EPA Safe Drinking Water Act standard of 20,000 picocuries per liter. The sample results were verified by a certified independent laboratory and reported to NDEP (DOE/NV 2011). Current groundwater models in the February 2009 Phase 1 Central and Western Pahute Mesa Transport Model and Western Pahute Mesa Corrective Action Plan display transport in this direction near Pahute Mesa. In 2010, a deeper portion of Well ER-EC-11 was sampled and no tritium was detected. This was not unexpected, as the aquifer sampled is isolated from the overlying contaminated aquifer by a confining unit, which does not readily conduct water (DOE/NV 2011).

In May 2010, Well PM-3, which is approximately 11,000 feet west of the NNSS border on the Nevada Test and Training Range, was found to have detectable levels of tritium at 48.3 picocuries per liter during monitoring under the RREM Program. Well PM-3 is 24,500 feet northwest of Well ER-EC-11 and 188 feet upgradient from Well ER-EC-11. The UGTA Project will collect and test additional water samples from Well PM-3 to confirm the presence of tritium in the well. The UGTA Project sampling results, as well as the RREM Program, will be considered in future data collection decisions and groundwater model evaluations (DOE/NV 2011).

Additionally, many wells have been drilled downgradient of the test cavities showing a migration trend of tritium transport at distance, and other radionuclides transporting very short distances over the same period of time. **Figure 4–21**, located at the end of this section, displays the locations of various wells used for monitoring groundwater at the NNSS and nearby offsite areas, as well as the concentration of tritium that has been detected. The sampling wells are located both at and near historic underground detonation sites and farther downgradient, where they have been strategically placed to intercept any contamination plumes originating from the historic underground tests.

In the past, a non-government group evaluated DOE/NNSA's groundwater monitoring network (Citizen's Alert 2004), pointing to a lack of monitoring wells in the area southwest of Pahute Mesa on the Nevada Test and Training Range. Citizen's Alert contended, among other things, that the monitoring well network was not properly designed and that the likelihood of detecting a plume of contamination off site was diminished because there had been no wells developed in the area southwest of Pahute Mesa on the Nevada Test and Training Range. Since that report was published, and based on DOE/NNSA's and NDEP's ongoing work to characterize groundwater flows and contaminant transport, as shown in Figure 4–21, nine groundwater characterization and monitoring wells have been developed so far within the area of concern by Citizen's Alert and, as previously noted, tritium has been detected at one of the offsite wells, ER-EC-11.

Routine Radiological Environmental Monitoring Plan. The RREM Plan was developed in 1998. The Long-Term Hydrological Monitoring Program was the RREM Plan's predecessor and had been in existence since 1972. Before 1972, groundwater was monitored by the U.S. Public Health Service, USGS, and the U.S. Atomic Energy Commission's contractor organizations. In 1999, there was a final transition from the Long-Term Hydrological Monitoring Program to the RREM Plan to have a single, integrated, and comprehensive monitoring program (DOE/NV 2000c). In 2002, the RREM Plan environmental surveillance system was revised in an effort to make the program more efficient. The purpose of the RREM Plan is to determine whether concentrations of radionuclides in groundwater and surface water at the NNSS pose a threat to public health or the environment. The RREM Plan includes a groundwater monitoring well network of 78 wells located on and off the NNSS, which are sampled at frequencies ranging from once every 3 months to once every 3 years. Ten additional wells have been added to the network and are sampled opportunistically. Of these 88 wells, 72 have been sampled since 1999. These 72 wells include 33 offsite monitoring wells, 29 onsite monitoring wells, and 10 onsite water supply wells. The remaining 16 wells identified by the RREM Plan, but not sampled since 1999, comprise 15 onsite monitoring wells and 1 offsite well. These 16 wells have not been sampled for one or more of the following reasons: they are not accessible, are used for other purposes, are blocked, provide water samples that are of poor quality or are contaminated (disqualifying them from monitoring), or contain waters with known high levels of radiological contamination that are not expected to change (DOE/NV 2009d).

Sampling of the NNSS potable supply wells continues to indicate that nuclear testing has not affected the NNSS water supply network. Gross alpha and gross beta radioactivity have been detected in supply wells at concentrations commensurate with background levels of naturally occurring radionuclides and not above the EPA maximum contaminant level (MCL) of 15 picocuries per liter. Tritium has not been detected above the Safe Drinking Water Act standard of 20,000 picocuries per liter in any of the potable supply wells (DOE/NV 2000c, 2001c, 2002b, 2003a, 2004a, 2005f, 2006a, 2007d, 2008a, 2009d). **Table 4–34** is a summary of the samples taken on site and off site, including potable and monitoring wells and the results from 2000 through 2008. The summary table dates back to 2000, as the Long-Term Hydrological Monitoring Program was transitioned over to the RREM Plan the previous year. The tritium analysis was conducted after the samples were enriched. The enrichment process concentrates tritium in a sample to provide very low minimum detectable concentrations (DOE/NV 2000c, 2001c, 2002b, 2003a, 2004a, 2005f, 2006a, 2007d, 2008a, 2009d). None of the samples taken within this timeframe under the RREM Plan has displayed concentrations of tritium greater than 11 percent of the Safe Drinking Water Act standard of 20,000 picocuries per liter.

Table 4–34 Routine Radiological Environmental Monitoring Plan Tritium Analysis Summary Table (2000 to 2008)

Year Samples Taken	*Total Number of Samples Analyzed* [a]	*Range of Results Minimum Detectable Concentration (picocuries per liter)*	*Percent of Safe Drinking Water Act Maximum Contaminant Level (20,000 picocuries per liter)*
2000	61	8 to 2,130	0.04 to 10.7
2001	60	10 to 32	0.05 to 0.16
2002	54	12 to 260	0.06 to 1.3
2003	45	18 to 28	0.09 to 0.14
2004	36	17 to 26	0.09 to 0.13
2005	55	13 to 35	0.07 to 0.18
2006	41	11 to 37	0.06 to 0.19
2007	39	17 to 28	0.09 to 0.14
2008	33	18 to 34	0.09 to 0.17

[a] Includes on- and offsite monitoring wells.
Source: DOE/NV 2000c, 2001c, 2002b, 2003a, 2004a, 2005f, 2006a, 2007d, 2008a, 2009d.

Only four onsite monitoring wells (PM-1, U-19BH, UE-7NS, and WW A) located within 0.6 miles of a historical underground nuclear test are known to have detectable concentrations of tritium above their respective minimum detectable concentrations; however, the concentrations are well below the Safe Drinking Water Act drinking water limit of 20,000 picocuries per liter (see **Table 4–35** for the 2008 sampling results). All have consistently had detectable levels of tritium in past years, and no trend of rising tritium concentrations has been observed in these wells since 2000.

Table 4–35 Tritium Analysis Results for the Nevada National Security Site Monitoring Wells (2008)

Underground Test Area Well	*Date Sampled*	*^{3}H±Uncertainty* [a] *(minimum detectable concentration) (picocuries per liter)*
PM-1	4-23-08	127 ± 25 (23)
U-19BH	3-17-08	31 ± 13 (19)
UE-7NS	2-27-08	90 ± 24 (30)
WW A	2-12-08	356 ± 59 (28)

^{3}H = tritium (hydrogen-3).
[a] ±2 standard deviations.
Source: DOE/NV 2009d.

Wells PM-1 and U-19BH are located in the Central Pahute Mesa CAU 101 (see Figure 4–19 for CAU and sampling well locations within the NNSS). PM-1 is located in Area 20 of the NNSS and has a history of tritium concentrations near 200 picocuries per liter over the last 10 years. Well U-19BH has a history of tritium concentrations and in 2002 measured with concentrations at approximately 48 picocuries per liter. The tritium concentrations measured at Well U-19BH since 1999 show a downward trend. Wells UE-7NS and WW A are located within the Yucca Flat CAU 97 (see Figure 4–19 for CAU locations within the NNSS). Well UE-7NS was routinely sampled from 1978 to 1987, with the resumption of sampling in 1991. In 2003, tritium concentrations ranged from 133 to 156 picocuries per liter, consistent with the trend of decreasing concentrations observed in recent years. Well WW A has had measureable tritium since the late 1980s. There was an increase in tritium concentrations between 1985 and 1999, which has been followed by a slight downward trend in concentrations since 2000 (DOE/NV 2000c, 2001c, 2002b, 2003a, 2004a, 2005f, 2006a, 2007d, 2008a, 2009d).

No adverse impacts on potable groundwater quality have resulted from operations since 1996 (DOE/NV 2002b). Due to the distance between existing water supply wells at the NNSS and the underground tests, DOE/NNSA believes that groundwater use at the NNSS has little or no effect on the migration or spread of contamination from underground nuclear testing. Groundwater at the NNSS is deep and slow moving, which affords protection to adjacent areas (DOE/NV 2010). Groundwater modeling is used to evaluate the effect of water use on potential radionuclide migration and assist in the selection of optimum water-production wells and monitoring wells. As studies are completed, monitoring plans are negotiated and approved for each of the underground test areas. Maintenance of the quality of waters that are currently clean is managed through the implementation of the Groundwater Protection Management Plan.

Offsite water use is far removed from the NNSS testing areas. The closest significant offsite withdrawals are in Oasis Valley, approximately 18.6 miles (30 kilometers) from the nearest underground test, and these withdrawals are not thought to affect contaminant migration.

The NNSS has implemented a Borehole Management Plan to protect groundwater from contamination via infiltration of contaminants at the wellhead. Over 4,000 boreholes were drilled on and off the NNSS in support of nuclear testing. Many of the boreholes are no longer used and are not candidates for future use. These boreholes could serve as a pathway for surface contamination to reach subsurface strata (DOE/NV 2002b). The NNSS has implemented the Borehole Management Plan, which identifies boreholes that should be plugged to avoid any potential contamination of groundwater. As of January 2009, the Borehole Management Program has plugged 617 of the 871 boreholes identified as needing closure. Of the boreholes requiring closure, 151 are believed to penetrate groundwater and underground nuclear test cavities and 93 of these boreholes have been plugged as of January 2009 (DOE/NV 2009d).

Water Resources—American Indian Perspective

Indian people believe water is a living organism that is fully sentient and willful. The forces of power in the world move along channels and combine into specific nodes or places of power. A common set of these channels follows the path of water. These paths begin at the tops of mountains, especially the highest peaks. Snow and rain falls on these highlands and peaks after being called down by the mountain itself. From this beginning, the water moves downhill in rivulets, washes, and streams. The water often goes underground where it forms similar networks of channels moving in various directions, only somewhat corresponding to what non-native people call hydrologic basins. Water is often attracted to volcanic activity, thus producing significant power places like hot mineral springs.

According to tribal elders, *"Water is life. Water is needed by the plants and animals. Indian people bless themselves with it. It purifies the body. Water is medicine and must be respected. American Indians need it to conduct religious ceremonies. It cleans the earth. It has a vast connection to the underground. Water shouldn't be contaminated or it will die and lose its spirit."*

Each of the discreet underground water basins, or hydrological basins, has its own origin story. One tribal story tells of a discreet underground water network created by Ocean Woman and where she placed her feet. According to this traditional story, there are points where the water emerges at the surface in springs and seeps. It was here that Ocean Woman placed her medicine staff into the ground and water emerged.

At other points, the surface water in low playa lakes meets the underground water channels. These points are like doorways between the surface world and the underworld.

Rain calling is a basic aspect of American Indian life and culture. Rain ceremonies from the spiritual world help facilitate rain production, and were led by rain callers, often called rain shamans or rain doctors in the English language. The rain caller calls upon the rain by singing songs, and is aided by his spirit helper, which is usually in the form of a mountain sheep. The mountains also had important roles in this activity, and were called up to interact with the clouds and the sky to call down the rain.

Even today, individual traditional Indian people can bring rain. One way this is done is by turning a stinkbug on his back. The rain will come, provided the stinkbug allows a person to tickle his belly with a small stick. As this person prays for rain, he tells the stinkbug why he is asking for rain.

Water Resources—American Indian Perspective (cont'd)

If too much rain fell, certain precautions are taken. For example, the children are not allowed to shake willows that will be used for weaving or to kill frogs as this brings more rain. Hummingbirds were not killed for many reasons, but if they are killed, there will be flooding and lightning storms, with lightning killing the person who killed the hummingbird.

The Snow Ceremony was performed to ensure a good winter with heavy snow fall. The spiritual leader, often called a weather doctor in the English language, would call the people together and meet at a special place in the mountains, sometimes near a pine nut gathering area. The spiritual leader would sing songs and offer prayers. According to Indian tradition, the Snow Ceremony is performed during the late fall when the weather becomes cold. A part of this ceremony involves calling on the Snow Fleas. They represent a special category of American Indian environmental knowledge because they are almost invisible and live at the highest elevations on the mountains. The Snow Fleas are the ones that make the snow wet and absorb into the mountain. Without them, the snow is dry and evaporates quickly, and there is less water for the mountains and the valleys below. The Snow Ceremony is conducted in relationship with ceremony of the seeds where young girls dance with seeds in winnowing trays and a spiritual person sings songs to bring whirlwinds, which surround the dancers and scatter the seeds as a gesture of fertilizing the earth. Water is called upon to nourish the soil and the seeds to make them fertile.

Because water is a powerful being it is associated with other powerful beings, such as water babies. Water babies are like the people of the water. They are highly respected by American Indian culture. If water is contaminated, the water babies will move to other areas that are not contaminated. Proof of their existence has been depicted in historic rock drawings throughout Nevada, including one pecked at the volcanic butte at Black Canyon, Pahranagat Valley.

According to a tribal elder, *"Water babies are important to our culture. They are supernatural. They connect everything and you don't want to disrespect them. The springs are all connected and they follow the water flow. Water babies are supernatural beings and are the guardians of the water. They can make sounds like a baby, and you don't want to startle them because they can disturb life. We are taking their native environment away when we drill and contaminate the water. It angers them. When they get mad, there are adverse impacts to wildlife as they can drain you spiritually and physically."*

Playas

The CGTO knows playas occupy a special place in American Indian culture. Playas are often viewed as empty and meaningless places by western scientists, but to Indian people, playas have a role and often contain special resources that do not occur anywhere else.

The CGTO knows that playas were used in traveling or moving to places where work, hunting, pine cutting, or gathering of other important foods and medicine could be done. One elder remembers crossing over dry lake beds and traveling around but near the edges, and how provisions were left there and at nearby springs by previous travelers at camping spots.

According to tribal elders, who were interviewed during previous NNSS evaluations, *"Indian people left caches in playa areas for people who crossed valleys when water and food was scarce. Frenchman playa is such a place. Indian people took advantage of traveling through this playa as mountains completely surround this area. The CGTO knows that most dry lakes are not known to be completely dry. An example is Soda Lake near Barstow, California. The Mohave River flows into this dry lake and most of the year it looks dry but it actually flows underground. Although some people continue to view Frenchman playa [and other playas] as a wasteland, the CGTO knows it is not."*

See Appendix C for more details.

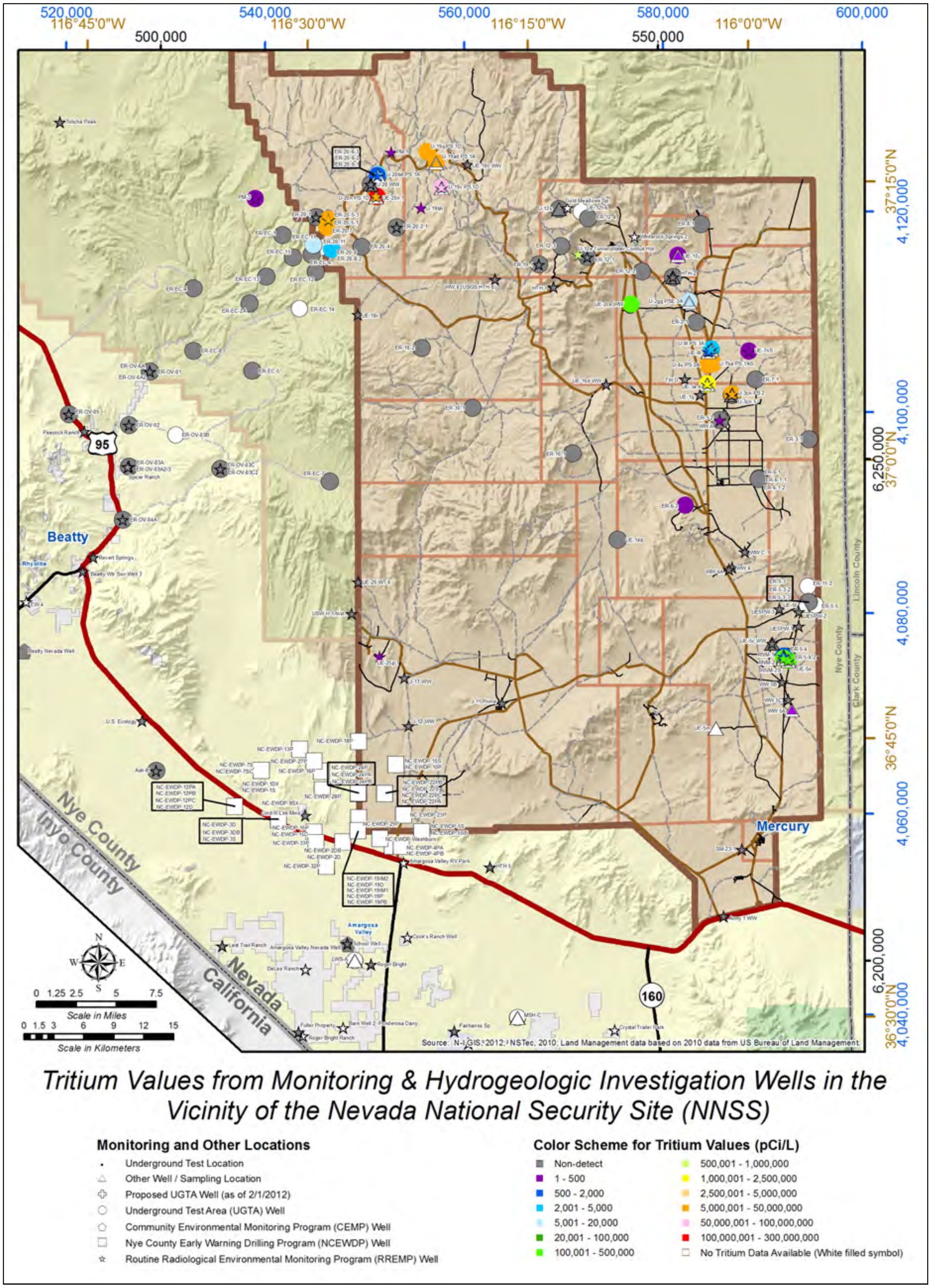

Figure 4–21 Concentration of Tritium Detected in Monitoring and Hydrogeologic Investigation Wells and Springs of the Nevada National Security Site

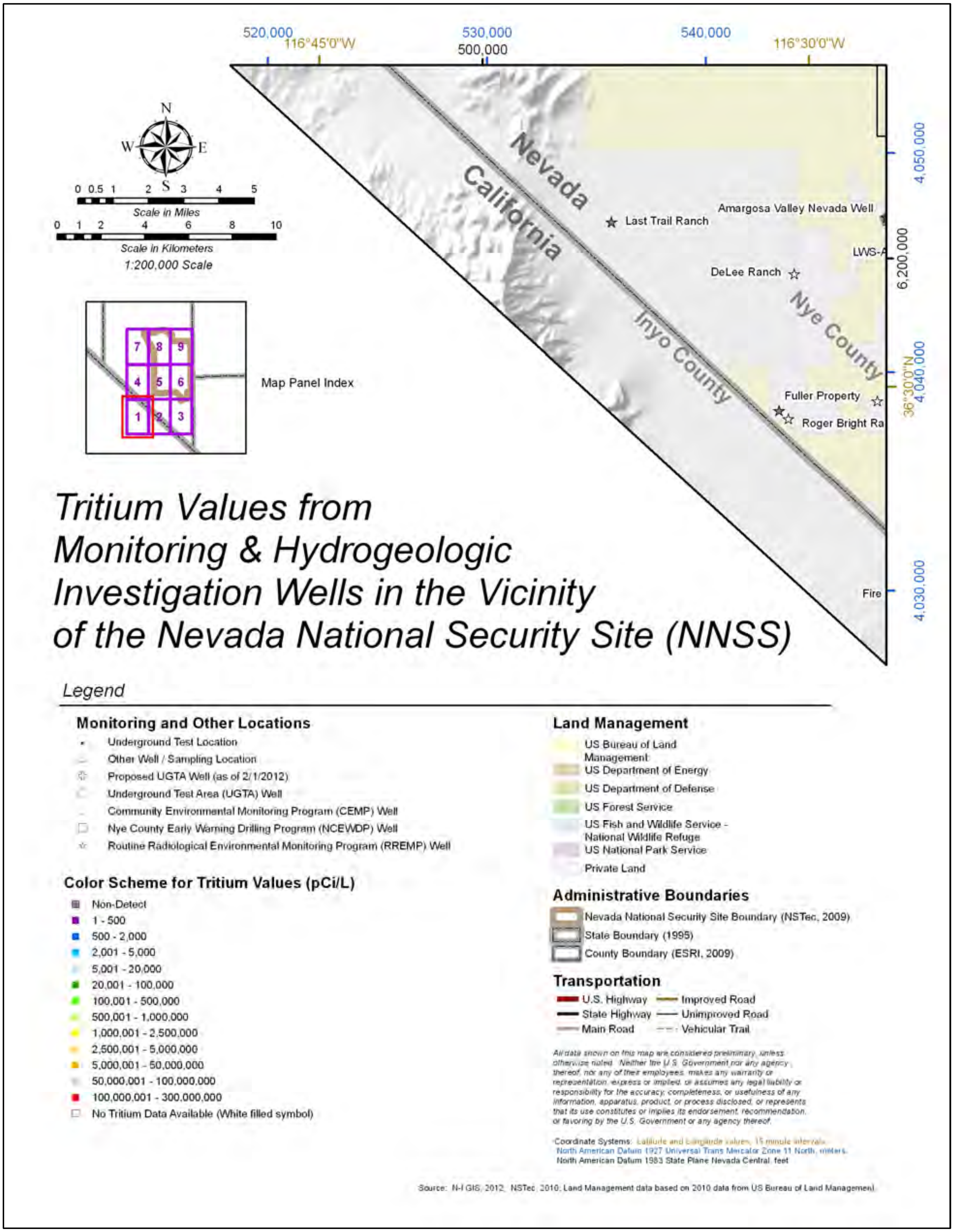

Figure 4–21 Concentration of Tritium (continued) – Panel 1

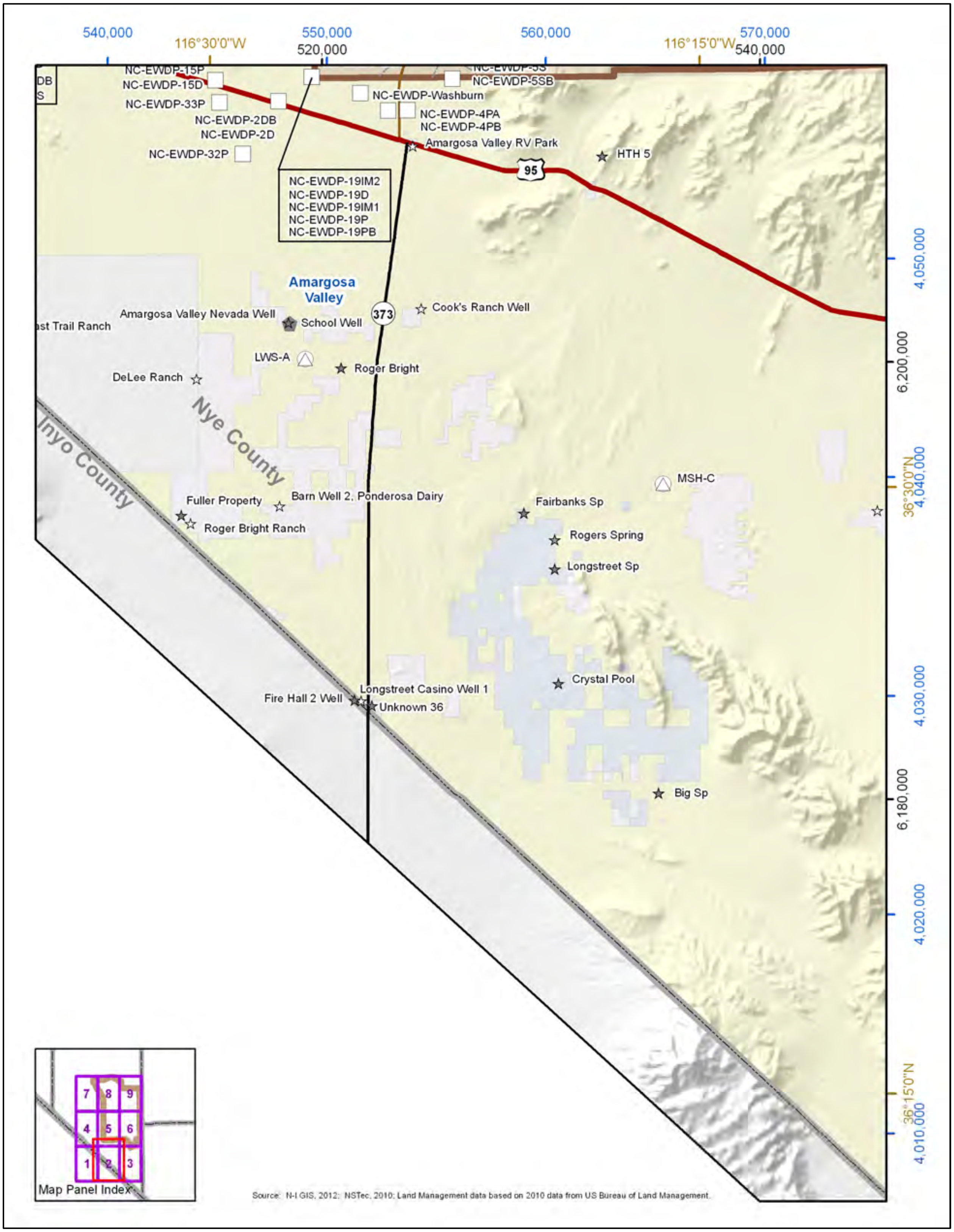

Figure 4–21 Concentration of Tritium (continued) – Panel 2

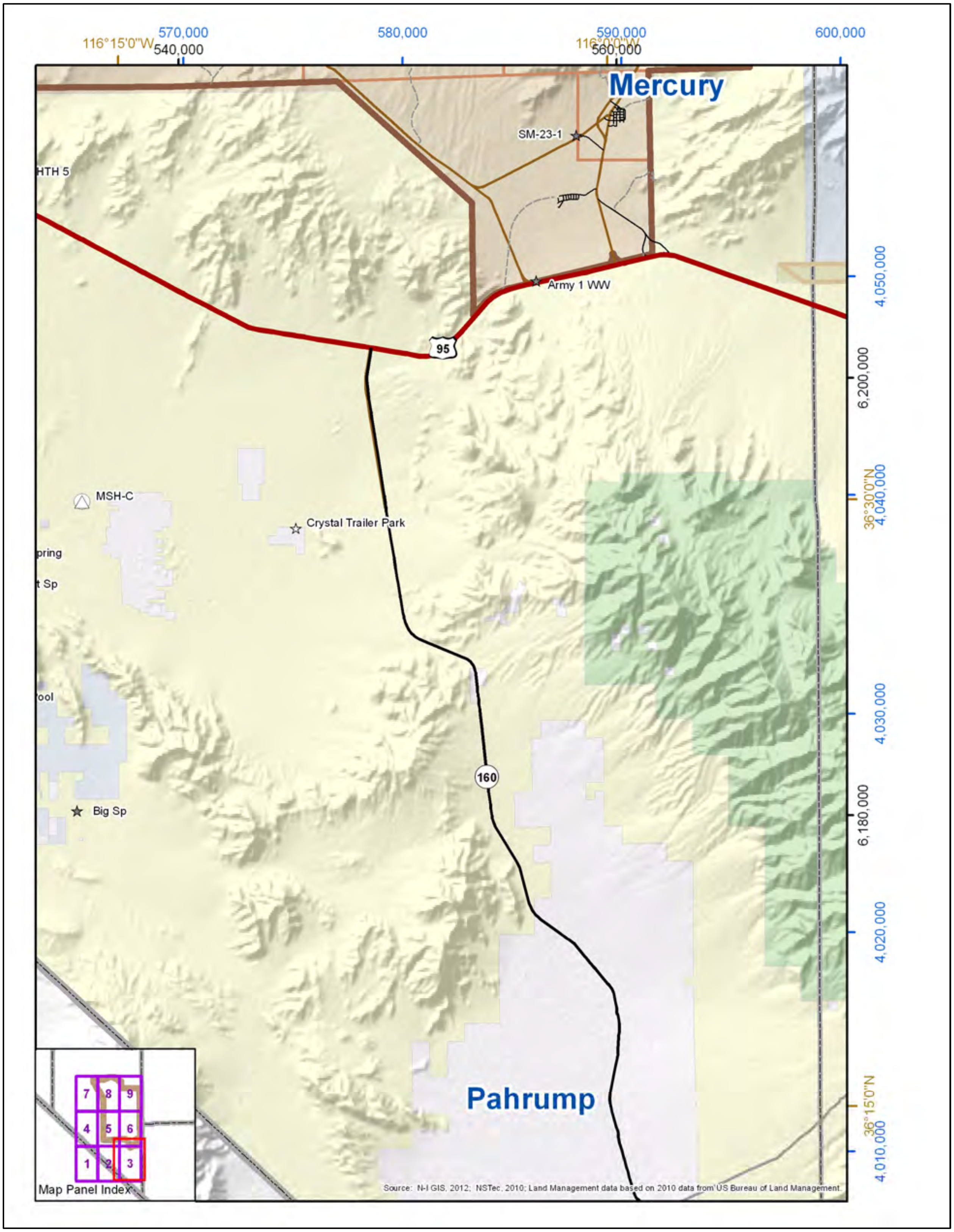

Figure 4–21 Concentration of Tritium (continued) – Panel 3

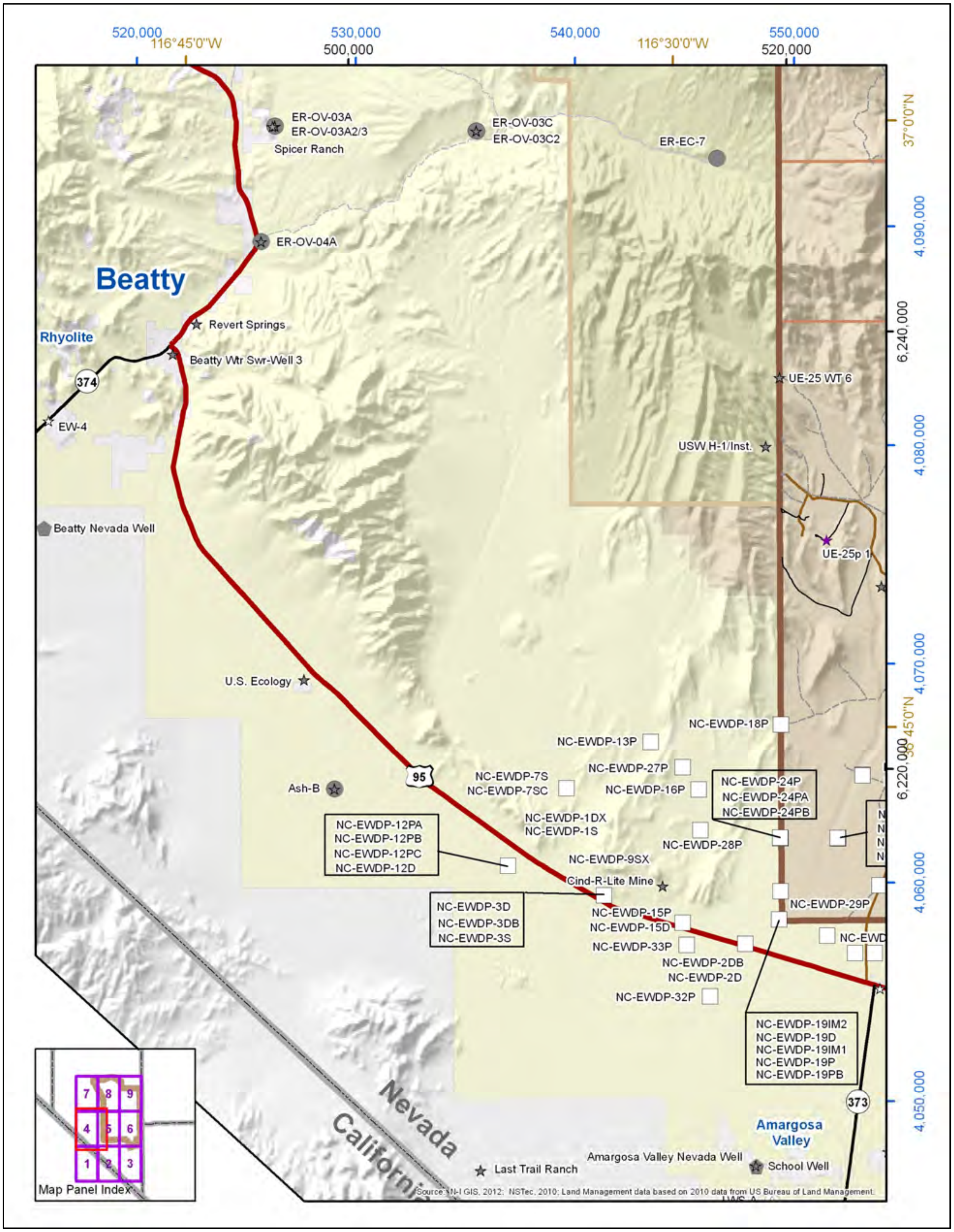

Figure 4–21 Concentration of Tritium (continued) – Panel 4

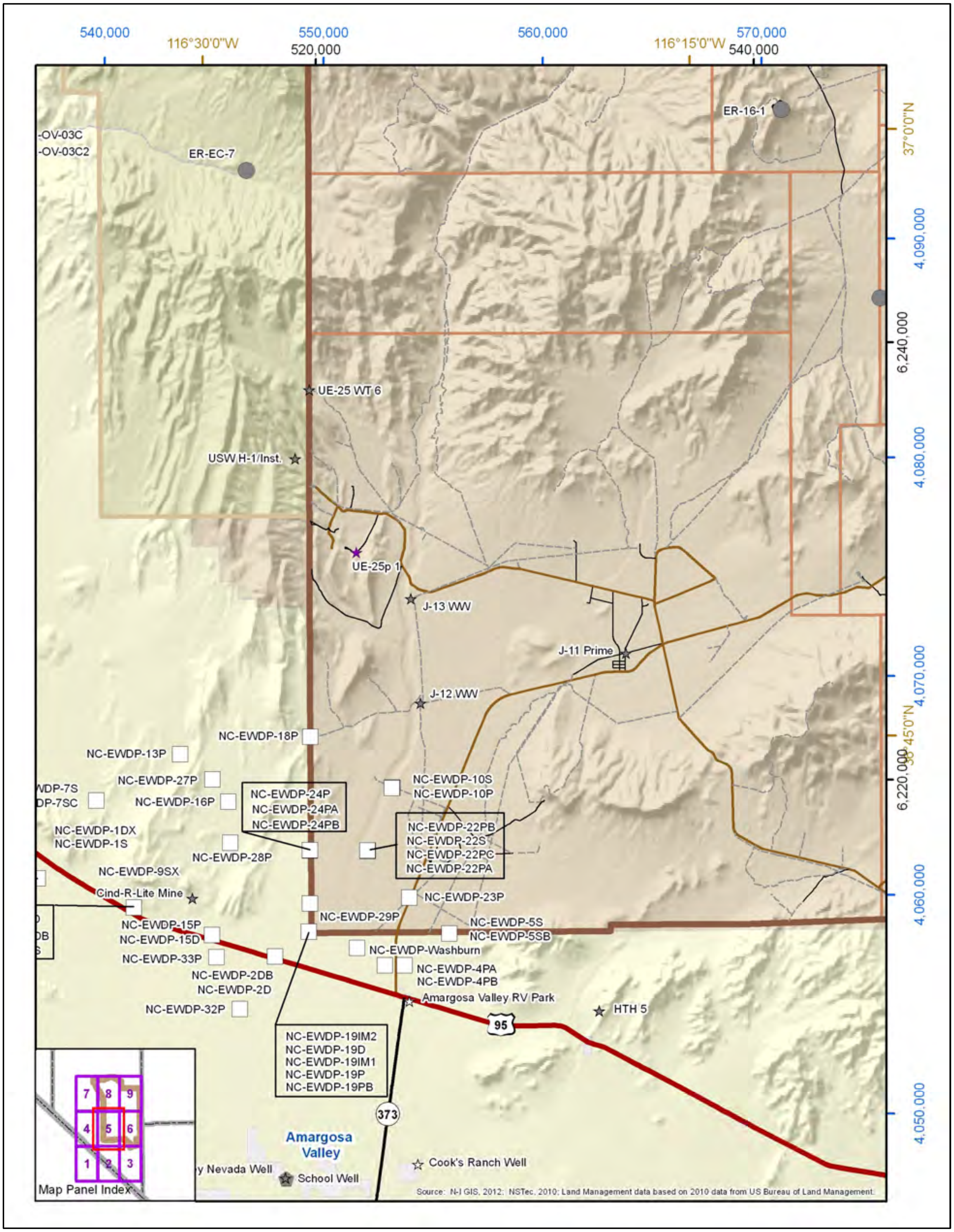

Figure 4–21 Concentration of Tritium (continued) – Panel 5

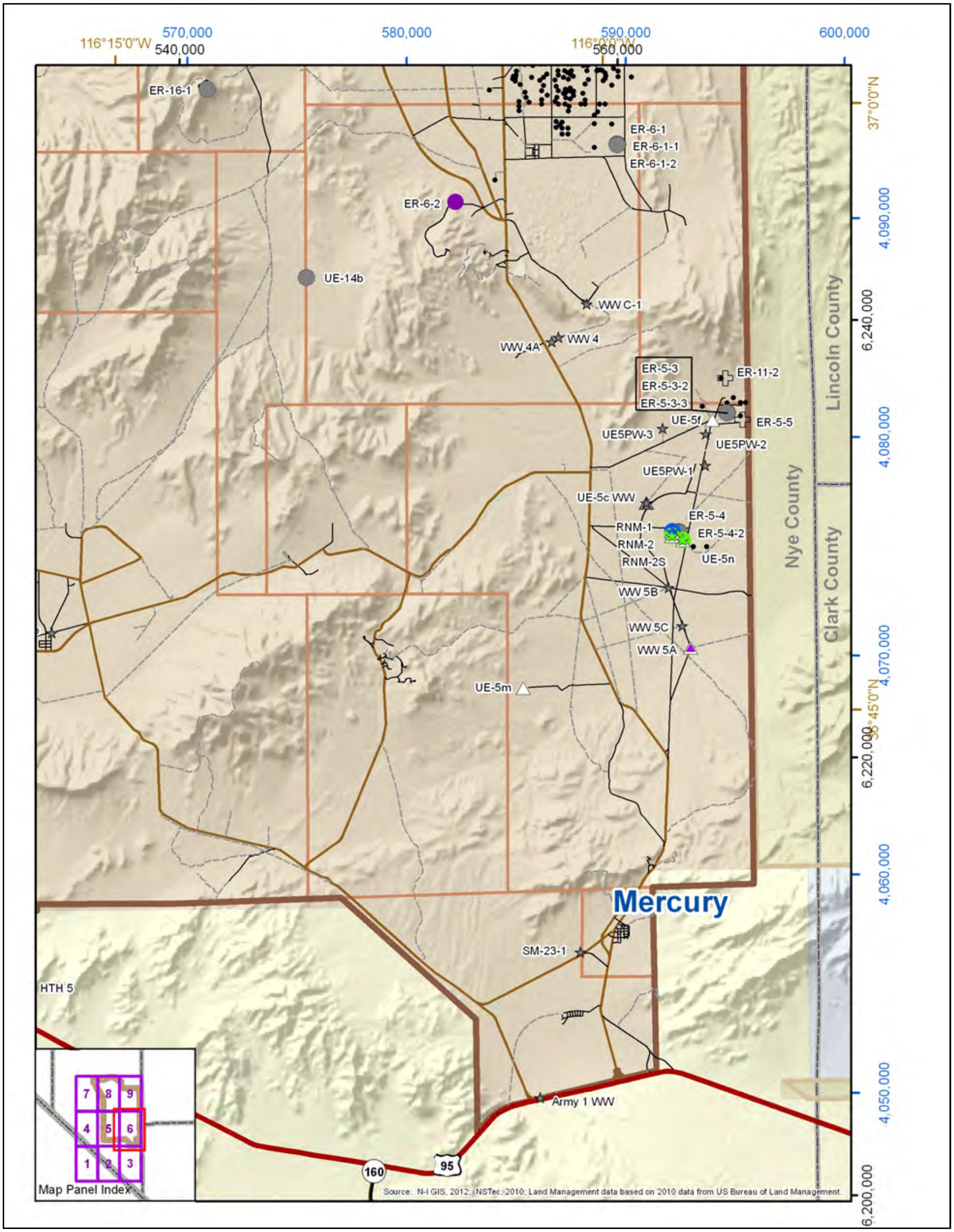

Figure 4–21 Concentration of Tritium (continued) – Panel 6

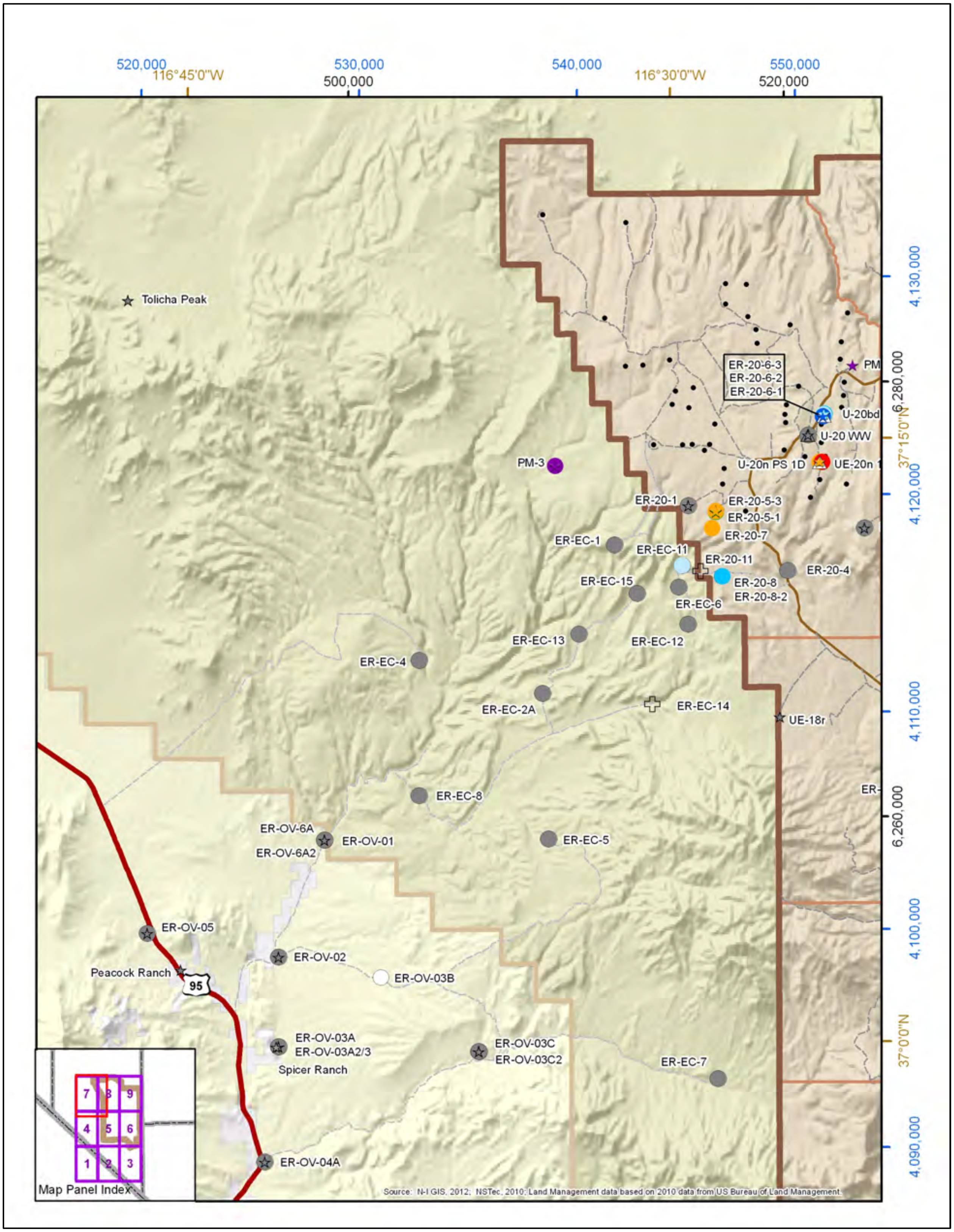

Figure 4–21 Concentration of Tritium (continued) – Panel 7

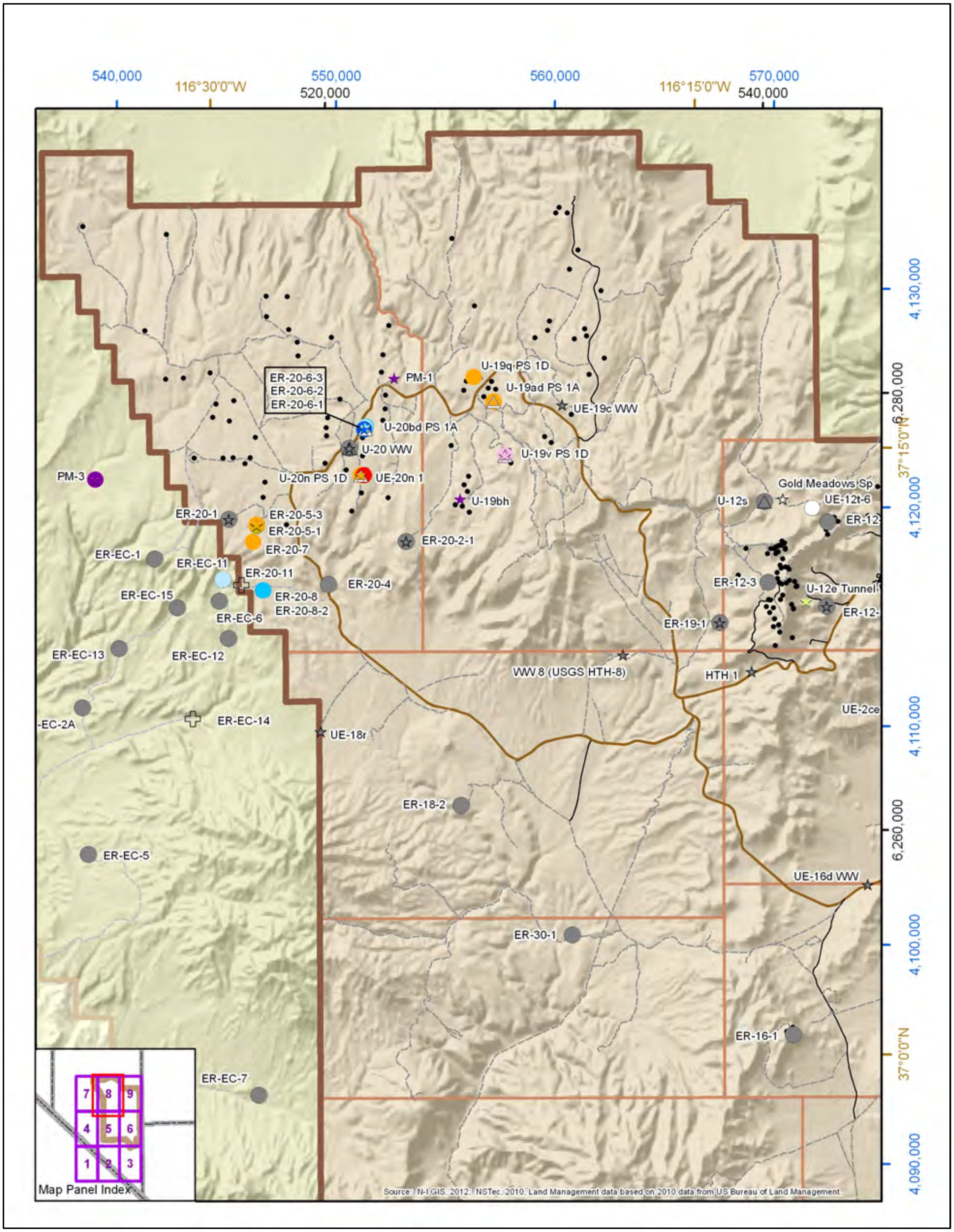

Figure 4–21 Concentration of Tritium (continued) – Panel 8

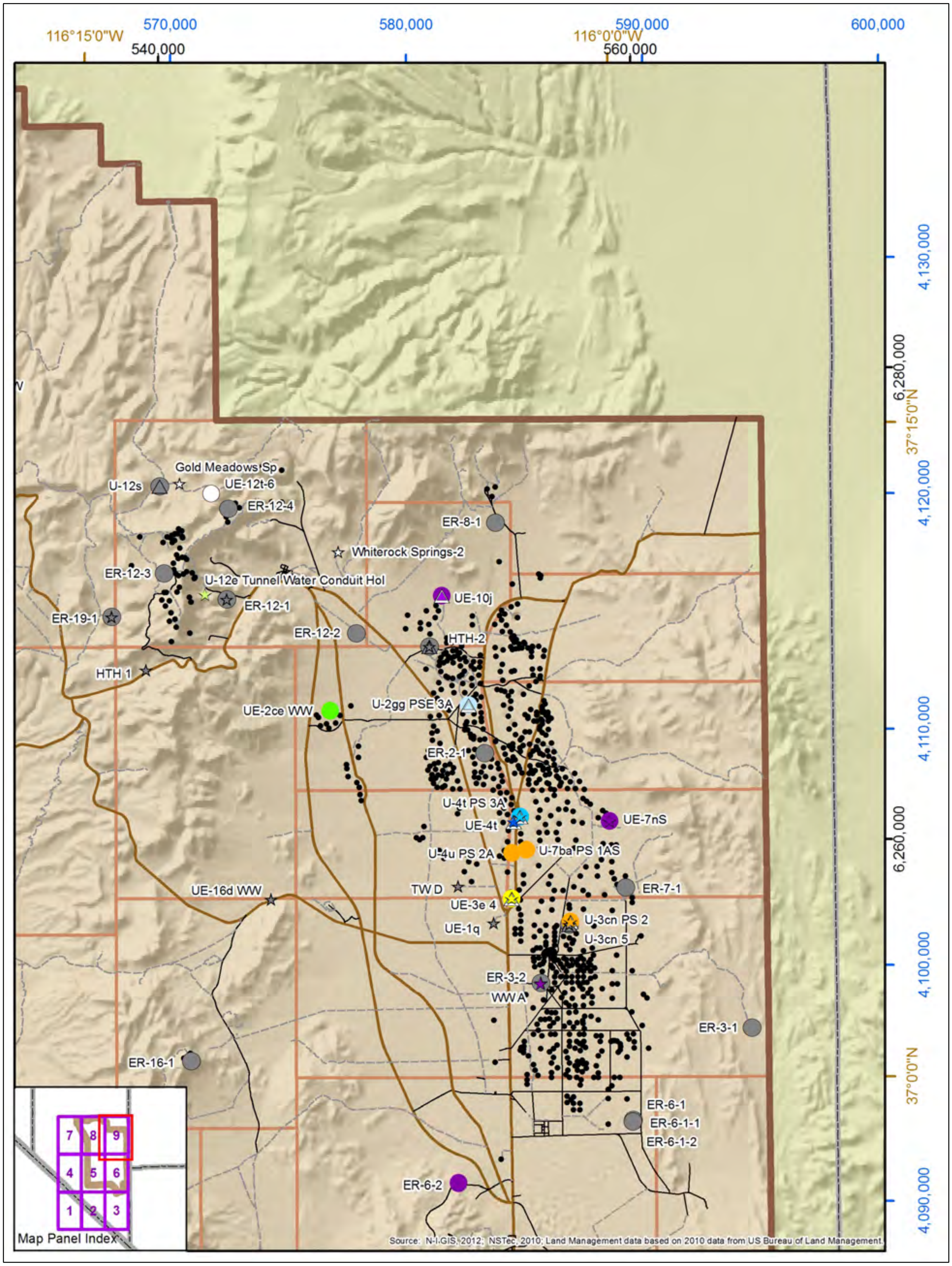

Figure 4–21 Concentration of Tritium (continued) – Panel 9

4.1.7 Biological Resources

The NNSS is located within the Basin and Range physiographic province and along the transition zone between the Mojave Desert and Great Basin ecoregions in south-central Nevada (Beatley 1975, 1976; DOE/NV 2000d) (see Figure 4–15). As a result, this site has a diverse and complex mosaic of plant and animal communities that are representative of both ecosystems, as well as some communities common only in the transition zone. This transition zone extends to the east and west far beyond the NNSS. Thus, the range of almost all species found on the NNSS also extends beyond the site, and there are few rare or endemic species found within the NNSS (DOE 1996c).

Elevation is an important factor affecting the distribution of plant and animal communities on the NNSS. Elevations generally increase from south to north, from a low of 2,688 feet in Jackass Flats to a high of 7,679 feet on Rainier Mesa. Climate and elevation result in a progression from Mojave Desert communities in the south to Great Basin communities in the north.

The biological diversity within the NNSS is also a result of topography. The valleys in the southern and western parts of the NNSS (e.g., Jackass Flats, Rock Valley, and Mercury Valley) have hydrologic connections to drainages outside the NNSS. In contrast, the two large valleys on the eastern side of the NNSS (Frenchman Flat and Yucca Flat) are closed basins. The lack of surface-water drainage out of these closed basins contributes to soil conditions, temperatures, and biotic communities that differ from those found at similar elevations in the open basins (Beatley 1975, 1976; DOE/NV 2000d).

To ensure compliance with laws, regulations, orders, and policies designed to protect plants and animals, the DOE/NNSA NSO has developed an Ecological Monitoring and Compliance (EMAC) Program. Over time, as requirements have progressed, the EMAC Program has become an integral part of the DOE/NNSA NSO Environmental Management System specified in DOE Order 436.1, *Departmental Sustainability*. The EMAC Program consists of several sub-programs and procedures tailored to monitor and protect the flora and fauna of the NNSS and incorporate protection of biological resources into project planning and the day-to-day activities of the NNSS, including the Desert Tortoise Compliance Program, the Sensitive Plant Monitoring Program, the Sensitive and Protected/Regulated Animal Monitoring Program, the Habitat Restoration Program, pre-activity biological surveys, surveys to assess the potential for wildland fires, and surveillance and monitoring of other relevant aspects of the NNSS flora and fauna, including invasive species. The following is a brief description of the various aspects of the EMAC Program.

Desert Tortoise Compliance Program. In August 1989, the desert tortoise was emergency listed under the Endangered Species Act, and the Mojave population of the desert tortoise was listed as threatened in April 1990. In October 1989, the manager of the DOE Nevada Operations Office (now the DOE/NNSA NSO) issued direction to all employees and contractors to protect tortoises on the NNSS, in part by suspending all off-road driving in tortoise habitat; forbade injuring or handling of tortoises; and strengthened existing environmental review requirements. The DOE/NNSA NSO Desert Tortoise Compliance Program was developed in 1992, when, in compliance with Section 7 of the Endangered Species Act (16 U.S.C. 1531 et seq.), the USFWS issued the first Biological Opinion for the NNSS. Since that time, new NNSS Biological Opinions were issued by USFWS in 1996 and 2009. The Desert Tortoise Compliance Program serves to implement the terms and conditions of the Biological Opinion for the NNSS, to document compliance actions taken, and to assist the DOE/NNSA NSO with USFWS consultations. Some of the activities of the Desert Tortoise Compliance Program include (1) reviewing proposed activities at the NNSS to determine if they may be located in tortoise habitat and if clearance surveys and/or monitoring are required, (2) conducting clearance surveys at project sites within 1 day of the start of project construction, (3) ensuring that environmental monitors are on site during heavy equipment operations, (4) developing training modules and ensuring that all personnel working on the NNSS are trained in the requirements of the *Final Programmatic Biological Opinion for Implementation of Actions Proposed on the Nevada Test Site, Nye County, Nevada* (*2009 Biological Opinion*), and (5) preparing annual compliance reports for submittal to USFWS. By implementing the Desert Tortoise

Compliance Program, the DOE/NNSA NSO would ensure that most, if not all, impacts on desert tortoises addressed in this analysis would involve harassment, rather than injury or mortality.

Sensitive Plant Monitoring Program. Under the NNSS Sensitive Plant Monitoring Program, the status or ranking of sensitive plant species known to occur on the NNSS is evaluated annually to ensure such plants are afforded the appropriate protection under Federal and state laws. Sensitive plant species populations on the NNSS are routinely monitored to assess plant density and plant vigor to identify any threats or impacts on the species.

Sensitive and Protected/Regulated Animal Monitoring Program. As part of the Sensitive and Protected/Regulated Animal Monitoring Program, to ensure such animal species are afforded the appropriate protection under Federal and state laws, the DOE/NNSA NSO currently monitors 18 animal species on the NNSS. The DOE/NNSA NSO also monitors raptorial bird species, including the western burrowing owl (*Athene cunicularia hypugaea*). In addition, the DOE/NNSA NSO conducts monitoring and other studies to evaluate species that may be added to the list of sensitive species to determine their abundance and distribution on the NNSS and shares the findings with USFWS and state wildlife agencies to help inform their decisions regarding those species.

Habitat Restoration Program. The Habitat Restoration Program involves the revegetation of disturbed land and evaluation of previous revegetation efforts. These activities are conducted at both the NNSS and the TTR.

Biological Surveys. Biological surveys are performed at project sites where land-disturbing activities are proposed. The goal is to minimize adverse effects of land disturbance on sensitive and protected/regulated plant and animal species, their associated habitat, and other important biological resources. Survey reports document species and resources found and provide mitigation recommendations.

Wildland Fire Surveys. In 2004, the DOE/NNSA NSO began annual surveys each spring to assess wildland fire hazards on the NNSS. NNSS ecologists conduct these wildland fire surveys in coordination with NNSS Fire and Rescue.

Additional Monitoring. Additional monitoring is conducted for such things as natural wetlands to characterize seasonal baselines and trends in physical and biological parameters; West Nile virus to help the Southern Nevada Health District ascertain the presence and/or prevalence of the virus in the NNSS mosquito population; and constructed water sources to assess their use by wildlife and to develop and implement mitigation measures to prevent them from causing significant harm to wildlife.

4.1.7.1 Flora

Based on an analysis of field data collected from ecological landform units, 10 vegetation alliances and 20 associations have been recognized on the NNSS (DOE/NV 2000d) (see **Table 4–36**). **Figure 4–22** shows the 10 vegetation alliances. Each vegetation alliance and association was named for the dominant tree or shrub species, based on relative abundance and the conventions of the Federal Data Committee and Ecological Society of America (DOE/NV 2000d). In terms of total area, the Great Basin Desert occupies approximately 40 percent of the NNSS, followed by the transition zone, which occupies 37 percent. The Mojave Desert occupies the southern 22 percent of the NNSS (DOE/NV 2000d). Within each of these three zones on the NNSS, there are populations of noxious/invasive plant species that have become established over the years. Measures employed by DOE/NNSA to control these unwanted plant species are described in Chapter 5, Section 5.1.7, and Chapter 7, Section 7.7.

Table 4–36 Vegetation Alliances and Associations on the Nevada National Security Site

Ecoregion	***Alliance***	***Association***
Mojave Desert	*Lycium* sp. (Shrubland Alliance)	*Lycium shockleyi–Lycium pallidum* (Shrubland)
	Larrea tridentata/Ambrosia dumosa (Shrubland Alliance)	*Larrea tridentata/Ambrosia dumosa* (Shrubland)
	Atriplex confertifolia–Ambrosia dumosa (Shrubland Alliance)	*Atriplex confertifolia–Ambrosia dumosa* (Shrubland)
Transition Zone	*Hymenoclea-Lycium* (Shrubland Alliance)	*Lycium andersonii–Hymenoclea salsola* (Shrubland)
		Hymenoclea salsola–Ephedra nevadensis (Shrubland)
	Ephedra nevadensis (Shrubland Alliance)	*Menodora spinescens–Ephedra nevadensis* (Shrubland)
		Eriogonum fasciculatum–Ephedra nevadensis (Shrubland)
		Krascheninnikovia lanata–Ephedra nevadensis (Shrubland)
		Ephedra nevadensis–Grayia spinosa (Shrubland)
	Coleogyne ramosissima (Shrubland Alliance)	*Coleogyne ramosissima–Ephedra nevadensis* (Shrubland)
Great Basin Desert	*Atriplex* sp. (Shrubland Alliance)	*Atriplex confertifolia–Kochia americana* (Shrubland)
		Atriplex canescens–Krascheninnikovia lanata (Shrubland)
	Chrysothamnus–Ericameria (Shrubland Alliance)	*Chrysothamnus viscidiflorus–Ephedra nevadensis* (Shrubland)
		Ericameria nauseosa–Ephedra nevadensis (Shrubland)
	Artemisia sp. (Shrubland Alliance)	*Ephedra viridis–Artemisia tridentata* (Shrubland)
		Artemisia tridentata–Chrysothamnus viscidiflorus (Shrubland)
		Artemisia nova–Chrysothamnus viscidiflorus (Shrubland)
		Artemisia nova–Artemisia tridentata (Shrubland)
	Pinus monophylla/Artemisia sp. (Woodland Alliance)	*Pinus monophylla/Artemisia nova* (Woodland)
		Pinus monophylla–Artemisia tridentata (Woodland)

Source: DOE/NV 2000d.

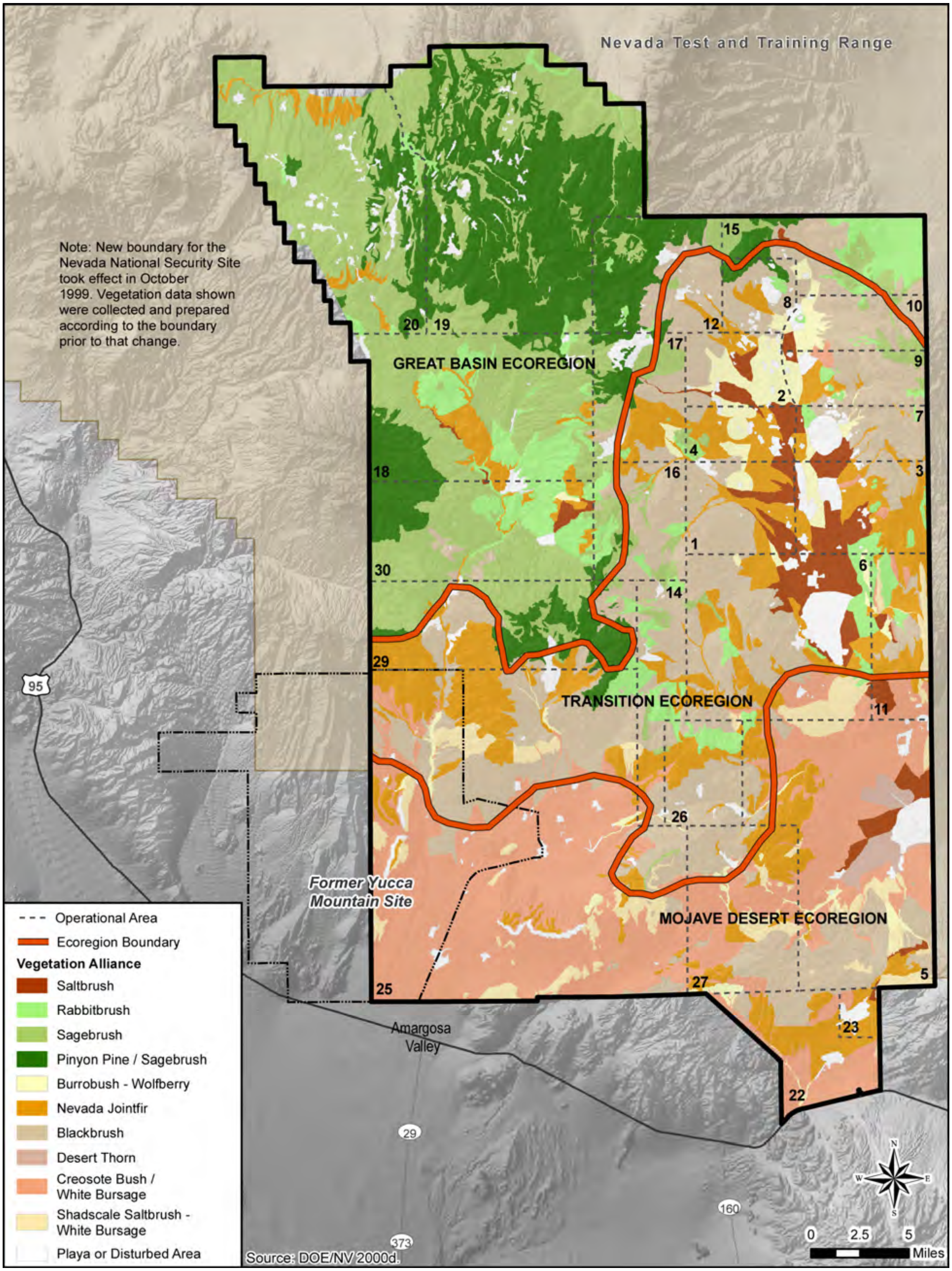

Figure 4–22 Nevada National Security Site Soil Alliances

The flora of the NNSS has been studied extensively and over 750 plant taxa have been collected (DOE/NV 2010). A list of plants found on the NNSS is presented in Appendix F, Tables F–2 and F–3. Table F–1 contains a list of sensitive plant species known to occur on or adjacent to the NNSS.

Early research on vegetation on the NNSS was conducted by Janice C. Beatley. Dr. Beatley established permanent plots on the NNSS in 1963, characterized the common plant associations of the northern Mojave and transition Great Basin Desert, and began documenting long-term changes in these ecosystems (Webb et al. 2003). Dr. Beatley collected data from these permanent plots between 1963 and 1975. In a 2003 USGS report, Webb et al. (2003) presented data on perennial vegetation on the Beatley plots from 1963 through 2003. Webb et al. relocated the Beatley plots and remeasured the vegetation, noting changes in vegetation since the original measurements made by Dr. Beatley. Webb et al. found a striking increase in plant biomass between 1963 and 2000. However, there were some changes in species composition since 1963. Plant associations dominated by creosote bush had large increases in the heights of individual plants, as well as increases in total cover, whereas those dominated by saltbush species had large decreases in cover. Some plots dominated by blackbrush had small decreases in perennial plant cover. The causes of the changes in vegetation are not certain, although Webb et al. indicated the most likely causes could be precipitation increases or increases in atmospheric carbon dioxide.

4.1.7.1.1 Mojave Desert

Mojave Desert plant communities are found at elevations below approximately 4,000 feet. These communities occur on the alluvial fans and valley bottoms of Jackass Flats, Rock Valley, and Mercury Valley and on the alluvial fans of Frenchman Flat. Creosote bush (*Larrea tridentata*) is the dominant shrub within these areas. The soil type and elevation are also contributing factors to the community composition. Shadscale saltbush (*Atriplex confertifolia*) is co-dominant with creosote bush on most alluvial fans where desert pavement is common. On deep, loose soil, such as exists on southern Jackass Flats and northeastern Frenchman Flat, creosote bush is co-dominant with white bursage (*Ambrosia dumosa*) and includes species such as winterfat (*Krascheninnikovia lanata*) and Indian ricegrass (*Achnatherum hymenoides*). Range ratany (*Krameria parvifolia*), Nevada jointfir (*Ephedra nevadensis*), and Fremont indigo bush (*Psorothamnus fremontii*) are common in both communities. At roughly an elevation of 3,500 to 4,000 feet along the northern and eastern slopes of Jackass Flats and the western half of Frenchman Flat, creosote bush, hopsage (*Grayia spinosa*), and wolfberry (*Lycium andersonii*, *L. pallidum*, and *L. shockleyi*) are the dominant shrub species.

4.1.7.1.2 Transition Zone

Two plant communities are unique to the transition zone between the Mojave Desert and Great Basin Desert ecoregions. The first is best developed at elevations from 4,000 to 5,000 feet on alluvial fans and valley floors. The dominant shrub in this community is blackbrush (*Coleogyne ramosissima*), which occurs in mixed stands with creosote bush on the northern alluvial fans of Jackass and Frenchman Flats below about 4,500 feet. At higher elevations (e.g., on the valley floor of Tonopah and Mid Valleys and on the western slopes of Yucca Flat), blackbrush occurs in large, nearly monotypic stands. The second unique transition community occurs in the bottom of the enclosed Frenchman Flat and Yucca Flat basins, where the trapped winter air lowers temperatures below those typical of the Mojave Desert (Beatley 1976). The most abundant shrubs in these areas are hopsage and three species of wolfberry. Winterfat is also common in silty soils. Shadscale saltbush, four-winged saltbush (*Atriplex canescens*), and horsebrush (*Tetradymia glabrata*) can also be found in enclosed basins. Little or no vegetation grows on the playas in these basins.

4.1.7.1.3 Great Basin Desert

Plant communities typical of the desert occur in the Great Basin at elevations generally above 5,000 feet in the northern third of the NNSS. Most of the basin floor is covered with shadscale, and winterfat is also common. On deep, loose soils at middle elevations (4,500 to 5,500 feet), the plant community is dominated by four-winged saltbush. Sagebrush (*Artemisia* sp.) begins to appear at 5,000 feet and is the dominant plant on large parts of Pahute Mesa and Rainier Mesa, as well as elsewhere in the northwestern part of the NNSS. Big sagebrush (*Artemisia tridentata*) is the most abundant shrub on sites with deep soils in this area, and black sagebrush (*Artemisia nova*) is most abundant on the shallow soils of slopes and uplands. Pinyon pine (*Pinus monophylla*) and Utah juniper (*Juniperus osteosperma*) are co-dominant with sagebrush above 6,000 feet and form open shrub woodland. Sites on the NNSS with vegetation or soil modified by nuclear test activities, construction, or other disturbances usually have plant communities that are different from adjacent undisturbed areas. Some of the species that colonize disturbed areas (e.g., cheesebush *[Hymenoclea salsola]* and punctate rabbitbrush *[Chrysothamnus paniculatus]*) are native plants that usually occur in washes. However, most species found on disturbed sites are introduced plants such as red brome (*Bromus rubens*), cheatgrass (*Bromus tectorum*), Russian thistle (*Salsola tragus*), and red-stemmed filaree (*Erodium cicutarium*).

Natural succession of disturbed areas on the NNSS is generally a slow process. Studies of natural succession in the Mojave Desert have shown that several decades, or even centuries, may be required to establish similar plant cover and productivity (Angerer et al. 1994). Because of the increased and more-consistent precipitation, succession rates in the Great Basin Desert are generally quicker than those in the Mojave Desert. Active revegetation of sites can greatly enhance secondary succession. Variables that have been determined to be important in revegetation success are (1) adequate moisture during seed germination and establishment; (2) favorable soil conditions, including depth, texture, fertility, and reduced compaction; and (3) use of species adapted or native to the site.

The only biological communities on and around the NNSS that are not widespread are those associated with springs or other permanent sources of water. There are 16 springs, 10 seeps, 4 tank sites (natural rock depressions that catch and hold surface runoff), and 2 ephemeral ponds on the NNSS (Bechtel Nevada 1998b, 1999; Hansen et al. 1997). Most natural springs are on the mesas and mountains in the northern part of the NNSS (see Figure 4–22); most reservoirs are scattered through the valley bottom to the east and south. There are no springs in the valley bottom areas. Groundwater under the NNSS flows primarily to the south and west and discharges from springs in Ash Meadows, Oasis Valley, and Death Valley (see Section 4.1.5). Most of the springs at the NNSS support wetland (hydrophytic) vegetation, such as cattail, sedges, and rushes, which likely constitute wetlands, as defined by the U.S. Army Corps of Engineers and EPA (33 *Code of Federal Regulations* [CFR] 328.3(b) and 40 CFR 230.3(t), respectively).

4.1.7.1.4 Important Habitats

In 1998, DOE/NNSA evaluated selected biotic and abiotic data collected from ecological landform units to identify areas of the NNSS that may warrant active protection from land-disturbing activities (Bechtel Nevada 1999). Four habitat types on the NNSS were identified as "important habitats": (1) pristine habitat includes areas that have few manmade disturbances; (2) unique habitat contains uncommon biological resources, such as a natural wetland; (3) sensitive habitat includes areas in which vegetation recovers very slowly from direct disturbance (e.g., areas with high susceptibility to wind erosion); and (4) diverse habitat has high plant species diversity (DOE/NV 1998d). Important habitats are shown in **Figure 4–23**. DOE/NNSA believes that the long-term protection of these important habitats is one method by which overall cumulative impacts on biological resources may be minimized. During siting for new projects, these important habitats are avoided whenever possible. Important habitats on the NNSS are not based on regulatory requirements, but were developed as management tools.

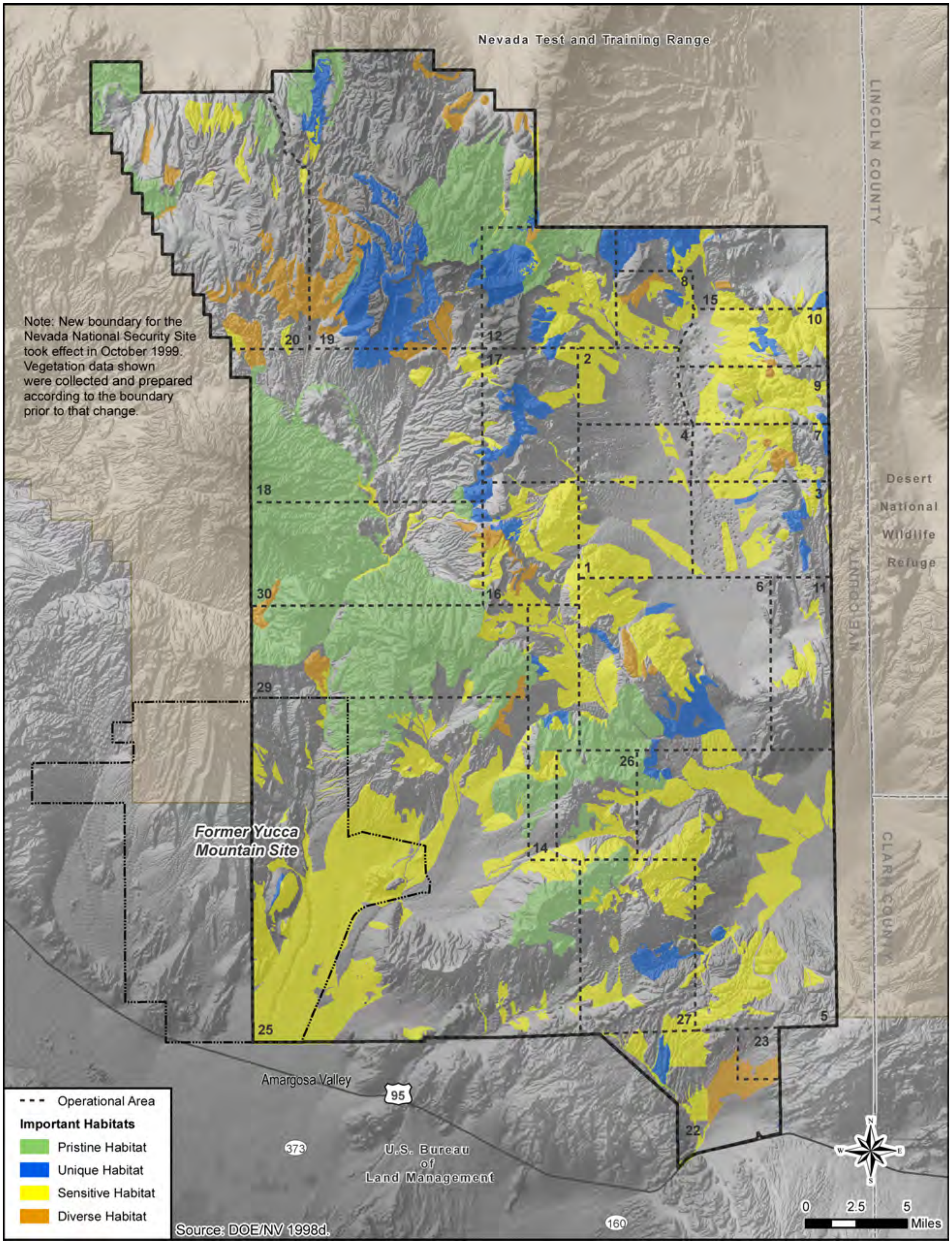

Figure 4–23 Important Habitats on the Nevada National Security Site

4.1.7.2 Fauna

At least 1,163 taxa of invertebrates within the phylum Arthropoda (animals that have an exoskeleton, a segmented body, and jointed appendages) have been identified on the NNSS. Of the known arthropods, 78 percent are insects (DOE/NV 2010). Ants, termites, and ground-dwelling beetles are probably the most important groups of insects on the NNSS in regard to distribution, abundance, and functional roles.

Approximately 300 vertebrate species have been observed on the NNSS, including 60 species of mammals, 239 species of birds, 34 species of reptiles, and 3 species of introduced fish (Wills and Ostler 2001). Approximately 80 percent of the bird species on the NNSS are migrants or seasonal residents (Wills and Ostler 2001). As of 2010, 26 bird species, including 9 raptor species (birds of prey), are known to breed on the NNSS. Raptors that breed on the NNSS include the golden eagle (*Aquila chrysaetos*), long-eared owl (*Asio otus*), red-tailed hawk (*Buteo jamaicensis*), Swainson's hawk (*Buteo swainsoni*), prairie falcon (*Falco mexicanus*), American kestrel (*Falco sparverius*), western burrowing owl (*Athene cunicularia hypugaea*), barn owl (*Tyto alba*), and great-horned owl (*Bubo virginianus*) (DOE 2002c). There have been about 300 sightings of golden eagles on the NNSS dating back to 1968. Golden eagle nesting at the NNSS is uncommon. There have been only two documented nests of golden eagles (both in 1999) and only one of those had confirmed young. One of these nests was located on Rainier Mesa near P Tunnel in Area 2 and the other was on the cliffs south of Tippipah Spring in Area 16 (Ostler 2012).

A list of animals that have been sighted on the NNSS is presented in Appendix F, Tables F–4 and F–5. See Table F–1 for a list of sensitive animal species known to occur on or adjacent to the NNSS. Many of the predators and scavengers in this region are widespread and utilize a variety of habitat types. These include coyote (*Canis latrans*), bobcat (*Lynx rufus*), common raven *(Corvus corax)*, red-tailed hawk, loggerhead shrike *(Lanius ludovicianus)*, speckled rattlesnake (*Crotalus mitchellii*), and gopher snake *(Pituophis catenifer)*. Other common species are the long-tailed pocket mouse (*Chaetodipus formosus*), desert woodrat (*Neotoma lepida*), white-tailed antelope squirrel (*Ammospermophilus leucurus*), black-tailed jackrabbit (*Lepus californicus*), black-throated sparrow (*Amphispiza bilineata*), horned lark (*Eremophila alpestris*), Say's phoebe (*Sayornis saya*), and western kingbird (*Tyrannus verticalis*). The side-blotched lizard (*Uta stansburiana*), western whiptail (*Cnemidophorus tigris*), and desert horned lizard (*Phrynosoma platyrhinos*) are the most abundant lizards on the NNSS (Wills and Ostler 2001). The nonnative bullfrog (*Rana catesbeiana*) is the only amphibian that is known to occur on the NNSS (DOE/NV 2010).

Many animal species on the NNSS are common only in the Mojave Desert habitats to the south or the Great Basin Desert habitats to the north. Typical Mojave Desert species found on the NNSS include kit fox (*Vulpes macrotis*), Merriam's kangaroo rat (*Dipodomys merriami*), desert tortoise (*Gopherus agassizii*), chuckwalla (*Sauromalus obesus*), western shovelnose snake (*Chionactis occipitalis)*, and sidewinder snake (*Crotalus cerastes*). Typical Great Basin species in this region include cliff chipmunk (*Eutamias dorsalis*), Great Basin pocket mouse (*Perognathus parvus)*, mule deer (*Odocoileus hemionus*), northern flicker (*Colaptes auratus*), western scrub-jay (*Aphelocoma californica*), Brewer's sparrow (*Spizella breweri*), western fence lizard (*Sceloporus occidentalis*), and striped whipsnake (*Masticophis taeniatus*). About 36 adult wild horses (*Equus caballus*) (not including foals) live on the northern part of the NNSS, usually on or near Rainier Mesa (NSTec 2010).

Some animal species on the NNSS have more-specific habitat requirements and are less widespread. Desert kangaroo rats (*Dipodomys deserti*) are associated with loose, sandy soils at lower elevations. Dark kangaroo mice (*Microdipodops megacephalus*) are restricted to fine, gravelly soils at higher elevations. Chuckwallas occur primarily in rocky outcrops. Desert night lizards (*Xantusia vigilis*) are usually found in stands of yuccas. Many of the birds on the NNSS, including almost all of the waterfowl and shorebirds, use the playas in Frenchman Flat and Yucca Flat, artificial ponds at springs, and sewage lagoons during their migration and/or during winter (Hayward et al. 1963). Bats often seek food over these water sources.

A total of 138 species of animals have been documented at NNSS wetland sites (Wills and Ostler 2001). The largest group of vertebrates using NNSS wetlands is birds (100 species). Passerine birds constitute the majority of birds recorded (80 species). Cane Spring and Yucca Playa Pond are the only natural NNSS locations that are known to attract migratory waterfowl. Many freshwater invertebrates occur in NNSS wetland sites, including an undescribed fairy shrimp. Scat of the desert tortoise has been found at the Rock Valley Tank site.

Wild horses occur in the northern half of the NNSS; their distribution may be related to the location of manmade ponds. Camp 17 Pond in the northwestern corner of Area 18 and Gold Meadows Spring in Area 12 (a natural water source) are heavily used by horses. Camp 17 Pond was used less frequently in 2008 compared with 2007 because 2008 had a wetter spring than 2007, which reduced the water needs of the wild horses (NSTec 2009a). Mule deer use these ponds as well.

An annual horse census is conducted by driving selected NNSS roads and using cameras to record individual markings of animals. Total numbers have dropped from 42 in 2007 to 35 in 2008 (see **Table 4–37**). A similar number of horses was observed in 2009 as in 2008 (i.e., 36 adults, 1 yearling, and 6 foals) (NSTec 2010j). Their estimated range of 222 square kilometers in 2009 is very similar in size to the horse range in 2007 and 2008 (NSTec 2010j). Camp 17 Pond and Gold Meadows Spring continue to be important summer water sources for horses.

Table 4–37 Number of Individual Horses Observed on the Nevada National Security Site by Age Class, Sex, and Year

Age Class	*Year*							
	2001	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*
Foals	11	5	6	5	5	8	8	9
Yearlings	2	0	9	9 [a]	6	8	1	0
Sex [b]	**M / F**	**M / F**	**M / F**	**M / F**	**M / F**	**M / F**	**M / F**	**M / F**
2-Year-Olds	2/2	0/2	0/0	4/4	5/4	3/3	2/3	0/0
3-Year-Olds	0/0	2/2	0/2	0/0	4/4	4/4	1/3	1/1
Older than 3 Years Old	11/20	8/19	8/20	6/21	5/21	7/24	5/27	6/27
Total	37	33	38	44	49	53	42	35

M = male; F = female.
[a] One of the nine was found dead.
[b] Excludes foals and dead horses.
Source: NSTec 2009a.

As described in Section 4.1.5.2, surface runoff periodically ponds on the playas in Yucca and Frenchman Flats. The length of time that water remains on playas and the extent to which playas are used by migratory shorebirds are not routinely monitored. However, water has been observed on the playas for periods of days to months following rainstorms. Occasionally, migratory shorebirds have been observed when the playas are inundated during the spring or fall migratory season.

Several species of state-designated game animals occur in the NNSS, including 412 mule deer (NSTec 2009a) and an unknown number of mountain lions (*Puma concolor*), desert and Nuttall's cottontails (*Sylvilagus nuttallii*), chukar (*Alectoris chukar*), Gambel's quail (*Callipepla gambelii*), mourning dove (*Zenaida macroura*), and several species of waterfowl. Pronghorn (*Antilocapra americana*) can be seen year-round on the NNSS, particularly in Yucca Flat and in Frenchman Flat in small numbers. Another game animal, the desert bighorn sheep (*Ovis canadensis* ssp. *nelsoni*), is a rare visitor on the NNSS, with only eight recorded observations of its presence on or near the NNSS since 1963. In the past, the species was observed in Mercury and on Rainier Mesa (Wills and Ostler 2001). During 2009, desert bighorn sheep were photographed by motion-activated cameras at Topopah Spring in Area 29 and on Skull Mountain in Area 25, and a ram was documented in Area 18. There is an established population of desert bighorns in the Specter Range south of the NNSS and other populations north and west of the NNSS. Until recently, it was thought the NNSS might only provide a suitable corridor for movement between these populations; however, as part of a recent study of mountain lions on the NNSS, a total of five kills of young (1- to 4-month-old) lambs have been documented in the Fortymile Canyon/Calico Hills area. Although lambing areas have not been documented on the NNSS, this evidence suggests they do exist (Ostler 2012). Further field studies will be needed to determine if the observed desert bighorn sheep are transients or if they are, or will become, residents on the NNSS (NSTec 2010j). Bobcats (*Lynx rufus*), gray foxes (*Urocyn cinereoargenteus*), and kit foxes (*Vulpes macrotis*) are the only state-designated fur-bearing animals on the NNSS. No hunting or trapping is allowed on the NNSS.

4.1.7.3 Threatened and Endangered Species

The only species that has been listed by USFWS as threatened or endangered that occurs on the NNSS is the Mojave Desert population of the desert tortoise. The desert tortoise was listed as threatened by USFWS in 1990. The State of Nevada classifies the desert tortoise as a threatened species, and it is protected under *Nevada Revised Statutes,* Chapter 501.

In 1996, USFWS issued the *Final Programmatic Biological Opinion for Nevada Test Site Activities* (*1996 Biological Opinion*) (USFWS 1996) to the DOE/NNSA NSO, covering activities occurring within desert tortoise habitat on the NNSS. The *1996 Biological Opinion* authorized the incidental "take" (accidental killing, injury, harassment, etc.) of desert tortoises that may occur during NNSS activities. In July 2008, the DOE/NNSA NSO provided USFWS with a biological assessment of activities anticipated to occur on the NNSS over the following 10 years and entered into formal consultation with USFWS to obtain a new Biological Opinion. In February 2009, USFWS issued the *2009 Biological Opinion* (USFWS 2009a) to the DOE/NNSA NSO. Both the *1996 Biological Opinion* and the *2009 Biological Opinion* concluded that activities anticipated to occur on the NNSS would not jeopardize the continued existence of the Mojave population of desert tortoises and no critical habitat would be destroyed or adversely modified. Under the *2009 Biological Opinion,* before implementing any new activity in desert tortoise habitat, DOE/NNSA provides specified information and consults with USFWS to determine if the anticipated incidental take for each action, at the project level, complies with the programmatic *2009 Biological Opinion*. If a proposed activity or group of activities would result in an exceedance of the *2009 Biological Opinion*, DOE/NNSA would consult with USFWS, in accordance with Section 7 of the Endangered Species Act.

Desert tortoises generally occur throughout the southern third of the NNSS (Rautenstrauch et al. 1994). They are found more commonly in bajadas and lower slopes of southern mountains and are rare or absent from the lower basins, particularly in Frenchman Flat. The northern boundary of the desert tortoise range on the NNSS is shown in **Figure 4–24**. Because the Former Yucca Mountain site was not under the jurisdiction of the NNSA/NSO at the time tortoise surveys were conducted for developing the data in Figure 4–24 and compatible data is not available, that area does not have any population densities displayed in the figure; however, for purposes of analysis in this SWEIS, it was assumed that tortoise population densities would be similar to adjacent areas of the NNSS (i.e., ranging from "None to Very Low" to "Low"). The total area of the NNSS (including the portion that is shown as the "Former Yucca Mountain Site in Figure 4–24) that is within the range of the desert tortoise is about 328,400 acres. Overall, approximately 7,350 acres, or 2 percent, of NNSS land within desert tortoise range has been disturbed in the past by construction of facilities and infrastructure and other activities. The net area of desert tortoise habitat at the NNSS is about 321,050 acres. The population density of desert tortoises on the NNSS is considered to be "very low" (USFWS 2009a). Within the NNSS, the northern extent of the desert tortoise occurs between elevations of approximately 3,900 and 4,880 feet. The vegetation in the boundary region is dominated by blackbrush, creosote bush, white bursage, spiny hopsage, and Anderson wolfberry (Beatley 1976; DOE/NV 2000d).

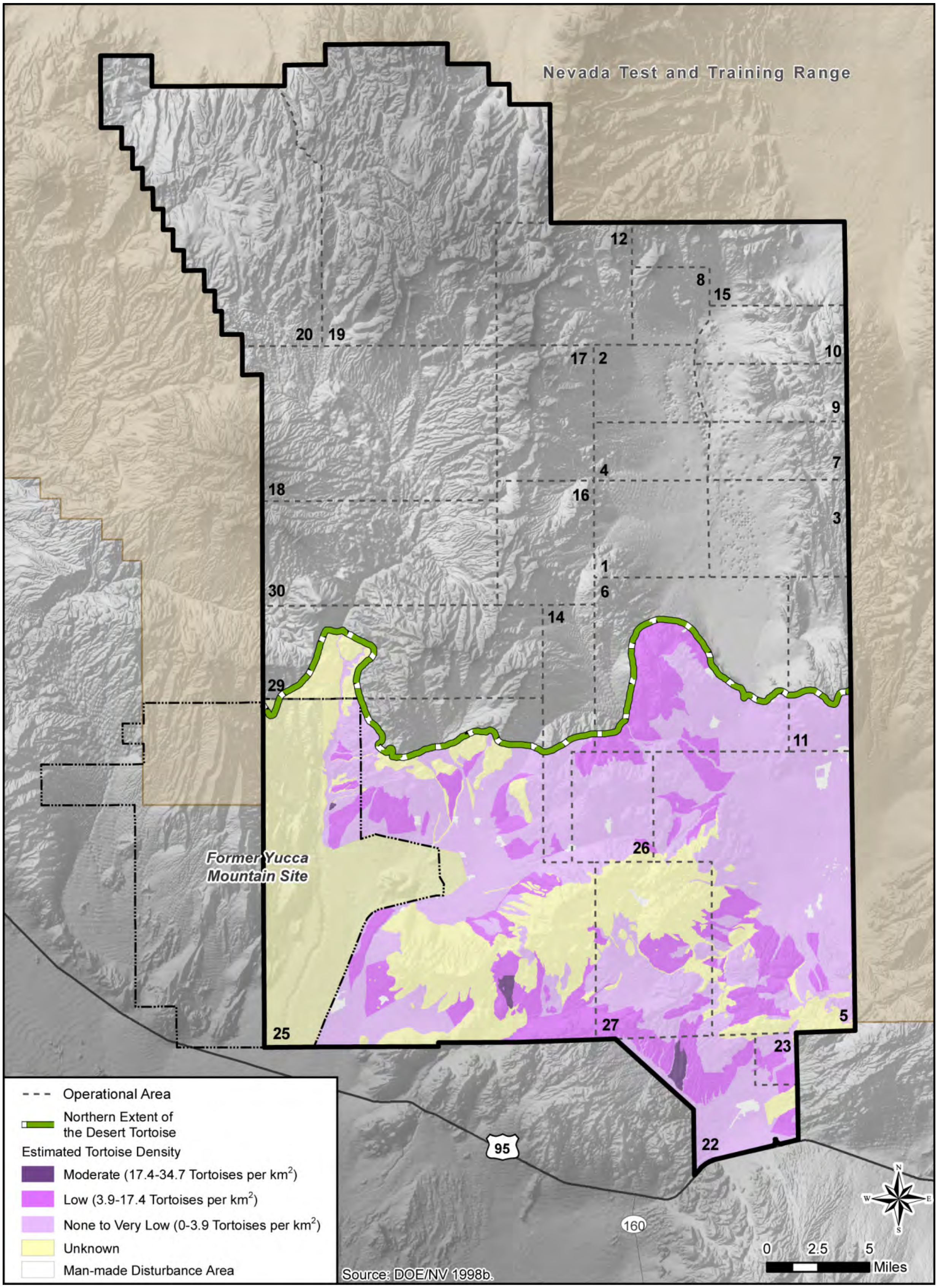

Figure 4–24 Northern Boundary of the Desert Tortoise Range on the Nevada National Security Site

Based on 1996 studies, the relative abundance of the desert tortoise on the NNSS ranges from very low or none (0–3.9 tortoises per square kilometer) to moderate (17.4–34.7 tortoises per square kilometer) (DOE/NV 1998b). Overall, the relative abundance of the desert tortoise on the NNSS is low to very low relative to other areas within the tortoise's range (EG&G 1991). The NNSS contains less than 1 percent of the total habitat of the overall desert tortoise population. A cumulative total of approximately 311 acres of desert tortoise habitat on the NNSS has been disturbed since the desert tortoise was listed in 1992 (NSTec 2009a). Critical habitat for the desert tortoise has not been designated on the NNSS, nor is the NNSS within any Desert Wildlife Management Area delineated in the *Desert Tortoise (Mojave Population) Recovery Plan* (USFWS 1994).

No federally listed threatened or endangered plants are known to occur on the NNSS (NSTec 2010j). However, 18 species of vascular plants and 1 non-vascular plant on the NNSS are considered to be sensitive by the Nevada Natural Heritage Program. Appendix F, Table F–1, includes a list of sensitive plant species known to occur on or near the NNSS. Also in Appendix F is a map showing the known locations of sensitive plant species on the NNSS.

The delisted peregrine falcon (*Falco peregrinus*) and delisted bald eagle (*Haliaeetus leucocephalus*) have also been reported on the NNSS. These species are rare migrants in this region and each has only been sighted once on the NNSS (Greger and Romney 1994). The peregrine falcon was removed from the threatened and endangered species list in 1999 (64 FR 46542), while the bald eagle was removed in 2007 (72 FR 37346). USFWS will monitor the bald eagle population status for a minimum of 5 years after delisting, as required by the Endangered Species Act. The bald eagle will continue to be protected under the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act. The State of Nevada lists this species as endangered.

4.1.7.4 Other Species of Concern

There are 88 sensitive and protected/regulated species known to occur on or adjacent to the NNSS (NSTec 2010j): 1 moss, 22 flowering plants (including 3 species of yucca, 1 of agave, and 18 cacti), 1 mollusk, 2 reptiles (including the desert tortoise), 15 birds, and 27 mammals. Two of the bird species, chukar (*Alectois chukar*) and Gambel's quail (*Callipepla gambelii*), are regulated as game species and 7 mammals are regulated as game species, as follows: pronghorn antelope (*Antilocarpra americana*), Rocky Mountain elk (*Cervus elaphus*), desert bighorn sheep (*Ovis canadensis nelsoni*), mule deer (*Odocoileus hemionus*), mountain lion (*Puma concolor*), Audubon's cottontail (*Sylvilagus audubonii*), and Nuttall's cottontail (*Sylvilagus nuttallii*). Three species are regulated as furbearers: bobcat, gray fox, and kit fox. Protected and sensitive species of plants and animals are listed in Appendix F, Table F–1. DOE/NNSA reviews the list of sensitive and protected/regulated species each year and conducts ongoing biological surveys to ascertain the presence of sensitive plant and animal species at the NNSS as part of its Ecological Monitoring and Compliance Program.

As discussed above, the Ecological Monitoring and Compliance Program monitors the ecosystem of the NNSS and ensures compliance with laws and regulations pertaining to NNSS biota. An annual report is prepared that summarizes program activities.

As noted above, there are a large number of sensitive wildlife species on the NNSS. One species of potentially sensitive reptiles is present, the western red-tailed skink (*Eumeces gilberti rubricaudatus*). NNSS-wide population numbers are unknown; however, eight red-tailed skinks were captured at 4 of 31 survey sites in 2008 (NSTec 2009a). Western red-tailed skinks have been found primarily in the western and northern portions of the NNSS (NSTec 2010j).

The western burrowing owl (*Athene cunicularia hypugaea*) is the main bird species that may be affected by activities on the NNSS. This species is ground-dwelling and uses burrows found in dry, open areas with flat to gradually sloping terrain. It can be found in most of the major valleys in the eastern and southern portions of the NNSS. Western burrowing owl monitoring, including trapping, has been ongoing on the NNSS for a number of years. A total of 26 breeding pairs and 122 young were detected over a 3-year period from 1999 to 2001 (Hall et al. 2003). There were 7, 8, and 11 breeding pairs and 24, 43, and 55 young detected during 1999, 2000, and 2001, respectively (Hall et al. 2003).

Eight bat species of concern that are known to occur on the NNSS include the spotted bat (*Euderma maculatum*), Townsend's big-eared bat (*Corynorhinus townsendii*), big free-tailed bat (*Nyctinomops macrotis*), long-eared myotis (*Myotis evotis*), small-footed myotis (*M. ciliolabrum*), fringed myotis (*M. thysanodes*), long-legged myotis (*M. volans*), and Yuma myotis (*M. yumaensis*) (Wills and Ostler 2001). Bat monitoring in 2008 included passive acoustic monitoring, preclosure monitoring at tunnels, and removing bats from buildings (NSTec 2009a).

Although not listed as sensitive, all bird species that occur on the NNSS, except chukar (*Alectois chukar*), Gambel's quail (*Callipepla gambelii*), English house sparrow (*Passer domesticus*), rock dove (*Columba livia*), and European starling (*Sturnus vulgaris*), are protected under the Migratory Bird Treaty Act (the noted bird species are not migratory and, therefore, are not covered by the Migratory Bird Treaty Act). As part of pre-activity planning on the NNSS, biological surveys are conducted to ensure protection of sensitive and otherwise protected species. Active nests of migratory birds are protected until the young fledge by avoiding activities that would cause direct harm, such as damaging or destroying a nest, or indirect harm, such as causing disturbance that would cause parent birds to abandon their eggs or young. For example, in 2009, three nests with chicks were protected from harm, including one Say's phoebe nest with four chicks and two nests of unknown species, each with chicks. NNSS activities that may have caused harm to these nests were postponed until the chicks fledged and the nests were empty (DOE/NV 2010).

4.1.7.5 Effects of Past Radiological Tests and Project Activities

A number of studies were conducted to document the types and extent of disturbances of the biological resources that may have resulted from past projects. Much of the focus was on determining the fate and effects of radionuclides, especially TRU radionuclides (Dunaway and White 1974; Gilbert et al. 1988; Howard and Fuller 1987; Howard et al. 1985; White and Dunaway 1975, 1976, 1978; White et al. 1977a, 1977b). Long-term impacts resulting from nuclear tests and nonradiological causes were also investigated (Hunter 1992, 1994a, 1994b, 1994c, 1995).

In areas where atmospheric tests, safety tests, or cratering experiments were conducted, there were measurable changes in the species composition and abundance of plants and animals. Immediately following some tests that deposited fallout containing beta-emitters, shrubs that were more radiosensitive, such as sagebrush, were killed, and a grass disclimax was established. The projects also involved nonradiological physical and mechanical disturbances that altered the characteristics of the soils and usually resulted in the removal of the shrubs, which are a key component of the structure and functioning of these desert ecosystems. The ecological changes observed were similar to effects associated with other human activities that disturb desert habitats, and few could be attributed solely to radiological impacts.

A herd of cattle was allowed to graze the northwestern part of the NNSS for 25 years (Smith and Black 1984). Periodically, tissues of cattle, deer, and bighorn sheep were analyzed for concentrations of radionuclides. Results of this program suggested that, since 1956, no significant amounts of biologically available radionuclides were contributed by activities on the NNSS. Except for periods immediately following the deposition of close-in fallout, tissue concentrations of cesium-137 and strontium-90 reflected the deposition of worldwide fallout. Concentrations of tritium were within the ranges present in the general environment, except in tissues of animals that had access to point sources of tritium, such as the Sedan Crater or the containment ponds in Area 12.

Hypothetical dose commitments for daily ingestion of NNSS beef over varying lengths of time were less than 2 percent of the Federal Radiation Council or the International Commission on Radiological Protection guidelines. Both the calving rate of the herd, which exceeded 85 percent annually, and the 180-day weaning weight, usually greater than 400 pounds, were above average. Routine necropsy and histopathological examinations revealed no harmful health effects that could be attributed to ionizing radiation in herbivores maintained for a lifetime on the NNSS.

Concentrations of radionuclides in soils, plants, and animals in the vicinity of some past tests were above general background levels. Concentrations usually decreased by a factor of 10 between soils and plants and between plants and animals. This is likely due to the fact that plants do not take up all of the contaminants available in the soil and animals, being mobile, may obtain their food from both contaminated and uncontaminated areas. In addition, some contaminants may not be absorbed by the animals, moving through the digestive tract of the animal and being excreted. Chromosomal aberrations were observed in cells of spiny sagebrush collected from Area 11, but the yields may not have been greater than what would be observed in the population naturally, and whether they were valuable or detrimental to the population was undetermined. Depressed levels of circulating lymphocytes and total leukocyte counts were found in kangaroo rats collected in areas contaminated with plutonium, but they were considered to be physiologically inconsequential. Gross pathological changes in native mammals appeared to be minimal and nonspecific. Reproduction in and recruitment to mammalian populations inhabiting contaminated areas were determined to occur largely in response to changes in the food supply of winter annual plants rather than in response to levels of radiation.

In a 2001 paper, Theodorakis et al. reported on a study that examined the effects of radionuclide exposure on Merriam's kangaroo rats at two radiologically contaminated atomic detonation locations on the NNSS. This research found that while genotoxic effects were not observed when all individuals were analyzed, individuals with gene sequences unique to the contaminated sites had greater chromosomal damage than contaminated-site individuals with gene sequences shared with reference (i.e., noncontaminated) sites. The researchers hypothesized that shared-gene-sequence individuals are potential migrants and that unique-gene-sequence individuals are potential long-term residents. They concluded that the radiologically contaminated detonation sites are ecological sinks and that immigration masks the potential mutagenic/carcinogenic effects of radiation on the resident population (Theodorakis et al. 2001). This suggests that individuals of a species that spend a majority of their lives living in a radiologically contaminated area would be more likely to exhibit genetic damage from the radioactivity than members of the same species that may only spend a small portion of their lives in the contaminated area. This would tend to reduce the likelihood of animals from the NNSS passing on damaged genes to animal populations in offsite areas.

The long-term consequences of past DOE activities were studied at past ground zero locations above which atmospheric tests were conducted, within subsidence craters formed following underground tests, in burned areas, on compacted drill pads and scrapes, and along roadsides. One of the major findings was that ecological impacts resulting from DOE/NNSA programs on the NNSS did not differ in type or magnitude from those resulting from other human activities that disturb desert ecosystems. Changes in the vegetation resulted from changes in patterns and amounts of precipitation. Changes in the species composition of vertebrates appeared to be linked to the structure of the vegetation associations, and changes in abundance were in response to altered food supplies, which were linked to vegetation.

Changes to the structure and function of ecosystems were restricted to the immediate vicinity of project sites, and few long-term effects could be attributed to radiological impacts. Concentrations of radionuclides did not produce genetic or cytological abnormalities that appeared to be detrimental to species or populations either in the short or long term. Restoration of disturbed sites will likely follow the routes and rates of succession observed in comparable, manipulated desert ecosystems.

Public access to the NNSS is restricted and precludes the harvest of plants for direct consumption by humans. However, animals may consume contaminated vegetation or water on the NNSS and become contaminated. Because animals may travel off the NNSS, the ingestion of game animals is the primary potential biotic pathway of radiological exposure to the public. The annual radiological monitoring program for the NNSS includes sampling plants and animals at sites with the highest known concentrations of radionuclides. Sampling includes both plants and small game animals and, when available, larger animals that have been found dead on the NNSS (DOE/NV 2003a).

4.1.7.6 Plant and Animal Monitoring for Radioactivity

Historical atmospheric nuclear weapons testing, outfalls from underground nuclear tests, and radioactive waste disposal sites provide sources of potential radiation contamination and exposure to NNSS plants and animals. DOE Order 458.1, *Radiation Protection of the Public and the Environment*, Change 2 (dated June 6, 2011), requires, in part, that radiological activities that have the potential to impact the environment must be conducted in a manner that protects populations of aquatic animals, terrestrial plants, and terrestrial animals in local ecosystems from adverse effects due to radiation and radioactive material released from DOE operations and that when actions taken to protect humans from radiation and radioactive materials are not adequate to protect biota then evaluations must be done to demonstrate compliance. To demonstrate compliance with this requirement, DOE/NNSA monitors plants, animals, and their habitat at the NNSS to determine if the radiological dose exceeds DOE-established limits expressed in "rad" (radiation absorbed dose). Radiological dose limits for plants and animals are found in DOE Standard 1153-2002. Under that standard, dose rates equal to or less than the following are expected to have no direct, observable effect on plant or animal reproduction:

- 1 rad per day (0.01 grays per day [Gy/d]) for aquatic animals
- 1 rad per day (0.01 Gy/d) for terrestrial plants
- 0.1 rad per day (1 milligray per day) for terrestrial animals

DOE/NNSA annually samples plants and game animals to measure the potential for radionuclide transfer through the food chain and determine if NNSS biota are exposed to radiation levels harmful to their own populations. This monitoring includes sampling plants, burrowing animals, and soils at the Area 3 Radioactive Waste Management Site (RWMS) and the Area 5 RWMC as a measure of the integrity of waste disposal cells.

The goal for vegetation monitoring is to sample the most contaminated plants within the NNSS environment. These plants are generally found inside demarcated radiological areas near the "ground zero" locations of historical aboveground nuclear tests. The species selected for sampling represent the most dominant plants, such as trees, shrubs, herbs, or grasses at these sites.

The goal of sampling animals for the purpose of determining potential dose to biota is to select species that are most exposed and most sensitive to effects from radiation. In general, mammals and birds are more sensitive to radiation than fish, amphibians, or invertebrates (DOE 2002a). In addition, animals are sampled to determine potential dose to the public from ingesting their meat. For these reasons, and because no native fish or amphibians are found on the NNSS, the game animals listed in **Table 4–38** are monitored. The sampling strategy used to assess the integrity of radioactive waste containment includes sampling plants, animals, and soil excavated by ants or small mammals on top of waste covers. The animals monitored for assessing the integrity of radioactive waste containment are listed in Table 4–38.

Table 4–38 Nevada National Security Site Animals Monitored for Radionuclides

Game Animals Monitored for Dose Assessments		
Small Mammals	***Large Mammals***	***Birds***
Cottontail rabbit (*Sylvilagus audubonii*) Jackrabbit (*Lepus californicus*)	Mule deer (*Odocoileus hemionus*) Pronghorn antelope (*Antelocarpa americana*)	Mourning dove (*Zenaida macroura*) Chukar (*Alectoris chukar*) Gambel's quail (*Callipepla gambelii*)
Animals Monitored for Integrity of Radioactive Waste Containment or as Game Animal Analogs		
Kangaroo rat (*Dipodomys* sp.) Mice (*Peromyscus* sp.) Antelope ground squirrel (*Ammospermophilius leucurus*) Desert woodrat (*Neotoma lepida*)		

Source: DOE/NV 2010.

As shown in **Table 4–39**, the results of this ongoing monitoring program have consistently demonstrated that, while plants and animals that inhabit radiological sites or radioactive waste containment covers may have elevated concentrations of radionuclides in their bodies, the concentrations are well below levels considered harmful to the health of the plants or animals.

Table 4–39 Site-Specific Dose Assessment Results for Terrestrial Plants and Animals Sampled on the Nevada National Security Site

Location	*Year*	*Estimated Radiological Dose (rad per day)*					
		To Plants			*To Animals*		
		Internal	*External*	*Total*	*Internal*	*External*	*Total*
Area 10 (Sedan Crater)	2010	0.00279	0.00072	0.00351	0.00021	0.00072	0.0093
Area 12 (E-Tunnel Ponds)	2010	0.00003	0.00032	0.00035		NM	
Area 15 (Baneberry)	2010	0.0000004	0.00029	0.00029		NM	
Area 11 (Plutonium Valley)	2009	0.00062	0.0012	0.0018	0.0028	0.0012	0.0040
Area 3 (RWMS)	2009	0.00045	0.00012	0.00057	0.00042	0.00012	0.00054
Area 5 (RWMC)	2009	0.26	0.000003	0.26	0.00011	0.000003	0.00012
Area 20 (Schooner Crater)	2008	0.008	0.003	0.01	0.001	0.002	0.002
Area 12 (E-Tunnel Ponds)	2007	0.000099	0.000091	0.00019	0.000073	0.000091	0.00016
Area 3 (RWMS)	2007	0.0000053	0.0000086	0.000014	0.0000015	0.0000086	0.000010
Area 5 (RWMC)	2007	0.000021	0.0000057	0.000027	0.000021	0.0000057	0.000027
Area 14 (T2 Site)	2006	0.0009	0.0025	0.0034	0.0005	0.0025	0.0030
Area 10 (Sedan Crater) (dove)	2005	0.0010	0.0014	0.0024	0.00015	0.0014	0.0016
(jackrabbits)					0.00016	0.004	0.0016
Area 19 (U-19ad sump) (doves)	2005	NM	NM	NM	0.00034	0.0057	0.0060
Area 11 (Plutonium Valley) (dove)	2004	TO	TO	0.0004	TO	TO	0.001
(jackrabbit)					TO	TO	0.0007
Area 12 (E-Tunnel Ponds) (bat)	2004	NM	NM	NM	TO	TO	0.0005
Area 20 (Cabriolet) (dove)	2003			0.002	TO	TO	0.008
Area 12 (E-Tunnel Ponds) (dove)	2003	NM	NM	NM	TO	TO	0.002
Area 10 (Sedan Crater)	2003	TO	TO	0.002	NM	NM	NM
		Dose limit = 1 rad per day			**Dose limit = 0.1 rad per day**		

NM = Not measured; RWMC = Area 5 Radioactive Waste Management Complex; RWMS = Area 3 Radioactive Waste Management Site; TO = only total dose reported.
Source: DOE/NV 2004a, 2005f, 2006a, 2007d, 2008a, 2009d, 2010, 2011.

Biological Resources—American Indian Perspective

The Consolidated Group of Tribes and Organizations (CGTO) knows the Nevada National Security Site (NNSS) contains an ancient playa, surrounded by mountain ranges. The runoff from these ranges serves to maintain a healthy desert floor and environment. Animals frequent the area, and there are numerous animal trails. Animals and the places where they live play a significant part in Indian history and lifestyle. The CGTO knows Indian people have lived on these lands since Creation value all plants and animals, yet some of these occupy more cultural significance in our lives. It is widely known that many Indian people still collect and use plants and animals that are found within the NNSS region. We describe these plants, animals, and insects in this section in an effort to demonstrate their importance to our well-being and survival, and their role in maintaining ecological balance to our Holy Land.

The CGTO knows, based on previous U.S. Department of Energy (DOE)-sponsored ethnobotany studies, that there are at least 364 American Indian traditional use plants on the NNSS (see Table C-1). Plants are still used for medicine, food, basketry, tools, homes, clothing, fire, and ceremony – both social and healing. Sage is used for spiritual ceremonies, smudging[1] and medicine. Indian rice grass and wheat grass are used for breads and puddings. Joshua tree is important for hair dye, basketry, foot ware, and rope. Globe mallow had traditional medicine uses, but in recent times is also used for curing European contagious diseases.

In order to convey the American Indian meaning of these plants, a series of ethnobotany studies were conducted and the findings used to establish a set of criteria for assessing the cultural importance of each plant and of places where plant communities exist. The CGTO provided these cultural guidelines so that National Environmental Poicy Act analyses and other agency decisions could be assessed from an American Indian perspective.

The CGTO knows, based on previous DOE-sponsored ethnofauna studies, there are at least 170 Indian use animals on the NNSS (see Table C-2). All are culturally important to Indian people.

The CGTO knows if they care for the earth and its resources, the Creator will always provide for them. The NNSS area was among the tribes' places to hunt and trap a variety of animals. It is known that special leaders within each tribe would organize large hunts where many Indian people participated. The Indian people would use these animals for many purposes, including food, bones for tool making, fur for warm blankets, ceremonial purposes, and described in traditional winter stories.

Indian people refrain from eating coyote, wolves, and some birds because these animals are fundamental to stories and songs that teach us life lessons to heal, to build character, and to become better people.

The relationships between the animals, the Earth, and Indian people are represented by the respectful roles they play in the stories of our lives then and now. For example, the NNSS contains a valley where an important spiritual journey occurred. It involved Wolf (*Tavats* in Southern Paiute, *Bia esha* in Western Shoshone, *Wi gi no ki* in Owens Valley Paiute) and is considered a Creation story. Out of respect to our traditional teachings, only parts of this story are presented here. When Wolf and Coyote had a battle over who was more powerful, Coyote killed Wolf and felt glorious. Everyone asked Coyote what happened to his brother Wolf. Coyote felt extremely guilty and tried to run and hide but to no avail. Meanwhile, the Creator took Wolf and made him into a beautiful Rainbow (*Paro wa tsu wu nutuvi* in Southern Paiute, *Oh ah podo* in Western Shoshone, *Paduguna* in Owens Valley Paiute). When Coyote saw this special privilege he cried to the Creator in remorse and he too wanted to be a Rainbow. Because Coyote was bad, the Creator put Coyote as a fine, white mist at the bottom of the Rainbow's arch. This story and the spiritual trails discussed in the full version are connected to the Spring Mountains and the large sacred cave in the Pintwater Range as well as to lands now called the NNSS. These areas comprise the home of Wolf, whose spirit is still present and watches over Indian people and our Holy Land.

Stink bugs, willows, frogs, hummingbirds, and snow fleas are all important to Indian people and our respect to rain and snow. (For additional information on these plants and animals, please see text box for Hydrological Resources, Section 4.5.)

The desert bighorn sheep and the desert tortoise are both culturally sensitive animals to Indian people. Among their many special qualities, when used ceremonially, they have the ability to bring rain and reduce drought impacts.

The desert tortoise has further significance to Indian people because of its healing powers, longevity, and wisdom. It is integral to our traditional stories, well-being and perpetuation of our native culture.

See Appendix C for more details.

[1] *Smudging is a spiritual cleansing involving the use of smoke from certain plants during prayers and ceremonies.*

4.1.8 Air Quality and Climate

4.1.8.1 Meteorology

Overview of NNSS Climate. The NNSS is located mostly in the southwestern corner of the Great Basin Desert, with the southern third of the NNSS located in the Mojave Desert (Warner 2004). The NNSS is located in the rain shadow (lee) of the southern Sierra Nevada mountain range and has the general climatic characteristics of a mid-latitude desert area, with relatively little precipitation throughout the year and low humidity, large diurnal and seasonal temperature ranges, and intense solar radiation in the summer. The normally dry desert climate specific to the NNSS can occasionally be interrupted by the southwestern monsoon and convective thunderstorms during the summer months, as well as Eastern Pacific tropical storm remnants in the late summer and fall. The climate conditions can be further modified from time to time during strong *El Niño* cycles, which generally bring more rainfall to the area.

Significant climate differences within the NNSS stem largely from differences in elevation. The NNSS generally slopes downward from north to south (from about 7,700 to 2,700 feet). There is considerable variability in terrain due to the number of mountain ranges (which are generally oriented north–south), mesas, basins, and flats. Local topographical features play an important role in defining local wind flow effects on both diurnal and seasonal time scales. Higher elevations within the NNSS generally experience cooler temperatures and more precipitation, while generally warmer temperatures and less precipitation occur in the basins.

Figure 4–25 shows the Meteorological Data Acquisition stations that monitor meteorological conditions across the NNSS. The NNSS areas are also labeled, and some geographic areas (e.g., Pahute Mesa, Frenchman Flat) are labeled and individually shaded. The following three major NNSS complexes that have historically released radiological and nonradiological hazardous air pollutants are labeled: BEEF, the Nonproliferation Test and Evaluation Complex (NPTEC), and Test Cell C. The Amargosa Valley CEMP station is shown, as is the Desert Rock hourly upper-air and Automated Surface Observing System. Terrain gradients are also shown.

Temperature. Average maximum temperatures range from 90 to 100 °F in the summer and from 50 to 60 °F in the winter. Average minimum temperatures range from 55 to 70 °F in the summer and 20 to 35 °F in the winter. At higher elevations, which are mostly in the northern NNSS, temperatures tend to be 10 to 15 °F cooler (NOAA 2006). For more information regarding temperature trends at the NNSS, please see Appendix D, Section D.1.1.1, of this SWEIS.

Precipitation. Higher elevations, mostly in the northern NNSS, receive an average of about 13 inches of precipitation per year, while locations in the southeastern NNSS near Frenchman Flat receive an average of about 5 inches per year, the lowest average amount (SORD 2008). Precipitation falls most often during winter and early spring (during Pacific storm passage) and during mid- to late-summer (during convective thunderstorms, monsoons, and occasional tropical storm remnants) (NOAA 2006). Nevada has had statewide drought conditions for most of the last decade, with precipitation amounts far below normal. For more information regarding precipitation patterns at the NNSS, including tornado statistics and snowfall and thunderstorm trends, please see Appendix D, Section D.1.1.1.

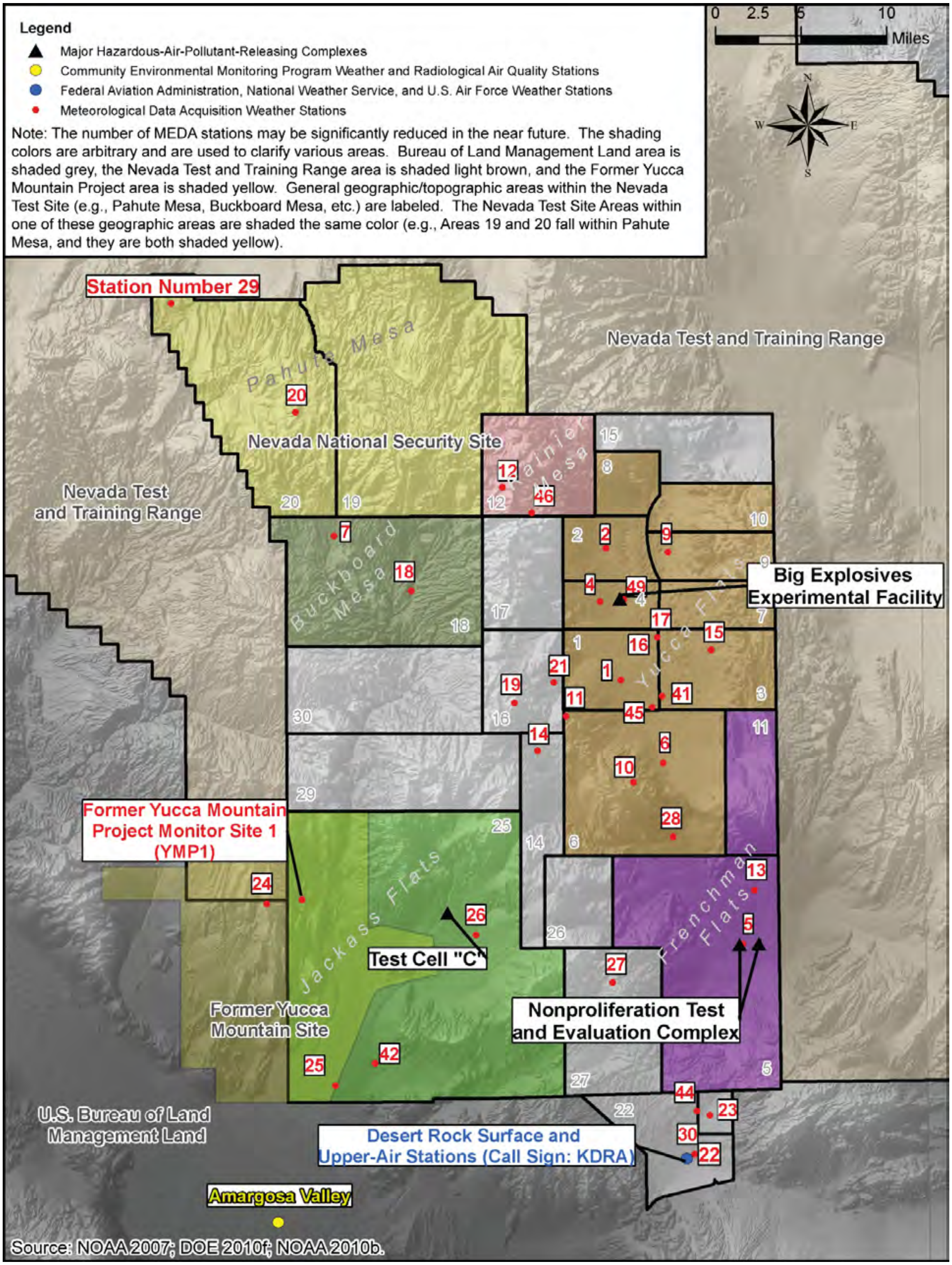

Figure 4–25 Meteorological Data Acquisition System Stations Across the Nevada National Security Site, as of 2010

Wind Flow

Wind conditions affecting the NNSS are perhaps the most complex of the site's meteorological conditions.

The surface winds show strong diurnal variations with distinct nighttime drainage winds in the basins and mountain slopes. Because the terrain tends to slope down in elevation from north to south, these nighttime drainage winds tend to be from the north. Localized terrain gradients that are not north-to-south modify this nighttime wind flow, as do rare low overcast conditions or conditions with extensive nighttime vertical mixing. **Figure 4–26** illustrates the localized wind patterns for the Meteorological Data Acquisition stations nearest the three NNSS sites that have historically, as well as recently, been permitted to release radiological and nonradiological hazardous air pollutants (i.e., BEEF, NPTEC, and Test Cell C). For more information regarding wind flow patterns at the NNSS, please see Appendix D, Section D.1.1.1.

Stability Overview

Cloud cover measurements used to estimate atmospheric stability are available from the Desert Rock site located in the southeastern corner of the NNSS. Based on data recorded from 1978 through 2004 at Desert Rock, stable conditions dominate at night, though stronger windspeeds will tend to mix in the atmosphere, leading to neutral conditions. Nighttimes tend to be more stable during the summer and fall months because of lighter winds at night, relative to the winter and spring periods. Because greater solar radiation leads to greater instability, unstable conditions dominate the daytime hours and the months with highest solar radiation (summer). These stability patterns would be slightly modified within the NNSS based primarily on windspeed differences and potentially on differences in local cloud cover and topology relative to what occurs at Desert Rock (NOAA 2006).

4.1.8.2 Ambient Air Quality

4.1.8.2.1 Region of Influence

The ROI for air quality and climate for the NNSS operations comprises southern Nye County, western Lincoln County, and northern Clark County, with prevailing downwind impacts extending into western Lincoln County. Historic data on pollutant emissions inventories and the compliance status for the State of Nevada are calculated at the county level, and these data provide a basis for determining both existing air quality in the ROI and a metric for emission comparison assessments.

4.1.8.2.2 Existing Air Quality

Current Ambient Air Quality Standards

Air quality is determined by measuring concentrations of certain pollutants in the atmosphere. EPA designates an area as "in attainment" for a particular pollutant if ambient air concentrations of that pollutant are below the National Ambient Air Quality Standards (NAAQS). Pollutants regulated under both the State of Nevada Ambient Air Quality Standards and NAAQS include the following:

- Ozone
- Carbon monoxide
- Nitrogen dioxide
- Sulfur dioxide
- Lead
- Particulate matter with an aerodynamic diameter less than or equal to 10 micrometers (PM_{10})
- Particulate matter with an aerodynamic diameter less than or equal to 2.5 micrometers ($PM_{2.5}$)

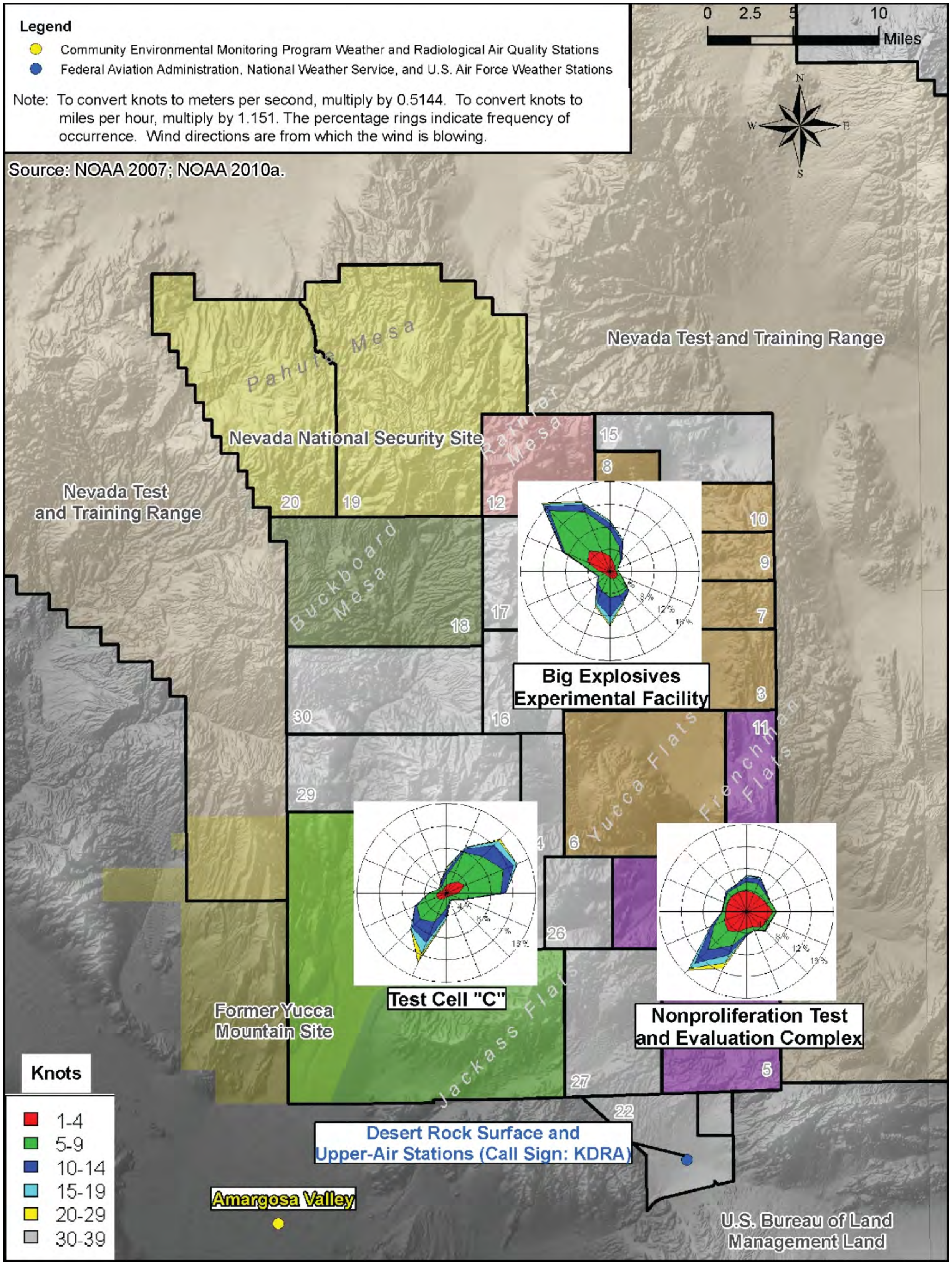

Figure 4–26 Annual Average Wind Roses for Meteorological Data Acquisition Stations near NPTEC, Test Cell C, and BEEF, 2004–2008

Collectively, these NAAQS pollutants are referred to as "criteria pollutants." **Table 4–40** lists NAAQS for both the primary public health standard and the secondary public welfare standard, which includes protection against decreased visibility and damage to animals, crops, vegetation, and buildings. Table 4–40 also lists the State of Nevada Ambient Air Quality Standards.

Table 4–40 State of Nevada and National Ambient Air Quality Standards

Pollutant	*Averaging Time Over Which Pollutant is Measured*	*Nevada Standard*	*National Primary Standard*	*National Secondary Standard*	*Notes Regarding the Air Quality Standard*
Ozone [a]	1 hour	0.12 ppm	None	None	The 1-hour ozone standard is attained when the expected number of days per calendar year with a maximum hourly average concentration above the standard is equal to or less than one.
	8 hours	None	0.075 ppm	Same as primary	The 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed this standard.
Carbon monoxide	8 hours	9 ppm (10,500 $\mu g/m^3$) elevations < 5,000 feet	9 ppm (10 mg/m^3) at any elevation	None	Not to be exceeded more than once per year.
		6 ppm (7,000 $\mu g/m^3$) elevations > 5,000 feet			
Carbon monoxide (at any elevation)	1 hour	35 ppm (40,500 $\mu g/m^3$)	35 ppm (40 mg/m^3)		
Nitrogen dioxide	Annual arithmetic mean	0.053 ppm (100 $\mu g/m^3$)	0.053 ppm (100 $\mu g/m^3$)	Same as primary	Not to be exceeded.
	1 hour	None	0.100 ppm (189 $\mu g/m^3$)	None	The 3-year average of the 98th percentile of the annual distribution of the daily maximum 1-hour average at each monitor within an area must not exceed this standard.
Sulfur dioxide [b]	Annual arithmetic mean	0.03 ppm (80 $\mu g/m^3$)	0.03 ppm (80 $\mu g/m^3$)	None	Not to be exceeded.
	24 hours	0.14 ppm (365 $\mu g/m^3$)	0.14 ppm (365 $\mu g/m^3$)		Not to be exceeded more than once per year.
	3 hours	0.5 ppm (1,300 $\mu g/m^3$)	None	0.5 ppm (1,300 $\mu g/m^3$)	
	1 hour	None	0.075 ppm	None	The 3-year average of the 99th percentile of the annual distribution of daily maximum 1-hour average concentration at each monitor within an area must not exceed this standard.
Lead	Quarterly arithmetic mean	1.5 $\mu g/m^3$	1.5 $\mu g/m^3$	Same as primary	Not to be exceeded.
	3-month rolling average	None	0.15 $\mu g/m^3$	Same as primary	
Hydrogen sulfide	1 hour	0.08 ppm (112 $\mu g/m^3$)	None	None	Not to be exceeded.

Pollutant	*Averaging Time Over Which Pollutant is Measured*	*Nevada Standard*	*National Primary Standard*	*National Secondary Standard*	*Notes Regarding the Air Quality Standard*
PM_{10}	Annual arithmetic mean	50 μg/m^3	None	None	The 3-year average of the weighted annual mean concentration from a single or multiple community-oriented monitors must not exceed this standard.
	24 hours	150 μg/m^3	150 μg/m^3	Same as primary	Not to be exceeded more than once per year on average over 3 years.
$PM_{2.5}$	Annual arithmetic mean	None	15 μg/m^3	Same as primary	The 3-year average of the weighted annual mean concentration from a single or multiple community-oriented monitors must not exceed this standard.
	24 hours		35 μg/m^3	Same as primary	The 3-year average of the 98th percentile of 24-hour concentrations at each population-oriented monitor within an area must not exceed this standard.

μg/m^3 = micrograms per cubic meter; mg/m^3 = milligrams per cubic meter; PM_n = particulate matter with an aerodynamic diameter less than or equal to *n* micrometers; ppm = parts per million.

[a] The U.S. Environmental Protection Agency (EPA) proposed a new standard of between 0.06 and 0.07 ppm in January 2010.

[b] On June 2, 2010, EPA revised the primary sulfur dioxide standard to 75 parts per billion over 1 hour and revoked both the 24-hour and annual standard.

Source: 40 CFR Part 50; NAC 445B.22097.

Air Quality Status. The NNSS is within Nevada Intrastate Air Quality Region 147. Nye County contains all of the NNSS, but has insufficient available data to determine the attainment status. Thus, it is designated as unclassified/attainment because EPA treats an unclassified area as if it is in attainment for regulatory purposes.

As of early 2010, the closest nonattainment areas to the NNSS are Inyo County, California (about 65 miles from the western border of the NNSS), and the Las Vegas Valley Area nonattainment area, located in Clark County (the closest distance is about 25 miles from the southeastern corner of the NNSS). Inyo County is in serious[1] nonattainment for PM_{10}, and the Las Vegas Valley Area of Clark County is in nonattainment for 8-hour ozone,[2] and serious nonattainment for both 8-hour carbon monoxide standards[3] and 24-hour PM_{10}[4] (EPA 2010c).

Prevention of Significant Deterioration (PSD) is a regulation incorporated into the Clean Air Act (CAA) that limits increases of certain pollutants in clean air areas (attainment areas) to certain increments even though ambient air quality standards are being met. CAA has three classes of areas with different increments. The smallest increments allowed are Class I areas, which are areas of special value (natural, scenic, recreational, or historic). Any degradation of existing air quality in these areas should be

[1] *EPA designates areas that do not obtain the NAAQS with respect to a particular air pollutant as nonattainment. Within that designation, classification categories have been established in the Clean Air Act based on the severity of the air pollution problem. Ozone has the broadest number of classification categories, including extreme, severe, serious, moderate, and marginal.*

[2] *Classification for 8-hour ozone under Subpart 2 as marginal with a nonattainment area that includes those portions of Clark County that lie in Hydrographic Areas 164A, 164B, 165, 166, 167, 212, 213, 214, 216, 217, and 218, but excludes the Moapa River Indian Reservation and the Fort Mojave Indian Reservation.*

[3] *Still designated as serious nonattainment for carbon monoxide, but has not had any violations of the carbon monoxide NAAQS since 1999. Clark County Department of Air Quality and Environmental Management submitted a request to EPA in September 2008 for a redesignation to attainment for carbon monoxide. The nonattainment area covers Hydrographic Area 212.*

[4] *Still designated as serious nonattainment for PM_{10}, but has not had any violations of the 24-hour or annual PM_{10} NAAQS since 2004. The nonattainment area covers Hydrographic Area 212.*

minimized. The closest PSD Class I areas to the NNSS are Grand Canyon National Park (about 130 miles to the southeast) and Sequoia National Park (about 105 miles to the west). The NNSS has no sources of pollution large enough to be subject to PSD requirements.

Calculations of Emissions on and near the NNSS

Table 4–41 shows the 2008 estimated air emissions for the criteria pollutants and hazardous air pollutants associated with various NNSS activities. PM_{10} and $PM_{2.5}$ emissions from diesel-fueled vehicles are included in the total PM_{10} and $PM_{2.5}$ emissions. Actions on efforts to mitigate diesel emissions are discussed in Chapter 7, Section 7.8. See Appendix D, Section D.1.1.2.1, for more information on how these emissions were determined and further partitioning by source type and vehicle type for the mobile sources.

Measurements of Ambient Air Concentrations on and near the NNSS

There are no regularly operating ambient air quality monitors for criteria pollutants and hazardous air pollutants within the NNSS. The most comprehensive source of representative data on ambient concentrations of criteria pollutants and hazardous air pollutants for the area surrounding the NNSS is a special study conducted in the southwest portion of the NNSS from October 1991 through September 1995 (see **Figure 4**–**27** for the locations of the monitors used in the study). During this period, the YMP1 station monitored carbon monoxide, nitrogen dioxide, PM_{10}, ozone, and sulfur dioxide. The YMP1 station was about 1 mile inside the western NNSS border in northwestern Area 25, and it is the only location on the NNSS where criteria pollutants other than PM_{10} have been measured for an extended period of time. Three additional sites monitored PM_{10} (DOE 1999a): YMP5 (about 6 miles southeast of YMP1 in Area 25, from April 1989 until 2002), YMP6 (about 4 miles northeast of YMP1 in extreme northwestern Area 25, from October 1992 until September 1999), and YMP9 (about 12 miles south-southeast of YMP1 in southwestern Area 25, from October 1992 until 2008). An earlier limited 1-month (August 15 – September 15, 1990) air quality monitoring study was done on the NNSS in Areas 6, 12, and 23 for carbon monoxide, sulfur dioxide, and PM_{10}; however, these results are not considered representative of today's ambient air quality concentrations, as overall activity levels at the NNSS have been substantially reduced since the 1992 nuclear testing moratorium. However, the monitored values were all well below the NAAQS and state ambient air quality standards.

The 1991 through 1995 ambient concentrations measured at the YMP1 station are conservative estimates of current concentrations at the NNSS for two reasons. First, the measured PM_{10} ambient concentrations among the four YMP monitors from 1989 through 2005 show a slight downward trend (see **Table 4–42**), and the NNSS onsite stationary emissions of criteria pollutants (see Appendix D, Section D.1.1.2) also trended downward from 1998 through 2008 (see Table 4–41). Second, the principal source of air pollutants is from population activity (vehicle trips and construction) and can be used as a surrogate for increases in PM emissions in the absence of new industrial activity. While Nye County's population increased by about 80 percent between 1990 and 2000, most of that growth occurred at the extreme southern tip of the county in the city of Pahrump, which is about 25 miles south-southeast of the extreme southern tip of the NNSS. Furthermore, the population directly bordering the Yucca Mountain site to its southwest (Amargosa Valley) grew by only about 16 percent, and the two counties in the prevailing upwind direction of the NNSS (Esmeralda County, Nevada, and Inyo County, California) had population decreases of up to almost 30 percent (USCB 2008b). Industrial activity has not changed over this period; thus, it is estimated that the criteria pollutant emissions near the NNSS have in general only decreased since the early 1990s.

Table 4–41 Estimated 2008 Air Emissions of Criteria Pollutants and Hazardous Air Pollutants Due to Nevada National Security Site-Related Activities

	Annual Air Emissions (tons per year)														
	Stationary Sources	*Government-Owned Vehicles*	*NNSS Commuters*			*Commercial Vendors*			*Radiological Waste Trucks*			*Total*			
	Nye County	*Nye County*		*Nye County*			*Nye County*			*Nye County*			*Nye County*		
Pollutant	*On-NNSS*	*On-NNSS*	*Clark County*	*On-NNSS*	*Off-NNSS*	*Clark County*	*On-NNSS*	*Off-NNSS*	*Clark County*	*On-NNSS*	*Off-NNSS*	*Clark County*	*On-NNSS*	*Off-NNSS*	*Total*
PM_{10}	0.22	0.82	0.83	0.14	0.19	0.24	0.11	0.032	0.17	0.0046	0.51	*1.2*	*1.3*	*0.73*	*3.3*
$PM_{2.5}$	0.22	0.66	0.56	0.11	0.11	0.22	0.1	0.029	0.16	0.0042	0.48	*0.94*	*1.1*	*0.62*	*2.7*
CO	0.94	39.6	97.0	18.5	21.0	0.98	0.46	0.13	0.67	0.018	2.0	*98.7*	*59.5*	*23.1*	*181.3*
NO_x	3.4	13.9	24.0	4.6	5.3	2.2	0.97	0.277494	2.3	0.064	7.2	*28.5*	*22.9*	*12.8*	*64.2*
SO_2	0.060	0.076	0.19	0.019	0.047	0.0041	0.0018	0.00051	0.0033	0.000088	0.010	*0.20*	*0.16*	*0.058*	*0.41*
VOCs	0.60	0.80	1.2	0.12	0.35	0.32	0.15	0.042	0.11	0.0029	0.33	*1.6*	*1.7*	*0.72*	*4.0*
Lead	0.0023	0.000022	0.000048	0.0000031	0.000013	0.0000038	0.0000018	0.00000052	0.0000022	0.000000017	0.0000019	*0.000054*	*0.0023*	*0.000015*	*0.0024*
Criteria Pollutant Total	*5.2*	*55.2*	*123.2*	*23.4*	*26.9*	*3.7*	*0.48*	*1.7*	*0.014*	*0.09*	*10.1*	*126.9*	*84.4*	*38.7*	*250.0*
HAPs	0.090	0.058	0.095	0.010	0.030	0.042	0.02	0.0056	0.17	0.00038	0.044	*0.31*	*0.18*	*0.080*	*0.56*

CO = carbon monoxide; HAP = hazardous air pollutant; NO_x = nitrogen oxides; NNSS = Nevada National Security Site; PM_n = particulate matter with an aerodynamic diameter less than or equal to *n* micrometers; SO_2 = sulfur dioxide; VOC = volatile organic compound.

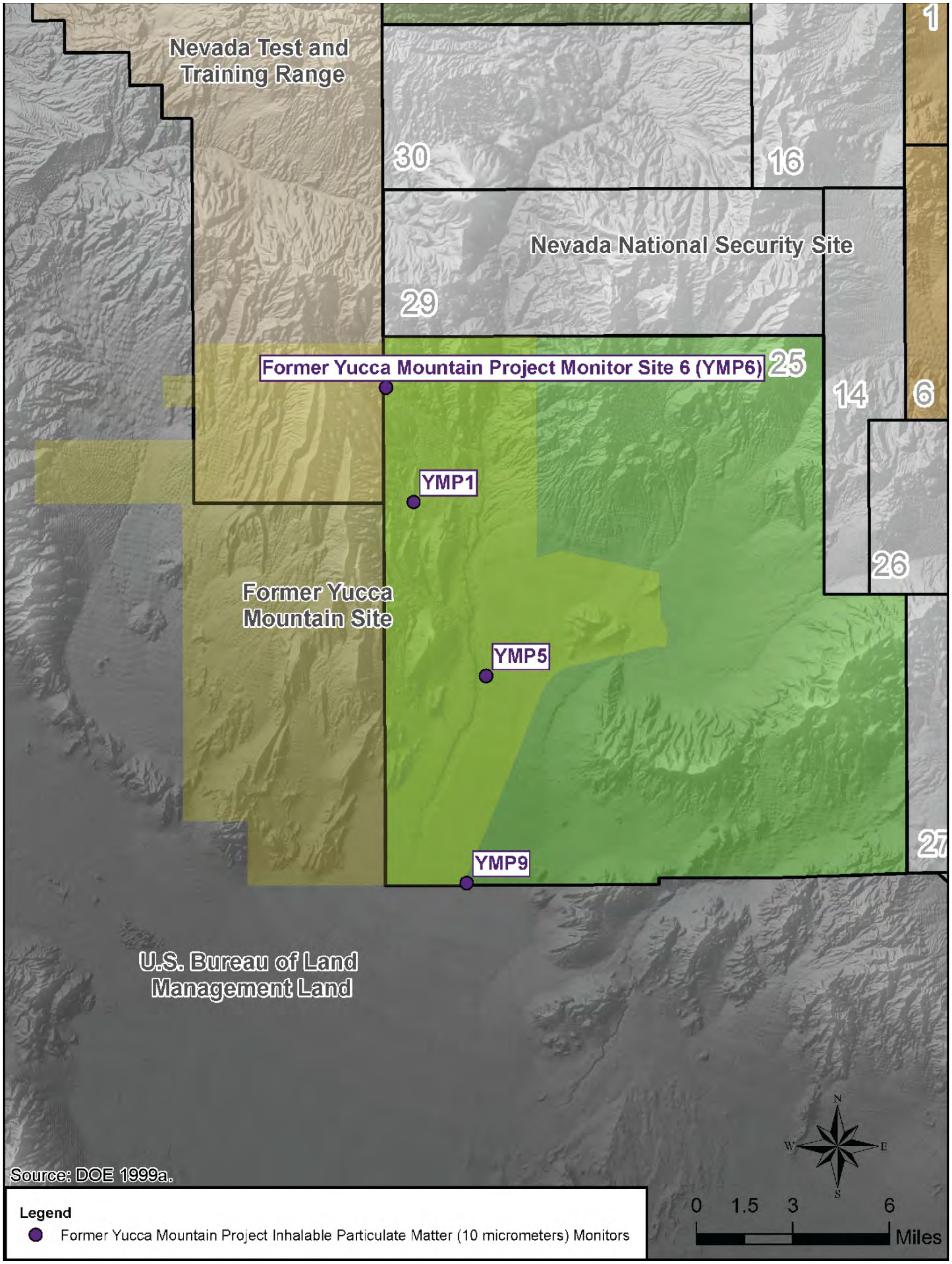

Figure 4–27 Locations of the Four Historical PM_{10} Monitors at the Former Yucca Mountain Site

Table 4–42 YMP1 Station Maximum Observed Ambient Air Quality Concentrations, October 1991 through September 1995, Compared with State of Nevada or National Ambient Air Quality Standards in Place at the Time of Monitoring

		Ambient Air Concentration (parts per million)				
Pollutant	***Measuring Time Increment***	***2009 Nevada or NAAQS, Whichever is Lower***	***Year 1 (October 1991 to September 1992)***	***Year 2 (October 1992 to September 1993)***	***Year 3 (October 1993 to September 1994)***	***Year 4 (October 1994 to September 1995)***
Carbon monoxide	1 hour [a]	35	**0.2**	**0.2**	**0.2**	**0.2**
	8 hours [a]	9 (elevations in Nevada under 5,000 feet above mean sea level)	**0.2**	**0.2**	**0.2**	**0.2**
Nitrogen dioxide	Annual [b]	0.053	0.00201	0.00208	**0.00214**	0.00209
Ozone [c]	1 hour [a]	0.12	**0.096**	0.093	0.081	0.083
	8 hours [d]	0.075	–	–	–	–
Sulfur dioxide	3 hours [a]	0.5	**0.002**	**0.002**	**0.002**	**0.002**
	24 hours [a]	0.14	**0.002**	**0.002**	**0.002**	**0.002**
	Annual [b]	0.03	**0.002**	**0.002**	**0.002**	**0.002**

NAAQS = National Ambient Air Quality Standards.
[a] Not to be exceeded more than once per year.
[b] Annual NAAQS are defined as a calendar year.
[c] The 1-hour Federal ozone standard of 0.12 parts per million, in place during the listed years, was phased out in 2005 and replaced with an 8-hour Federal ozone standard of 0.075 parts per million. The State of Nevada still retains the 1-hour ozone standard of 0.12 parts per million.
[d] The 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitoring station within an area over each year must not exceed this standard.
Note: The highest measured concentration in each row is shown in bold font.

As shown in Tables 4–42 and **4–43**, and further discussed in Appendix D, Section D.1.1.2, the Yucca Mountain site has been well within the attainment status of the applicable ambient air quality standards since at least the early 1990s. Given that the 1991 through 1995 ambient concentration measurements from the YMP1 station are still likely representative of the current concentrations on the NNSS as described above, it remains very likely that the ambient air quality on the NNSS is well within all applicable ambient air quality standards.

4.1.8.3 Radiological Air Quality

National Emission Standards for Hazardous Air Pollutants (NESHAPs) are established under Title I of CAA to limit ambient levels of some hazardous air pollutants. The radionuclide inhalation NESHAP for Federal facilities is set at the emissions total (cumulative across all radionuclides) that would cause a member of the public to receive an effective dose equivalent of 10 millirem in a year (DOE/NV 2009d). To put the dose of 10 millirem per year in perspective: a person would receive a dose of about 3 millirem from a single 5-hour jet flight, a dose of about 8 millirem from a single chest x-ray, and a dose of about 200 millirem per year from natural radon (DOE/NV 2009d). The average natural background radiation exposure, excluding that from radon, for persons residing in select U.S. cities is provided in **Table 4–44**.

Table 4–43 Summary of PM_{10} Concentrations, 1989 through 2005, for Four Monitoring Stations in Area 25

Monitoring Station	*Measuring Time Increment*	*Ambient Air Concentration (micrograms per cubic meter)*																	
		Current (2009) NAAQS	*1989*	*1990*	*1991*	*1992*	*1993*	*1994*	*1995*	*1996*	*1997*	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*
YMP1	24-hour highest	150 [a]	41	**62**	33	30	30	39	21	60	31	30	18	38	23	52	33	24	32
	Annual average	50 [b]	**12**	**12**	10	**12**	10	10	10	10	9	8	8	11	8	10	8	8	9
YMP5	24-hour highest	150 [a]	40	51	45	49	21	42	**67**	57	26	26	24	45	27	N/A	N/A	N/A	N/A
	Annual average	50 [b]	**13**	10	10	12	9	9	10	10	9	7	8	12	10	N/A	N/A	N/A	N/A
YMP6	24-hour highest	150 [a]	N/A	N/A	N/A	N/A	21	25	14	32	**59**	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Annual average	50 [b]	N/A	N/A	N/A	N/A	**9**	7	7	**9**	8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
YMP9	24-hour highest	150 [a]	N/A	N/A	N/A	31	21	39	15	**57**	29	22	18	36	22	43	39	27	26
	Annual average	50 [b]	N/A	N/A	N/A	N/A	9	8	7	10	8	6	8	**11**	9	10	**11**	9	9

N/A = not available; NAAQS = National Ambient Air Quality Standards; PM_n = particulate matter with an aerodynamic diameter less than or equal to *n* micrometers.
[a] Not to be exceeded more than once per year on average over 3 years.
[b] The 3-year average of the weighted annual mean concentration from a single or multiple community-oriented monitors must not exceed this standard.
Note: The highest measured concentration in each row is shown in **bold** font. N/A indicates that the monitor was either not operating or the data are not available.
Source: CRWMS M&O 1997, 1999; DOE 2002d, 2003b, 2004b, 2005a, 2006b; SAIC 1992a, 1992b.

Table 4–44 Average Natural Background Radiation Exposure, Excluding That from Radon, for Select U.S. Cities

City	*Radiation Exposure (millirem per year)*
Denver, Colorado	164.6
Wheeling, West Virginia	111.9
Rochester, New York	88.1
St. Louis, Missouri	87.9
Portland, Oregon	86.7
Los Angeles, California	73.6
Las Vegas, Nevada	69.5
Fort Worth, Texas	68.7
Richmond, Virginia	64.1
Tampa, Florida	63.7
New Orleans, Louisiana	63.7

Source: DOE 1990.

Table 4–45 indicates the NESHAPs concentration levels for environmental compliance for isotopes of americium, cesium, hydrogen, and plutonium. Because analytical methods cannot readily distinguish between plutonium-239 and plutonium-240, the NESHAPs concentration level for plutonium-239 is used for both isotopes. Uranium is not shown because any uranium detected on the NNSS in recent years has been determined to be naturally occurring rather than enriched or depleted (DOE/NV 2009d). Note, however, that 0.06 curies of depleted uranium were estimated to have been released in 2008 from activities at BEEF, in Area 4 (DOE/NV 2009d). A curie is a common measurement of radioactivity and is defined as 3.7×10^{10} disintegrations per second, which is the approximate decay rate of 1 gram of radium (radium-226).

Table 4–45 The Concentration Levels for Five Radionuclides Corresponding to the NESHAPs Effective Dose Equivalent of 10 Millirem per Year in One Year

Radionuclide	*NESHAPs Annual Average Concentration Levels for Environmental Compliance ($\times 10^{-15}$ micrograms per milliliter)*
Americium-241	1.9
Cesium-137	19
Hydrogen-3 (Tritium)	1,500,000
Plutonium-238	2.1
Plutonium-239	2

NESHAPs = National Emission Standards for Hazardous Air Pollutants.
Source: DOE/NV 2009d.

To demonstrate that total radioactivity is in compliance with NESHAPs, the following steps are performed: (1) divide the concentration level of each detected manmade radionuclide by its NESHAP concentration level (concentration ÷ NESHAP concentration level); (2) sum those fractions for all radionuclides; and (3) confirm that the sum is less than 1.0 at each monitoring station used for monitoring NESHAPs compliance. The NNSS has been in compliance with NESHAPs since the *1996 NTS EIS* (DOE 1996c).

The locations of the ambient radiological monitors on and surrounding the NNSS are discussed in Section 4.1.8.3.1. The locations of potential radiation emissions on the NNSS and the types of activities that might produce them are discussed in Section 4.1.8.3.2. The recent radiation concentrations and exposure levels are discussed in Section 4.1.8.3.3.

4.1.8.3.1 Ambient Radiological Monitoring on and near the Nevada National Security Site

On the NNSS, 6 of the 16 sites established by DOE/NNSA that monitor ambient tritium levels are considered "critical receptors." These "critical receptors" are approved to monitor levels of various radionuclides for NESHAPs compliance. Most of these 16 ambient monitors are placed at or near locations of historical nuclear testing or current radiological operations (DOE/NV 2011). The locations of the 16 tritium monitors, with notations for the 6 that are critical receptors, are shown in **Figure 4–28**. The monitoring data from the 6 "critical receptors" demonstrate that the NNSS has been in compliance with the NESHAPs since the *1996 NTS EIS*. Further details on the NNSS ambient radiological monitoring can be found in Appendix D, Sections D.1.1.3.1 and D.1.1.3.

The Desert Research Institute of the Nevada System of Higher Education runs CEMP, which constitutes an offsite non-regulatory network of environmental monitors across southern Nevada, southeastern California, and southwestern Utah. CEMP is a public information and outreach program that monitors for radionuclides that might be released from the NNSS. As of 2008, there were 29 CEMP monitors; the 22 monitors near the Nevada Test and Training Range and Las Vegas area are shown in **Figure 4–29**. Since CEMP was upgraded in 1999 (DOE/DRI 2009), the CEMP monitors have not detected radiation that can be definitively attributed to NNSS activities, and the monitored radiation levels have been well within the background levels observed in other parts of the country (DOE/NV 2011). More details about the radiation detected at CEMP locations are provided in Appendix D, Sections D.1.1.3.1 and D.1.1.3.3.

4.1.8.3.2 Sources of Radiation on the Nevada National Security Site

Between 1951 and 1992, 100 atmospheric and 828 underground nuclear tests were conducted on the NNSS (DOE/NV 2011). Nuclear testing ended in 1992, and since then the NNSS radiation monitoring has focused on detecting airborne radionuclides from historically contaminated soils. Due to occasional high winds, some contaminated soil becomes airborne. Results from the air samplers in these areas indicate that americium-241 and plutonium-230+240 are routinely detected, but only in concentrations slightly above the minimum detectable concentrations. The total emissions (in curies) produced each year from all known legacy sites on the NNSS are estimated with a mathematical resuspension model. For 2008, total annual emissions from legacy sites were estimated as follows: americium-241 – 0.047 curies, plutonium-238 – 0.050 curies, and plutonium-239+240 – 0.29 curies (DOE 2009d). The methods used to estimate all NNSS radiological emissions (both point sources and fugitive dust from the legacy sites) include the use of annual field and water monitoring data, historical soil inventory data, and accepted soil resuspension and air transport models (DOE 2009d). Additional detail on radiological emissions and how they are determined is in Appendix D, Section D.1.1.2.2, Radiological Air Quality. In 1990, most areas within the NNSS had measureable amounts of americium-241 and plutonium-238, -239, and -240 in the first 2 inches of soil (McArthur 1991). Over time, the measurable airborne quantities of radionuclides have decreased as a result of radioactive decay, radionuclide immobilization in soil, and decreases in NNSS activities that would resuspend radionuclides from the soil to the air. According to a 1994 aerial survey, the largest areas of soil contamination correspond to the places where the bulk of nuclear testing occurred—especially the northeastern quarter of the NNSS (on Yucca Flat; locations north and east of Areas 1 and 17), but with notable locations in eastern Frenchman Flat (in Area 5), in northwestern Pahute Mesa (in Area 20), in central Buckboard Mesa (in Area 18), and near Dome Mountain (in Area 30). Evaporation and evapotranspiration can also resuspend tritium from contaminated soil, plants, and ponds such as the ones in Area 12 that receive tritium-contaminated water from East Tunnel. For more information regarding the sources of radiation at the NNSS, please see Section D.1.1.3.2.

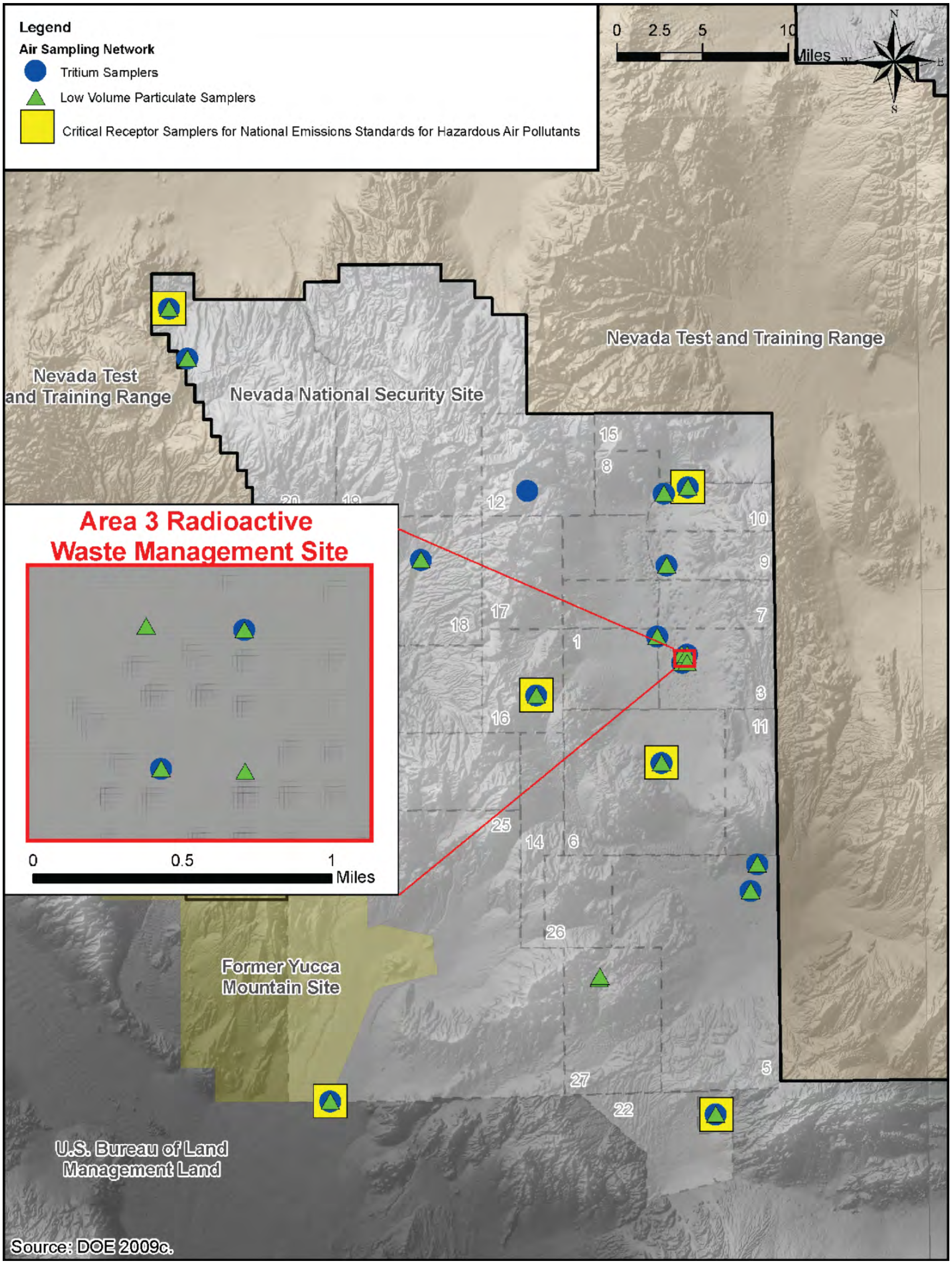

Figure 4–28 Ambient Radiological Monitoring and Critical Receptor Sampling Locations for Air Particulates and Tritium

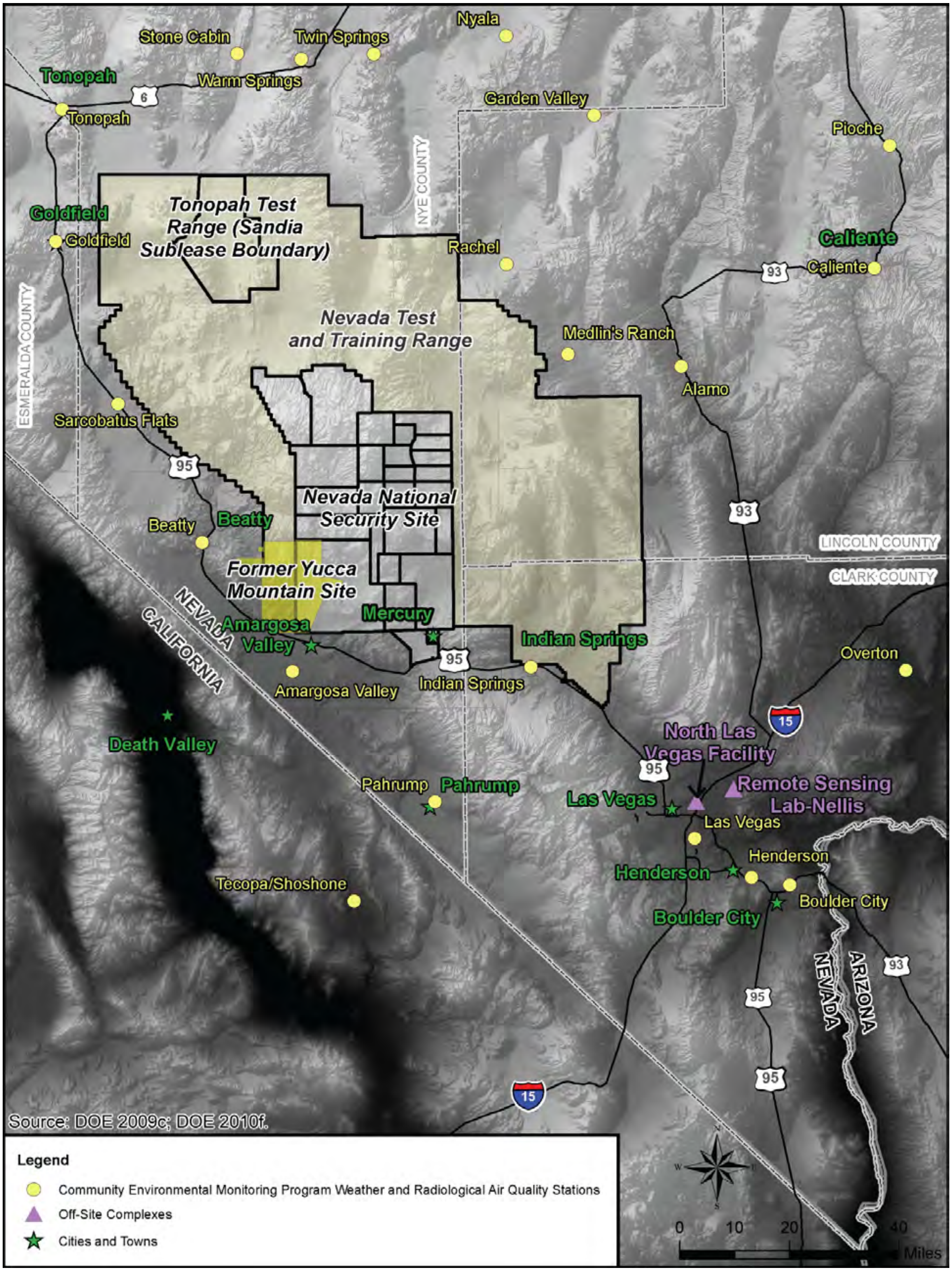

Figure 4–29 Community Environmental Monitoring Program Air Surveillance Network Locations near the Nevada Test and Training Range and Las Vegas, 2008

4.1.8.3.3 Radiation Levels on and near the Nevada National Security Site

The NNSS has been in compliance with the NESHAPs since the *1996 NTS EIS* (DOE 1996c). The maximum annual average radiation at critical receptor locations was from tritium over the most recent years, 2002 through 2008, with a measured concentration of 434×10^{-12} microcuries per milliliter, which is 29 percent of the NESHAPs concentration level. The radiological monitoring network overall indicates that levels of americium-241; plutonium-238, -239, and -240; cesium-137; and tritium on the NNSS have been well below the NESHAPs concentration levels since the *1996 NTS EIS*. In addition, offsite CEMP stations continue to show radiation levels that are well within natural background radiation levels (DOE/NV 2011). For more information regarding the radiation levels on and near the NNSS, please see Appendix D, Section D.1.1.2.2.3.

4.1.8.4 Climate Change

This section describes the affected environment in terms of current and anticipated trends in greenhouse gas emissions and climate. The effects of emissions on the climate involve very complex processes and interact with natural cycles, complicating the measurement and detection of changes. Recent advances in the state of the science, however, are contributing to an increasing body of evidence that it is very likely (greater than 90 percent probability) that anthropogenic greenhouse gas emissions affect climate in detectable and quantifiable ways (IPCC 2007b).

This section begins with a discussion of emissions and then turns to climate. Both discussions start with a description of conditions in the United States, followed by a description of conditions on the NNSS.

4.1.8.4.1 Greenhouse Gas Emissions

Greenhouse gas emissions in the United States in 2007[5] were estimated at 7,150.1 million carbon-dioxide-equivalent[6] metric tons (EPA 2009a), which is about 18 percent of total global emissions[7] (WRI 2009). Annual national emissions, which have increased 17 percent since 1990 and typically increase each year, are heavily influenced by "general economic conditions, energy prices, weather, and the availability of non-fossil alternatives" (EPA 2009a). Carbon dioxide is by far the primary greenhouse gas emitted in the United States, representing almost 85.4 percent of all U.S. greenhouse gas emissions in 2007 (EPA 2009a). The other gases include methane, nitrous oxide, and a variety of fluorinated gases, including hydrofluorocarbons, perfluorinated carbons, and sulfur hexafluoride. The fluorinated gases are collectively referred to as "high global warming potential" (GWP) gases. Methane accounts for 8.2 percent of the remaining greenhouse gases on a GWP-weighted basis, followed by nitrous oxide (4.4 percent) and high-GWP gases (2.1 percent) (EPA 2009a).

Greenhouse gases are emitted from a wide variety of sectors, including energy, industrial processes, waste, agriculture, and forestry. Most U.S. greenhouse gas emissions are from the energy sector, largely due to carbon dioxide emissions from the combustion of fossil fuels, which alone account for 80 percent of total U.S. greenhouse gas emissions (EPA 2009a). Fossil fuel combustion contributes 97 percent of national total carbon dioxide emissions. As stated, carbon dioxide emissions from fossil fuel combustion are dominated by electricity generation, which contributes 42 percent of the total carbon dioxide emissions; the transportation sector contributes 33 percent; the industrial sector, 15 percent; the residential sector, 6 percent; and the commercial sector, 4 percent (EPA 2009a).

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[5] *Most recent year for which an official EPA estimate is available.*
[6] *Each greenhouse gas has a different level of radiative forcing—that is, the ability to trap heat. To compare their relative contributions, gases are converted to a carbon-dioxide equivalent using their unique global warming potential.*
[7] *Based on 2005 data and excludes carbon sinks from forestry and agriculture.*

4.1.8.4.2 Greenhouse Gas Emissions Due to Nevada National Security Site-Related Activities

Table 4–46 provides greenhouse gas emissions due to NNSS-related activities for 2008. The greenhouse gas emissions are presented in carbon-dioxide-equivalent form and are partitioned by various mobile and stationary source types. These emissions were derived from fuel use, vehicle activity, and power consumption data. The greenhouse gas emissions were calculated using the EPA Climate Leaders Simplified Greenhouse Gas Emissions Calculator (EPA 2010b). These emissions were compared with a reference amount of 25,000 metric tons (27,558 tons), which is an indicator for when a quantitative assessment may be warranted (CEQ 2010).

Power generation (electrical energy generation) is by far the largest single source of greenhouse gas emissions related to NNSS activities. Overall, NNSS-related activities created about 50,478 carbon-dioxide-equivalent tons of greenhouse gas emissions in 2008, about 83 percent over the reference level.

Table 4–46 Carbon-Dioxide-Equivalent Emissions of Greenhouse Gases by Activities Related to the Nevada National Security Site in 2008

Source Type	*Carbon-Dioxide-Equivalent Emissions (tons per year)*	*Fraction of Reference Point of 27,558 Tons Per Year* [a]
STATIONARY SOURCES		
Power generation	28,517	1.03
Natural gas heating	0	0
Other stationary sources, except air conditioning/refrigeration and natural gas heating	747	0.03
Sulfur hexafluoride from refrigeration/air conditioning	690	0.03
Hydrofluorocarbons from refrigeration/air conditioning	326	0.01
All Stationary Sources	*30,280*	*1.10*
MOBILE SOURCES		
Onsite government vehicles	4,920	0.18
Commuting	13,201	0.48
Hazardous waste transport (nongovernment)	837	0.03
Commercial vendors	1,240	0.05
All Mobile Sources	*20,198*	*0.73*
Total	***50,478***	***1.83***

Note: Fractional amount may not match the shown emission rate due to rounding.

4.1.8.4.3 Current Changes in Climate

This section describes observed historical and current climate change impacts on the United States and, in particular, on the desert southwest. Much of the material that follows is drawn from the following sources, including the citations therein: *Technical Support Document for Endangerment and Cause or Contribute Findings for Greenhouse Gases under Section 202(a) of the Clean Air Act* (EPA 2009b) and the *Scientific Assessment of the Effects of Global Change on the United States* (NSTC 2008).

The past decade has been the warmest in more than a century of direct observations; average temperatures for the contiguous United States have risen at a rate near 0.58 °F per decade in the past few decades. In the southwest, the average annual temperature has increased by 1.4 °F over the 1960 to 1978 baseline (Karl et al. 2009). The annual average temperature across the region is projected to rise approximately 4 to 10 °F over the 1960 to 1978 baseline by the end of the century, depending upon how much greenhouse gas emissions increase (Karl et al. 2009).

Higher temperatures cause higher rates of evaporation and plant transpiration, meaning that more water vapor is available in the atmosphere for precipitation events. Depending on atmospheric conditions, increased evaporation means that some areas experience increases in precipitation events, while other areas are left more susceptible to droughts. For the southwest, a severe drought prevailed from 1999 to 2008 (NSTC 2008). Most climate models project a decrease in precipitation for many areas in the southwestern United States throughout the twenty-first century (EPA 2009b; NSTC 2008).

Melting snow and ice, increased evaporation, and changes in precipitation patterns all affect surface water. Stream flow decreased about 2 percent per decade over the past century in the central Rocky Mountain region (NSTC 2008). Annual peak stream flow (dominated by snowmelt) in western mountains occurs at least a week earlier than in the middle of the twentieth century. Changes in temperature and precipitation also affect frozen surface water. Spring and summer snow cover has decreased in the west. In mountainous regions of the western United States, the April snow water equivalent has declined 15 to 30 percent since 1950, particularly at lower elevations and primarily due to warming (NSTC 2008). This decrease in stream flow will likely reduce the groundwater recharge throughout the southwestern United States (NSTC 2008).

Air Quality and Climate—American Indian Perspective

The Consolidated Group of Tribes and Organizations (CGTO) knows that the air is alive. The Creator puts life into the air, which is shared by all living things. When a child is born, he pulls in the air to begin its life. The mother watches carefully to make sure that the first breath is natural and that there is no obstruction in the throat. It is believed if the day of birth is a windy day, it is a good day and the child will have a good life.

According to tribal elders' perspectives from Area 5 Nevada National Security Site activities, *"…You can listen to the wind. The wind talks to you. Things happen in nature. Our people had weather watchers, who are kinds of people who will know when crops and things should be done. They watch the different elements in nature and pray to ask the winds to come and talk about these things. Sometimes you ask the north wind to come down and cool the weather. The north wind is asked to blow away the footsteps of the people who have passed on to the afterlife. That kind of wind helps people, it is positive. The wind also brings you songs and messages. Sometimes the messages are about healing people, a sign that the sickness is gone now from the person, or that it is coming to get that sickness to take it away, or it is coming to bring you the strength that you will need to deal with the illness."*

See Appendix C for more details.

4.1.9 Visual Resources

Identifying an area's visual resources and conditions involves three steps: (1) objective identification of the visual features (visual resources) of the landscape; (2) assessment of the character and quality of those resources relative to overall regional visual character; and (3) determination of the importance to people, or *sensitivity*, of views of visual resources in the landscape.

The aesthetic value of an area is a measure of its visual character and quality, combined with the viewer response to the area (FHA 1988). Scenic quality can best be described as the overall impression that an individual viewer retains after driving through, walking through, or flying over an area (BLM 1980). Viewer response is a combination of viewer exposure and viewer sensitivity. Viewer exposure is a function of the number of viewers, number of views seen, distance of the viewers from key observation points to what is being viewed, and viewing duration. Viewer sensitivity relates to the extent of the public's concern for a particular viewshed. These terms and criteria are described in greater detail in the following sections.

Visual Character. Natural and artificial landscape features contribute to the visual character of an area or view. Visual character is influenced by geologic, hydrologic, botanical, wildlife, recreational, and urban features. Urban features include those associated with landscape settlements and development, including roads, utilities, structures, earthworks, and the results of other human activities. The perception of visual character can vary significantly seasonally, even hourly, as weather, light, shadow, and elements that compose the viewshed change. The basic components used to describe visual character for most visual assessments are the elements of form, line, color, and texture of the landscape features (BLM 1980; USFS 1995; FHA 1988). The appearance of the landscape is described in terms of the dominance of each of these components.

Scenic Quality. Scenic quality was evaluated using the scenic quality classes established in the *1996 NTS EIS* and includes the following:

- Class A – The visual environment is made up of outstanding natural and manmade physical features.
- Class B – The visual environment is made up of a combination of outstanding natural and manmade physical features and those that are common to the region.
- Class C – The visual environment is made up of natural and manmade physical features that are common to the region.

Visual Exposure and Sensitivity. The measure of the quality of a view must be tempered by the overall sensitivity of the viewer. Viewer sensitivity or concern is based on the visibility of resources in the landscape, proximity of viewers to the visual resource, elevation of viewers relative to the visual resource, frequency and duration of views, number of viewers, and type and expectations of individuals and viewer groups.

Public roadways, mostly highways, provide the only public vantage points of the NNSS. Commuters and nonrecreational travelers have generally fleeting views and tend to focus on commute traffic, not on surrounding scenery; therefore, they are generally considered to have low visual sensitivity. Highways pass by the NNSS in areas that are largely undeveloped, and views of the sites are fleeting at standard highway speeds. Because roadways provide the majority of views and the viewer sensitivity of roadway users is generally low, the number of viewers that pass by and have views of the NNSS and other DOE/NNSA-managed offsite locations was used to determine the level of sensitivity and to analyze effects on visual resources (see Chapter 5, Section 5.1.9). The 2008 *Annual Traffic Report* (NDOT 2008c) was used to determine traffic volumes on public roadways with views of the NNSS and other DOE/NNSA-managed offsite locations. **Figure 4–30** shows the sensitivity levels assigned to roadways near the NNSS and other DOE/NNSA-managed offsite locations based on traffic volumes; these are as follows:

- High Visual Sensitivity – 3,000 or more average annual daily viewers
- Moderate Visual Sensitivity – 1,000 to 2,999 average annual daily viewers
- Low Visual Sensitivity – 0 to 999 average annual daily viewers

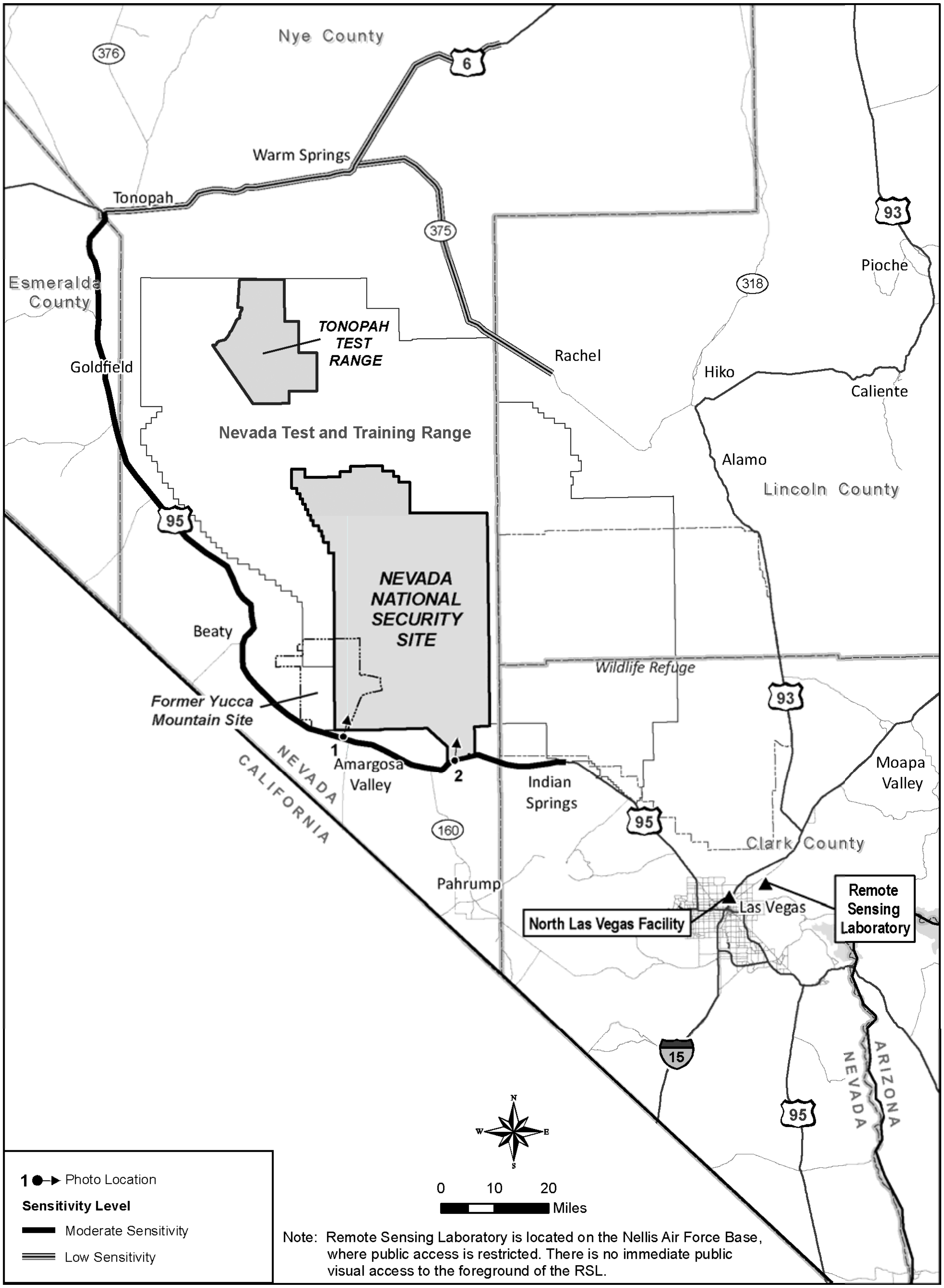

Figure 4–30 Photograph Locations and Sensitivity Levels at the Nevada National Security Site and Other Nevada Locations Managed by the U.S. Department of Energy/National Nuclear Security Administration

The importance of a view is related in part to the position of the viewer to the resource; therefore, visibility and visual dominance of landscape elements depend on their location within the viewshed. A viewshed is defined as all of the surface area visible from a particular location (e.g., an overlook) or sequence of locations (e.g., a roadway or trail) (FHA 1988). To identify the importance of views of a resource, a viewshed must be broken into distance zones of foreground, middleground, and background. Generally, the closer a resource is to the viewer, the more dominant it is and the greater its importance to the viewer. Although distance zones in a viewshed may vary between different geographic regions or types of terrain, the standard foreground zone is up to 0.5 miles from the viewer, the middleground zone is 0.5 miles to 4 miles from the viewer, and the background zone is 4 miles and beyond (USFS 1995).

Visual sensitivity depends on the number and type of viewers and the frequency and duration of views. Visual sensitivity also varies with differences in viewer activity, awareness, and visual expectations in relation to the number of viewers and viewing duration. For example, visual sensitivity is generally higher for views seen by people who are driving for pleasure; people engaging in recreational activities such as hiking, biking, or camping; and homeowners. Sensitivity tends to be lower for views seen by people driving to and from work or as part of their work (USFS 1995; FHA 1988; U.S. Soil Conservation Service 1978). As described above, commuters and nonrecreational travelers have low visual sensitivity. Residential viewers typically have extended viewing periods and are concerned about changes in the views from their homes; therefore, they are generally considered to have high visual sensitivity. Recreational viewers (e.g., those using recreation trails and areas, scenic highways, and scenic overlooks) are usually assessed under the assumption that they have high visual sensitivity.

Visual Resources—American Indian Perspective

All landforms within the Nevada National Security Site (NNSS) have high sensitivity levels for American Indians. The ability to see the land without the distraction of buildings, towers, cables, roads, and other objects is essential for the spiritual interaction between Indian people and our traditional lands.

Views from places are an important cultural resource that contributes to the location and performance of American Indian ceremonialism. Views combine with other cultural resources to produce special places where power is sought for medicine and other types of ceremony. Views can be of any landscape, but more central viewscapes are experienced from high places, which are often the tops of mountains and the edges of mesas. Indian viewscapes tend to be panoramic and are made special when they contain highly diverse topography. The viewscape panorama is further enhanced by the presence of volcanic cones and lava flows.

Viewscapes are tied with songscapes and storyscapes especially when the vantage point has a panorama composed of multiple locations described by traditional songs or stories. Our traditional songscapes and storyscapes can be compromised if projects like geothermal energy development are pursued. If geothermal resources are altered, our songs and stories will be impacted and will no longer accurately reflect key traditional aspects of the viewscape.

The Consolidated Group of Tribes and Organizations (CGTO) recognizes the cultural significance of viewscapes and have identified a number of these on the NNSS. The Timber Mountain Caldera contains a number of significant vantage points with different panoramas including but not limited to Scrugham Peak, Shoshone Mountain, and Buckboard and Pahute Mesa. The CGTO feels revisiting sites within the viewscapes are essential to Indian people to interact with the land, communicate with the spirits who watch over the land, conduct religious ceremonies with prayers and songs, and monitor each site's condition. Special considerations should be given to tribal elders and youth to provide an educational experience and reinforce positive connections with our culture.

See Appendix C for more details.

Nevada National Security Site Vicinity. The NNSS landscape is typical of the Basin and Range Physiographic Province. Key visual features include the Mercury Valley, on either side of U.S. Route 95, gently sloping upward toward the mountains, mesas, and hills enclosing the valley. Representative locations where photographs were taken and sensitivity levels of the roadways in the area are shown in Figure 4–30. Lower elevations in the valley are vegetated with creosote bush and white bursage shrubland, transitioning to spiny menodora, Nevada jointfir, and white bursage shrubland at higher elevations (DOE/NV 2000d). While this vegetation looks rougher in the foreground, it appears smoother as it recedes into the distance. The coarse, angular terrain of the mountain, mesa, and hill slopes provides visual interest during different times of the day, providing simple-to-complex light and shade patterns (see **Figure 4–31**). These patterns provide visual contrast to the smooth valley floor that does not cast visually dynamic shadows. Light and shade also affect the perceived color of the terrain by saturating or dulling the color hues present in the landscape. Development is limited to the Mercury and Amargosa Valleys. While both of these developed areas are small in scale, the use of light-colored building materials makes these areas more visually apparent against the darker natural landscape (see **Figure 4–32**).

Most of Areas 22 and 23 and portions of Area 25 are the only areas of the NNSS that are visible to the public from U.S. Route 95 and the Amargosa Valley. All other public visual access to the interior of the NNSS is limited by terrain. Portions of the study area visible from U.S. Route 95 are considered to have a Class B scenic quality rating due to the lack of visual intrusions and picturesque views of the natural landscape that vary throughout the day and seasonally, combined with commonality of these views to the region.

Figure 4–31 Landscape Photographs – Visual Interest of Terrain near the Nevada National Security Site

Figure 4–32 Landscape Photographs – Developed Areas near the Nevada National Security Site

4.1.10 Cultural Resources

This section discusses the known prehistoric, ethnographic, and historic cultural resources within the boundaries of the NNSS. Unless otherwise noted, the information in this section is derived from the *1996 NTS EIS* (DOE 1996c). Additional information regarding cultural resources on the NNSS was obtained from the Desert Research Institute, which provides cultural resources program support to the DOE/NNSA NSO (DOE 2010a). Information sources provided by the Desert Research Institute include the *Cultural Resources Management Plan for the Nevada Test Site* update (DOE 2010a); short report summaries; lists of recorded sites on the NNSS and their National Register of Historic Places (NRHP) eligibility status; and excerpts from major archaeological, ethnographic, and historical studies conducted on the NNSS for the DOE/NNSA NSO.

Cultural resources include prehistoric and historic archaeological districts, sites, buildings, structures, or objects created or modified by human activity. Cultural resources also include traditional cultural properties, locations of American Indian significance that are important to a community's practices and beliefs and maintain a community's cultural identity. Under Federal regulation, a significant cultural resource, designated as a "historic property," warrants consideration with regard to potential adverse impacts resulting from proposed Federal actions (DOE 2002e). A cultural resource is a historic property if its attributes make it eligible for listing in the NRHP. Federal agencies also are required to consider the effects of their actions on sites, locations, and other resources, such as plants, that are of cultural or religious significance to American Indians, as established under the American Indian Religious Freedom Act (42 U.S.C. 1996). American Indian graves, associated funerary objects, and objects of cultural patrimony are protected by the Native American Graves Protection and Repatriation Act (25 U.S.C. 3001 et seq.).

The area of influence for cultural resources is the geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist. The area of influence for the NNSS is defined as all ground areas that would be disturbed by construction, maintenance, or operations of program facilities and activities occurring on site. Based on current knowledge of cultural resources on the NNSS, all areas have the potential to contain cultural resources. Therefore, the area of influence for this SWEIS comprises the entire NNSS.

The NNSS lies within the Southern Great Basin physiographic region and possesses a long history of American Indian occupation and more-recent European-American settlement and American military use. The following is a brief outline of prehistoric, ethnographic, and historic cultural chronologies.

Archaeological research has documented 12,000 years of human occupation on the NNSS. Numerous prehistoric chronological sequences have been developed for the Southern Great Basin (Lyneis 1982; Pippin 1995, 1998a; Warren and Crabtree 1986). The chronological periods are defined primarily by major changes in patterns of artifact assemblage composition, subsistence, settlement, and land use characterizing each period. The chronology developed by Pippin is most applicable to the NNSS (Pippin 1998a). These chronologies of cultural adaptations generally fall into periods occurring during the late Pleistocene (12,000–10,000 BP [years before present]); early Holocene (10,000–7,500 BP); middle Holocene (7,500–4,500 BP); and late Holocene (4,500–150 BP) (DOE 2010a).

At the time of historic contact during the mid-nineteenth century, the region in which the NNSS is situated was occupied by Numic-speaking hunter-gatherer groups now known as the Western Shoshone and the Southern Paiute, whose territories were defined by ethnicity, political affiliation, and subsistence and settlement patterns (Drollinger et al. 2009; Pippin 1998b).

The first European Americans known to traverse what is now the NNSS were emigrants on their way to California in 1849 (DOE 2010a). The area remained sparsely populated and served primarily as a transportation corridor. However, short-lived periods of mining and ranching occurred in the region as well. Military use of the area began in 1940; since that time, the NNSS has remained associated with national security missions, military research and training, and nuclear weapons testing.

4.1.10.1 Recorded Cultural Resources

Current knowledge of cultural resources on the NNSS results from numerous cultural resources studies completed over the last 30 years. Many of these studies were completed prior to NNSS activities, but most were completed within the framework of the NNSS Cultural Resources Management Program. Over 600 cultural resources studies have been conducted on the NNSS and almost 2,000 cultural resources sites have been recorded (see **Table 4–47**). Approximately 4 percent of the NNSS has been surveyed for cultural resources. Surveys are generally completed as part of Section 110 inventory requirements or Section 106 compliance for NNSS projects. In the past, projects were frequently conducted at the higher elevations in the northern end of the NNSS; therefore, the amount of acreage surveyed in these areas, along with the number of identified cultural resources, is greater in the north relative to other portions of the NNSS. However, over the past 10 years, most projects and their associated cultural resources studies have occurred at lower elevations. While all areas of the NNSS have the potential to possess cultural resources, the areas with higher numbers of recorded cultural resources are Rainier and Pahute Mesas in the northwest, followed by Jackass Flats in the southwest, and Yucca Flat in the east (DOE 2010a).

Table 4–47 Nevada National Security Site Cultural Resources Sites by Site Type and Hydrographic Basin

	Prehistoric Site Types							*Historic Site Types*		*Untyped Sites*	*Total Sites*	*NRHP-Eligible*
Hydrographic Basin	RB	TC	EL	PL	LO	CA	STA	HI	NT	UT		
Mercury Valley	0	0	0	0	3	0	0	1	2	0	6	2
Rock Valley	0	1	1	1	15	0	0	0	1	0	19	4
Fortymile Canyon–Jackass Flats	1	36	17	62	243	7	1	8	8	9	392	120
Fortymile Canyon–Buckboard Mesa	0	111	7	109	211	6	1	3	0	54	502	346
Oasis Valley	0	14	1	20	90	0	0	1	0	2	128	49
Gold Flat	0	25	1	97	131	10	0	2	1	1	268	169
Kawich Valley	0	9	1	25	37	0	0	2	0	8	82	58
Emigrant Valley/Groom Lake Valley	0	0	0	0	5	0	0	0	0	0	5	0
Yucca Flat	4	68	10	37	132	57	1	44	25	17	395	176
Frenchman Flat	1	3	2	43	60	0	0	11	34	0	154	58
Total Sites	**6**	**267**	**40**	**394**	**927**	**80**	**3**	**72**	**71**	**91**	**1,951**	**982**

CA = cache; EL = extractive locality; HI = historic site; LO = locality; NRHP = National Register of Historic Places; NT = nuclear testing; PL = processing locality; RB = residential base; STA = station; TC = temporary camp; UT = untyped.
Note: This table does not include isolated artifacts or features. This table does include sites recorded within environmental restoration sites in the Nevada Test and Training Range adjacent to the NNSS.

Prehistoric archaeological sites make up 90 percent of recorded cultural resources. The remaining 10 percent are historic archaeological sites and structures, more-recent facilities and locations associated with scientific research, or sites of unknown age (DOE 2010a). Numerous evaluations of nuclear weapons testing facilities have been conducted since the *1996 NTS EIS* was completed, resulting in 38 sites and historic districts associated with NNSS activities becoming eligible for listing in the NRHP.

The types of cultural resources found on the NNSS include prehistoric and historic sites, features, and artifacts. These resources provide a range of information about past human activity. The terminology used to describe these resources is derived from site type definitions used by the Desert Research Institute (DOE 2010a) and adapted from the *1996 NTS EIS* (DOE 1996c). Prehistoric sites consist of residential bases, temporary camps, extractive localities, processing localities, uncategorized localities, caches, and stations. Historic site types are presented here in two categories: historic sites reflecting mining, ranching, communications, or transportation activities, and those sites and features associated with nuclear weapons testing of the Cold War era. Untyped sites lack enough information to assign a more specific category. Isolated artifacts consist of single prehistoric or historic artifacts or features that lack context and provide limited information about past human activity.

Residential bases are locations of extended occupation of prehistoric people. Temporary camps are occasional operational centers of prehistoric populations or task-oriented groups. These sites served as bases for resource collection and processing, tool manufacture and maintenance, and living activities. The wide range of artifact categories and features at these sites provides important data reflecting the diverse activities conducted by prehistoric populations. Extractive localities are sites where resources were procured. These sites may consist of quarries, water sources, plant-gathering areas, and hunting blinds. Processing localities are areas where groups brought procured resources, such as plant and animal resources or toolstone material, for processing or manufacture. Uncategorized localities lack sufficient information to determine what type of activity is represented. These three locality site types are areas of focused activity that lack the diverse artifact assemblages that residential bases or temporary camps possess. Caches are places used for storing tools or plant and animal resources. Stations are areas where information about game movement, travel routes, or ritual activity was shared and may consist of cairns marking travel routes, geoglyphs, rock art, and observation points.

Historic sites reflect broad categories of activities that occurred after European Americans arrived in the area. These activities are reflected in material remains at mining sites and ranching sites, and on transportation and communication routes.

Documents providing further information used to assess cultural resources located on the NNSS include prehistoric overviews (Pippin 1986, 1995; DuBarton and Drollinger 1996; Drollinger et al. 2000; Jones 2001), ethnographic and historical studies (DuBarton and Drollinger 1996; Pippin 1998a; Johnson et al. 1999; Zedeno et al. 1999; Drollinger and Nials 1996; Jones 2001; Drollinger 2003), and studies associated with nuclear testing (Beck et al. 1996; Johnson and Edwards 2000; Johnson et al. 2000; Jones et al. 2005; Drollinger et al. 2009; and others). The following discussion presents a brief description of known cultural resources on the NNSS, most documented as a result of cultural resource compliance studies associated with DOE/NNSA activities. Because the NNSS covers a large geographic area, cultural resources are grouped by the 10 hydrographic basins located within the NNSS boundary (NDWR 2010a) (see Figure 4–15 and Table 4–47). The cultural resources described below consist of archaeological sites and historic NNSS facilities; isolated artifacts and features are not discussed.

4.1.10.1.1 Mercury Valley

Mercury Valley is bounded by the Spotted Range and the Specter Range. Twenty-six cultural resources studies have been conducted within the portion of Mercury Valley that lies within the NNSS. Approximately 338 acres have been surveyed for cultural resources. Only six sites have been recorded as a result of these surveys. Of these, three are prehistoric localities and one is a historic site, none of which is eligible for listing in the NRHP. One historic district associated with nuclear testing, the Camp Desert Rock Historic District, was recorded, evaluated, and determined to be eligible for listing in the NRHP. The Camp Desert Rock Historic District contains building foundations and features associated with the administration and housing of troops who participated in the Desert Rock atmospheric exercises (Edwards 1997).

4.1.10.1.2 Rock Valley

Rock Valley is bounded by the Specter Range to the south and Skull and Little Skull Mountains to the north. The majority of Rock Valley lies within the NNSS boundary. Eleven archaeological reconnaissance surveys have been conducted within Rock Valley and approximately 445 acres have been surveyed for cultural resources. A total of 19 sites have been recorded as a result of these studies, including 1 temporary camp, 1 extractive locality, 1 processing locality, 15 uncategorized localities, and 1 event associated with nuclear testing. Of these 19 sites, 4 are eligible for listing in the NRHP, 1 of which exhibits occupation from the prehistoric, ethnographic, and historic periods (Jones 2001).

4.1.10.1.3 Fortymile Canyon–Jackass Flats

The Fortymile Canyon–Jackass Flats Hydrographic Basin is bounded by Skull and Little Skull Mountains to the south and the Shoshone Mountains to the north. Almost the entire basin falls within the NNSS boundary. A total of 167 cultural resources studies have been conducted within this area, covering approximately 575 acres. The number of cultural resources identified in this basin is high, reflecting the extensive cultural resources studies associated with NNSS activities in the area. A total of 392 cultural resources sites have been recorded as a result of these studies. This number includes 1 residential base, 36 temporary camps, 17 extractive localities, 62 processing localities, 243 uncategorized localities, 7 caches, 1 station, 9 untyped sites, 8 historic sites, and 8 sites related to nuclear testing. To date, 120 sites are eligible for listing in the NRHP.

4.1.10.1.4 Fortymile Canyon–Buckboard Mesa

This hydrographic basin includes Buckboard Mesa and a portion of Pahute Mesa. It is bounded by the Shoshone Mountains to the west and the Eleana Range to the east. Sixty-nine cultural resources studies have been conducted within the portion of Buckboard Mesa that lies within the NNSS boundary. Approximately 6,138 acres have been surveyed for cultural resources. Buckboard Mesa possesses the highest number of recorded archaeological sites on the NNSS. To date, 502 sites have been recorded in the Fortymile Canyon–Buckboard Mesa Hydrographic Basin. This total includes 111 temporary camps, 7 extractive localities, 109 processing localities, 211 uncategorized localities, 6 caches, 1 station, 3 ranching sites, and 54 untyped archaeological sites. Of these resources, 346 sites are eligible for listing in the NRHP. The large number of prehistoric sites, particularly localities and temporary camps, suggests that this region was intensively used by prehistoric hunter-gatherers.

4.1.10.1.5 Oasis Valley

The eastern portion of the Oasis Valley Hydrographic Basin lies within the NNSS boundary and includes portions of Pahute Mesa. A total of 32 cultural resources investigations have been conducted within the portion of Oasis Valley that lies within the NNSS boundary, and 10 studies have been conducted on environmental restoration sites within the Nevada Test and Training Range adjacent to the NNSS. Approximately 3,477 acres have been surveyed for cultural resources. To date, 128 cultural resources have been recorded in this portion of Oasis Valley. These include 14 temporary camps, 1 extractive locality, 20 processing localities, 90 uncategorized localities, 1 historic period site, and 2 untyped sites. Of these, 49 sites are eligible for listing in the NRHP.

4.1.10.1.6 Gold Flat

The southern portion of the Gold Flat Hydrographic Basin lies within the NNSS boundary and includes part of Pahute Mesa. Fifty-two cultural resources studies have been conducted in the portion of Gold Flat that lies within the NNSS. Approximately 6,371 acres have been surveyed for cultural resources. To date, 268 sites have been recorded as a result of these studies. These sites include 25 temporary camps, 1 extractive locality, 97 processing localities, 131 uncategorized localities, 10 caches, 2 historic sites, 1 site associated with a nuclear testing event, and 1 untyped site. Of these, 169 prehistoric sites are eligible for listing in the NRHP.

4.1.10.1.7 Kawich Valley

The southern part of Kawich Valley lies within the NNSS boundary and includes a portion of Pahute Mesa. Twenty-two cultural resources studies have been conducted in the portion of this basin that lies within the NNSS boundary. Approximately 2,635 acres have been surveyed for cultural resources. To date, 82 sites have been recorded as a result of cultural resources studies. These sites include 9 temporary camps, 1 extractive locality, 25 processing localities, 37 uncategorized localities, 2 historic sites, and 8 untyped sites. Of these sites, 58 are eligible for listing in the NRHP.

4.1.10.1.8 Emigrant Valley

A very small portion of the Emigrant Valley Hydrographic Basin lies within the NNSS boundary. This basin includes a portion of the Belted Range. Two cultural resources surveys have been conducted in the portion of the basin that lies within the NNSS boundary and one study has been conducted on an environmental restoration site on the Nevada Test and Training Range just northeast of the NNSS. Approximately 60 acres have been surveyed for cultural resources. Five prehistoric localities have been recorded in this area, none of which is eligible for listing in the NRHP.

4.1.10.1.9 Yucca Flat

Most of the Yucca Flat Hydrographic Basin lies within the NNSS boundary and is bounded by the Eleana Hills to the west and the Halfpint Range to the east. Yucca Dry Lake lies at the southern end of the basin. To date, 150 cultural resources studies have been conducted in Yucca Flat. Approximately 9,030 acres have been surveyed for cultural resources. To date, 395 sites have been recorded within Yucca Flat. These sites consist of 4 residential bases, 68 temporary camps, 10 extractive localities, 37 processing localities, 132 uncategorized localities, 57 caches, 1 station, 44 historic sites, 25 sites associated with nuclear testing, and 17 untyped sites. Currently, 176 sites are eligible for listing in the NRHP, 18 of which are associated with nuclear testing. One site, Sedan Crater, is already listed in the NRHP. Numerous structures associated with atmospheric nuclear testing are eligible for listing in the NRHP, such as the Yucca Flat Historic District (Jones et al. 2005; Johnson and Edwards 2000; Drollinger et al. 2009).

4.1.10.1.10 Frenchman Flat

Frenchman Flat is bounded by the Spotted Range to the east; Mine Mountain and Massachusetts Mountain to the north; the Shoshone Mountains, Lookout Peak, and the Skull Mountains to the west; and the Ranger Mountains to the south. The western half of the Frenchman Flat Hydrographic Basin lies within the NNSS boundary. Sixty-three cultural resources studies have been completed for the portion of Frenchman Flat that lies within the NNSS boundary. Approximately 9,047 acres have been surveyed for cultural resources. To date, 154 sites have been recorded as a result of these studies. These sites consist of 1 residential base, 3 temporary camps, 2 extractive localities, 43 processing localities, 60 uncategorized localities, 11 historic sites, and 34 sites associated with nuclear testing and research. Of these, 58 sites are eligible for listing in the NRHP, 8 of which are associated with nuclear testing. One of these is the Frenchman Flat Historic District; it includes buildings, structures, and features associated with nuclear atmospheric testing (Johnson et al. 2000).

4.1.10.2 Sites of American Indian Significance

In compliance with Federal laws and DOE policy, the DOE/NNSA NSO conducts an ongoing American Indian consultation program to address American Indian concerns about archaeological sites, plant and animal resources, traditional cultural properties, and sacred sites on the NNSS that hold great cultural value. This program has been in place since 1987 and recognizes the government-to-government relationship between the DOE/NNSA NSO and American Indians. The DOE/NNSA NSO consults with representatives of 16 tribal groups and 1 American Indian organization representing 3 ethnic groups (Western Shoshone, Southern Paiute, and Owens Valley Paiute) who have cultural and historic ties to the NNSS area. These American Indian groups are collectively known as the CGTO. Representatives express their respective tribal concerns and perspectives to DOE/NNSA and provide input regarding the protection and management of sites and resources that hold important cultural values for CGTO (DOE 2010a).

Ongoing consultation with CGTO, consisting of meetings, interviews, and site visits, has resulted in several studies that identify sites and locations throughout the NNSS that possess cultural significance for contemporary American Indians (Stoffle et al. 1989a, 1989b, 1994). These sites and locations consist of numerous ethnoarchaeological, ethnobotanical, and ethnozoological sites; rock art sites; and sites of spiritual significance (DOE 2010a). These consultation efforts have resulted in a better understanding of the cultural significance these sites and locations possess in relation to traditional cultural landscapes (Zedeno et al. 1999; Stoffle et al. 1996; Stoffle et al. 2001).

4.1.10.3 American Indian Cultural Resources

As a part of consultation efforts conducted for this SWEIS, the CGTO American Indian Writers Subgroup documented American Indian perspectives on cultural resources on the NNSS, in relation to the proposed undertaking. This information is presented in the following text box.

Cultural Resources—American Indian Perspective

American Indians consider cultural resources to include not only archaeological remains left by their ancestors but also natural resources and geologic formations in the region, such as plants, animals, water sources, minerals, and natural landforms that mark important locations for keeping their history alive and for teaching their children about their culture. The Consolidated Group of Tribes and Organizations (CGTO) knows, based upon its collective knowledge of Indian culture and past American Indian studies, that American Indian people view cultural resources as being interconnected.

The Nevada National Security Site (NNSS) area and nearby lands were significant to the Western Shoshone, Southern Paiute, and Owens Valley Paiute and Shoshone people. The lands were central in the lives of these people and were mutually shared for religious ceremony, resource use, and social events. When Europeans encroached on these lands, the numbers of Indian people, their relations with one another, and the condition of their traditional lands began to change. European diseases killed many Indian people; European animals replaced Indian animals and disrupted fields of natural plants; Europeans were guided to and then assumed control over Indian minerals; and Europeans took Indian agricultural areas. Indian people believe that the natural state of their traditional lands was what existed before European contact, when Indian people were fully responsible for the continued use and management of these lands.

The withdrawal of Nevada's lands for military purposes in the 1940's, followed by use of the land by the U.S. Department of Energy (DOE) continued the process of Euroamerican encroachment on Indian lands. Land-disturbing activities followed, thus causing some places to become unusable again for Indian people. On the other hand, many places were protected by this land withdrawal because "pothunters" were kept from stealing artifacts from rock shelters and European animals were kept from grazing on Indian plants. The forced removal of Indian people from the land was combined with their involuntary registration and removal to distant reservations in the early 1940s. Indian people were thus removed from lands that had been central to their lives for thousands of years.

DOE has supported several cultural resource studies at the NNSS, most occurring as a result of recommendations made by the CGTO in the 1996 NTS FEIS and commitments made by DOE in the subsequent Record of Decision. Many of these studies are cited throughout Appendix C of the SWEIS. These studies were also designed to comply with various federal laws and executive orders, including the American Indian Religious Freedom Act, Native American Grave Protection and Repatriation Act, and Executive Order 13007, *Indian Sacred Sites*.

Through these studies, the CGTO confirmed that American Indians used traditional sites in the NNSS area to make tools, stone artifacts, and ceremonial objects; many sites are also associated with traditional healing ceremonies and power places. Several areas in the NNSS region are recognized as traditionally or spiritually important. For example, Fortymile Canyon was an important crossroad where trails from such distant places as Owens Valley, Death Valley, and the Avawatz Mountain came together. Black Cone, in Crater Flat, is an important religious site that is considered to be an entry to the underworld. Alice Hill, (refine location with acceptable language) is also regarded as a culturally important place. Prow Pass was an important ceremonial site and, because of this religious significance, tribal representatives have recommended that DOE avoid affecting this area. Oasis Valley was another important area for trade and ceremonies. In 1993, tribal members visited a rockshelter site containing perishable basketry and crookneck staff on the NNSS, and recommended that the items be left in place, with annual monitoring to assess their condition. Gold Meadows is also extremely important to the Indian people. Other areas are considered important based on the abundance of artifacts, traditional-use plants and animals, rock art, and possible burial sites.

See Appendix C for more details.

4.1.11 Waste Management

Introduction

Radioactive and nonradioactive wastes are generated and managed at the NNSS as part of operations in support of National Security/Defense and Nondefense Mission programs; decontamination and demolition of unneeded structures and facilities; and the Environmental Restoration Program, including remediation of soil sites and industrial facilities and, to a small extent, the UGTA Project.[8] Radioactive wastes generated and/or managed at the NNSS include LLW and MLLW, and TRU waste. The Waste Management Program also manages nonradioactive hazardous waste regulated under the Resource Conservation and Recovery Act (RCRA) (42 U.S.C. 6901 et seq.); wastes containing asbestos or polychlorinated biphenyls (PCBs) regulated under the Toxic Substances Control Act (TSCA) (15 U.S.C. 2601 et seq.); explosive wastes; and nonhazardous wastes, including sanitary solid waste, construction and demolition debris, and hydrocarbon-contaminated soil and debris. These wastes are defined in Chapter 12, "Glossary."

> **Nevada National Security Site (NNSS) Low-Level and Mixed Low-Level Radioactive Waste Management Programs**
>
> The NNSS low-level radioactive waste (LLW) management program addresses waste containing radioactive constituents (LLW as defined in Chapter 12, "Glossary"), as well as LLW containing regulated (friable) asbestos, polychlorinated biphenyls (PCBs) in low concentrations (e.g., radioactive PCB bulk product waste containing PCBs in concentrations less than 50 parts per million), or hydrocarbon-contaminated soil and debris. The NNSS mixed low-level radioactive waste (MLLW) program addresses waste containing both radioactive and hazardous constituents (MLLW as defined in Chapter 12, "Glossary"), as well as radioactive waste containing PCBs in sufficient concentrations (e.g., radioactive PCB remediation waste containing PCBs in large capacitors or fluorescent light ballasts).

LLW and MLLW managed at the NNSS include wastes generated by activities within the NNSS or other in-state locations such as the TTR, as well as wastes received from authorized out-of-state DOE and DoD generators, including classified wastes.[9] The NNSS also accepts for disposal selected nonradioactive classified wastes that result from cleanup of current and former DOE weapons production facilities. Wastes thus generated or received may be disposed within authorized and/or permitted disposal units located at the NNSS Area 5 RWMC and the Area 3 RWMS. (The Area 3 RWMS has been in standby mode since July 1, 2006.)

MLLW received from authorized out-of-state generators must be treated in accordance with EPA land disposal restriction requirements before delivery to the NNSS. MLLW generated at the NNSS or by other authorized in-state generators may be treated at the Area 5 RWMC, then disposed, provided the treated waste meets the acceptance criteria for disposal. In-state-generated MLLW that cannot be properly treated at the NNSS is transferred to offsite treatment, storage, or disposal facilities.[10] In-state-generated LLW containing regulated PCBs in sufficient concentrations, asbestos, or hydrocarbon-contaminated soil and debris may be disposed at the NNSS in state-permitted disposal units, provided the waste meets the NNSS waste acceptance criteria for disposal.[11]

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8 *The NNSS Environmental Restoration Program includes compliance with the FFACO, which was entered into in 1996 by DOE, DoD, and the State of Nevada (NDEP 1996). DOE's Office of Legacy Management has responsibility for the Central Nevada Test Area and Project Shoal and became a signatory to the FFACO in August 2006. The FFACO provides a process for identifying sites that have potential historic contamination, implementing state-approved corrective actions, and instituting closure actions for remediated sites.*

9 *Some LLW or MLLW consists of classified material that has not been sanitized, demilitarized, or declassified. In addition, the NNSS is designated as a Classified Waste Disposal Facility and accepts low-level classified waste (with or without hazardous constituents) for disposal without sanitization.*

10 *MLLW treated at offsite facilities may be disposed off site or returned to the NNSS for disposal.*

11 *Hydrocarbon-contaminated LLW received from out-of-state generators may be disposed in any LLW disposal unit.*

TRU waste generated as part of ongoing NNSS operations or from in-state environmental restoration programs is sent to the Area 5 RWMC for temporary storage before shipment off site for further characterization and/or final disposition.

Tritiated liquids generated by environmental restoration or other in-state DOE activities are managed by evaporation.

Hazardous waste (and waste regulated under the TSCA or other statutes) generated at the NNSS may be sent directly from the point of generation to permitted offsite treatment, storage, or disposal facilities. Waste may be temporarily stored in the Area 5 RWMC and consolidated, pending shipment to offsite treatment, storage, or disposal facilities. The waste may also be sent off site for recycle or reuse as part of the NNSS Pollution Prevention and Waste Minimization Program.

Small quantities of explosives or wastes containing explosives may be treated at the Area 11 Explosives Ordnance Disposal Unit in accordance with a RCRA permit.

Nonhazardous waste generated at the NNSS or by other in-state generators may be recycled, reused, or disposed in permitted landfills such as those operating in Areas 6, 9, and 23 of the NNSS.

Waste management construction, storage, treatment, and disposal activities at the NNSS are summarized in **Table 4–48** and discussed in this section. The status column in the table relates the current status of the listed activity with respect to its analyses in the *1996 NTS EIS* (DOE 1996c) and the *Supplement Analysis for the Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada* (DOE 2002g).

Table 4–48 Current Nevada National Security Site Waste Management Activities

Activity	*Status* [a]	*Remarks*
Area 3 Radioactive Waste Management Site		
Disposal		
DOE/NNSA NSO-generated LLW	On standby	The Area 3 RWMS would be used for specific waste streams for which it would be economically or environmentally advantageous to dispose at that facility.
Other LLW		
Closure		
Disposal Crater Complex U3ax/bl	Complete	Facility closure as a RCRA-regulated MLLW disposal unit was completed in 1999.
Disposal Craters U3ah/at and U3bh	On standby	Additional crater disposal is possible pending final closure in accordance with an integrated closure and monitoring plan.
Construction		
Future LLW disposal units	Not developed	Additional existing subsidence craters would be developed as needed if the Area 3 RWMS is re-opened.
Expanded support facility	Not constructed	This project to double the size of an existing support building by adding a prefabricated structure was not implemented. It may be needed in the future if the Area 3 RWMS is re-opened.
Truck decontamination facility	Not constructed	This facility was not constructed but may be needed in the future if the Area 3 RWMS is re-opened.
Area 5 Radioactive Waste Management Complex		
Disposal		
DOE/NNSA NSO-generated LLW	Ongoing	Disposal is expected to continue for as long as needed by the U.S. Department of Energy complex in a variety of types of disposal units constructed with consideration of the radiological and chemical characteristics of the wastes to be disposed (e.g., deeper disposal for high-activity wastes).
LLW received from other authorized generators		
MLLW	Ongoing	Disposal of in-state- and out-of-state-generated MLLW continues at the Area 5 RWMC in a new NDEP-permitted Mixed Waste Disposal Unit (Cell 18) [b]. Previously used Pit 3 ceased acceptance of MLLW on November 30, 2010, and was closed as part of the existing 92-Acre Area closure.

Activity	*Status* [a]	*Remarks*
Greater confinement disposal	Complete	The performance assessment for existing greater confinement disposal boreholes was completed, and no new waste has been disposed in them. The boreholes were closed as part of closure of the existing 92-Acre Area.
Regulated asbestos LLW	Ongoing	LLW containing regulated asbestos (also called asbestiform waste) was accepted for disposal in Pit 6, but Pit 6 was closed as part of closure of the existing 92-Acre Area. Disposal of this waste continues in a new Mixed Waste Disposal Unit (Cell 18) at the Area 5 RWMC.
Nonradioactive classified waste	Ongoing	Nonradioactive classified waste is accepted for disposal from current and former DOE weapons production facilities.
Storage		
Mixed waste	Ongoing	DOE/NNSA NSO possesses a RCRA permit for temporary storage of in-state and out-of-state MLLW.
TRU waste	Ongoing	Except for two TRU spheres, all stored legacy TRU wastes were shipped off site for characterization at INL and/or disposal at WIPP. The TRU spheres will be stored pending offsite shipment. Experiments at JASPER generate small annual quantities of TRU waste. Environmental restoration activities may also generate TRU waste. All TRU wastes will be safely stored pending offsite shipment for characterization at INL and/or disposal at WIPP.
Hazardous waste	Ongoing	DOE/NNSA NSO possesses a RCRA permit for temporary storage of hazardous waste before shipment to offsite treatment, storage, or disposal facilities.
Treatment		
Macroencapsulation Microencapsulation	Ongoing	Treatment technologies are currently performed on debris generated by in-state environmental restoration programs to meet disposal requirements such as RCRA land disposal restrictions. Treatment occurs at the TRU Waste Storage Pad.
Facility Construction Activities		
Real-Time Radiography	Complete	A real-time radiography unit is operational for nondestructive examination of LLW and MLLW.
TRU Waste Certification Facility	Complete	Also known as the Waste Examination Facility. Within the Waste Examination Facility, modifications were made to the Visual Examination and Repackaging Building to support repackaging of TRU waste for offsite shipment, which has been completed. The facility is available for future use for waste treatment projects.
TRU Waste Handling and Loading Facility		
LLW disposal units	Ongoing	New disposal units are typically constructed as needed, based on waste forecasts and baseline operating budgets. The current threshold for new disposal unit construction is when remaining total capacity falls below 3.5 million cubic feet.
MLLW disposal units	Ongoing	DOE/NNSA received an NDEP-issued RCRA permit in December 2010 for a new MLLW disposal unit (Cell 18). Cell 18 is in operation.
Hazardous waste storage unit (expansion)	Not constructed	If needed in the future, increase to 0.138 acres, with a capacity of 55,000 gallons.
Maintenance building	Not constructed	This 3,200-square-foot storage facility for equipment and machinery was not constructed, but may be needed in the future.
LLW Storage Facility	Not constructed	This 3,000-square-foot curbed concrete pad was not constructed, but may be needed in the future.
Closure Activities		
Close LLW disposal units	Ongoing	Individual disposal units are operationally closed as they are filled to capacity with waste. The existing 92-Acre Area was closed in 2011 under the approved 92-Acre Area closure plan. Closure of current and future disposal units will occur in accordance with a formal plan addressing the entire Area 5 RWMC.
Close MLLW disposal units		
Close greater confinement disposal units	Complete	All existing disposal units were operationally closed, filled to grade as needed, and closed in 2011 as part of closure of the existing 92-Acre Area.

Activity	***Status*** [a]	***Remarks***
Area 6		
Storage Activities		
PCB-contaminated waste	Ongoing	The Area 6 facility operated temporarily as part of an NNSS program to collect and dispose PCB-contaminated waste. Currently, in-state-generated PCB-contaminated waste may be stored at the Hazardous Waste Storage Unit in the Area 5 RWMC before offsite shipment for disposal. LLW and MLLW containing regulated PCBs in concentrations greater than or equal to 50 parts per million are disposed in the Mixed Waste Disposal Unit (Cell 18).
Disposal Activities		
Hydrocarbon landfill	Ongoing	Hydrocarbon-contaminated soils and materials generated at the NNSS are disposed at this NDEP-permitted facility. Small quantities of hydrocarbon waste may also be disposed at the U10c Landfill in Area 9. Hydrocarbon-contaminated LLW is disposed at the Area 5 RWMC.
Area 9		
Disposal Activities		
U10c Landfill	Ongoing	Accepts inert debris and small quantities of hydrocarbon-contaminated soil and debris.
Area 11		
Treatment Activities		
Explosives Ordnance Disposal Unit	Ongoing	This RCRA-permitted treatment unit may detonate up to 100 pounds of approved waste per hour, and up to 4,100 pounds in a year.
Area 23		
Disposal Activities		
Landfill	Ongoing	Accepts less than 20 tons daily of sanitary solid waste.

DOE/NNSA = U.S. Department of Energy/National Nuclear Security Administration; INL = Idaho National Laboratory; JASPER = Joint Actinide Shock Physics Experimental Research Facility; LLW = low-level radioactive waste; MLLW = mixed low-level radioactive waste; NDEP = Nevada Division of Environmental Protection; NNSS = Nevada National Security Site; NSO = Nevada Site Office; PCB = polychlorinated biphenyl; RCRA = Resource Conservation and Recovery Act; RWMC = Area 5 Radioactive Waste Management Complex; RWMS = Area 3 Radioactive Waste Management Site; TRU = transuranic; WIPP = Waste Isolation Pilot Plant.

[a] Status relative to the analysis performed for these activities in the *Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada* (DOE 1996c) and the *Supplement Analysis for the Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada* (DOE 2002g).

[b] Waste disposed in the Mixed Waste Disposal Unit (Cell 18) includes classified MLLW, LLW containing regulated PCBs in concentrations greater than or equal to 50 parts per million, and LLW containing regulated asbestos.

Source: Clark et al. 2005; Di Sanza and Carilli 2006; DOE 1996c, 2002g; Gordon 2009b.

4.1.11.1 Radioactive Waste Management

This section addresses NNSS management of LLW and MLLW, and TRU waste.

4.1.11.1.1 Low-Level and Mixed Low-Level Radioactive Waste Management and Disposal

LLW management and disposal currently occurs within the Area 5 RWMC. The Area 5 RWMC is also used for management and disposal of MLLW, and for management of TRU and hazardous wastes. The Area 3 RWMS has been used for disposal of LLW, but is currently in standby mode.

The NNSS receives for disposal LLW and MLLW generated within the DOE complex from numerous DOE sites across the United States, including the NNSS, as well as from DoD sites that carry a national security classification[12] (DOE/NV 2009d). In DOE's December 1996 ROD (61 FR 65551) for the *1996 NTS EIS*, DOE selected the Expanded Use Alternative for most activities, but selected the Continue Current Operations (No Action) Alternative for LLW and MLLW management (61 FR 65551) pending a

[12] *A security classification is a category to which national security information and material are assigned to denote the degree of damage that unauthorized disclosure would cause to national defense or foreign relations of the United States and to denote the degree of protection required.*

decision reached through the *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste* (*WM PEIS*) (DOE 1997). On February 25, 2000 (65 FR 10061), in the fourth ROD for the *WM PEIS*, DOE established the NNSS as one of two regional LLW and MLLW disposal sites for the DOE complex. This 2000 ROD also modified DOE's December 1996 ROD (61 FR 65551) for the *1996 NTS EIS* by selecting the Expanded Use Alternative for management of LLW and MLLW (see Chapter 1, Section 1.4).

4.1.11.1.1.1 Area 3 Radioactive Waste Management Site

The Area 3 RWMS is located in the northwestern quadrant of Area 3 (see **Figure 4–33**). It covers about 120 acres and includes two support buildings (an office trailer and a change area), as well as land dedicated to waste disposal. It is an access-controlled facility surrounded by a wire fence and earthen berms to mitigate potential flooding (DOE/NV 2007c). The Area 3 RWMS includes five disposal units configured from seven subsidence craters caused by underground weapons testing (see **Table 4–49**). Opened in the late 1960s, it was used for disposal of bulk and containerized LLW, such as contaminated soil and debris. The facility has been unutilized since July 1, 2006 (Di Sanza and Carilli 2006; DOE/NV 2011). Under the Expanded Operations Alternative, the Area 3 RWMS could be opened to receive LLW generated from environmental restoration and other activities at DOE/NNSA sites within the State of Nevada. Specifically, this action could be triggered by a need for additional disposal space beyond that available in the Area 5 RWMC for disposal of large on-site remediation debris, or soils from clean-up activities on the NTTR. While there is no near-term need to use the Area 3 RWMS, However, should DOE/NNSA need to activate the Area 3 Radioactive Waste Management Site, it would first undergo detailed consultation with the State of Nevada, and would limit disposal to in-state generated LLW.

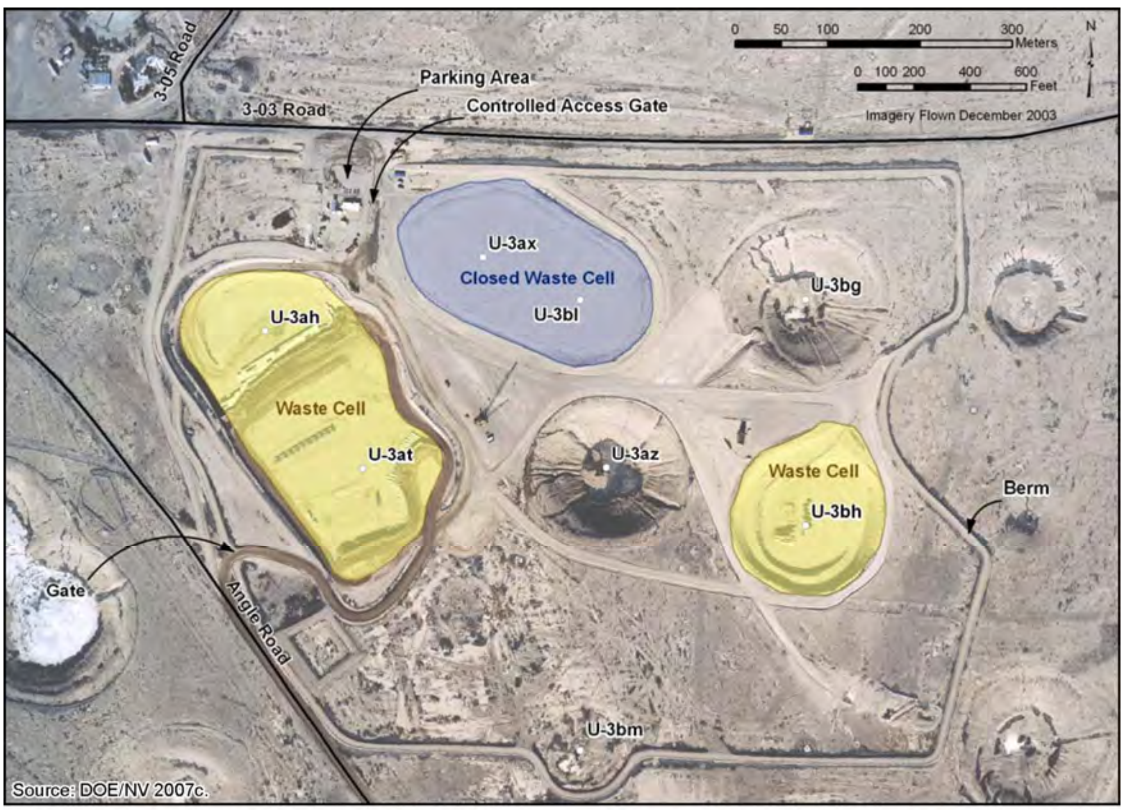

Figure 4–33 Area 3 Radioactive Waste Management Site

Table 4–49 Area 3 Radioactive Waste Management Site Disposal Units

Available Disposal Units [a]	*Closed Disposal Units*	*Undeveloped Disposal Units*
U-3ah/at [b] U-3bh	U-3ax/bl [b]	U-3az U-3bg

[a] As of July 1, 2006, these two disposal units were placed into inactive status.
[b] These disposal units were configured from two subsidence craters.
Source: DOE/NV 2011.

In FY 2001, the U-3ax/bl disposal unit, which contains hazardous constituents regulated under RCRA (CAU 110), was closed in accordance with a closure plan approved by NDEP. In FY 2001, a lysimeter, which measures water content in soil, was constructed at the Area 3 RWMS to gain data to be used to design final closure covers for NNSS disposal areas.

4.1.11.1.1.2 Area 5 Radioactive Waste Management Complex

In 1961, an area northwest of Frenchman Lake was reserved as an LLW disposal site under regulatory provisions derived from the Atomic Energy Act of 1954, as amended. In 1977, the area was designated the Area 5 Radioactive Waste Management Site (DOE 1996c). Since then, activities at the area have been expanded to include management or disposal of other types of waste. The entire complex of waste treatment, storage, management, disposal, and support capacity is termed the Area 5 RWMC (see **Figure 4–34**). Current operations at the Area 5 RWMC include LLW and MLLW examination, repackaging if necessary, and disposal; temporary hazardous and MLLW storage; treatment of some MLLW before disposal; and temporary storage of in-state-generated TRU waste pending offsite shipment.

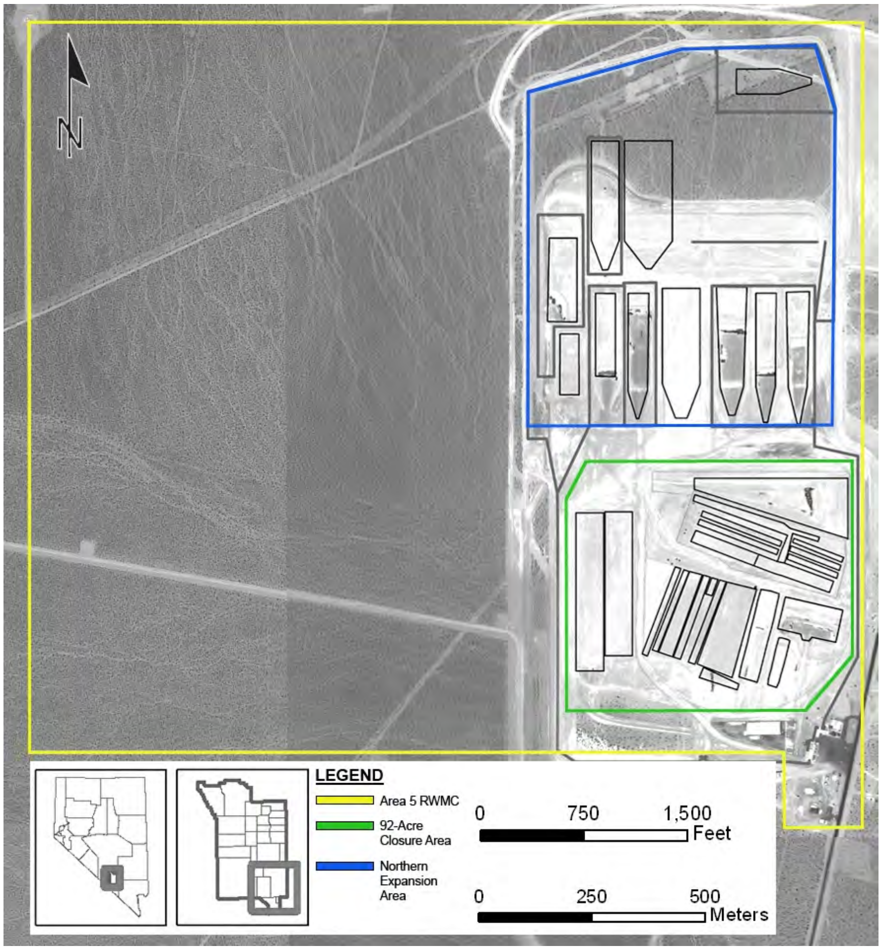

Figure 4–34 Area 5 Radioactive Waste Management Complex

Past and current waste disposal operations are summarized in this section. Additional information about activities at the Area 5 RWMC is provided in the following sections:

- Section 4.1.11.1.1.3, Waste Disposal Support Activities
- Section 4.1.11.1.2, Mixed Low-Level Radioactive Waste Management
- Section 4.1.11.1.3, Transuranic Waste Management
- Section 4.1.11.2.1, Hazardous Waste Management

The Area 5 RWMC covers about 740 acres of DOE/NNSA-owned land[13] and is surrounded by a 1,000-foot-wide buffer zone. The Area 5 RWMC includes several equipment storage yards, as well as structures that are used for offices, laboratories, utilities, and routine operations. Support facilities include:

- Real-Time Radiography Facility (used for verification of MLLW using x-ray technology)
- TRU Waste Storage Pad and Pad Cover Building (used for storage of TRU waste)
- Waste Examination Facility (used to examine and repackage TRU waste for offsite shipment)
- Mixed Waste Storage Units
- Visual Examination and Repackaging Building (located within the Waste Examination Facility)
- Area 5 Hazardous Waste Storage Unit

In addition, a lysimeter facility located southwest of the Area 5 RWMC has been in operation since 1994; data from this facility will be used along with data recorded at the Area 3 RWMS lysimeter to design final disposal covers for NNSS disposal areas.

Waste disposal within the Area 5 RWMC started within a 92-acre area in the southern portion of the site (the "92-Acre Area"), but disposal operations have expanded to the north of this area. The total area used to date for waste disposal, including operational disposal units, covers about 200 acres. The 92-Acre Area consists of 31 pits and trenches and 13 greater confinement disposal (GCD) boreholes. Additional pits have been constructed in the northern expansion area (see **Table 4–50**). The 92-Acre Area was closed under an NDEP-approved Corrective Action Decision Document and Corrective Action Plan that addressed all waste disposed in the 92-Acre Area (see Section 4.1.11.1.1.3).

Table 4–50 Area 5 Radioactive Waste Management Complex Disposal Units [a]

Pits and Trenches	***GCD Boreholes***
Active	
7 cells authorized for LLW 1 cell authorized for MLLW, asbestiform LLW, and LLW containing regulated PCBs in concentrations greater than or equal to 50 ppm (Cell 18)	Not applicable
Permanently Closed	
17 LLW cells 11 LLW and MLLW cells 1 pit permitted for MLLW (Pit 3) 2 cells permitted for asbestiform LLW (Pits 6A and 7)	4 boreholes containing no waste 4 boreholes containing TRU waste 5 boreholes containing LLW

GCD = greater confinement disposal; LLW = low-level radioactive waste; MLLW = mixed low-level radioactive waste; PCB = polychlorinated biphenyl; ppm = parts per million; TRU = transuranic.
[a] As of September 2011.

[13] *In November 2009, permanent ownership of and accountability for the land encompassing the Area 5 RWMC was transferred from BLM to DOE (see Section 4.1.1.3).*

New disposal units will continue to be constructed to the north and west of the 92-Acre Area. It is estimated that the currently unused portion of the Area 5 RWMC could accommodate disposal of several million cubic yards of waste. Disposal services are expected to continue at the Area 5 RWMC for as long as the DOE complex requires them (Di Sanza and Carilli 2006; DOE 2008f; DOE/NV 2008b, 2009d).

Seven disposal units are currently active for LLW, and one disposal unit is active for disposal of MLLW, LLW containing regulated asbestos (also called asbestiform LLW), and LLW containing regulated PCBs in concentrations greater than or equal to 50 parts per million (Cell 18).[14] Thirty-one pits and trenches and all GCD boreholes have been permanently closed with construction of a final closure cover over the 92-Acre Area (see Section 4.1.11.1.1.3).

Of the 31 pits and trenches, 11 pits and trenches contain LLW that also contain constituents that are regulated under RCRA or TSCA. One pit (Pit 3) was operated under RCRA interim status for disposal of MLLW. Two pits contain LLW with regulated asbestos. Seventeen pits and trenches contain LLW that does not include constituents regulated under RCRA or TSCA. One of the trenches, however, is a classified materials trench that contains TRU waste that was inadvertently disposed in 1986. This inadvertent disposal involved two waste shipments containing approximately 102 55-gallon drums (about 1,100 cubic feet) of classified waste originally thought to be LLW (DOE/NV 2006b).

Thirteen GCD boreholes were constructed in the 1980s as an experimental concept for disposal of wastes that were not considered appropriate for near-surface disposal. Of these, nine boreholes were used to dispose TRU waste and some high-activity LLW, and the remaining four boreholes were never used. The boreholes were constructed to depths of about 120 feet. After waste placement, the boreholes containing about 10,350 cubic feet of combined waste were backfilled with at least 60 feet of fill (DOE 1996c; DOE/NV 2001a).

Under current operations, LLW received at the Area 5 RWMC is disposed without further treatment. Some onsite-generated MLLW, however, is repackaged and/or treated at the Area 5 RWMC before disposal (see Section 4.1.11.1.2). Offsite-generated MLLW must be treated to comply with RCRA land disposal restrictions prior to receipt at the NNSS; this waste is disposed without further treatment.

Disposal units are excavated, used, and operationally closed as needed, and are used for disposal of waste typically delivered to the site in drums, soft-sided containers, large cargo containers, and boxes. Currently, one to two new LLW disposal units are excavated each year, as needed. The designs of the waste disposal units vary depending on waste characteristics, as do operational procedures. Some wastes may require special handling or disposal because of size or weight, or because of radiological or chemical characteristics. For example, cover material over wastes in some disposal units may be thicker. In other instances, the disposal unit may be designed for easy offloading of physically large or long wastes, or to safely accommodate high-activity or high-exposure-rate waste packages (e.g., trenches dug within disposal units). Operational practices, such as remote waste placement using large cranes, or placement of waste containers into prepared pockets nested within a dedicated disposal unit, have also been used. Some disposal units may be dedicated for particular types of waste. Examples include Cell 18, used for disposal of MLLW, and pits and trenches used for disposal of classified waste or material (Clark et al. 2005; Di Sanza and Carilli 2006; DOE/NV 2011).

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[14] LLW containing non-regulated PCBs in concentrations less than 50 parts per million can be disposed in any active LLW disposal unit.

All LLW and MLLW disposed at the NNSS must meet the NNSS waste acceptance criteria for disposal. In addition, all MLLW must meet applicable RCRA land disposal restrictions.[15] The most recent version of the NNSS waste acceptance criteria was issued in February 2012 and requires generators to provide specific information about the characteristics of the wastes, including volume, radionuclide content and quantity, treatment history, and waste form (DOE/NV 2012b). Candidate waste forms for NNSS disposal include (but are not limited to) those listed in the following text box, which illustrates the large variety of different forms in which LLW and MLLW may exist. Some of the listed waste forms (e.g., aqueous liquid) must be processed (e.g., solidified) or specially packaged before receipt and acceptance at the NNSS for disposal. Specific processing and packaging requirements are provided in the NNSS waste acceptance criteria.

Examples of Low-Level and Mixed Low-Level Radioactive Waste Forms Accepted for Nevada National Security Site Disposal[1]

Charcoal	Cation exchange media	Compactable trash
Incinerator ash	Anion exchange media	Noncompactable trash
Soil	Mixed bed ion-exchange media	Animal carcasses
Gas	Contaminated equipment	Biological material (except animal carcasses)
Oil	Organic liquid (except oil)	Activated material (except activated metal)
Aqueous liquid	Glassware or labware	Activated metal
Filter media	Sealed source or device	Other
Mechanical filter	Paint or plating	
EPA hazardous	Evaporator bottoms, sludges, or concentrates	
Demolition rubble		

[1] This list does not include all radioactive waste forms accepted for disposal at the NNSS but provides examples for informational purposes only.
Source: DOE/NV 2009b.

As of 1996, DOE was operating under RCRA interim-status conditions for disposal of MLLW generated by DOE within the state of Nevada (DOE 1996c). By 2002, DOE had applied for a RCRA Part B permit for disposal of MLLW from DOE generators from inside and outside the state of Nevada (DOE 2002g). Pit 3 operated under interim status for disposal of MLLW until it was permanently closed in 2010, and a permit reissued in 2005 removed the restriction on accepting MLLW from outside Nevada. Pursuant to the permit, the NNSS could accept no more than 20,000 cubic meters (about 706,300 cubic feet) of MLLW from outside the state of Nevada and had to permanently close Pit 3 by December 2010, whichever situation occurred first (DOE/NV 2006a).

Waste was received for disposal at Pit 3 through November 30, 2010. Because not all disposal space would have been used by that time, the DOE/NNSA NSO also disposed LLW, as well as MLLW, in Pit 3. After disposal operations in Pit 3 ceased, remaining disposal space was filled with native soil and the disposal unit was closed in 2011 as part of final closure of the 92-Acre Area. Postclosure monitoring started in the same year (DOE/NV 2008b, 2011, 2012a).

On September 29, 2009, DOE submitted an application to NDEP for a new RCRA Part B permit for a new disposal unit for MLLW, including LLW containing PCBs in concentrations greater than or equal to 50 parts per million. The DOE/NNSA NSO received final permit approval from the state in December 2010. The permitted capacity of Cell 18, the new Mixed Waste Disposal Unit, is approximately 900,000 cubic feet. It began operation in January 2011.

[15] *Wastes containing radionuclides and regulated TSCA constituents must also meet any applicable treatment requirements before NNSS disposal.*

The *1996 NTS EIS* projected disposal of about 40,310,000 cubic feet (1,141,422 cubic meters) of LLW and about 10,600,000 cubic feet (300,500 cubic meters) of MLLW over a period of 10 years (DOE 1996c). However, from 1996 through 2008, the NNSS actually disposed about 21,400,000 cubic feet of LLW and about 225,000 cubic feet of MLLW. About 60 percent of this waste was disposed at the Area 5 RWMC and the rest at the Area 3 RWMS. Over these 13 years, annual LLW disposal volumes ranged from about 400,000 cubic feet in 1998 to 3,740,000 cubic feet in 2004, and averaged about 1,540,000 cubic feet; annual MLLW disposal volumes ranged from zero in 1997, 2001, 2003, 2004, and 2005, to about 154,000 cubic feet in 2007, and averaged about 17,300 cubic feet. Since July 1, 2006, all LLW and MLLW disposal has occurred in the Area 5 RWMC. From 2004 through 2008, annual LLW volumes ranged from about 919,000 to 3,630,000 cubic feet, and averaged about 1,698,000 cubic feet; annual MLLW volumes ranged from zero to about 154,000 cubic feet, and averaged about 41,600 cubic feet (Gordon 2009b).

Radioactive Waste Acceptance Program

The U.S. Department of Energy/National Nuclear Security Administration Nevada Site Office Radioactive Waste Acceptance Program (RWAP) ensures that low-level and mixed low-level radioactive wastes (LLW and MLLW) disposed at the Nevada National Security Site (NNSS) meets the NNSS Waste Acceptance Criteria, which includes requirements set forth by the U.S. Department of Energy, the U.S. Department of Transportation, the Resource Conservation and Recovery Act, and other appropriate Federal laws and regulations. The RWAP process consists of two parts: A waste generator evaluation and a waste acceptance process.

4.1.11.1.1.3 Waste Disposal Support Activities

Management and disposal of LLW is regulated by DOE through its authority under the Atomic Energy Act of 1954, as amended. Management and disposal of MLLW containing hazardous constituents is regulated by DOE under the Atomic Energy Act and by EPA and the State of Nevada under RCRA. Management and disposal of LLW containing regulated PCBs in sufficient concentrations, asbestos, or hydrocarbon-contaminated soil and debris is regulated by DOE under the Atomic Energy Act and by EPA and the state under statutes such as TSCA. Safe disposal is assured through operational procedures; compliance with the NNSS waste acceptance criteria; the Radioactive Waste Acceptance Program (RWAP); risk assessments; air, groundwater, and soil monitoring; and disposal unit closure.

Waste Acceptance. Approval to ship waste to the NNSS for disposal may be granted only after a waste generator demonstrates that it has a waste characterization and certification program that meets the requirements stated in the NNSS waste acceptance criteria. These criteria include specific requirements for waste form, characterization, packaging, and transportation. RWAP personnel provide assistance, interpretation, guidance, and technical expertise on the waste acceptance criteria. Through onsite facility evaluations, RWAP personnel are also responsible for verifying that a waste generator has an established program that complies with regulations regarding the characterization, management, and transportation of radioactive waste. Waste is not accepted at the NNSS until the generator meets the prescribed approval process and a specific waste profile has been reviewed and approved (Gordon 2009a).

The waste disposal process begins when a generator (e.g., DOE or DoD) site proposes a specific waste stream for disposal. If initial discussions with the DOE/NNSA NSO indicate that the proposed waste stream may meet NNSS eligibility and waste acceptance criteria, RWAP personnel conduct an evaluation to ensure that the generator has implemented a waste certification program that is compliant with the NNSS waste acceptance criteria. During this evaluation, RWAP personnel complete an onsite examination of the waste generator's processes and procedures through all stages of waste management, including waste generation, characterization, packaging, and shipment. Potential waste generators must also provide documentation demonstrating the implementation of the NNSS waste acceptance criteria in their program. If issues are identified during the facility evaluations, corrective actions must be approved and implemented prior to waste certification program approval and eventual waste shipment and disposal (Gordon 2009a).

Once a generator has been authorized as an approved generator, it is required to maintain a Quality Assurance Program Plan (QAPP) demonstrating compliance with the current revision of the NNSS waste acceptance criteria; DOE Order 435.1, *Radioactive Waste Management*; DOE Order 414.1D, *Quality Assurance*; and/or 10 CFR 830.122, *Quality Assurance*. Generators are required to submit their current revision of the QAPP to the RWAP manager. Generators must also prepare and submit an NNSS Waste Acceptance Criteria Implementation Crosswalk to the RWAP manager each year. This document references the applicable procedures, processes, or methods affecting quality and personnel directly responsible for implementation of the generator's program. In addition, the generator must submit a written list that identifies key site personnel who certify that the waste meets the NNSS waste acceptance criteria and is safely packaged, marked, and labeled in accordance with U.S. Department of Transportation regulations. RWAP personnel verify the qualifications of these key personnel through the review of training records during the facility evaluations.

Approved waste generators are required to submit documentation (waste profiles) to validate that each proposed waste stream is in compliance with the NNSS waste acceptance criteria. These waste profiles must be in the format prescribed by the DOE/NNSA NSO and include information on waste origin, quantity, composition, and packaging, and the analytical and preparatory methods used to characterize the waste. Waste Acceptance Review Panel personnel review these profiles to ensure that established waste form criteria are met. Copies of the waste profiles are routed to NDEP for concurrent evaluation (Gordon 2009a).

Upon arrival of an LLW or MLLW shipment at the NNSS, the shipment documentation is reviewed to ensure consistency with the pre-approved waste stream profile(s). While this document verification is being conducted, the trucks and trailers carrying the waste are monitored to determine whether external radiation and surface contamination levels are below required limits. As a trailer is unloaded, inspectors verify the physical integrity of the waste packages and check to ensure that container marking and labeling meet NNSS waste acceptance criteria requirements. In addition, onsite real-time radiography (x-ray technology) may be used to visually verify waste package contents, as discussed below.

MLLW requiring treatment prior to disposal may be subject to independent waste verification (real-time radiography examination, visual verification at the generating facility) and chemical screening conducted by RWAP personnel, as determined by the Waste Acceptance Review Panel during the waste profile approval process.[16] At the discretion of the Waste Acceptance Review Panel, LLW may also undergo examination by real-time radiography.

At the Area 5 RWMS, real-time radiography may be performed on pre-selected MLLW and LLW streams, subject to container size and weight limitations associated with the analytical mounting fixture. The procedure is conducted on a predetermined percentage of received containers of waste, based on approved profile specifications, to confirm that the waste form meets the approved profile.

These waste verification activities ensure that the waste form listed on shipment documentation is consistent with the waste form received for disposal. In the unlikely[17] event that any actual waste shipment is deemed not compliant with the NNSS waste acceptance criteria, it is returned to the waste generator for corrective action, consistent with DOE policy (Gordon 2009a).

Disposal Authorization and Performance Assessment

Waste disposal occurs in accordance with authorizations issued by DOE and with permits for MLLW issued by external regulatory agencies. The authorization and permit approval processes are based on formal, quantitative analyses of worker and public health and safety during construction, operation, and closure, as well as consideration of possible long-term (thousands of years) impacts on the public and the

[16] NDEP participates on the Waste Acceptance Review Panel.
[17] For example, during FYs 2004 through 2008, only two shipments were returned to the waste generators (DOE/NV 2005b, 2005g, 2007a, 2007e, 2009a).

environment after the disposal facilities are closed. The results of the analyses must determine that disposal activities would comply with all applicable regulatory requirements.

These analyses include performance assessments and composite analyses prepared in compliance with DOE Order 435.1. The Area 3 RWMS performance assessment and composite analysis were issued in October 2000 (DOE/NV 2000b); the Area 5 RWMC performance assessment, in 1998 (DOE/NV 1998a); and the Area 5 RWMC composite analysis, in September 2001 (DOE/NV 2001a). An addendum to the Area 5 RWMC composite analysis was also issued in November 2001 (DOE/NV 2001d). The scenarios and waste acceptance criteria for the Area 5 RWMC were updated through an April 2000 addendum to the 1998 performance assessment (DOE/NV 2000a). A second addendum to the Area 5 RWMC performance assessment was issued in 2006 and was reviewed by DOE's Low-Level Radioactive Waste Federal Review Group. This review group recommended, without conditions, DOE's approval of the performance assessment, which confirms that it meets the requirements of DOE Order 435.1 (Carilli and Krenzien 2007).

DOE has also conducted analyses of TRU waste disposal to assess compliance with EPA's TRU waste disposal requirements in 40 CFR Part 191. In 2003, DOE approved an analysis addressing disposal of TRU and other waste in the GCD boreholes, concluding that the long-term performance of the boreholes would comply with 40 CFR Part 191 (Colarusso et al. 2003). An additional analysis also concluded compliance with 40 CFR Part 191, as well as with all applicable requirements in DOE Manual 435.1-1 for TRU waste that had been inadvertently disposed in an Area 5 RWMC trench (Colarusso et al. 2003; Shott, Yucel, and Desotell 2008). DOE/NNSA has closed the trench containing the TRU waste as part of permanent closure of the 92-Acre Area (see below).

The performance assessments and composite analyses support the continued operation of the disposal facilities. DOE requires that performance assessments and composite analyses be maintained after their preparation. The maintenance process includes performing annual reviews, carrying out special analyses, and revising the performance assessments and composite analyses as necessary. A maintenance plan for the Area 3 and 5 performance assessments and composite analyses has been issued (DOE/NV 2002a).

Decision Support System

A decision support system has been implemented that allows rapid assessment and documentation of the consequences of waste management decisions using current site characterization information, the radionuclide inventory, and a conceptual model. The core of the decision support system is a probabilistic inventory and performance assessment model that supports multiple graphic capabilities for documentation of data sources, conceptual model, mathematical implementation, and results. The combined models can be used to estimate disposal site inventory, contaminant concentrations in environmental media, and radiological doses to hypothetical members of the public at various locations. The model is routinely used to provide annual updates of site performance, evaluate the consequences of disposal of new waste streams, develop waste concentration limits, optimize the design of new disposal units, and assess the adequacy of environmental monitoring programs (Shott et al. 2006).

The decision support system maintains a database of the inventories of specific radionuclides on both an actual and a projected basis. Generators proposing to dispose waste at the NNSS must submit a waste profile setting forth projected waste volumes and radionuclide distributions. This information is checked through screening analyses, and more-detailed analyses as needed, to enable a determination that proposed disposal of the waste would not result in impacts that would exceed any of the performance objectives or other numerical criteria for the disposal facility.[18] Waste inventory data are routinely updated in the site database as disposal occurs and as new projections of waste inventories are received.

[18] Pursuant to DOE Order 435.1, DOE disposal sites must be operated so that disposal would be in compliance with a number of performance objectives. For example, there are limits on the radiation dose that may be received by a potential future member of the public as determined by performance assessment modeling.

The performance assessment model is updated annually with the latest inventory estimates, and new estimates of the performance measures are calculated. In this way, the DOE/NNSA NSO ensures that final closure of the site when it is filled to capacity will be in compliance with applicable disposal requirements.

Area 3 and 5 Monitoring

DOE/NNSA's environmental monitoring program for the Area 3 and Area 5 disposal sites includes monitoring of radiation exposure, air, groundwater, meteorology, vadose zone, subsidence, and biota. Monitoring data for calendar year (CY) 2008 indicated that the Area 3 and Area 5 disposal sites were performing within the expectations of the model and parameter assumptions for the facility performance assessments (DOE/NV 2009c).

Closure

Final closure of the Area 3 RWMS and Area 5 RWMC will occur in accordance with integrated closure and monitoring plans that are intended to ensure that closure will be in compliance with all applicable standards, including DOE Order 435.1, DOE Manual 435.1-1, 40 CFR Part 191, 40 CFR Part 265, *Nevada Administrative Code* (NAC) 444.743, and RCRA requirements as incorporated into NAC 444.9632. Final closure of the U3ax/bl disposal unit at the Area 3 RWMS has occurred, as has final closure of the 92-Acre Area at the Area 5 RWMC. Current and future disposal units at Area 3 and Area 5 will be operationally closed when appropriate, and their final closure will occur in accordance with the integrated closure and monitoring plans.

Closure plans have been developed and updated over several years, considering schedules, waste inventories, NNSS and facility characterization data, and final cover designs. An integrated closure and monitoring plan for the Area 3 RWMS and Area 5 RWMC was issued in 2001 (DOE/NV 2001b) and updated in 2005 (DOE/NV 2005d). A closure strategy for the Area 5 RWMC was issued in 2007 (DOE/NV 2007b), and updated closure plans for the Area 3 RWMS and Area 5 RWMC were issued in 2007 (DOE/NV 2007c) and 2008 (DOE/NV 2008b), respectively.

The closure plan for the Area 3 RWMS specifically addresses closure of the U-3ah/at and U-3bh disposal units. (A final closure cover has already been placed over unit U-3ax/bl [CAU 110].) The final cover will consist of a monolayer evapotranspiration layer expected to be somewhat less than 10 feet thick. The requirements of postclosure maintenance and monitoring will be determined in the final closure plan, which will address the applicable monitoring requirements prescribed by DOE directives and other Federal regulations and NDEP (DOE/NV 2007c).

The closure plan for the Area 5 RWMC addresses closure of the 92-Acre Area, as well as the remainder of the Area 5 RWMC. As noted in Section 4.1.11.1.1.2, final closure of the 92-Acre Area addressed 31 inactive pits and trenches and all 13 GCD boreholes. The GCD boreholes were filled to grade and the area comprising the pits, trenches, and boreholes was covered with an 8-foot-thick monolayer evapotranspiration cap. This activity was largely completed by May 2011. In October 2011, major portions of the 92-Acre Area were reseeded, and in December, a temporary watering system was installed to sustain germinated vegetation until springtime (DOE/NV 2012a).

The balance of the Area 5 RWMC used for waste disposal will be closed with covers in a fashion similar to the 92-Acre Area, and adjacent areas between the cover systems will be graded for proper drainage. Following final closure of the entire Area 5 RWMC, institutional controls—including control of public access, cover maintenance, and monitoring—will continue thereafter in accordance with applicable Federal and state requirements. Long-term monitoring provisions for the Area 5 RWMC will be developed as part of its final closure plan (DOE/NV 2008b).

4.1.11.1.2 Mixed Low-Level Radioactive Waste Management

MLLW generated at the NNSS may be stored at the Area 5 RWMC. In November 2010, the DOE/NNSA NSO received an NDEP permit for temporary storage of MLLW (Area 5 RWMC) from authorized out-of-state generators.

Onsite treatment of in-state-generated MLLW may occur at the Area 5 RWMC. The treated and/or repackaged waste is then disposed in the Area 5 RWMC (Gordon 2009b).

Disposal of MLLW at the NNSS is described in Section 4.1.11.1.1.2.

4.1.11.1.3 Transuranic Waste Management

For several years, the NNSS stored legacy TRU waste received from Lawrence Livermore National Laboratory, Rocky Flats Environmental Technology Site, Lawrence Berkeley Laboratory, and EG&G, and from environmental restoration at the NNSS and the TTR. In recent years, however, DOE completed a program to repackage, characterize, and ship this legacy waste to WIPP, near Carlsbad, New Mexico, for disposal. Most waste was shipped directly to WIPP, and some waste was shipped to Idaho National Laboratory for final characterization before transfer to WIPP.

Remaining TRU waste consists of two 3-foot-diameter steel spheres that were used in subcritical experiments. The spheres cannot be shipped in their current configuration in approved Transuranic Package Transporter Model 2 (TRUPACT-II) casks because their plutonium content exceeds the current TRUPACT-II limit of 325 grams. The spheres are being stored pending the availability of suitable processing capability.

Currently, small quantities of TRU waste are generated annually from experiments at JASPER and temporarily stored pending offsite shipment. As of December 2010, 25 standard waste boxes (about 1,660 cubic feet) containing this waste were in storage. Environmental restoration at the NNSS or other in-state locations is also expected to occasionally generate small quantities of TRU waste.

The legacy spheres and accumulated TRU waste from JASPER are temporarily stored at the Area 5 RWMC. Most TRU waste at the Area 5 RWMC is stored in a steel-framed, fabric-covered structure known as the TRU Pad Cover Building. This structure rests on a 2.1-acre asphalt pad containing a protective waterproof layer, plus an 8-inch curb to prevent run-on and runoff (DOE/NV 2006c). Classified TRU material is stored in a separate storage building.

4.1.11.1.4 Tritium Waste Disposal by Evaporation

Liquids containing tritium continue to be disposed at the NNSS by evaporation into the air from ponds and open tanks. The sources of the tritium include tritium-containing water removed from tunnels in Area 12 and from onsite wells that were contaminated from past nuclear tests. In recent years, tritiated water to be evaporated has included air conditioning condensate removed from a sump in the basement of a building at NLVF.[19] Some of this tritiated water is evaporated at NLVF, and the remainder is transported to the NNSS for disposal in NNSS sewage lagoons. The tritium inventory for all sources discharged for evaporation at the NNSS ranged from about 9.5 to 130 curies per year from 1996 through 2008, and averaged about 42 curies per year. From 2004 through 2008, the tritium inventory ranged from about 9.5 to 35 curies per year, averaging about 17 curies (DOE/NV 1997b, 1998c, 1999, 2000c, 2001c, 2002b, 2003a, 2004a, 2005f, 2006a, 2007d, 2008a, 2009d).

[19] *As addressed in Section 4.3.12, a 1995 accident resulted in a release of tritium within the basement of Building A-1. Although the contamination was cleaned up to the extent practical, some of the tritium penetrated into the concrete floor of the basement. Tritium emanating from the concrete as water vapor is condensed by the building cooling system.*

4.1.11.2 Nonradioactive Waste Management

Nonradioactive wastes include hazardous waste, nonhazardous waste, explosive waste, and classified nonradioactive waste from DOE weapons production facilities.

4.1.11.2.1 Hazardous Waste Management

Hazardous and toxic materials used or stored at the NNSS are controlled and managed through the use of a Hazardous Substance Inventory database, which facilitates compliance with the operational and reporting requirements of TSCA; the Federal Insecticide, Fungicide, and Rodenticide Act; the Emergency Planning and Community Right-to-Know Act; and the Nevada Chemical Catastrophe Act. Chemicals to be purchased are subject to a requisition compliance review process.

Hazardous waste (and certain PCB wastes regulated under TSCA as discussed below) generated through NNSS activities may be sent to offsite treatment, storage, or disposal facilities; recycled; or reused. Much of these wastes derives from environmental restoration activities (DOE/NV 2009d). Waste shipped to offsite treatment, storage, or disposal facilities is addressed below; recycle and reuse is addressed in Section 4.1.11.3.

Non-bulk (packaged) hazardous waste generated at the NNSS may be stored temporarily in the RCRA-permitted Hazardous Waste Storage Unit located in proximity to the Area 5 RWMC.[20] NNSS-generated waste containing only PCBs in sufficient amounts, or PCBs mixed with hazardous constituents regulated under RCRA, may also be stored in the Hazardous Waste Storage Unit pending shipment off site for treatment and disposal. PCB-contaminated waste is not routinely generated during operations at the NNSS, but is sometimes generated during environmental restoration and decontamination and decommissioning activities at the NNSS or other in-state locations, and may be received mixed with LLW. Nonradioactive waste containing PCBs in concentrations less than 50 parts per million may generally be disposed as nonhazardous solid waste in a permitted NNSS landfill. Waste quantities shipped off site for treatment and disposal from 2004 through 2008 ranged from 10.8 to 399 tons per year, averaging 111 tons per year (DOE/NV 2005f, 2006a, 2007d, 2008a, 2009d).

4.1.11.2.2 Explosive Ordnance Disposal

Nonradioactive explosive ordnance generated at the NNSS from tunnel operations, the NNSS Security firing range, the resident national laboratories, and other DOE/NNSA activities may be treated by open detonation at the Explosives Ordnance Disposal Unit in Area 11.[21] The Explosives Ordnance Disposal Unit is a detonation pit permitted under RCRA (NEV HW0101) and surrounded by an earthen pad with dimensions of about 25 feet by 100 feet. It includes ancillary equipment such as a bunker, electric shot box, and electric wire. DOE/NNSA is permitted to detonate a maximum of 100 pounds of approved waste at a time, not to exceed one detonation event per hour. The maximum annual treatment capacity is 4,100 pounds.

Annual quantities treated have been much smaller than permitted levels. From 2004 through 2008, the maximum quantity treated was 4.9 pounds in 2004; no wastes were treated in other years (DOE/NV 2005f, 2006a, 2007d, 2008a, 2009d).

[20] *Much of the environmental restoration waste is delivered directly as bulk shipments (dump trucks, roll-off boxes) to offsite treatment, storage, or disposal facilities. The Hazardous Waste Storage Unit only manages packaged (non-bulk) hazardous waste.*

[21] *Explosive waste is not accepted for treatment from offsite sources. Any explosive waste generated at the TTR, for example, is treated at the TTR under Emergency Treatment Permits obtained from NDEP.*

4.1.11.2.3 Nonhazardous Waste Management

Nonhazardous wastes annually generated through NNSS activities may be sent to NNSS landfills to be disposed, recycled, or reused. NNSS disposal is addressed below; recycle and reuse is addressed in Section 4.1.11.3.

The NNSS operates three permitted landfills for disposal of nonhazardous wastes: the Area 6 Hydrocarbon Disposal Site (Permit SW-13-097-02), Area 9 U10c Landfill (Permit SW-13-097-03), and Area 23 Landfill (Permit SW-13-097-04).[22] Soils and sludge contaminated with hydrocarbons are disposed in the Area 6 Hydrocarbon Disposal Site, while inert debris, such as construction waste and demolition debris, is disposed in the Area 9 U10c Landfill. The Area 9 U10c Landfill can also accept small quantities of hydrocarbon-contaminated waste, as well as nonfriable asbestos waste. The Area 23 Landfill can accept less than 20 tons daily (based on an annual average) of sanitary solid waste, including friable, nonradioactive asbestos waste. All landfills only accept waste from the NNSS and offsite Nevada locations under DOE/NNSA NSO control (DOE 2002g).

From 2004 through 2008, the Area 6 Hydrocarbon Disposal Site received 19 to 1,166 tons of waste for disposal per year, averaging 548 tons per year. Over this time period, the Area 9 U10c Landfill received 4,569 to 15,446 tons of waste for disposal per year, averaging 8,200 tons per year. The Area 23 Landfill received 573 to 1,819 tons of waste for disposal per year, averaging 963 tons per year (DOE/NV 2005f, 2006a, 2007d, 2008a, 2009d). According to a 2008 survey of remaining landfill capacity, the estimated remaining waste capacities for the landfills are as follows: Area 6 Hydrocarbon Disposal Site, 2.8 million cubic feet; Area 9 U10c Landfill, 15 million cubic feet; and Area 23 Landfill, 13 million cubic feet (Gordon 2009b).

4.1.11.2.4 Nonradioactive Classified Waste

The NNSS accepts for disposal in the Area 5 RWMC select nonradioactive classified wastes resulting from cleanup of current or former DOE weapons production facilities.

4.1.11.3 Pollution Prevention and Waste Minimization

DOE/NNSA's pollution prevention and waste minimization initiatives entail processes to reduce the volume and toxicity of waste generated at the NNSS and its satellite facilities. The processes also ensure that proposed methods of treatment, storage, and disposal minimize potential threats to human health and the environment. These initiatives address the requirements of several Federal and state regulations applicable to operations at the NNSS. The goals are to minimize the generation, release, and disposal of pollutants to the environment by implementing cost-effective pollution protection technologies, practices, and policies. Pollution prevention and waste minimization components include source reduction, recycling, reuse, affirmative procurement, and employee and public awareness. Impetus was given to these initiatives by the October 5, 2009, Executive Order 13514, *Federal Leadership in Environmental, Energy, and Economic Performance*.

The accomplishments of the Pollution Prevention and Waste Minimization Program at the NNSS and satellite facilities are documented in the annual NNSS environmental reports. **Table 4–51** illustrates the types and quantities of hazardous and nonhazardous wastes that were managed by other means than disposal for the years 2006 through 2008.

[22] *An additional permit (SW-13-097-02) is for landfill disposal of LLW containing regulated asbestos in Pit P06UA in the Area 5 RWMC.*

Table 4–51 Waste Reduction Activities, Calendar Years 2006–2008

Activity	*Calendar Year Quantities (tons)*		
	2006	***2007***	***2008***
Hazardous Waste [a]			
Bulk used oil sent to an offsite vendor for recycling	108.2	84.4	84.2
Lead acid batteries shipped to an offsite vendor for recycling	38.0	53.2	196.8
Computer equipment returned to vendor to be refurbished and resold	6.4	42.1	13.3
Spent fluorescent light bulbs and mercury, metal hydride, and sodium lamps sent to an offsite vendor for recycling	3.4	2.3	1.4
Rechargeable batteries sent to an offsite vendor for recycling	1.8	0.3	0.2
Lead scrap metal sold for reuse/recycle	5.7	0.9	b
Lead tire weights reused instead of being disposed as hazardous waste	0.8	0.8	b
Hazardous chemicals relocated to new users through the Material Exchange Program, diverting them from disposal	0.3	b	b
Total:	**164.7**	**184.1**	**296.0**
Nonhazardous Waste			
Scrap ferrous metal sold to a vendor for recycling	593.8	872.8	92.8
Mixed paper and cardboard sent off site for recycling	170.2	668.2	177.5
Food waste from cafeterias sent off site to be reused as pig feed	73.9	52.4	49.2
Shipping materials, including pallets, Styrofoam, bubble wrap, and shipping containers, that were reused	22.8	17.6	9.5
Scrap nonferrous metal sold to a vendor for recycling	19.2	256.1	6.6
Spent toner cartridges sent off site for recycling	2.9	3.2	3.0
Nonhazardous chemicals, equipment, and supplies relocated to new users through the Material Exchange Program, diverting them from disposal	2.0	1.2	3.7
Aluminum cans sent off site for recycling	0.4	0.8	0.8
Total:	**885.1**	**1,872.3**	**343.0**

[a] In accordance with regulations issued pursuant to the Resource Conservation and Recovery Act, the Toxic Substances Control Act, or other applicable Federal or state statutes.
[b] Not reported for this year.
Source: DOE/NV 2007d, 2008a, 2009d.

4.1.12 Human Health and Safety

The health and safety of the general public and site workers are discussed in this section. Environmental health risks from NNSS activities include the effects of environmental noise and acute and chronic exposures to ionizing radiation and hazardous chemicals. Regular programs are administered to monitor releases and evaluate associated potential health impacts. Additionally, studies have been conducted to assess the exposure pathways and potential risks of radionuclide and toxic chemical releases during past NNSS operations. These studies focused on the impacts of releases in terms of health risks to site workers and the general public. Results of current assessments and historic studies indicate (1) there is little risk of enhanced carcinogenesis (the production or manifestation of cancer) due to radionuclide and chemical releases during site operations; (2) doses from site radionuclide releases tend to be far lower than those from natural background radiation; and (3) chemical exposures are well within established guidelines. To optimally protect vulnerable populations, DOE maintains a comprehensive Emergency Management Program that features hazard-specific plans, procedures, and controls (DOE Order 151.1C).

4.1.12.1 Public Radiation Exposure and Safety

4.1.12.1.1 General Site Description

Major sources of background radiation and average doses from background radiation exposure to individuals in the NNSS vicinity are shown in **Table 4–52**.[23] The average annual dose from background radiation is approximately 670 millirem. About half of the annual dose is from ubiquitous, natural background sources (355 millirem) that can vary depending on geographic location, individual buildings in a geographic area, and age, but are all essentially from space or naturally occurring in the Earth. About half of the dose is from medical exposure to radiation (300 millirem), including computed tomography, interventional fluoroscopy, x-rays and conventional fluoroscopy, and nuclear medicine (use of unsealed radionuclides for diagnosis and treatment). Another approximately 14 millirem per year are from consumer products and other sources (nuclear power, security, research, and occupational exposure) (NCRP 2009). Average background radiation doses from these sources are expected to remain fairly constant over the period of the proposed actions. Background radiation doses identified in Table 4–52 are unrelated to NNSS operations.

Table 4–52 Sources of Radiation Exposure of Individuals Unrelated to Nevada National Security Site Operations [a]

Source	***Effective Dose (millirem per year)*** [a]
Natural Background Radiation	
Cosmic and external terrestrial radiation [b]	98
Internal radiation	29
Radon in homes (inhaled)	228
Other Background Radiation	
Diagnostic x-rays and nuclear medicine	300
Consumer products	13
Industrial, Security, Medical, Educational, and Research	0.3
Occupational	0.5
Total (rounded)	670

[a] Except for cosmic and external terrestrial radiation, values are averages for an individual in the United States.
[b] The dose from cosmic and external terrestrial radiation is based on field readings using a pressurized ion chamber (DOE/NV/2009d).
Source: DOE/NV 2009d; NCRP 2009.

Releases of radionuclides to the environment from NNSS operations provide another potential source of radiation exposure to individuals in the vicinity of the NNSS. Types and estimated quantities of radionuclides released from NNSS operations in 2008 are listed in the *Nevada Test Site Environmental Report, 2008* (DOE/NV 2009d). Estimated doses to the public resulting from these releases are presented in **Table 4–53**. The reported total dose to the maximally exposed individual (MEI) is a conservative estimate. It is based on the concentration of radionuclides at a location on the NNSS (referred to as a "critical receptor station") where a member of the public could not live and includes the assumed consumption of game animals collected on the NNSS (not at offsite locations). MEI doses estimated in a similar manner for the years 2004 through 2008 range from 2 to 2.9 millirem per year. These doses fall within the limits invoked by DOE Order 458.1, Change 2, and are much lower than those due to background radiation.

[23] Average doses from cosmic and terrestrial sources of background radiation are measured by a pressurized ion chamber in the vicinity of the NNSS. Other background doses are assumed to approximate the average dose to an individual in the U.S. population.

Table 4–53 Radiation Doses to the Public from Nevada National Security Site Operations in 2008 (Total Effective Dose Equivalent)

Receptor	*Atmospheric Releases* [a]	*Liquid Releases* [b]	*Game Animals*	*Total* [c]
Maximally exposed individual (millirem)	1.9	0	0.5	2.4 [d]
Population within 50 miles (person-rem) [e]	< 1 (0.47)	0	(d)	< 1 (0.47)
Average individual within 50 miles (millirem) [f]	< 0.02	0	(d)	< 0.02

rem = roentgen equivalent man.
[a] DOE Order 458.1, Change 2, invokes the Clean Air Act regulations in 40 CFR Part 61, Subpart H, which establish a compliance limit of 10 millirem per year to a maximally exposed individual.
[b] There is no dose to the public from surface-water or groundwater pathways.
[c] DOE Order 458.1, Change 2, establishes a dose limit of 100 millirem per year to individual members of the public exposed through all pathways.
[d] The dose from the ingestion of contaminated game (cottontail rabbit or doves) is applicable to the maximally exposed individual only.
[e] In 2008, site reports did not present a calculated population dose; however, a population dose exceeding 1 person-rem is very unlikely (DOE 2008b). In 2004, the last year that a specific population dose was reported, the estimated dose to a population of 42,871 living within 50 miles of the Area 6 Control Point was 0.47 person-rem (DOE/NV 2005a).
[f] The average dose to an individual was obtained by dividing the population dose by the number of people living within 50 miles of the site.
Source: DOE 2008b; DOE/NV 2005a, 2009d; Warren 2011.

Using a risk coefficient of 600 cancer deaths per 1 million person-rem (or 0.0006 latent cancer fatalities [LCFs] per rem) (DOE 2003c), the risk of an LCF to the MEI due to radionuclide releases from NNSS operations in 2008 was estimated to be 1.4×10^{-6}. That is, the probability of this person dying of cancer at some time in the future as a result of a radiation dose associated with emissions from 1 year of NNSS operations is about 1 chance in 710,000. The hypothetical MEI is a person whose place of residence and lifestyle make it unlikely that any other member of the public would receive a higher radiation dose from NNSS releases. This person was assumed to be exposed to radionuclides in the air and on the ground from NNSS emissions at the Schooner critical receptor station, a location in the far northwestern corner of the NNSS.

Using the same risk coefficient, the calculated LCF risk to the estimated population for 2004 (the last year in which a population dose was estimated) was 0.00028 (DOE/NV 2005a). This low calculated risk implies that no LCFs are expected as a result of radioactive emissions. For comparison, the annual risk of a cancer in the U.S. population in the year 2000 was about 200 deaths per 100,000 people, or 0.2 percent per year (Weir et al. 2003). At that rate, expected fatalities from all cancers in the population living within 50 miles of the NNSS would be 86.

No members of the public receive direct gamma radiation exposure that is above background levels as a result of past or present NNSS operations. Gamma radiation exposure rates measured at areas accessible to the public are comparable to natural background rates from cosmic and terrestrial radiation. Radioactively contaminated areas on the NNSS are isolated from members of the general public, given the considerable distances between these areas and the site boundary, so members of the public are not exposed to any measurably contaminated soil, either directly or through resuspension (DOE/NV 2009d).

Radiation Basics

What is radiation? Radiation is energy emitted from unstable (radioactive) atoms in the form of atomic particles or electromagnetic waves. This type of radiation is also known as ionizing radiation because it can produce charged particles (ions) in matter.

What is radioactivity? Radioactivity is produced by the process of unstable (radioactive) atoms trying to become stable. Radiation is emitted in the process. In the United States, radioactivity is measured in units of curies (Ci). Smaller fractions of the curie are the millicurie (1 mCi = 1/1,000 Ci), the microcurie (1 μCi = 1/1,000,000 Ci), and the picocurie (1 pCi = 1/1,000,000 μCi).

What is radioactive material? Radioactive material is any material containing unstable atoms that emits radiation.

What are the four basic types of ionizing radiation?

Alpha (α) – Alpha particles consist of two protons and two neutrons. They can travel only a few centimeters in air and can be stopped easily by a sheet of paper or by the skin's surface.

Beta (β) – Beta particles are smaller and lighter than alpha particles and have the mass of a single electron. A high-energy beta particle can travel a few meters in the air. Beta particles can pass through a sheet of paper, but may be stopped by a thin sheet of aluminum foil or glass.

Gamma (γ) – Gamma rays (and x-rays), unlike alpha or beta particles, are waves of pure energy. Gamma radiation is very penetrating and can travel several hundred feet in air. Gamma radiation requires a thick wall of concrete, lead, or steel to stop it.

Neutrons (n) – A neutron is an atomic particle that has about one-quarter the weight of an alpha particle. Like gamma radiation, it can easily travel several hundred feet in air. Neutron radiation is most effectively stopped by materials with high hydrogen content, such as water or plastic.

What are the sources of radiation?

Natural sources of radiation – (1) Cosmic radiation from the sun and outer space; (2) natural radioactive elements in the Earth's crust; (3) natural radioactive elements in the human body; and (4) radon gas from the radioactive decay of uranium naturally present in the soil.

Manmade sources of radiation – Medical radiation (x-rays, medical isotopes), consumer products (TVs, luminous dial watches, smoke detectors), nuclear technology (nuclear power plants, industrial x-ray machines), and worldwide fallout from past nuclear weapons tests or accidents.

What is radiation dose? Radiation dose is the amount of energy of ionizing radiation absorbed per unit mass of any material. For people, radiation dose is the amount of energy absorbed in human tissue. In the United States, radiation dose is measured in units of rad or rem. Smaller fractions of the rem are the millirem (1 millirem = 1/1,000 rem) and the microrem (1 μrem = 1/1,000,000 rem).

Regarding groundwater monitoring programs, annual monitoring has detected tritium-contaminated groundwater in a well beyond the NNSS boundary. The well is a monitoring well that is on federally controlled land (the Nevada Test and Training Range), and there are no indications that contaminated groundwater has migrated to any wells that supply water to members of the public. Consequently, there is no radiation dose incurred by the public from the groundwater pathway. Groundwater monitoring programs are discussed in more detail in Section 4.1.6.2.

Radioactive airborne emissions at the NNSS are monitored on site to ensure compliance with NESHAPs under CAA. A network of 19 air sampling stations and a network of 109 thermoluminescent dosimeters are located throughout the NNSS, primarily within operational areas where historic nuclear testing has occurred or where current radiological operations occur. Air sampling stations monitor tritium, manmade radionuclides, and gross alpha and beta activity in airborne particulates that result either from current site operations or from activities such as environmental restoration that resuspend material at legacy testing locations. Thermoluminescent dosimeters monitor direct gamma radiation exposure.

The total amounts of manmade radionuclides that were emitted to the air from all sources on the NNSS in 2008 were estimated to be 440 curies of tritium, 0.047 curies of americium-241, 0.050 curies of plutonium-238, 0.29 curies of plutonium-239 and -240, and 0.60 curies of depleted uranium. Since the cessation of atmospheric nuclear testing, the annual releases into the air have ranged from 48 to

2,200 curies for tritium, 0.0018 to 0.40 curies for plutonium, and 0.039 to 0.049 curies for americium. These emissions cannot be distinguished from the background airborne radiation measured in communities surrounding the NNSS. Potential radioactive emissions are monitored at stations in selected towns and communities within 240 miles of the NNSS by the independent CEMP. Its purpose is to provide monitoring for radionuclides that may be released beyond the confines of the NNSS boundary. A network of 29 CEMP stations is in use; these stations monitor gross alpha and beta activity, gamma radiation, and meteorological parameters (see Section 4.2.8.3) (DOE/NV 2009d).

4.1.12.2 Occupational Radiation Exposure and Safety

NNSS workers receive the same dose as the general public from background radiation, but they receive an additional dose from working in and near facilities or areas with radioactive material. The average dose to the individual worker and the cumulative dose to all workers at the NNSS from operations in 2008 are presented in **Table 4–54**. Using a risk coefficient of 0.0006 LCFs per person-rem, the projected LCF risk among NNSS workers from normal operations in 2008 was 0.0033. The largest dose received by a worker in 2008 was 451 millirem (Enyeart 2009); the increased risk of an LCF from this dose was 0.00027.

The average dose of 70 millirem in 2008 is comparable to the average doses over the prior 5-year period (2003–2007) of 46 to 81 millirem (DOE 2006a, 2009n).

Table 4–54 Radiation Doses to Workers from Nevada National Security Site Normal Operations in 2008 (Total Effective Dose Equivalent)

Workers	*Onsite Releases and Direct Radiation*	
	Standard [a]	*Actual*
Maximally exposed worker (millirem)	5,000	451
Average radiation worker (millirem)	None	70
Total of all radiation workers (person-rem) [b]	None	5.2

rem = roentgen equivalent man.

[a] No standard is specified for an "average radiation worker"; however, the maximum dose to a worker is limited as follows: The dose limit for an individual worker is 5,000 millirem per year (10 CFR Part 835). However, DOE's goal is to maintain radiation exposure as low as is reasonably achievable (ALARA). DOE has, therefore, established an Administrative Control Level of 2,000 millirem per year; the site contractor sets facility administrative control levels below the DOE level, with 500 millirem per year considered a reasonable goal for trained radiation workers.

[b] There were 75 workers with measurable doses in 2008.

Note: Total radiation worker dose presented in the table slightly differs from that calculated from data shown due to rounding.

Source: 10 CFR 835.202; DOE 1999e, 2009n; Enyeart 2009.

Worker occupational risks are generally associated with activities such as waste handling, construction, environmental restoration, and decontamination and decommissioning. DOE's Computerized Accident/Incident Reporting System provides statistics on worker injury and illness information, including accidents involving government-owned vehicles. Although the total number of hours worked showed an upward trend between 1996 and 2005, the rate of total recorded cases per 200,000 hours worked remained fairly stable, as did the rates of accident cases causing days away from work, restricted work, or job transfer (DART cases). These accident statistics are comparable to those for the DOE complex as a whole. In 2006, the total recorded accident/incident case rate at the NNSS was 2.3, and the DART case rate was 0.9; the comparative rates for 2006 over the entire DOE complex were 1.6 and 0.7, respectively. From 1996 through 2004, accident rates for government vehicles at the NNSS averaged 0.5 accidents per million vehicle miles, while the overall DOE/NNSA accident rates over this period averaged 1.7 accidents per million vehicle miles. In addition, it is noteworthy to mention that a key Lessons Learned (DOE 2002b) implemented in 2002, which consisted of holding a weekly roundtable discussion focused on safety between managers and staff, was responsible for eliminating injury incidents for the better part of the following annual period. This implementation focused on the initiation of regular weekly roundtable discussions between managers and workers during scheduled safety meetings. It is these types of programs and recognition that are regularly set in place at the NNSS in an effort to keep an accident goal of "zero accidents/incidents" with "zero work-days lost" (DOE 2008f, 2009m).

4.1.12.3 Chemical Exposure and Risk

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, through which people may come in contact with hazardous chemicals. Hazardous chemicals can cause cancer and non-cancer-related health effects.

Because of the NNSS's remote location and large size, there is no risk of chemical exposure to the surrounding public population resulting from normal site operations. Nevertheless, monitoring efforts and baseline studies are regularly performed. However, certain workers at the NNSS are at risk of chemical exposure depending on their job function and proximity to various sources.

Of key concern at the NNSS is exposure to beryllium. Beryllium can cause acute respiratory disease (for which a workplace air concentration limit has long been in place), and chronic beryllium exposure can cause lung disease. In December 1999, DOE promulgated the Chronic Beryllium Disease Prevention Program (64 FR 68853), and in February 2006, DOE included the program in worker safety and health regulations established to govern contractor activities at DOE sites (71 FR 6857). DOE/NNSA has implemented the program at the NNSS to reduce the number of workers potentially exposed to beryllium and establish a medical surveillance program for early detection of the disease. DOE sponsors and funds a screening program for former DOE workers who may have been exposed to beryllium at the NNSS and other DOE sites.

As discussed in Section 4.1.8, common sources of chemical air pollutants at the NNSS include various particulate matter from construction activities, aggregate production, surface disturbances, fuel-burning equipment, state-authorized open burning, fuel storage facilities, and chemical release tests conducted at NPTEC. An estimated 6.05 tons of criteria air pollutants were released on the NNSS in 2008. The majority of the emissions comprised nitrogen oxides from diesel generators. Total air emissions of lead were 4.56 pounds, and the total quantity of hazardous air pollutants released in 2008 was 0.09 tons. Other emitters included carbon monoxide, sulfur dioxide, and volatile organic compounds, all in quantities well below emission criteria limits (DOE/NV 2009d).

As for monitoring potential chemicals released to drinking water and wastewater systems at the NNSS, six permitted wells on the NNSS serve the drinking water needs of NNSS workers and visitors. The wells are regularly monitored for potability and purity. In 2008, water samples from these wells (in addition to potable-water hauling trucks) met all national primary and secondary drinking water standards. In addition, site operating lagoon systems are tested for biochemical oxygen demand, pH, total suspended solids, and a suite of toxic chemicals; all lagoon water measurements were found to be within permit limits in 2008. Discharge water at the site is also tested for a host of potential contaminants. In 2008, no contaminants were detected at levels that exceeded permit limits (DOE/NV 2009d).

Regarding risks from handling toxic or hazardous chemicals, worker safety programs at the NNSS are enforced via required adherence to Federal and state laws; DOE Orders; Occupational Safety and Health Administration requirements; EPA guidelines; and plans and procedures for performing work, including training, monitoring, use of personal protective equipment, and administrative controls. Although chemical inventories have varied to a limited extent over recent years, administrative controls continually ensure that quantities do not approach levels that pose undue risk due to storage, concentration, bulk quantity, or logistical factors. Any amounts that potentially exceed threshold planning quantities require reporting under Federal regulations (40 CFR Part 355; 40 CFR Part 370).

4.1.12.4 Health Effects Studies

There have been numerous studies conducted over the years examining the potential health effects that U.S. populations may have incurred from exposure to fallout associated with the NNSS atmospheric nuclear tests. Most notable are those discussed below.

A 1979 study reported in the *New England Journal of Medicine* concluded that a significant excess of leukemia deaths occurred in children up to 14 years of age living in Utah between 1959 and 1967. This excess was concentrated in the cohort of children born between 1951 and 1958, and was most pronounced in those residing in Utah counties receiving high fallout. Mortality increased by 2.44 times (95 percent confidence, 1.18 to 5.02) to just slightly above that of the United States in the high-exposure cohort residing in the high-fallout counties, and was greatest in 10- to 14-year-old children. For other childhood cancers, no consistent pattern was found in relation to fallout exposure (NEJM 1979).

In 1994, DOE published a report entitled *Development of the Town Data Base: Estimates of Exposure Rates and Times of Fallout Arrival Near the Nevada Test Site* in an effort to model public radiation exposure rates in populated areas of Nevada, California, Arizona, and Utah at the time of fallout arrival and at 12-hour intervals thereafter. This report only focused on empirical exposure rate data (e.g., intensity isopleths across land areas) and did not convey interpretations of associated resulting health effects on potentially affected populations (DOE/NV 1994). In a 1997 report by the National Cancer Institute, it was determined that 90 atmospheric tests at the NNSS deposited high levels of iodine-131 (149 million curies) across a large portion of the contiguous United States during the 1950s and 1960s, especially in 1952, 1953, 1955, and 1957; the resulting doses were large enough to produce 10,000 to 75,000 cases of thyroid cancer and had the potential of being the causational link for up to 212,000 cases. Results of the study show that, depending on their age at the time of the tests, where they lived, and what foods they consumed, particularly milk, Americans were exposed to varying levels of iodine-131 (which accumulates in the thyroid gland) for about 2 months following each of the 90 tests, after which the isotope decayed to essentially harmless levels. Rain, wind, and the food supply spread iodine-131 from these tests across the United States, with the largest deposits immediately downwind of the NNSS and the lowest on the west coast, upwind of the NNSS. The average cumulative thyroid dose to approximately 160 million people who lived in the United States during the testing era was about 2 rad, about five times the radiation dose emitted by a mammogram. Americans were exposed to varying levels depending on their residence, age, and food consumption. People who lived in the western states to the north and east of the NNSS, such as Colorado, Idaho, Montana, South Dakota, and Utah, had the highest per capita thyroid doses, ranging from 9 to 16 rad. Children between 3 months and 5 years old in these high-fallout areas probably received three to seven times the average dose for the population in their county because they had smaller thyroids and tended to drink more milk than adults (NCI 1997).

Milk was a major exposure vehicle because iodine-131 was deposited on pasture grasses and then consumed by cows. However, an estimated 20,000 people who drank goats' milk during the testing years were at an even greater risk because the iodine-131 was more concentrated in goats' milk than cows' milk. Thyroid doses to the individuals who drank goats' milk could be 10 to 20 times greater than those to residents of the same county who were the same age and gender, and drank an equal amount of cows' milk. Other pathways included inhaling contaminated air or ingesting tainted leafy vegetables, cottage cheese, and eggs. However, the relationship between iodine-131 and thyroid cancer still is not fully known. It makes up less than 1 percent of cancer cases nationwide each year, and cancer registries do not indicate that fallout has caused an epidemic, although record-keeping did not start until the early 1970s (NCI 1997).

A Centers for Disease Control and Prevention report states that fallout from the NNSS, combined with nuclear tests conducted overseas by the United States and other countries, could ultimately be responsible for an additional 17,000 cancer deaths (CDC/NCI 2001).

Studies investigating potential impacts on American Indians from exposure to iodine-131 suggest that doses to this group could have been larger than those calculated for the general population. For the general population, the major exposure pathway was the ingestion of milk; additional exposure pathways considered were inhalation of contaminated air and ingestion of contaminated greens, cheese, and eggs. Evaluations show that exposures via the wild game pathway may have an increased food-chain-related thyroid dose and consequent risk. Therefore, for people eating a diet heavy in small wild game, the major exposure route may be the wild game. The analysis suggests that Duckwater, Nevada (north of the NNSS), residents, who were exposed to contaminated milk in addition to contaminated game, experienced a greater thyroid cancer risk than people whose primary exposure pathway was cows' milk (Russ et al. 2005).

In regard to potential health effects on onsite military and DoD civilian participants during the testing years, the Nuclear Test Personnel Review Program, administered by the U.S. Defense Threat Reduction Agency, was implemented to (1) confirm veteran participation in U.S. atmospheric nuclear tests from 1945 to 1962 and (2) upon confirmation, provide either an actual or estimated radiation dose received by the veteran, leading to potential financial dispensation (via the U.S. Department of Veterans Affairs) associated with a presumptive adverse health condition resulting from this dose. Each dose assessment, thousands of which have been conducted since the program's inception in 1978, can be interpreted as an independent radiation exposure health effects study. Outside of the Nuclear Test Personnel Review Program, there have been numerous other financial claims independently submitted against the Federal Government by employees at the NNSS, alleging similar adverse health effect manifestations resulting from their involvement or presence during the testing era.

There are no studies that indicate adverse health effects in populations near the NNSS as a result of activities or operations supporting the current NNSS missions.

4.1.12.5 Accident History

Nuclear testing began at the NNSS in 1951. There were 100 atmospheric nuclear explosions before the Limited Test Ban Treaty was implemented in 1963. Nuclear tests were conducted underground until October 1992, when the nuclear testing moratorium was implemented. Since 1970, there have been 126 nuclear tests that released approximately 54,000 curies of radioactivity to the atmosphere. Of this amount, 11,500 curies were accidental due to containment failure (massive releases or seeps) and late-time seeps (small releases after a test, when gases diffuse through pore spaces of overlying rock). The remaining 42,500 curies were operational releases. From the perspective of human health risk, if the same person had been standing at the boundary of the NNSS in the area of maximum concentration of radioactivity for every test since 1970, that person's total exposure would be equivalent to 32 extra minutes of normal background exposure, or the equivalent of one-thousandth of a single chest x-ray (OTA 1989).

As with nuclear testing, accidents have occurred in the past that are associated with the unique type of work and experiments performed at the NNSS. Because of the change in the work performed on the NNSS, similar accidents have no or little likelihood of occurring in the future.

- Collapses of the ground surface above underground nuclear tests have resulted in worker injury.
- Explosive accidents have occurred and resulted in injuries to workers; for example, a hydrogen explosion during a post-test re-entry resulted in worker injuries.

In addition to the above accidents that were unique to the NNSS, other accidents similar to those that might occur at a large industrial site have also occurred at the NNSS.

- Vehicle accidents have occurred, ranging from minor accidents resulting only in property damage to more severe accidents resulting hospital treatment of injuries, and in a few cases, fatalities. Inclement weather contributed to difficult driving conditions in some of the accidents.

- Workers have been exposed to hazardous materials during the course of their work. Incidences have included exposure to radioactive materials, for example, during borehole management, and exposure to chemicals, for example, during a training exercise.
- Accidents involving energized electrical systems have occurred, resulting in near misses or worker shock. For example, workers have cut cables or penetrated buried cables that were energized; other instances involved workers performing inspections, maintenance, or repairs on panels or equipment that were not fully secure (loose wires, systems that were thought to be de-energized).
- A variety of industrial accidents have occurred, resulting in employee impacts ranging from mild injuries to severe injuries to fatalities. Examples include sprains, strains, or fractures from accidents associated with lifting or walking over difficult terrain; lacerations or cuts (including a severed fingertip) when equipment that was being worked on moved unexpectedly; hazards from collapse of excavation walls, falls from scaffolding/elevated platforms, and failure of rigging; and injuries from working near or with pressurized systems that fail, impacting workers.
- Natural phenomena have resulted in accidents, some that have threatened or impacted workers. Lightning has caused fires on the NNSS, as well as injuring an employee. High winds have caused damage to buildings, trailers, and utility poles, thereby posing a threat to workers.

4.1.12.6 Emergency Preparedness

Each DOE site has established an Emergency Management Program, developed in accordance with DOE Order 151.1C, *Comprehensive Emergency Management System*, that would be activated in the event of an accident. This program has been developed and maintained to ensure adequate response for postulated 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 DOE/NNSA NSO Consolidated Emergency Plan is designed to document all aspects of the site's Emergency Management Program, including provisions to effectively and efficiently respond to an operational emergency, and minimize the consequences of an emergency event for the health and safety of workers, responders, the public, and the environment. 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. DOE/NNSA coordinates emergency response planning and training with local governments. In accordance with the National Incident Management System, the coordination ensures that communications systems and equipment are interoperable and that personnel and equipment can be effectively deployed in the event of an emergency. The DOE/NNSA NSO Site Manager has the responsibility to respond, manage, and recover from an emergency occurring at the NNSS.

The plan provides for identification and notification of personnel for any emergency that may develop during operational and nonoperational hours. DOE/NNSA receives warnings, weather advisories, and any other communications that provide advance warning of a possible emergency. The plan is based upon current DOE/NNSA vulnerability assessments, resources, and capabilities regarding emergency preparedness.

4.1.12.7 Environmental Noise

The acoustic environment in areas adjacent to the NNSS is characteristic of uninhabited desert areas or small rural communities where natural phenomena, such as wind and rain, account for most of the background noise. Manmade noise in some areas of the ROI is caused by vehicles traveling along public highways and an occasional military aircraft. The Creech Air Force Base and the Desert Rock Airstrip are located near the southern border of the NNSS and generate intermittent increases in noise levels in the surrounding area. Although no ambient noise data are available, monitoring measurements from communities with similar environmental settings show that day–night average noise levels from such communities typically range from 45 to 65 decibels, A-weighted[24] (DOE 2008d).

Major sources of noise at the NNSS include equipment and machines, blasting and explosives experiments, aircraft operations, and vehicles. Explosives at BEEF and other areas in the Nuclear and High Explosives Test Zone (Areas 1, 2, 3, 4, 12, and 16), Areas 5 and 26, and the Explosives Ordnance Disposal Unit in Area 11 occasionally result in increased acute noise levels (less than 10 times per year at each site) (Morris 2009). Because of the NNSS's remote location, large size, access restrictions, and lack of a nearby population, the general public has little to no exposure to noise generated within the NNSS. The closest sensitive receptors to the site boundary are residences located approximately 1 mile to the south, in Amargosa Valley. At the NNSS boundary, away from most facilities, noise from most sources within the NNSS is barely distinguishable above background noise levels. Traffic generated by personnel commuting to and from work and occasional aircraft operations are the main NNSS-related contributors to increased noise levels in nearby communities.

Section 4 of the Noise Control Act of 1972, as amended (42 U.S.C. 4901 et seq.), directs Federal agencies to carry out programs in their jurisdictions "to the fullest extent within their authority" and in a manner that furthers a national policy of promoting an environment free from noise that jeopardizes health and welfare. The Occupational Safety and Health Administration regulations (Occupational Noise Exposure; Hearing Conservation Amendment, 29 CFR 1910.95) require hearing conservation and protection for all employees potentially exposed to criteria noise levels. Standards issued under the authority of the DOE Manual 440.1-1A, *DOE Explosives Safety Manual*, establish safety requirements applicable to operations involving the development, testing, handling, and processing of explosives, including noise protection guidelines during the detonation of explosives (DOE 2006c). High-explosives experiments must be conducted in accordance with this directive. Except for the prohibition of nuisance noise, neither the State of Nevada nor local governments have established specific environmental noise standards. Occupational noise exposure is regulated to the extent required by law.

4.1.13 Environmental Justice

Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, requires identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental impacts of Federal programs, policies, and activities on minority and low-income populations.

This section presents a summary of the demographic analysis prepared to analyze the potential impacts on low-income and minority populations affected by the programs discussed in this SWEIS. Demographic analysis is the first step in determining disproportionately high and adverse human health or environmental effects on low-income and minority populations. This analysis sets the stage for the impacts analysis presented in Chapter 5. Demographic analysis includes defining the ROI, census block groups, low-income populations, and minority communities.

The ROI for analyzing environmental justice in this SWEIS comprises Nye and Clark Counties, Nevada. DOE/NNSA did not consider areas outside Clark and Nye Counties because any impacts extending beyond this area would impact the population equally and would not have a disproportionately adverse impact on low-income or minority communities.

CGTO has also identified areas and nearby lands as culturally important to American Indian peoples. Although many of the American Indian groups live outside Clark and Nye Counties, American Indian peoples continue to value and recognize traditional ties to the NNSS and surrounding area. In recognition of these traditional ties, DOE/NNSA has established a relationship with CGTO. Specific aspects of the

[24] *A decibel is a unit that expresses the relative intensity of sounds on a logarithmic scale where 0 is below human perception and 130 is above the threshold of pain to humans. The A-weighted decibel scale corresponds approximately to the frequency response of the human ear and thus correlates well with loudness.*

participation of the group in DOE/NNSA cultural resources management projects are discussed in Section 4.1.10.2. CGTO has also presented additional viewpoints on environmental justice in Chapters 4 and 5 and Appendix C of this SWEIS.

4.1.13.1 Methodology

DOE/NNSA used the Council on Environmental Quality definition of low-income and the annual statistical poverty thresholds from the U.S. Census Bureau in its environmental justice analysis. A low-income community exists when the percentage of low-income people in the area of interest is meaningfully greater than the corresponding percentage in the general population. For purposes of analysis, DOE/NNSA used the state-wide average of 11.2 percent to define the percentage of low-income people in the general population. To identify low-income populations, DOE/NNSA used Census Bureau data for census block groups (USCB 2000, 2008b) where the percentage of low-income people exceeded the state average (sorted into ranges of 11–20, 21–30, and greater than 30 percent). The census block group, which typically consists of between 600 and 3,000 people, with an optimal size of 1,500 people, is the smallest census unit for which the Census Bureau releases income data (to protect confidentiality).

DOE/NNSA followed the Council on Environmental Quality guidance, which considers a minority population to exist where either (1) minority individuals in the affected area exceed 50 percent of the population or (2) the percentage of minority individuals in the affected area is meaningfully greater than the corresponding percentage in the general population or other appropriate unit of geographic analysis. The state-wide percentage of minority individuals (used to represent the general population) is 38.2 percent. For purposes of analysis, DOE/NNSA identified census block groups where the percentage of minority individuals was greater than 50 percent.

4.1.13.2 Low-Income Populations

Poverty thresholds are dollar amounts the Census Bureau uses to determine poverty status. In 2008, the weighted average threshold for households with two people was $14,051; that for households with three people was $17,163.

In 2008, the average household size for Clark County was 2.66; that for Nye County was 3.22. For purposes of analysis, DOE/NNSA rounded the average household size for the counties within the ROI—an average household size of 3 was used for Clark and Nye Counties.

Census data were available for the number of households with an income less than $15,000 and those with an income between $15,000 and $24,999. DOE/NNSA used the combined number of households with incomes less than $24,999 as the poverty threshold for Clark and Nye Counties.

Analysis of the data (see **Figure 4–35**) illustrates that there are numerous census block groups with low-income populations between 11 and 20 percent (that is, at or above the state-wide average) distributed throughout the ROI, including large (but sparsely populated) block groups adjacent to the NNSS. Block groups with low-income populations in the 21–30 and greater-than-30 percent ranges are found further to the east in the Las Vegas metropolitan area, closer to the RSL and NLVF facilities (see Sections 4.2.13 and 4.3.13).

4.1.13.3 Minority Populations

There are no block groups in Nye County (the county the NNSS is located within) with minority populations greater than 50 percent. Within the ROI, the closest block group to the NNSS with a minority population greater than 50 percent is Census Tract 5818, Block Group 1, in Clark County; approximately 2 miles east of the southeastern corner of the NNSS (see **Figure 4–36**). Additional block groups with minority populations greater than 50 percent are found further to the east in the Las Vegas metropolitan area, closer to the RSL and NLVF facilities (see Sections 4.2.13 and 4.3.13).

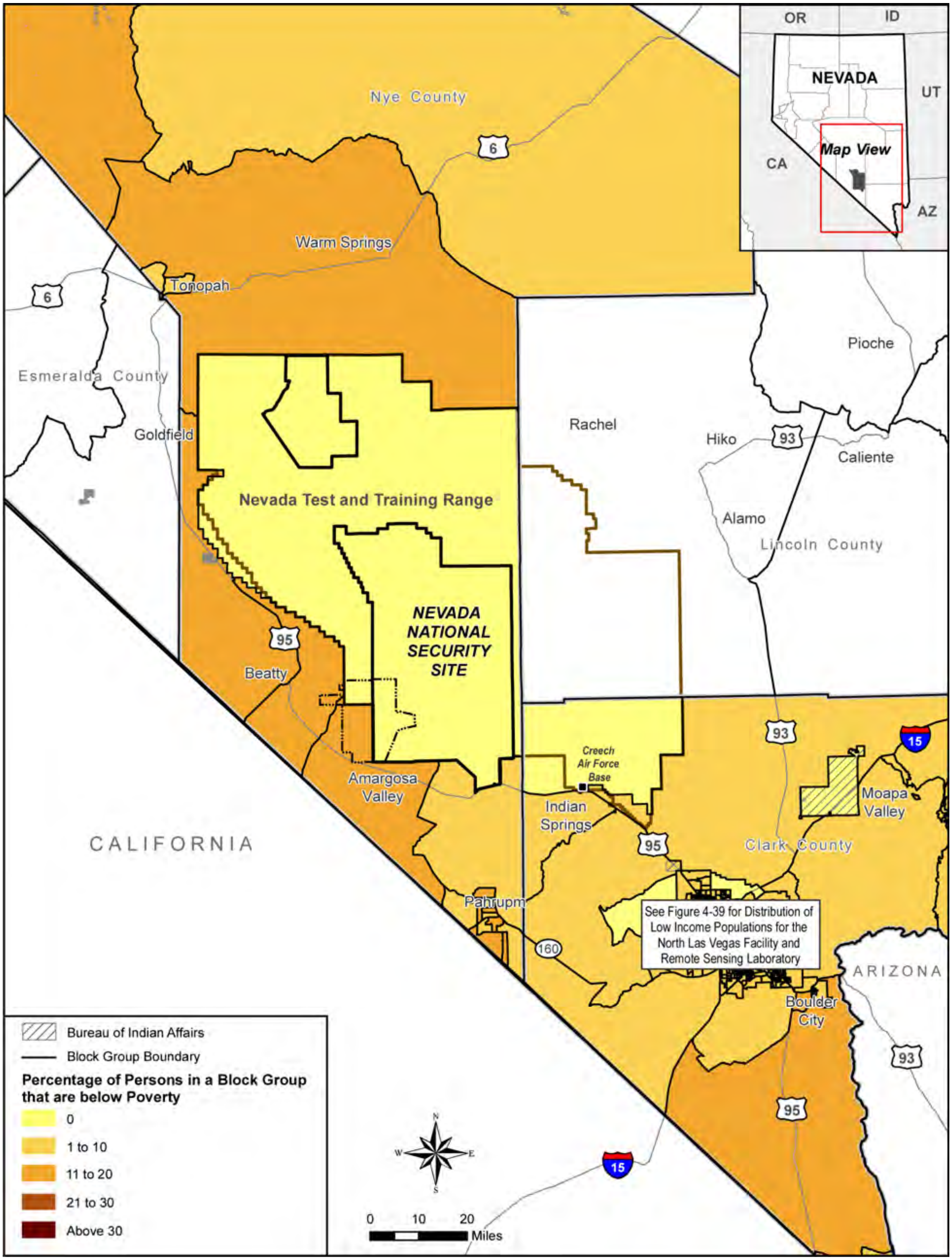

Figure 4–35 Distributions of Low-Income Populations for the Nevada National Security Site and the Tonopah Test Range

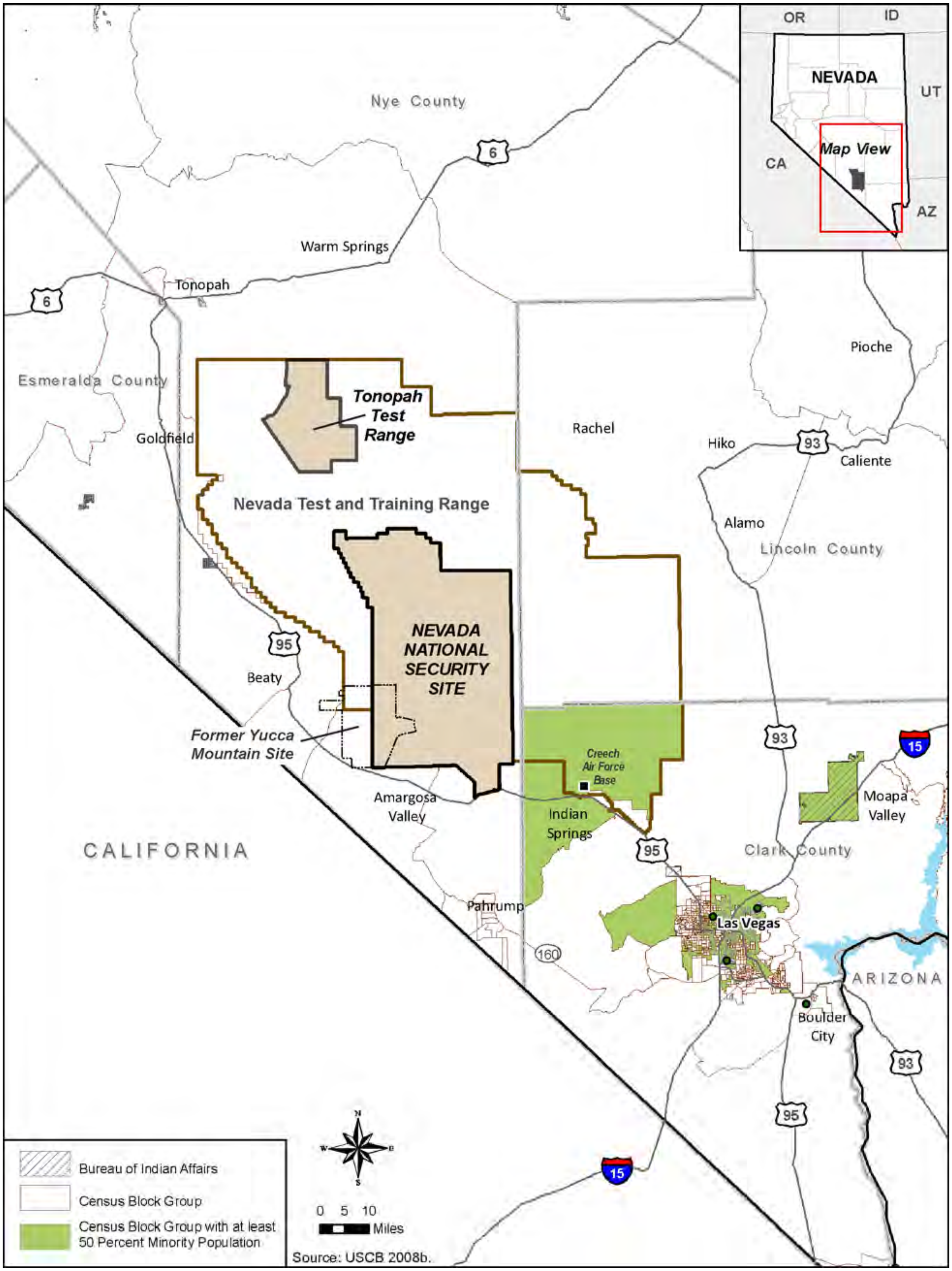

Figure 4–36 Nevada National Security Site and Tonopah Test Range Distributions of Minority Populations Greater than 50 Percent

4.2 Remote Sensing Laboratory

This section describes the existing environmental conditions at RSL. RSL is located adjacent to the main runway on Nellis Air Force Base, in North Las Vegas, Nevada. RSL provides emergency response resources for incidents involving weapons of mass destruction through the development and customization of state-of-the-art instruments and remote sensing technologies.

4.2.1 Land Use

RSL, located on Nellis Air Force Base, is approximately 8.5 miles northeast of the center of Las Vegas. This land is federally owned and withdrawn from the public for military use. Nellis Air Force Base is located adjacent to the city of North Las Vegas to the north and west, the city of Las Vegas to the south and west, and public lands managed by BLM to the east and south. In accordance with a Memorandum of Agreement with the USAF, DOE/NNSA leases the land under a 25-year lease (starting in 1989), with an option for two term extensions (DOE 2009f). The facility, initially occupied in 1989, is located on approximately 35 secured acres and comprises seven buildings used for research, testing, and fabrication laboratories and shops. RSL totals 168,012 gross square feet (DOE 2008f, 2008i). There is no public access to RSL.

Federal regulations and the Integrated Natural Resources Management Plan for Nellis Air Force Base and the Nevada Test and Training Range, developed in May 2007, restrict land use on Nellis Air Force Base. This resource plan was developed to provide guidance for the conservation of natural resources on the installation. The guidelines have been developed within the context of the military mission at Nellis Air Force Base. Private development on the base is not allowed under this mission. Through the guidelines and recommendations in the resources plan, land conservation and natural resource protection is imposed; however, mission needs take precedent (USAF 2007c).

4.2.1.1 Adjacent Land Use

Nellis Air Force Base entirely surrounds RSL. Nellis Air Force Base is a secured military installation and is currently used for aircraft operations and maintenance, weapons storage, rock quarrying, and housing and offices. A large portion of the installation is undeveloped.

The 11,300-acre Nellis Air Force Base is divided into three major functional areas. RSL is within Nellis Air Force Base Area III, which is located just east of Las Vegas Boulevard and adjacent to Nellis Air Force Base Area I. Area III contains housing, a hospital, a runway, and open space (USAF 2010c). The surrounding land to the east and portions to the north of Nellis Air Force Base are managed by BLM's Southern Nevada District Office.

4.2.2 Infrastructure and Energy

4.2.2.1 Infrastructure and Utilities

This section discusses the RSL buildings and transportation infrastructure; potable water, wastewater, and communications utilities; and support services, including law enforcement and security, fire protection, and health care. Further transportation-related information is discussed in Section 4.2.3. Solid waste collection is discussed in Section 4.2.11. Energy systems (electricity, natural gas, and liquid fuels) are discussed in Section 4.2.2.2.

4.2.2.1.1 Infrastructure

Facilities. As stated above, RSL comprises seven DOE/NNSA buildings, all leased from the USAF. The total floor space at RSL is approximately 161,528 square feet, as shown in **Table 4–55**, presented according to building function.

Table 4–55 Remote Sensing Laboratory Building Floor Space by Function

Function	*Floor Space (square feet)*
Administrative	0
Storage	16,454
Industrial/Production/Process	0
Research and Development	144,059
Service Buildings	0
Other	1,015
TOTAL	161,528

Source: NNSA/NSO 2009b.

Transportation Systems. RSL is located on Nellis Air Force Base, adjacent to the runway. There are no railroads at RSL. According to an agreement with the USAF, RSL has access to and use of the runway for mission purposes.

4.2.2.1.2 Utilities

Water Supply. Potable water sources at Nellis Air Force Base include five active government-owned and -operated wells (three wells located off base and two wells located on base) and water purchased from the Southern Nevada Water Authority via bulk-supply pipelines from Lake Mead (NAFB 2005). The base also purchases a small quantity from the City of North Las Vegas Water District. The existing water supply at Nellis Air Force Base is considered adequate.

The water system at RSL suffers from low pressure and limited supply capability. DOE/NNSA is working with Nellis Air Force Base officials to address these issues (DOE 2008f). See Section 4.2.6 for more information on the water supply.

Wastewater Collection and Treatment Systems. RSL wastewater is discharged to existing municipal sewage systems. RSL holds an Industrial Wastewater Discharge Permit (Permit Number CCWRD-080) from the Clark County Water Reclamation District (DOE/NV 2009d).

Communication Systems. RSL has standard communications services (e.g., telephone, internet). RSL has recently undergone extensive fiber optic communications and LAN systems upgrades, bringing the facility up to technological standards, so that it is currently able to function at peak efficiency.

4.2.2.2 Energy

4.2.2.2.1 Electrical Energy

Electrical energy at RSL is supplied by three sources as follows: 65 percent by NV Energy; 10 percent by Western Area Power Administration (Hydropower); and 25 percent by Solar Star, Inc. (the Nellis Air Force Base Solar photovoltaic project). In FY 2009, RSL's electrical usage was 4,850 megawatt-hours (NNSA/NSO 2010b). The existing electrical distribution system at RSL is capable of supporting present demands (DOE 2008f). According to the *FY 2009 NNSA/NSO Ten-Year Site Plan*, the RSL electrical distribution system is slated for improvements in 2014 (DOE 2008i).

As part of energy conservation efforts under Energy Saving Performance Contract funding, buildings at RSL have been retrofitted with low-energy light fixtures (NSTec 2008b).

4.2.2.2.2 Natural Gas

Natural gas at RSL is provided by the Southwest Gas Corporation via 2-inch-high pressure gas lines. Natural gas is regulated to low pressure at three locations. In FY 2009, RSL used 33,673 therms of natural gas (NNSA/NSO 2010b). There is adequate capacity to serve current demands, and the condition of the gas lines is satisfactory (NSTec 2010i).

4.2.2.2.3 Liquid Fuels

RSL maintains liquid-fueled boilers, water heaters, and emergency generators. The underground storage tank program at RSL/Nellis Air Force Base consists of two active permitted tanks (one 550-gallon gasoline tank and one 550-gallon diesel fuel tank), one inactive tank (empty used oil tank), one deferred tank (as per 40 CFR 280.10(d)) for emergency power generation, and three unregulated tanks. The permitted and deferred tanks are located at Building 2211 (DOE/NV 2009d). The two permitted tanks supply RSL with fuel used for the various forklifts, generators, and other onsite needs.

RSL maintains five aircraft that carry out remote sensing operations. These aircraft use approximately 111,030 gallons of JP-8 jet fuel annually (NNSA/NSO 2010b). Nellis Air Force Base provides all JP-8 jet fuel for RSL assets (NSTec 2010i). RSL currently does not use any alternative form of fuel (e.g., E85).

4.2.3 Transportation

4.2.3.1 Onsite Transportation

RSL is located within Nellis Air Force Base, which has several access gates. RSL can be accessed by most of the gates at the base. Hollywood Gate is the gate closest to RSL and may be used by authorized personnel to access the base during designated morning and afternoon hours. As shown in **Figure 4–37**, Access Road provides traffic circulation around RSL facilities and parking areas.

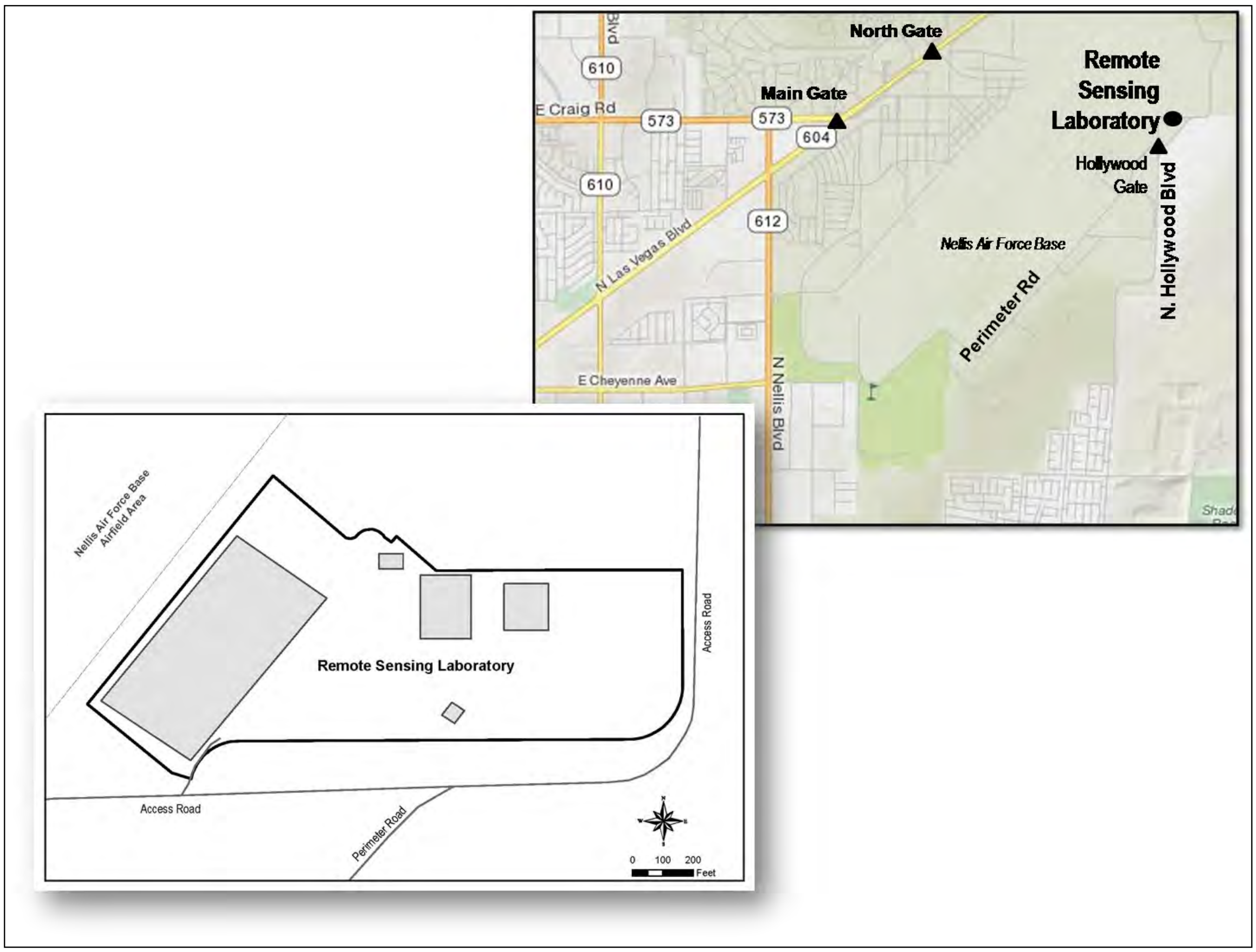

Figure 4–37 Remote Sensing Laboratory Roadways

4.2.3.2 Regional Transportation

The primary access points are the Main Gate and North Gate, which are both located on North Las Vegas Boulevard (see Figure 4–37). The Main Gate is open 24 hours daily, and the North Gate is open from 5:00 A.M. to 5:00 P.M. daily. Access to RSL is provided by Perimeter Road, near Nellis Boulevard (also known as Nevada State Route 612) in the eastern portion of the North Las Vegas region. Traffic volumes and levels of service on roadways in the Las Vegas metropolitan area are discussed in Section 4.1.3.2.2. Traffic volumes near RSL are represented by Las Vegas Boulevard and Nellis Boulevard, presented in Table 4–11; these roadways experience moderate-to-high daily traffic volumes and are operating at levels of service A and B, respectively.

4.2.4 Socioeconomics

General existing socioeconomic conditions within the ROI of RSL (Clark County) are presented in Section 4.1.4.

Police Protection. The USAF provides security services on the wider Nellis Air Force Base, but WSI, a private contractor, provides security services at RSL, following guidelines established by DOE/NNSA NSO Safeguards and Security. Nellis Air Force Base Security Forces respond to RSL when called. The Police Services portion of the current Inter-Service Support Agreement between DOE/NNSA and Nellis Air Force Base, dated January 2006, reads, "In the event of an emergency, Nellis Security Forces response will be limited to securing the exterior of the facility only."

Fire Protection. Fire protection is provided by Nellis Air Force Base.

Health Care. RSL does not have a medical facility. In the event of a medical emergency at RSL, Nellis Air Force Base would dispatch an ambulance from the base hospital (99th Medical Group).

The 99th Medical Group provides medical care for the military community to ensure maximum wartime readiness and combat capability. The group's functions include flight medicine, surgical services, maternal and child care, pharmacy, laboratory, radiology, dental care, medical benefits and information, and diagnostic and therapeutic services.

Emergency calls (9-1-1) reach the Base Fire Department emergency dispatch station directly. Depending on the nature of the emergency, the appropriate response organization is dispatched (e.g., fire department, ambulance).

4.2.5 Geology and Soils

4.2.5.1 Physiography

RSL is located in the northeastern section of the city of Las Vegas on Nellis Air Force Base. Las Vegas is situated in the Las Vegas Valley, a broad northwest–southeast trending basin in the Basin and Range Physiographic Province. The valley was formed during the extensional tectonics and gradually filled with sedimentary deposits that eroded from the surrounding mountain ranges. The deepest sediments are Tertiary in age, and gradually become younger, up to the Quaternary lake bed and stream deposits. The Las Vegas Valley is bounded by the Las Vegas shear zone to the north, by Frenchman Mountain to the east, by the Spring Mountains to the west, and by the McCollough and Bird Spring Ranges to the south (Rodgers et al. 2005).

Nellis Air Force Base is located northwest of Sunrise and Frenchman Mountains, which form the eastern border of the city of Las Vegas. The topography is generally flat at Nellis Air Force Base, although there is a gradual slope to the south. RSL is located approximately 1,850 feet above sea level.

4.2.5.2 Geology

The geologic history for the Las Vegas Valley is described in Section 4.1.5.2. Nellis Air Force Base is located on a series of alluvial fans formed from eroded sediments from the Sunrise, Las Vegas, and Dry

Lake Mountain Ranges. The surrounding mountain ranges are primarily composed of Permian-age limestone, mixed with sandstone, shale, dolomite, and gypsum interbedded with quartzite. Gravity and seismic tests have estimated the maximum thickness of the alluvial deposits in Las Vegas Valley to be up to 3.1 miles thick (Rodgers et al. 2005). The alluvium is approximately 1.86 miles deep beneath RSL (Rodgers et al. 2005).

The alluvial fans around Nellis Air Force Base overlap and are carved by numerous drainage channels. The grain size is largest and poorly sorted closer to the source bedrock, and becomes increasingly finer and well sorted at a farther distance from the mountain range. The deposits found in the alluvium at RSL are pink to pale-brown sand and pebble to cobble conglomerate.

4.2.5.2.1 Structural History

The Las Vegas Valley is bounded to the north by the Las Vegas Valley shear zone, which is a subsidiary zone in the larger Walker Lane shear zone, described in Section 4.1.5.1. The mountain ranges that bound the valley to the east, west, and south are all bounded by normal faults from the extensional tectonics described in Section 4.1.5.2.

The closest normal fault sequence to RSL is the Frenchman Mountain Fault, which creates a structural boundary between Frenchman Mountain and the Las Vegas Valley. The Frenchman Mountain Fault stretches from the northwest to southeast, and gradually curves to the east. The normal fault is typical of the Basin and Range sequence of faults that forms the basin topography. Scarps in the Quaternary-aged alluvium suggest that there has been movement within the last 130,000 years (Anderson 1999b).

In addition to the normal faults at the edge of the Las Vegas Valley, there are several scarp sequences that trend north–south through metropolitan Las Vegas. The scarps can be up to 98.4 feet high and 16.8 miles long. It is unclear if the scarps are related to past tectonic activity or internal basin features (Anderson 1999a). Most of the scarps have been modified by the development of Las Vegas. One prominent scarp in the northwestern section of the Las Vegas Valley is named the Eglington Fault, and may be related to faults within the basin bedrock (Anderson 1999c).

4.2.5.2.2 Faulting and Seismic Activity

An earthquake database search was performed for the area within 30 miles of the center of Las Vegas from 1973 to the present. Because the NNSS is outside of this 30-mile radius, the seismic tests from nuclear testing were not included in the database search. There have been 44 seismic events recorded around Las Vegas since 1973 (USGS 2010c). None of the earthquakes had a magnitude larger than 3.9, and approximately half of the earthquakes had a magnitude of less than 3. Section 4.1.5.2.3 presents a history of the seismic activity in the NNSS area and the greater Basin and Range region, which includes the Las Vegas Valley. Seismic design requirements are discussed in Section 4.1.5.2.3.

Due to the proximity of Las Vegas to the NNSS, seismic effects from nuclear testing have been a concern. Starting in the 1960s, a series of seismic stations were distributed throughout the Las Vegas Valley to measure the shockwaves from earthquakes and nuclear testing at the NNSS. Recordings were taken from 1968 through 1989, when the greatest number of tests occurred at the NNSS. The amount of ground motion recorded at the seismic station network correlated with the size of the nuclear test. The largest explosions at the NNSS (Boxcar, Handley, Muenster, and Fontina) generated the greatest ground motion in Las Vegas. These largest explosions were typically felt as IV or less on the Modified Mercalli Intensity Scale, which is used to measure the felt intensity of an earthquake (Rodgers et al. 2005). At that point, shaking is felt on the ground, but there is generally little to no damage to structures. The Modified Mercalli Intensity IV rating is roughly equivalent to a Richter magnitude of 4.0 (Rodgers et al. 2005). Smaller tests (e.g., Bambwell) generated minimal ground motion in the Las Vegas Valley; typically below 20 square centimeters per second (approximately 2 percent of the coefficient of gravity), which would be felt as weak motion with a low potential for structural damage (Rodgers 2008).

4.2.5.2.3 Geotechnical Hazards

RSL is located on the flat portion of the alluvial fans that fill the Las Vegas Valley. Sunrise Mountain is approximately 1.5 miles to the southeast of the facility. Runoff from Sunrise Mountain and Nellis Air Force Base collects in gullies to the south of RSL, which indicates that RSL would not be affected by landslides.

Section 4.1.5.2.4 describes how soils with shrink-swell properties could affect construction. RSL is located on Glencarb silt loam, which contains moderate amounts of clays and has a moderate shrink-swell potential (USDA 1985).

4.2.5.2.4 Geologic Resources

RSL is located on thick alluvial fans in the Las Vegas Valley. Gravel from alluvial deposits is the only geologic resource in the immediate vicinity of the facility.

4.2.5.3 Soils

The soils at Nellis Air Force Base and RSL have been labeled as Glencarb silt loam by the Natural Resources Conservation Service soil survey. The soil forms on the alluvial deposits from the surrounding mountain ranges and is often eroded and reworked by water. The soil is well drained, with a light, sandy loam with gravel and clay-rich sand in the upper layer. Up to 60 inches beneath the surface is a layer of caliche, which restricts root growth (USDA 1985). Due to the high percentage of clay, the soil does have some shrink-swell properties; however, this does not prevent construction of small commercial buildings. The topsoil is very susceptible to erosion by wind, as the fine-grained silt can be easily stripped from the coarser deposits. This soil is not classified as a prime farmland soil by the U.S. Department of Agriculture.

4.2.5.4 Radiological Sources as a Result of Testing

There has been no nuclear testing at Nellis Air Force Base or RSL; therefore, the soils are not contaminated with radioactive materials.

4.2.6 Hydrology

4.2.6.1 Surface Hydrology

RSL is located on Nellis Air Force Base in the northern portion of the Las Vegas Valley, which extends in a northwest-to-southeast direction and drains through the Las Vegas Wash into Lake Mead (USAF 2007c).

Surface-Water Features. No natural perennial streams, lakes, or springs are found on Nellis Air Force Base due to low precipitation, high evaporation rates, and low humidity. Water erosion is rare in the Las Vegas Valley, but can be somewhat prominent along alluvial fans. Nellis Air Force Base contains several ephemeral streams or washes that eventually flow into the Las Vegas Wash. One ephemeral stream originates near the northeastern corner of the RSL site (USAF 2007c).

Flood Hazards. The Federal Emergency Management Agency Flood Insurance Rate Map covering RSL (Map Number 32003C2200 E) indicates that the facility is located within Zone X. Zone X indicates an area of minimal flood hazard, which is determined to be above the 500-year flood level (FEMA 2002b).

Water Discharges and Regulatory Compliance. RSL holds an Industrial Wastewater Discharge Permit (Permit Number CCWRD-080) from the Clark County Water Reclamation District. The permit includes water chemistry limits and requires quarterly monitoring and reporting (DOE/NV 2011). In 2010, no permit limits were exceeded (see **Table 4–56**).

4.2.6.2 Groundwater

Hydrogeologic Setting. RSL is located on Area 1 of Nellis Air Force Base and is under lease to DOE/NNSA. Nellis Air Force Base is located on the eastern side of the Las Vegas Valley Hydrographic Basin, an intermountain basin within the Basin and Range Physiographic Province of the United States within the Colorado River Basin. The Las Vegas Valley Hydrographic Basin is approximately 1,600 square miles, with an estimated perennial yield of 25,000 acre-feet per year (NDWR 2010b). Groundwater flow within the Las Vegas Valley Hydrographic Basin is generally from west to east (USAF 2007c).

The little precipitation that is captured on site is drawn into the valley's principal basin-fill aquifer, shallow aquifers, and the Colorado River. Nellis Air Force Base is underlain by carbonate rock aquifers of the Colorado aquifer system, which is hydrologically connected to shallower alluvial aquifer systems composed of sand and gravels. The principal aquifer in the Las Vegas Valley Hydrographic Basin is naturally recharged by 30,000 to 35,000 acre-feet per year mostly from the Spring Mountains on the west valley boundary. Recharge of the shallow aquifers also occurs, primarily as a result of irrigation water percolating into the ground (USAF 2008c).

Table 4–56 Water Quality Results for Remote Sensing Laboratory Industrial Wastewater Discharges in 2010

Contaminant	*Permit Limit*	*Outfall*
Ammonia (ppm)	No limit listed	22.1
Cadmium (ppm)	0.35	0.00076
Chromium (total) (ppm)	1.7	0.00209
Copper (ppm)	3.36	0.330
Cyanide (total) (ppm)	1	<0.006
Lead (ppm)	0.99	0.0017
Nickel (ppm)	10.08	0.00426
Oil and Grease (ppm)	100	<5.0
Phosphorus (ppm)	No limit listed	6.2
Silver (ppm)	6.3	0.0011
Total Dissolved Solids (ppm)	No limit listed	1,094
Total Suspended Solids (ppm)	No limit listed	411
Zinc (ppm)	23.06	0.463
pH (Standard Units)	5.0–11.0	8.28
Temperature (degrees Fahrenheit)	140	76.3

pH = a measure of acidity or basicity; ppm = parts per million.
Note: Permit limits are set forth in Clark County Water Reclamation District Industrial Wastewater Discharge Permit (Permit Number CCWRD-080).
Source: DOE/NV 2011, Tables A–7 and A–8.

Groundwater Supply. Sources of groundwater are available from the principal alluvial-fill aquifer underlying the Las Vegas Valley. Approximately 29 percent of the Nellis Air Force Base water supply comes from groundwater, and the base is allotted 7.1 million gallons per day of surface water and groundwater (USAF Air Combat Command 2008). Potable water sources at Nellis Air Force Base include five active government-owned and -operated wells (three wells located off base and two wells located on base) and water purchased from Southern Nevada Water Authority via bulk-supply pipelines from Lake Mead. Virtually all of the water in Lake Mead begins as snowmelt in the Rocky Mountains and arrives via the Colorado River. All the water drawn from Lake Mead is sent to the Alfred Merritt Smith or River Mountains water treatment facilities.

The water supplied by the Southern Nevada Water Authority is supplemented by a small percentage of groundwater from wells located on the base and near the base within the northeastern part of the valley. This groundwater comes from the Las Vegas Valley Aquifer (NAFB 2005). The base also purchases a small quantity from the City of North Las Vegas Water District. The existing water supply at Nellis Air Force Base is considered adequate.

The raw water from base wells is chlorinated and then mixed with the Southern Nevada Water Authority water prior to use as drinking water. The two on-base wells have arsenic concentrations that exceed the MCL, but, when blended with the Southern Nevada Water Authority water and off-base well water, the resultant arsenic concentration is below the current arsenic MCL of 10 parts per billion. The revised arsenic MCL regulation became effective in January 2006 (NAFB 2005).

The water system supplying RSL, located on Nellis Air Force Base, suffers from low pressure and limited supply capability. DOE/NNSA is working with Nellis Air Force Base officials to address these issues (DOE 2008f). No expansion or addition of water-consuming facilities can be made at RSL until a new water source can be installed.

Nellis Air Force Base announced a water loop project in 2008, which is to take place within 5 years, and invited DOE/NNSA to participate. In the interim, Nellis Air Force Base has offered to allow DOE/NNSA to obtain water from the water line running to Area 2 and to extend the line approximately 4,000 feet from Perimeter Road to the compound. Eventually, this interim line could be capped and the same connection used on the new loop that would be adjacent to the property. The most economical new source for Nellis Air Force Base is approximately 1 mile east of the compound and belongs to the Southern Nevada Water Authority (DOE 2007c).

Groundwater Monitoring and Quality. Technicians collect and analyze water samples monthly from Nellis Air Force Base's drinking water and water treatment facilities. The water is tested more frequently and extensively than the Safe Drinking Water Act and the *Nevada Administrative Code* require (NAFB 2005).

Nellis Air Force Base had two regulatory compliance violations in 2005 (June and September). In June 2005, two samples tested positive for total coliform and one tested positive for *Escherichia coli* bacteria. In September 2005, two samples tested positive for total coliform. Public notifications were issued after both instances, and all subsequent test results were negative for total coliform and *E. coli* bacteria (NAFB 2005).

4.2.7 Biological Resources

RSL is in the Southern Basin and Range Ecoregion. This facility is located in an urban setting that includes buildings, pavement, and landscaping. No original undisturbed native vegetation remains on the site; current vegetation on the site consists of urban landscape. Few wildlife species exist at the site because it is located in an urban area and contains little vegetation.

4.2.7.1 Flora

This facility is located in an urban setting; no native vegetation within a natural setting occurs at this site.

4.2.7.2 Fauna

This facility is located in an urban setting; only urban-adapted wildlife occurs at this site. The only species that exist in this habitat include those that are adapted to urban habitats, which may include small mammals such as the house mouse (*Mus musculus*) and Norway rat (*Rattus norvegicus*), as well as ubiquitous bird species such as the northern mockingbird (*Mimus polyglottos*), European starling (*Sturnus vulgaris*), house finch (*Carpodacus mexicanus*), house sparrow (*Passer domesticus*), ruby-crowned kinglet (*Regulus calendula*), mourning dove (*Zenaida macroura*), and rock dove (*Columba livia*).

4.2.7.3 Threatened and Endangered Species

This facility is located in an urban setting; no threatened, endangered, or rare species are expected to occur at this site. No designated critical habitats for federally listed species exist at RSL. The urban areas of Clark County are not considered tortoise habitat.

4.2.7.4 Other Species of Concern

No other species of concern inhabit RSL.

4.2.7.5 Effects of Past Radiological Tests and Project Activities

This facility is located in an urban setting; no past radiological tests or project activities are anticipated to affect wildlife or vegetation at this site.

4.2.8 Air Quality and Climate

4.2.8.1 Meteorology

Downtown Las Vegas is located in Clark County, Nevada, about 56 miles southeast of the southeastern edge of the NNSS. RSL, at Nellis Air Force Base, is about 14 miles northeast of downtown. RSL is located in the Las Vegas Valley, which is situated in the northeastern corner of the Mojave Desert and in the rain shadow (lee) of the southern Sierra Nevada mountain range.

The Las Vegas Valley has the general climatic characteristics of a mid-latitude desert area, with relatively little precipitation throughout the year and low humidity, large diurnal and seasonal temperature ranges, and intense solar radiation in the summer. The generally dry, desert conditions specific to the area can occasionally be modified by the southwestern monsoon and convective thunderstorms during the summer months and Eastern Pacific tropical storm remnants in the late summer and fall. The dry conditions also tend to be moderated during strong *El Niño* cycles, which generally bring more rainfall to the area.

The average maximum temperatures range from about 95 to 105 °F in the summer and from about 55 to 65 °F in the winter. The average minimum temperatures range from about 70 to 80 °F in the summer and from about 35 to 45 °F in the winter, based on average temperatures recorded from 1971 through 2000 at the Las Vegas Weather Service Office Airport (NCDC 2009).

The Las Vegas Valley ranges in elevation from about 2,300 to 2,620 feet above mean sea level and is bounded by mountains to the north, south, and especially to the west, where the Spring Mountains peak above about 6,560 feet. This terrain causes wind flows in the Las Vegas Valley to be dominated by upslope and downslope conditions. The Clark County Department of Air Quality and Environmental Management (DAQEM) maintains an ambient air monitoring site (the J.D. Smith monitor, at 1301 East Tonopah Road) near RSL. **Figure 4–38** shows the wind roses for the J.D. Smith and E. Craig Road (at 4701 Mitchell Street) Clark County DAQEM sites for 2004 through 2008 (Clark County 2010) and the average wind direction and speed data surrounding both RSL and NVLF for the same time period. For additional information regarding the meteorological characteristics of RSL, see Appendix D, Section D.1.2.1.

The nearest upper-air measurements, used in estimating atmospheric stability, are available from the National Weather Service Desert Rock site located in the southern end of the NNSS about 58 miles northwest of downtown Las Vegas. Based on data recorded from 1978 through 2004 at Desert Rock, stable conditions dominate at night, though stronger windspeeds will tend to mix in the atmosphere, leading to neutral conditions. As greater solar radiation leads to greater instability, unstable conditions dominate the daytime hours and the months with the highest solar radiation (summer). These stability patterns are slightly modified within the Las Vegas Valley because of the lower elevation and slightly higher temperatures, windspeed differences, and potential differences in local cloud cover relative to what occurs at Desert Rock (Soulé 2006). A limited comparison study between Desert Rock and Las Vegas upper-air measurements suggests that differences above the first few tens of meters are minimal (Lehrman et al. 2006).

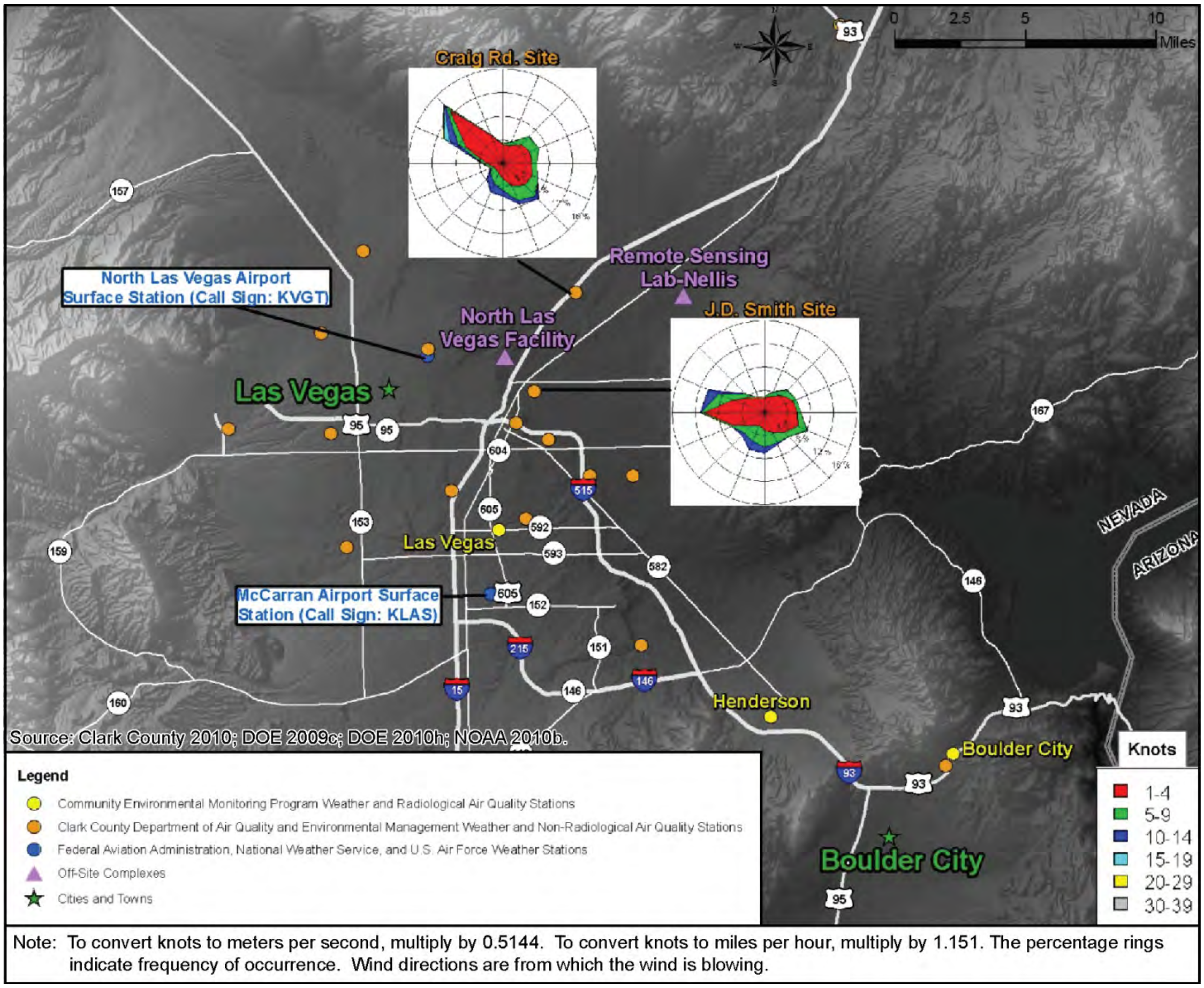

Figure 4–38 Wind Roses for J. D. Smith and E. Craig Road Clark County DAQEM Sites, 2004–2008

4.2.8.2 Ambient Air Quality

4.2.8.2.1 Region of Influence

RSL is located about 60 miles southeast of the southern border of the NNSS. The ROI for air quality and climate for RSL operations comprises northern Clark County. Historic data on pollutant emission inventories and compliance status for the State of Nevada are calculated at the resolution of county or hydrographic areas; these data provide a basis for determining existing air quality in the ROI and a metric for emission comparison assessments.

4.2.8.2.2 Existing Air Quality

Current Ambient Air Quality Standards. See Section 4.1.8.2.2 for a discussion on the current national and Nevada ambient air quality standards.

Air Quality Status. RSL is within Hydrographic Area 212. Clark County is in nonattainment for 8-hour ozone[25] and 24-hour $PM_{10.}$[26] Clark County is no longer in nonattainment for 8-hour carbon monoxide.[27] All other pollutants are in attainment.

PSD is a regulation incorporated into CAA that limits increases of certain pollutants in clean air areas (attainment areas) to certain increments even though ambient air quality standards are being met. CAA has three classes of areas with different increments. The smallest increments allowed are Class I areas, which are areas of special value (natural, scenic, recreational, or historic). Any degradation of existing air quality in these areas should be minimized. The closest PSD Class I areas are Grand Canyon National Park (about 65 miles to the east) and Sequoia National Park (about 165 miles to the west). RSL currently has no sources of pollution large enough to be subject to PSD requirements. However, because RSL is located in a nonattainment area, it could potentially be subject to nonattainment new source review if the emissions were of sufficient strength; however, they have been determined not to meet the threshold for new source review. Nonattainment new source review requirements are customized for the classification and type of air pollutant nonattainment area.

Emissions Due to RSL Operations. Title V of CAA gives states the authority to use air quality permits to regulate stationary source emissions of criteria pollutants. At RSL, a Facility 348 Authority to Construct/Operating Permit regulates emissions from sources such as boilers, water heaters, cooling towers, emergency generators, a spray paint booth, and a vapor degreaser. Except for 1.3 tons of nitrogen oxides emitted in 2004, emissions of carbon monoxide, nitrogen oxides, PM_{10}, sulfur dioxide, volatile organic compounds, and hazardous air pollutants were each less than 1 ton annually from 2003 through 2008. Total emissions of these pollutants over this 6-year period are about 6 tons (DOE 2004b, 2005b, 2006a, 2007b, 2008j, 2009c).

Table 4–57 shows the onsite emissions due to stationary sources and aircraft-related sources, as well as Clark County emissions due to RSL commuters and commercial vendors. The onsite stationary sources include both permitted sources and natural gas combustion used principally for heating. See Appendix D, Section D.1.2.2.2, for further details and a discussion of the methodology used to determine the stationary source emissions, aircraft emissions, commuter vehicle emissions, and commercial vendor emissions.

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[25] *Classified as marginal for 8-hour ozone under former Subpart 1 with a nonattainment area that includes those portions of Clark County that lie in Hydrographic Areas 164A, 164B, 165, 166, 167, 212, 213, 214, 216, 217, and 218, but excludes the Moapa River Indian Reservation and the Fort Mojave Indian Reservation. However, on March 29, 2011, EPA made the determination that Clark County is in attainment with 1997 ozone NAAQS (76 FR 17343). EPA is expected to redesignate the area's status to attainment upon approval of the Ozone Redesignation Request and Maintenance Plan submitted to EPA Region 9 in early April 2011.*

[26] *Designated as serious nonattainment for $PM_{10.}$ The nonattainment area covers Hydrographic Area 212. However, on August 3, 2010, EPA made the determination that the Las Vegas Valley is in attainment with the PM_{10} NAAQS based on monitoring data (75 FR 45485). EPA is expected to redesignate the area's status to attainment upon approval of the maintenance plan and request for redesignation that Clark County is expected to submit.*

[27] *A CO Maintenance Plan and formal request for resdesignation to attainment was submitted to the EPA in 2008 and approved on September 7, 2010 (75 FR 59090).*

Table 4–57 Estimated 2008 Air Emissions of Criteria Pollutants and Hazardous Air Pollutants Due to Remote Sensing Laboratory Activities

	Annual Air Emissions (tons per year)						
	Stationary Sources	*Aircraft-Related Sources*	*RSL Commuters*	*Commercial Vendors*	*Total*		
	Clark County						
Pollutant	*On-RSL*	*On-RSL*	*Off-RSL*	*Off-RSL*	*On-RSL*	*Off-RSL*	*Total*
PM_{10}	0.038	0.00040	0.030	0.043	*0.038*	*0.073*	***0.11***
$PM_{2.5}$	0.038	0.00037	0.016	0.04	*0.038*	*0.056*	***0.094***
CO	0.36	0.88	3.1	0.18	*1.2*	*3.3*	***4.5***
NO_x	0.9	0.045	0.76	0.4	*0.95*	*1.2*	***2.1***
SO_2	0.01	0.016	0.0084	0.00074	*0.026*	*0.0091*	***0.035***
VOCs	0.032	>0.17	0.062	0.058	*~0.2*	*0.12*	***~0.32***
Lead	<0.01	0.00040	0.0000020	0.00000068	*~0.01*	*0.0000027*	***~0.010***
Criteria Pollutant Total	*1.4*	*~1.1*	*4.0*	*0.68*	*~2.4*	*4.7*	***~7.2***
HAPs	0.0071	~0.17	0.0048	0.0076	*~0.18*	*0.012*	***~0.19***

CO = carbon monoxide; HAP = hazardous air pollutant; NO_x = nitrogen oxides; PM_n = particulate matter with an aerodynamic diameter less than or equal to *n* micrometers; RSL = Remote Sensing Laboratory; SO_2 = sulfur dioxide; VOC = volatile organic compound.

Measurements of Ambient Air Concentrations on and near RSL. The Clark County DAQEM maintains an air quality monitoring network. The E. Craig Road monitor (at 4701 Mitchell Street) is about 3 miles west of RSL. It monitors hourly ozone and PM_{10} levels. **Table 4–58** shows (1) maximum 8-hour average concentrations of ozone and (2) maximum 24-hour average and annual average concentrations of PM_{10} measured at the E. Craig Road monitor from 2006 through 2008. Sulfur dioxide, carbon monoxide, and $PM_{2.5}$ values shown are the highest concentrations measured in the Las Vegas Valley. For ozone and PM_{10}, about 25 percent of the 2008 observations were missing, so the maximum concentration numbers for that year could potentially be higher than what is shown; however, the maximum concentration over the past 3 years is likely representative of the current conditions. The ambient air quality standards are also shown in the table. See Table 4–40 for more information on the standards. Note that the E. Craig Road monitor may be moved about 7 miles south in 2010; if that happens, the closest Clark County DAQEM monitor to RSL would be the J.D. Smith monitor (1301 East Tonopah Road), about 5 miles southwest of RSL.

Ozone measurements at the E. Craig Road monitor (at 4701 Mitchell Street) exceeded the 8-hour ozone NAAQS in 2006 and 2007. The largest 8-hour ozone concentration was 0.084 parts per million (ppm) (in 2006), which is 0.009 ppm larger than the current NAAQS (0.075 ppm). Maximum ambient ozone concentration levels have generally remained constant at this and other nearby monitors since at least 1998 (DAQEM 2009). The second-highest 24-hour average PM_{10} concentration at the E. Craig Road monitor (at 4701 Mitchell Street) was 168 micrograms per cubic meter (in 2008), which is 18 micrograms higher than the NAAQS of 150 micrograms per cubic meter. The largest annual average PM_{10} concentration was 35 micrograms per cubic meter (in 2006), well below the Nevada ambient air quality standard of 50 micrograms per cubic meter (there is no national PM_{10} annual average standard). This monitor typically observes the largest PM_{10} concentrations of all the PM_{10} monitors in the Las Vegas Valley.

All other criteria pollutants are well below NAAQS. No lead monitoring data are available in the Las Vegas Valley.

Table 4–58 Ambient Air Quality Monitoring Data in the Vicinity of the Remote Sensing Laboratory, 2006–2008

Year	*2nd Max 1-hour CO (ppm)*	*2nd Max 8-hour CO (ppm)*	*Annual Mean NO_2 (ppm)*	*2nd Max 1-hour NO_2 (ppm)*	*4th Max 8-hour O_3 (ppm)*	*2nd Max 1-hour SO_2 (ppm)*	*2nd Max 24-hour SO_2 (ppm)*	*Annual Mean SO_2 (ppm)*	*98th percentile $PM_{2.5}$ (µg/m³)*	*Annual Mean $PM_{2.5}$ (µg/m³)*	*2nd Max 24-hour PM_{10} (µg/m³)*	*Annual Mean PM_{10} (µg/m³)*
2006	6.3	5	0.021	0.080	**0.084**	0.015	0.007	0.002	24.3	9.4	124	35
2007	4.6	3.8	0.020	0.066	**0.081**	0.007	0.003	0.001	22.6	10.3	120	34
2008	4.7	3.7	0.016	0.062	**0.080**	0.006	0.001	0.001	22.5	9.1	**168**	33
NAAQS	35.0	9.0	0.053	0.100	0.075	0.075	0.030	0.140	35.0	15.0	150	None

µg/m³ = micrograms per cubic meter; CO = carbon monoxide; NAAQS = National Ambient Air Quality Standards; NO_2 = nitrogen dioxide; O_3 = ozone; PM_n = particulate matter with an aerodynamic diameter less than or equal to *n* micrometers; ppm = parts per million; SO_2 = sulfur dioxide.

Note: Monitored values are from the E. Craig Road monitor (at 4701 Mitchell Street) for O_3 and PM_{10}; other values are the highest monitored values in the Las Vegas Valley. All exceedances of the NAAQS are shown in **bold** font.

Source: EPA 2010a.

4.2.8.3 Radiological Air Quality

Radiation sources currently used at RSL at Nellis Air Force Base are sealed in locations that prevent the release of radionuclides or any elevated gamma radiation from reaching the public. Therefore, radiation monitoring for public health is not performed (DOE 2009e), and exposure levels are at natural background levels. See Section 4.1.8.3 for more information on radiation sources and radiation monitoring on and near the NNSS.

4.2.8.4 Climate Change

This section describes the affected environment in terms of current and anticipated trends in greenhouse gas emissions and climate. The effects of emissions on the climate involve very complex processes and interact with natural cycles, complicating the measurement and detection of change. Recent advances in the state of the science, however, are contributing to an increasing body of evidence that anthropogenic greenhouse gas emissions affect climate in detectable and quantifiable ways.

For information on greenhouse gas emissions in the United States, please see Section 4.1.8.4.1. Greenhouse gas emissions at RSL are discussed in the next section. Details on the methodology used to determine these emissions are discussed in Appendix D, Section D.2.2.1.1.

4.2.8.4.1 Greenhouse Gas Emissions

Table 4–59 provides greenhouse gas emissions due to RSL-related activities for 2008. The greenhouse gas emissions are presented in carbon-dioxide-equivalent form and are partitioned by various mobile and stationary source types. These emissions were derived from fuel use, vehicle activity, and power consumption data. The greenhouse gas emissions were calculated using the EPA Climate Leaders Simplified Greenhouse Gas Emissions Calculator (EPA 2010b). These emissions were compared with a reference amount of 25,000 metric tons (27,558 tons), which is the threshold for which a quantitative assessment may be meaningful (CEQ 2010).

Table 4–59 Carbon-Dioxide-Equivalent Emissions of Greenhouse Gases from Remote Sensing Laboratory Activities in 2008

Source Type	*Carbon-Dioxide-Equivalent Emissions (tons per year)*	*Fraction of Reference Point of 25,000 Metric Tons* [a]
STATIONARY SOURCES		
Power generation	2,046	0.07
Natural gas heating	203	0.01
All stationary sources, except air conditioning/refrigeration and natural gas heating	11	0.01
All Stationary Sources	*2,260*	*0.08*
MOBILE SOURCES		
Aircraft and ground support equipment	1,184	0.04
Commuting	473	0.02
Commercial vendors	138	0.01
All Mobile Sources	*1,795*	*0.07*
Total	***4,055***	***0.15***

[a] 25,000 metric tons are equal to about 27,558 short tons.

Electricity consumption is by far the largest single source of greenhouse gas emissions related to RSL activities, emitting approximately 2,046 carbon-dioxide-equivalent tons of greenhouse gases, or 50 percent of the RSL-related greenhouse gas emissions total. Stationary sources altogether emitted about 2,260 carbon-dioxide-equivalent tons of greenhouse gases. Mobile sources emitted about 1,795 carbon-dioxide-equivalent tons. Overall, RSL-related activities created about 4,055 carbon-dioxide-equivalent tons of greenhouse gas emissions in 2008, which in itself is well below the threshold reporting level.

4.2.8.4.2 Current Changes in Climate

For a discussion of climate change impacts in the region, please see Section 4.1.8.4.2.

4.2.9 Visual Resources

RSL is located at Nellis Air Force Base, to the east of the northern end of the runways. This area is primarily developed, with the RSL facilities, adjacent runways, and infrastructure such as roadways, fences, and utility lines. The immediate surrounding land is undeveloped desert shrubland of the lower Mojave Desert (USAF 2006c). Public access to the airfield and RSL is restricted.

The area surrounding RSL is Nellis Air Force Base land. Public, middleground views exist from Las Vegas Boulevard North, located over a mile north of RSL, but development along the roadway and infrastructure associated with the airfield are more readily visible. RSL blends with this visual environment. Visible portions of RSL are considered to have a Class C scenic quality rating (see Section 4.1.9 for information on the visual impact rating system) due to the developed nature of the landscape, combined with high intrusion of manmade elements and lack of elements that help to improve aesthetics, such as landscaping. There is no immediate public visual access to the foreground of RSL.

4.2.10 Cultural Resources

For introductory information regarding cultural resources, see Section 4.1.10. Unless otherwise noted, the information in this section is derived from the *1996 NTS EIS* (DOE 1996c).

RSL is situated in the northern Las Vegas Valley, within the Las Vegas Valley Hydrographic Basin, an intermountain basin within the Basin and Range Physiographic Province of the United States (NDWR 2010a). RSL is located in Area III of Nellis Air Force Base, adjacent to the northern end of the Nellis Air Force Base runway. The facility is constructed in a highly built military setting that includes operations buildings, maintenance structures, paved runways, and ornamental landscaping. There is no original undisturbed ground surface on RSL.

The area of influence for cultural resources includes all areas where facilities, operations, and maintenance of DOE/NNSA programs would take place. For the purposes of this SWEIS, the area of influence includes the entire 35-acre RSL facility.

4.2.10.1 Recorded Cultural Resources

There are no recorded cultural resources within the boundary of RSL.

4.2.10.2 Sites of American Indian Significance

There are no known sites of American Indian significance within the boundary of RSL. As part of the preparation of this SWEIS, DOE/NNSA consulted with CGTO to determine whether any sites of American Indian significance exist within RSL.

4.2.11 Waste Management

RSL is a small-quantity generator of hazardous waste that also generates sanitary solid waste and recyclable materials. Hazardous wastes are stored on site at RSL for no more than 90 days before being transferred as needed to an offsite facility. As the landlord for RSL, the USAF provides waste management services, including removal and disposal of miscellaneous laboratory and process equipment wastes. Sanitary solid waste is collected and disposed by a municipal waste service. DOE occasionally ships scrap metal to the NNSS to be combined with other accumulated scrap metal at the NNSS and recycled under the NNSS Pollution Prevention and Waste Minimization Program (see Section 4.1.11.3).

4.2.12 Human Health and Safety

No human health impacts on the public or workers are associated with the regular operation of RSL. Because RSL is located within the Nellis Air Force Base, the greatest contributors to background noise conditions are aircraft operations and vehicular traffic. No environmental noise data are available at RSL; however, because of the surrounding land uses, it is assumed that background noise levels are those typical of an industrial land use area, ranging from 50 to 65 decibels, A-weighted (EPA 1974).

4.2.13 Environmental Justice

As seen in **Figure 4–39**, Nellis Air Force Base (the host installation for the RSL) directly borders several block groups where the low-income population is between 11 and 20 percent, and additional block groups in the 21–30 and greater-than-30 percent range are located further to the southwest. RSL is located in an area where the majority of block groups have minority populations exceeding 50 percent (see **Figure 4–40**).

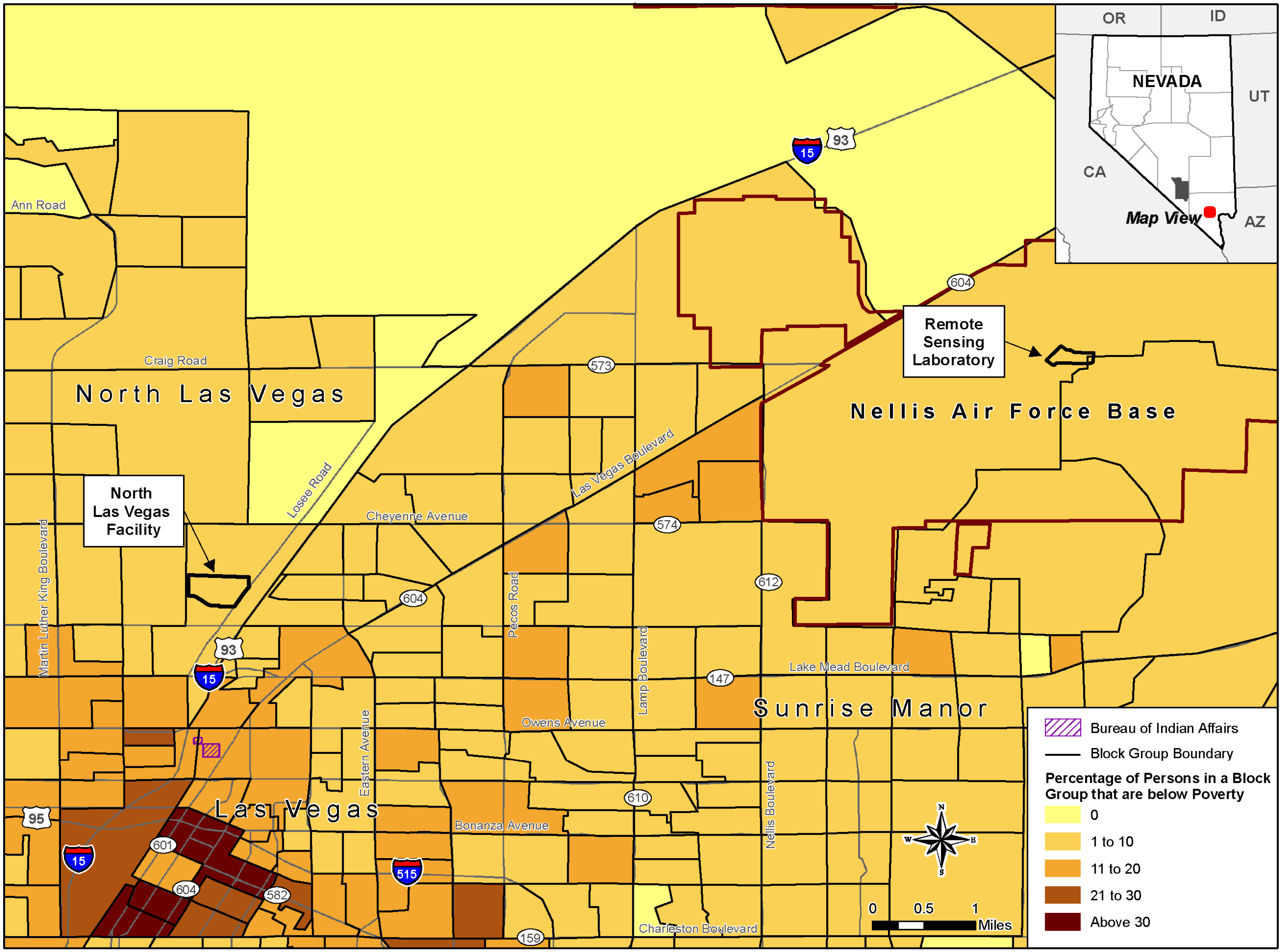


Figure 4–39 Distributions of Low-Income Populations for the North Las Vegas Facility and Remote Sensing Laboratory

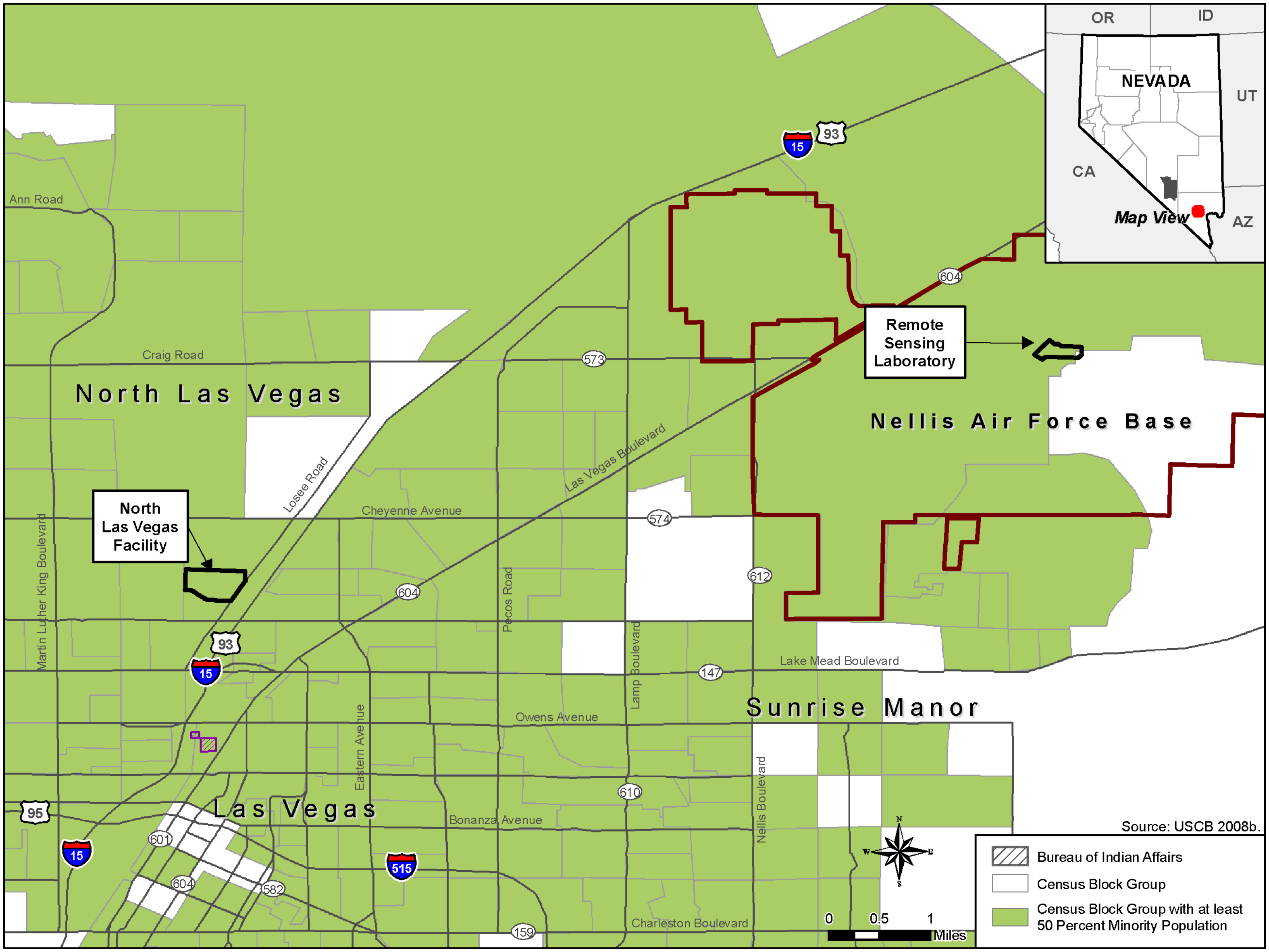


Figure 4–40 North Las Vegas Facility and Remote Sensing Laboratory Distributions of Minority Populations Greater than 50 Percent

4.3 North Las Vegas Facility

This section describes the existing environmental conditions at NLVF. NLVF is located in North Las Vegas, Nevada, and occupies 80 acres along Losee Road, about 0.2 miles west of Interstate 15 (Las Vegas Freeway) and a railroad corridor. Many of the NNSS project management, diagnostic development and testing, designing, engineering, procurement, and environmental compliance activities take place at NLVF. The DOE/NNSA NSO support facility is also located within NLVF. Public access to NLVF is restricted (DOE 2008i).

4.3.1 Land Use

NLVF consists of 30 buildings, parking lots or paved surfaces, and one trailer within the fenced complex. The existing structures account for 665,988 gross square feet of developed space. Buildings A-1 and C-3 provide space for communications, test fabrication and assembly, radiography, and other diagnostics. Building A-1 houses machine shops and overhead cranes that would be essential if nuclear tests were conducted in the future. Building C-3 houses a laboratory, stockpile stewardship experimental facilities, and readiness assets (DOE 2009f). The property is located within a heavy industrial land use area, and the property is zoned for general industry.

4.3.1.1 Adjacent Land Use

The primary land uses adjacent to NLVF are industrial and include manufacturing, processing, warehousing, storage, shipping, and other uses similar in function or intensity. Secondary uses include office uses and commercial uses supporting industrial development.

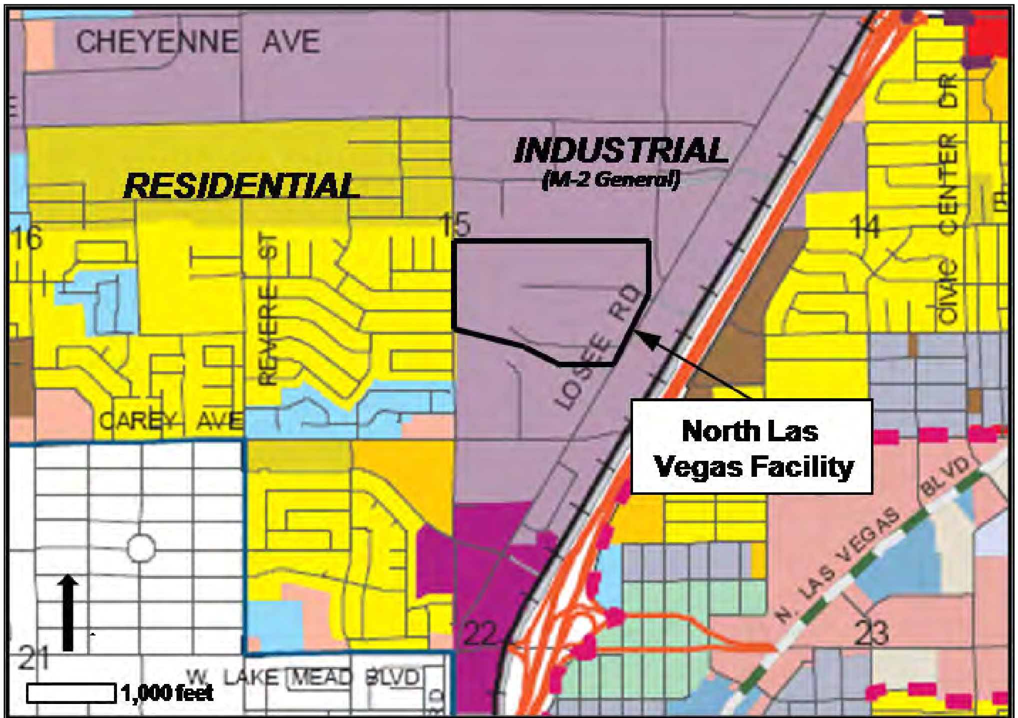
With the exception of the residential area just west of the NLVF western boundary, across North Commerce Street, the land uses adjacent to NLVF consist primarily of businesses in the manufacturing and distribution sectors, with warehouse and office buildings occupying the properties. Products manufactured in this area include automobile engines and transmissions, electrical equipment, and component parts.

The City of North Las Vegas manages land use. Regulations are imposed on the city through the North Las Vegas *2006 Comprehensive Plan*, adopted in 2006. This plan establishes policy and guiding principles for the city for the next 20 years, including a balanced land use mix, a diverse economic base, and thriving and attractive commercial and business centers. Leaders use this plan to help them make decisions about development, programs, and investments in the city. This plan identifies three Specific Planning Areas (SPAs) to help implement and achieve goals of the City of North Las Vegas. The three types of SPAs are as follows (NLV 2006):

- Residential neighborhoods – includes older neighborhoods, areas still under construction and areas yet to be developed
- Activity centers – includes areas planned for mixed-use development, which will serve as key areas of social, commercial, and employment activity for the community
- Employment districts – includes the industrial and primary employment corridors within the city of North Las Vegas and the lands planned for these uses in the future

NLVF is zoned for a general industrial district (M-2) and is within the Employment District SPA, and specifically, within the Industrial District. The M-2 designation provides an area for the development of uses that would not be compatible with those in most other zoning districts because of the nature of the operations, appearance, traffic generation, or emissions associated with industrial activities. These activities are necessary and desirable to the city and are typically located in close proximity to each other (NLV 2010).

Figure 4–41 depicts NLVF and zoning in the city of North Las Vegas.



Source: NLV 2006.

Figure 4–41 Zoning in the City of North Las Vegas and the North Las Vegas Facility

4.3.2 Infrastructure and Energy

4.3.2.1 Infrastructure and Utilities

NLVF facilities are divided into three distinct areas. The first area covers 20 acres and supports the Lawrence Livermore National Laboratory test program. The second area covers 20 acres and supports the Los Alamos National Laboratory test program. The third area covers 38.3 acres and supports a computer center and administrative and engineering support facilities.

4.3.2.1.1 Infrastructure

This section discusses the NLVF buildings and transportation infrastructure; potable water, wastewater, and communications utilities; and support services, including law enforcement and security, fire protection, and health care. Further transportation-related information is discussed in Section 4.3.3. Solid waste collection is discussed in Section 4.3.11. Energy systems (electricity, natural gas, and liquid fuels) are discussed in Section 4.3.2.2.

Facilities. NLVF is a fenced complex composed of 30 buildings (including one trailer), with a total of 665,988 square feet of floor space. **Table 4–60** presents this space according to building function.

Table 4–60 North Las Vegas Facility Building Floor Space by Function

Function	*Floor Space (square feet)*
Administrative	444,090
Storage	22,179
Industrial/Production/Process	58,969
Research and Development	136,079
Service Buildings	4,023
Other	648
Total	665,988

Source: NNSA/NSO 2009b.

Transportation Systems. NLVF consists of a network of approximately 4,000 feet of roadway providing access to the buildings and parking lots. These roads and parking lots are in poor condition and will require replacement or rehabilitation in the near future. There are no railroads or aircraft facilities at NLVF.

4.3.2.1.2 Utilities

Water Supply. Potable water at NLVF is adequately supplied from city services by the Las Vegas Valley Water District (DOE 2008f). NLVF conserves water by using only desert landscaping, which requires minimal use of potable water.

Wastewater Collection and Treatment Systems. NLVF wastewater is discharged to existing municipal sewage systems of the City of North Las Vegas. NLVF holds National Pollutant Discharge Elimination System (NPDES) Permit NV0023507 and Class II Wastewater Contribution Permit VEH-112 (DOE 2008k).

Communication Systems. NLVF has standard communications infrastructure, including telephone, internet, data transmission and storage, radio systems, etc. The telephone communication systems equipment was installed over 20 years ago and is functional but less than adequate; however, some upgrades have been recently installed. Projects are currently under way to modernize NLVF data movement needs.

4.3.2.2 Energy

4.3.2.2.1 Electrical Energy

Electrical energy at NLVF is supplied by NV Energy from the Miller Substation. The main switch is 12.47 kilovolts at 1,200 amperes. The power is distributed throughout the site through an underground distribution system to multiple pad-mounted switches and step-down transformers, where it is transformed to usable 480-volt power (NSTec 2010i). In FY 2009, NLVF's electrical usage was 15,447 megawatt-hours (NNSA/NSO 2010b). The peak demand recorded in 2008 and 2009 was approximately 3,200 kilowatts, recorded in August 2008 during on-peak afternoon hours.

NNSA has met the requirements for installing electrical meters (as set forth in Section 103 of the Energy Policy Act of 2005) for 90 percent of the electricity used by NNSS and NLVF (NSTec 2011c). The metering allows for better tracking of NLVF's use of electricity, water, and gas, thus improving its ability to identify conservation opportunities.

As part of energy conservation efforts under Energy Saving Performance Contract funding, buildings at NLVF have been retrofitted with low-energy light fixtures. All NLVF buildings are equipped with an energy management system that controls lighting and heating, ventilation, and air conditioning 24 hours a day, 7 days a week (NSTec 2008b).

4.3.2.2.2 Natural Gas

Natural gas at NLVF is provided by Southwest Gas Corporation via 2-inch-high pressure gas lines (NSTec 2010i). In FY 2009, the North Las Vegas Complex used 25,947 therms and the Nevada Site Facility (part of the North Las Vegas Complex) used 22,226 therms, for a total natural gas usage of 48,173 therms at NLVF (NNSA/NSO 2010b). There is adequate capacity to serve current demands, and the condition of the gas lines is satisfactory.

4.3.2.2.3 Liquid Fuels

NLVF maintains liquid-fueled boilers and emergency generators. There are currently two liquid fuel storage tanks at NLVF: a diesel tank (267 gallons) and a gasoline tank (391 gallons) (NSTec 2010i; DOE 2008k).

4.3.3 Transportation

4.3.3.1 Onsite Transportation

As shown in **Figure 4–42**, Atlas Drive and Energy Way provide access from Losee Road to NLVF; security gates are located on these roadways. Energy Way provides the main access point for personnel. Paved roads and parking lots at the facility are deteriorating and require replacement or rehabilitation (DOE 2007c).

4.3.3.2 Regional Transportation

NLVF is located on Losee Road, which is adjacent and parallel to Interstate 15 to the east. Traffic volumes and levels of service on roadways in the Las Vegas metropolitan area are discussed in Section 4.1.3.2.2. Traffic volumes on Losee Road are presented in Table 4–11; this roadway experiences moderate levels of daily traffic volumes and is currently operating at level of service B near NLVF.

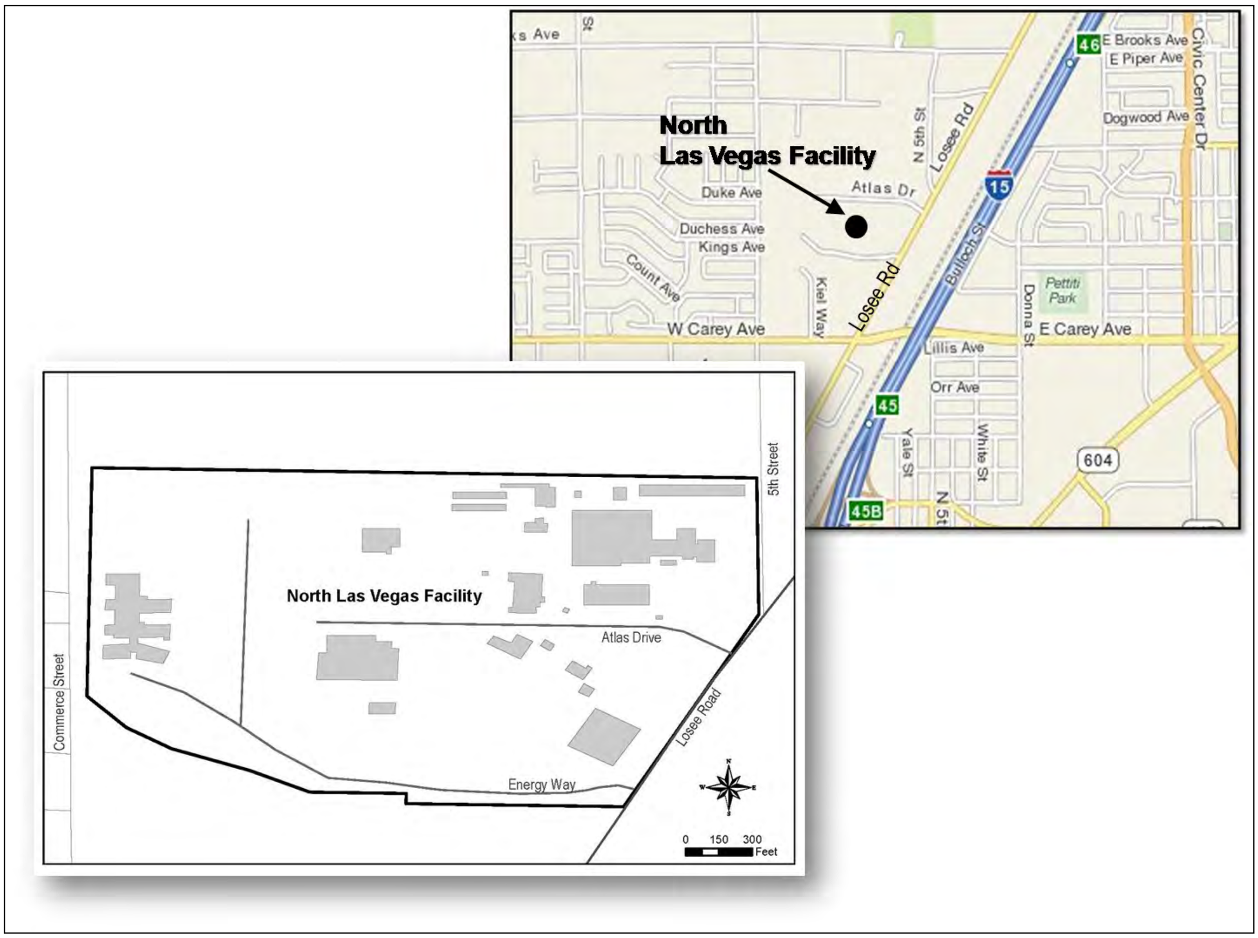


Figure 4–42 North Las Vegas Facility Roadways

4.3.4 Socioeconomics

General existing socioeconomic conditions within the ROI of NLVF (Clark County) are presented in Section 4.1.4.

Police Protection. NLVF is a controlled-access area. WSI, a private contractor, provides security enforcement at NLVF, following guidelines established by DOE/NNSA NSO Safeguards and Security.

Law enforcement at NLVF is provided by the North Las Vegas Police Department.

Fire Protection. Fire protection is provided by the North Las Vegas Fire Department.

Health Care. NLVF has a fully operational occupational medicine center with diagnostic and laboratory support facilities. The center offers a complete array of certification and surveillance exams and has rooms for urgent care, Employee Assistance Program, and ergonomic services. This occupational medicine center can respond to normal and emergency medical situations in North Las Vegas.

4.3.5 Geology and Soils

4.3.5.1 Physiography

NLVF is located in the northern section of the city of Las Vegas. As it is also located in the Las Vegas Valley, the physiography is similar to that described for RSL in Section 4.2.5.1. The facility property has been graded for the construction of its buildings; however, there is a slight grade from west to east. The elevation at the site is approximately 2,000 feet above sea level. The location is surrounded by other urban lands that have also been graded.

4.3.5.2 Geology

NLVF is located on alluvial sediments eroded from the surrounding mountain ranges, as described in Section 4.2.5.2. Although the sediment depth becomes shallower closer to the edges of the valley, the alluvial deposits for most of the valley are at least 0.62 miles deep (Rodgers et al. 2005).

4.3.5.2.1 Structural History

Section 4.2.5.2.1 presents the structural history for the Las Vegas Valley, which includes NLVF. NLVF is located approximately 4.8 miles from the Eglington Fault scarps in northwestern Las Vegas.

4.3.5.2.2 Faulting and Seismic Activity

Section 4.2.5.2.2 presents the faulting and seismic activity for the Las Vegas Valley, which includes NLVF.

4.3.5.2.3 Geotechnical Hazards

The geotechnical hazards would be similar to those discussed in the NNSS and RSL discussions. NLVF is located well within the city boundaries and away from the mountain ranges. Gypsum can generate electrochemical reactions in normal concrete, so foundations for new structures would require concrete resistant to sulfate corrosion (USDA 1985). The presence of several inches of hardpan indicates that heavy machinery would be required for deep excavation.

4.3.5.2.4 Geologic Resources

There are no geologic resources at NLVF.

4.3.5.3 Soils

Soils surveys of the area show that soils at NLVF range from stiff to very stiff, silty and sandy clay, and clay with interbedded medium-dense clayey and silty sand. These soils have been determined acceptable for standard construction (DOE 1996c).

NLVF is located in an urban location, where the soils have previously been disturbed. Two soil associations are found at NLVF. Neither is classified as prime farmland soil. Approximately 60 percent of the site is Las Vegas-McCarran-Grapevine Complex on 0 to 4 percent slopes. The Las Vegas-McCarran-Grapevine Complex is a sandy loam, typically found in basin floor remnants. The soil complex contains three soil associations that are typically too intermingled to define individually. The soil develops in alluvium from limestone, sandstone, and lake bed sediments. The soil profile can be shallow to deep but is generally well drained. The upper section of the soil is typically brown fine, sandy loam that gradually becomes coarser at the bottom. A root-restricting later of hardpan gypsum or lime can be found within approximately 11 inches of the surface (USDA 1985).

The rest of the soils at NLVF constitute Skyhaven very fine sandy loam on 0 to 4 percent slopes. The Skyhaven association is a moderately deep, well-drained soil found on relic alluvial flats. The soil consists of fine, sandy loam over light-brown clay loam that becomes coarser at depth. The soil forms on a variety of rock parent materials, as long as they are rich in lime. A root-constricting layer of lime-cemented materials is found within 15 inches of the surface (USDA 1985).

4.3.5.4 Radiological Sources as a Result of Testing

There has been no nuclear testing at NLVF; therefore, soils are not contaminated with radioactive materials.

4.3.6 Hydrology

4.3.6.1 Surface Hydrology

NLVF is located in the Las Vegas Valley, which has a drainage area of 2,200 square miles in a desert region between sharp, rugged mountain ranges. The lowest point of the valley is the Las Vegas Wash, which drains the area toward Lake Mead (NPS 2001).

Surface-Water Features. There are no surface-water features located at or in close proximity to NLVF.

Flood Hazards. The Federal Emergency Management Agency Flood Insurance Rate Map covering NLVF (Map Number 32003C2160 E) indicates that the facility is located within Zone X. Zone X indicates an area of minimal flood hazard, which is determined to be above the 500-year flood level. There is an area approximately 500 feet north of the facility noted as Zone A, which indicates this location has a 1 percent chance of flooding annually (i.e., a 100-year floodplain) (FEMA 2002a).

Water Discharges and Regulatory Compliance. NLVF has an extensive storm drainage system, consisting of a retention basin, a network of slotted drains, storm drains of reinforced concrete pipe, directed sheetflow, and manmade channels. Stormwater pollution prevention is managed through a variety of measures including, but not limited to, general good housekeeping; spill prevention and response measures (including the implementation of a spill prevention, control, and countermeasures plan); sediment and erosion control measures; and employee training and education (DOE n.d.). NLVF has a "No Exposure Certification" for exclusion from NPDES stormwater permitting, which is afforded to certain facilities where potential contamination sources are protected from exposure to precipitation (Radack 2009).

Wastewater permits for NLVF include a Class II Wastewater Contribution Permit (Permit Number VEH-112) from the City of North Las Vegas for discharges to the city sewer system. This permit specifies concentration limits for contaminants in the wastewater discharges. In 2010, no exceedances of permit limits occurred at either of the two outfalls to the city sewer system (DOE/NV 2011) (see **Table 4–61**).

NLVF also operates under an NPDES permit (Permit Number NV0023507) issued by EPA, which is used for dewatering operations to control rising groundwater levels that surround the facility. Four dewatering wells pump groundwater into a storage tank. The permit allows for the discharge of water from the storage tank to groundwater via percolation, when used for landscape irrigation and dust suppression, and into the Las Vegas Wash via direct discharge into the City of North Las Vegas stormwater drainage system. In accordance with permit requirements, water chemistry analyses are performed quarterly, annually, and biennially for samples collected from the storage tank. In 2010, no permit limits were exceeded (see **Table 4–62**) (DOE/NV 2011).

Table 4–61 Water Quality Results for North Las Vegas Facility Sewer Discharges in 2010

Contaminant	Permit Limit	Outfall A	Outfall B
Ammonia (ppm)	61.0	48.5	22.5
Arsenic (ppm)	2.3	0.00146 [a]	<0.003
Barium (ppm)	13.1	0.140	0.195
Beryllium (ppm)	0.02	<0.00025	0.0000621 [a]
Cadmium (ppm)	0.15	0.000307 [a]	<0.0025
Chromium (hexavalent) (ppm)	0.10	<0.02	0.06
Chromium (total) (ppm)	5.60	<0.001	<0.001
Copper (ppm)	0.60	0.086	0.285
Cyanide (total) (ppm)	19.9	<0.005	<0.005
Lead (ppm)	0.20	<0.0015	<0.0015
Mercury (ppm)	0.001	<0.000066	0.00013
Nickel (ppm)	1.10	0.00301 [a]	0.00348 [a]
Oil and Grease (animal or vegetable) (ppm)	250	<10.0	<10.0
Oil and Grease (mineral or petroleum) (ppm)	100	<10.0	<10.0
Organophosphorous or Carbamate Compounds (ppm)	1.0	0.168	0.168
pH (Standard Units)	5.0–11.0	8.22	7.93
Phenols (ppm)	33.6	<0.05	<0.05
Phosphorus (total) (ppm)	0.50	4.48	4.61
Selenium (ppm)	2.70	<0.0025	<0.0025
Silver (ppm)	8.20	<0.00075	<0.00075
Zinc (ppm)	13.1	0.176	0.264

< = less than; pH = a measure of acidity or basicity; ppm = parts per million.
[a] Estimated concentration; the concentration between the method detection limit and the method reporting limit.
Note: Permit limits set forth in City of North Las Vegas Class II Wastewater Contribution Permit (Permit Number VEH-112).
Source: DOE/NV 2011, Table A-2.

Table 4–62 Water Quality Results for North Las Vegas Facility Dewatering Operations Measured at Water Storage Tank in 2010

Parameter	Sample Frequency	Permit Limit	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
Daily Maximum Flow (MGD)	Continuous	0.005184	0.002486	0.002238	0.002342	0.002401
Total Petroleum Hydrocarbons (ppm)	Annually (4th Quarter)	1.0	NS	NS	NS	ND
Total Suspended Solids (ppm)	Quarterly	135	ND	ND	ND	ND
Total Dissolved Solids (ppm)	Quarterly	1,900	975	985	995	963
Total Inorganic Nitrogen as N (ppm)	Quarterly	20.0	1.38	0.165	0.929	0.965
pH	Quarterly	6.5–9.0	7.81	7.70	8.22	7.64
Tritium (pCi/L)	Annually (4th Quarter)	MR	NS	NS	NS	ND

MGD = million gallons per day; MR = monitor and report; ND = not detected; NS = sample not required that quarter; pCi/L = picocuries per liter; pH = a measure of acidity or basicity; ppm = parts per million.
Note: Permit limits set forth in U.S. Environmental Protection Agency National Pollutant Discharge Elimination System permit (Permit Number NV0023507).
Source: DOE/NV 2011, Table A-3.

4.3.6.2 Groundwater

Hydrogeologic Setting. NLVF is located within the center region of the Las Vegas Valley Hydrographic Basin, an intermountain basin within the Basin and Range Physiographic Province. The Las Vegas Valley Hydrographic Basin is approximately 1,600 square miles, with an estimated perennial yield of 25,000 acre-feet per year (NDWR 2010b). The basin is bordered by Spring Mountains (west), Frenchman Mountains (east), the McCullough Range (south), and the Sheep Range (north). Groundwater flow within the Las Vegas Valley is generally from west to east (USAF 2007c).

Groundwater Supply. All of the utility service lines at the NLVF complex (i.e., power, water, sewage, and natural gas) are owned by DOE/NNSA. NLVF receives its potable water from the Las Vegas Valley Water District, which is a member agency of the Southern Nevada Water Authority (SNWA). Southern Nevada gets nearly 90 percent of its water from the Colorado River. The other 10 percent comes from groundwater that is obtained from production wells in Clark County (LVVWD 2010b). Groundwater comes from three major aquifer zones (underground rock or sediment that is permeable and can conduct water) of the Las Vegas Valley aquifer, generally situated from 300 to 1,500 feet below land surface. Groundwater in the Las Vegas Valley aquifer is naturally recharged from precipitation in the Spring Mountains and the Sheep Range. This drinking water supply is protected from surface contamination by a layer of clay and fine-grained sediments throughout most of the Las Vegas Valley (LVVWD 2010a).

Groundwater Monitoring and Quality. EPA sets national standards for drinking water to protect public health. SNWA requires public drinking water systems to meet these health-based water standards and send customers an annual water quality report. While EPA requires water systems to monitor for approximately 90 regulated contaminants, the Las Vegas Valley Water District monitors for these contaminants as well as about 30 additional unregulated contaminants. Water delivered by the Las Vegas Valley Water District meets or surpasses all Federal and state drinking water standards (LVVWD 2009).

The water table at NLVF occurs at shallow depths ranging from approximately 13 to 50 feet from ground surface. In 1995, a release of tritium occurred in the basement of Building A-1, resulting in the contamination of groundwater that was not discovered until 1999 (Radack 2010b). Remediation was initiated in 2001, when a sump well was installed in the basement of Building A-1. The sump well was used to capture contaminated groundwater until 2002, when remedial operations were completed. All contaminated groundwater was disposed at the NNSS Area 5 sewage lagoon. In early 2003, the sump well was again used intermittently to support NLVF's Dewatering Program. The Dewatering Program was established to control encroaching groundwater beneath Building A-1 (DOE/NV 2011). Although the levels of tritium are now one-tenth of the SNWA limit, water that is pumped from the sump well is disposed at the NNSS Area 5 sewage lagoon in the winter months and is evaporated through swamp coolers located at NLVF during the summer months (DOE/NV 2011; Radack 2010a).

Under the NLVF Dewatering Program, water table elevation monitoring is conducted at 12 monitoring wells, and water levels are monitored continuously at the sump well in Building A-1. In addition, the total volume of groundwater discharged and groundwater chemistry are monitored in accordance with the NPDES permit (NV0023507) (DOE/NV 2011; Radack 2010a).

Groundwater Control. In 1999, groundwater intruded into the elevator pit of Building A-1 (DOE/NV 2008a). As a result of this groundwater intrusion, DOE/NNSA initiated groundwater studies and eventually instituted a Dewatering Program to control rising groundwater levels surrounding the facility. Groundwater studies conducted in 2002 and 2003 revealed a complex hydrogeologic setting. Borehole data from the studies indicate that fine-grained sediments represent a low-energy, mid-valley alluvial and fluvial environment. Individual lithologic units are complexly interbedded, and several normal faults have been mapped in the vicinity.

The hydrogeologic setting suggests that the source of the rising groundwater is water flowing upward along local faults from deeper confined aquifers. This condition is considered a long-term adjustment that can be attributed to a combination of causes, including a seasonal water injection program conducted by SNWA and shifting of regional pumping centers away from the vicinity of NLVF (Bechtel Nevada 2005).

The Dewatering Program at NLVF is regulated under an NPDES permit (NV0023507), which establishes contaminant and discharge limitations. Dewatering wells (NLVF-13, -15, -16, and -17) pump groundwater into a 10,500-gallon storage tank. The permit allows for the discharge of water from the storage tank to groundwater via percolation, when used for landscape irrigation and dust suppression, and into the Las Vegas Wash via direct discharge into the City of North Las Vegas stormwater drainage system (see Section 4.3.2.1.2 for more information regarding discharges). In accordance with the permit, sampling and analyses of discharge water are performed quarterly, annually, and biennially (DOE/NV 2011).

Discharge rates have not exceeded NPDES permit limits. In 2008, the four dewatering wells produced a total of 2,553 gallons per day (average daily flow) that were directed into the storage tank. The pumping rates varied from 0.72 to 0.24 gallons per minute. The average combined discharge from all four wells was about 78,000 gallons per month (DOE/NV 2009d).

4.3.7 Biological Resources

NLVF is in the Southern Basin and Range Ecoregion. It was built on cleared, previously disturbed land that now consists of an urban setting that includes buildings, pavement, and landscaping. No original undisturbed native vegetation remains on the site. Current vegetation at NLVF consists of urban landscape. Few wildlife species exist at NLVF because it is located in an urban area and contains little vegetation.

4.3.7.1 Flora

This facility is located in an urban setting; no native vegetation within a natural setting occurs at this site.

4.3.7.2 Fauna

This facility is located in an urban setting; only urban-adapted wildlife occurs at this site. Wildlife species would be similar to those described in Section 4.2.7.2 for RSL.

4.3.7.3 Threatened and Endangered Species

NLVF is located in urban Las Vegas, Nevada, on previously disturbed land within a fenced site. No threatened, endangered, or rare species are expected to exist at this site. No designated critical habitats for federally listed species exist at NLVF. The urban areas of Clark County are not considered tortoise habitat.

4.3.7.4 Other Species of Concern

No other species of concern inhabit NLVF.

4.3.7.5 Effects of Past Radiological Tests and Project Activities

This facility is located in an urban setting; no past radiological tests or project activities are anticipated to affect wildlife or vegetation at this site.

4.3.8 Air Quality and Climate

4.3.8.1 Meteorology

Downtown Las Vegas is located in Clark County, Nevada, about 56 miles southeast of the southeastern edge of the NNSS. NLVF is about 10 miles northeast of downtown. The facility is located in the Las Vegas Valley, which is situated in the northeastern corner of the Mojave Desert and in the rain shadow (lee) of the southern Sierra Nevada mountain range.

The Las Vegas Valley has the general climatic characteristics of a mid-latitude desert area, with relatively little precipitation throughout the year and low humidity, large diurnal and seasonal temperature ranges, and intense solar radiation in the summer. The generally dry desert conditions specific to the area can occasionally be modified by the southwestern monsoon and convective thunderstorms during the summer months and Eastern Pacific tropical storm remnants in the late summer and fall. The dry conditions can also be moderated by strong *El Niño* cycles, which generally bring more rainfall to the area.

The Las Vegas Valley ranges in elevation from about 2,300 to 2,620 feet above mean sea level and is bounded by mountains to the north, south, and especially to the west, where the Spring Mountains peak above about 6,560 feet. This terrain causes wind flows in the Las Vegas Valley to be dominated by upslope and downslope conditions. The Clark County DAQEM maintains an ambient monitoring site (the J.D. Smith monitor, at 1301 East Tonopah Road) near the North Las Vegas Campus. For more information regarding the meteorological characteristics of NLVF, see Appendix D, Section D.1.2.1.

4.3.8.2 Ambient Air Quality

4.3.8.2.1 Region of Influence

NLVF is located about 55 miles southeast of the NNSS. The ROI for air quality and climate for NLVF operations comprises northern Clark County. Historic data on pollutant emissions inventories and compliance status for the State of Nevada are calculated at the resolution of county or hydrographic areas. These data provide a basis for determining existing air quality in the ROI and a metric for emission comparison assessments.

4.3.8.2.2 Existing Air Quality

Ambient Air Quality Standards. See Section 4.1.8.2.2 for a discussion on the current national and Nevada ambient air quality standards.

Air Quality Status. NLVF is within Hydrographic Area 212. Clark County is in nonattainment for 8-hour ozone[28] and 24-hour $PM_{10.}$[29] Clark County is no longer in nonattainment for 8-hour carbon monoxide.[30] All other pollutants are in attainment.

PSD is a regulation incorporated into CAA that limits increases of certain pollutants in clean air areas (attainment areas) to certain increments even though ambient air quality standards are being met. CAA has three classes of areas with different increments. The smallest increments allowed are Class I areas, which are areas of special value (natural, scenic, recreational, or historic). Any degradation of existing air quality in these areas should be minimized. The closest PSD Class I areas are Grand Canyon National Park (about 65 miles to the east) and Sequoia National Park (about 165 miles to the west). NLVF currently has no sources of pollution large enough to be subject to PSD requirements. However, because NLVF is located in a nonattainment area, it could potentially be subject to nonattainment new source review if the emissions were of sufficient strength; however, they have been determined not to meet the threshold for new source review. Nonattainment new source review requirements are customized for the classification and type of air pollutant nonattainment area.

[28] *Classified as marginal for 8-hour ozone under former Subpart 1 with a nonattainment area that includes those portions of Clark County that lie in Hydrographic Areas 164A, 164B, 165, 166, 167, 212, 213, 214, 216, 217, and 218, but excludes the Moapa River Indian Reservation and the Fort Mojave Indian Reservation. However, on March 29, 2011, EPA made the determination that Clark County is in attainment with 1997 ozone NAAQS (76 FR 17343). EPA is expected to redesignate the area's status to attainment upon approval of the Ozone Redesignation Request and Maintenance Plan submitted to EPA Region 9 in early April 2011.*

[29] *Designated as serious nonattainment for $PM_{10.}$ The nonattainment area covers Hydrographic Area 212. However, on August 3, 2010, EPA made the determination that the Las Vegas Valley is in attainment with the PM_{10} NAAQS based on monitoring data (75 FR 45485). EPA is expected to redesignate the area's status to attainment upon approval of the maintenance plan and request for redesignation that Clark County is expected to submit.*

[30] *A CO Maintenance Plan and formal request for resdesignation to attainment was submitted to the EPA in 2008 and approved on September 7, 2010 (75 FR 59090).*

Emissions Due to NLVF Operations. Title V of CAA gives states the authority to use air quality permits to regulate stationary source emissions of criteria pollutants. At NLVF, a Source 657 Authority to Construct/Operating Permit regulates emissions from sources such as an aluminum sander, an abrasive blaster, emergency generators, boilers, cooling towers, and a spray paint booth. The emissions of carbon monoxide, nitrogen oxides, PM_{10}, sulfur dioxide, volatile organic compounds, and hazardous air pollutants were each less than 1 ton annually from 2003 through 2008 for these permitted facilities. Total emissions of these pollutants over this 6-year period are about 4.4 tons (DOE 2004b, 2005b, 2006a, 2007b, 2008j, 2009c).

Table 4–63 shows the onsite emissions due to stationary sources, as well as emissions due to NLVF commuters, commercial vendors, and radioactive waste trucks in Clark County and in Nye County both on the NNSS and off the NNSS, where appropriate. The onsite stationary sources include both permitted sources and natural gas combustion for heating. See Appendix D, Section D.3.2.1, for more information on mobile and stationary source emission methodology.

Measurements of Ambient Air Concentrations on and near NLVF. The Clark County DAQEM maintains an air quality monitoring network throughout Clark County. The J.D. Smith monitor (at 1301 East Tonopah Road) is located about 1 mile northwest of NLVF. It monitors hourly ozone, carbon monoxide, and nitrogen dioxide levels and daily PM_{10}, and $PM_{2.5}$ levels. **Table 4–64** shows these results along with the highest sulfur dioxide value monitored in the Las Vegas Valley. Note that at least 25 percent of the 2008 observations were missing, so the maximum concentrations could potentially be higher than what is shown for that year. The ambient air quality standards are also shown in the table. See Table 4–40 for more information on the standards.

Ozone measurements at the J. D. Smith monitor (at 1301 East Tonopah Road) exceeded the 8-hour ozone NAAQS in 2006 and 2007. The largest 8-hour ozone concentration was 0.081 ppm (in 2006), which is 0.006 ppm larger than the current NAAQS of 0.075 ppm. Maximum ambient ozone concentration levels have generally remained constant at this level and other nearby monitors since at least 1998 (DAQEM 2009).

PM_{10} measurements at the J.D. Smith monitor (at 1301 East Tonopah Road) indicated that the second-highest 24-hour average PM_{10} concentration was 136 micrograms per cubic meter (in 2006), which is 14 micrograms lower than the NAAQS of 150 micrograms per cubic meter. Although this 24-hour PM_{10} concentration is below the NAAQS, other monitoring locations within the Las Vegas Valley exceed the standard and the entire valley has been designated as nonattainment for PM_{10}. The largest annual average PM_{10} concentration was 33 micrograms per cubic meter (in 2006), which is well below the Nevada ambient air quality standard of 50 micrograms per cubic meter (there is no national PM_{10} annual average standard).

All other criteria pollutants are well below NAAQS. No lead monitoring data are available for the Las Vegas Valley.

Table 4–63 Estimated 2008 Air Emissions of Criteria Pollutants and Hazardous Air Pollutants Due to North Las Vegas Facility Activities

	Annual Air Emissions (tons/year)											
	Stationary Sources	***NLVF Commuters***		***Commercial Vendors***	***Radiological Waste Trucks***			***Total***				
	Clark County	***Clark County***	***Nye County***	***Clark County***	***Clark County***	***Nye County***		***Clark County***		***Nye County***		
Pollutant	***On-NLVF***	***Off-NLVF***	***Off-NNSS***	***Off-NLVF***	***Off-NLVF***	***On-NNSS***	***Off-NNSS***	***On-NLVF***	***Off-NLVF***	***On-NNSS***	***Off-NNSS***	***Total***
PM_{10}	0.037	0.25	0.0015	0.19	0.0051	0.00032	0.00048	*0.037*	*0.45*	*0.00032*	*0.0020*	***0.48***
$PM_{2.5}$	0.037	0.13	0.00086	0.17	0.0048	0.0003	0.00045	*0.037*	*0.30*	*0.00030*	*0.0013*	***0.34***
CO	0.19	25.5	0.16	0.76	0.02	0.0013	0.0019	*0.19*	*26.3*	*0.0013*	*0.16*	***26.6***
NO_x	0.73	6.2	0.042	1.7	0.069	0.0045	0.0068	*0.73*	*8.0*	*0.0045*	*0.049*	***8.8***
SO_2	0.017	0.069	0.00039	0.0032	0.000098	0.0000062	0.0000094	*0.017*	*0.072*	*0.0000062*	*0.00040*	***0.090***
VOCs	0.028	0.51	0.0032	0.25	0.0033	0.00021	0.00032	*0.028*	*0.76*	*0.00021*	*0.0035*	***0.80***
Lead	<0.01	<0.01	<0.01	0.0000029	<0.01	<0.01	<0.01	*<0.01*	*~0.020*	*<0.01*	*<0.01*	***~0.060***
Criteria Pollutant Total	1.0	32.5	0.21	0.76	0.097	0.0064	0.0096	*1.0*	*33.4*	*0.0064*	*0.22*	***34.6***
HAPs	0.0026	0.04	0.00026	0.033	0.00043	0.000028	0.000042	*0.0026*	*0.073*	*0.000028*	*0.00030*	***0.076***

CO = carbon monoxide; HAP = hazardous air pollutant; NLVF = North Las Vegas Facility; NNSS = Nevada National Security Site; NO_x = nitrogen oxides; PM_n = particulate matter with an aerodynamic diameter less than or equal to *n* micrometers; SO_2 = sulfur dioxide; VOC = volatile organic compound.

Table 4–64 Ambient Air Quality Monitoring in the Vicinity of the North Las Vegas Facility, 2006–2008

Year	*2nd Max 1-hour CO (ppm)*	*2nd Max 8-hour CO (ppm)*	*Annual Mean NO_2 (ppm)*	*2nd Max 1-hour NO_2 (ppm)*	*4th Max 8-hour O_3 (ppm)*	*Max 1-hour SO_2 (ppm)*	*2nd Max 24-hour SO_2 (ppm)*	*Annual Mean SO_2 (ppm)*	*98th Percentile $PM_{2.5}$ ($\mu g/m^3$)*	*Annual Mean $PM_{2.5}$ ($\mu g/m^3$)*	*2nd Max 24-hour PM_{10} ($\mu g/m^3$)*	*Annual Mean PM_{10} ($\mu g/m^3$)*
2006	4.8	3.7	0.021	0.072	**0.081**	0.015	0.007	0.002	22.1	8.2	136	33
2007	4.5	2.8	0.020	0.066	**0.080**	0.007	0.003	0.001	19.7	8.8	110	32
2008	3.6	2.4	0.016	0.062	0.068	0.006	0.001	0.001	18.8	8.9	109	31
NAAQS	35.0	9.0	0.053	0.100	0.075	0.075	0.030	0.140	35.0	15.0	150	None

$\mu g/m^3$ = micrograms per cubic meter; CO = carbon monoxide; NAAQS = National Ambient Air Quality Standards; NO_2 = nitrogen dioxide; O_3 = ozone; PM_n = particulate matter with an aerodynamic diameter less than or equal to *n* micrometers; ppm = parts per million; SO_2 = sulfur dioxide.

Note: Monitored values are from the J.D. Smith monitor (at 1301 East Tonopah Road), except for SO_2, which was the highest monitored value in the Las Vegas Valley.

All exceedances of the NAAQS are shown in bold font.

Source: EPA 2010a.

4.3.8.3 Radiological Air Quality

Direct radiation monitoring is conducted near Buildings A-1 (Source Range Laboratory) and C-3 (High Intensity Source) at NLVF. These are the two locations at NLVF that currently use radioactive sources or are where radiation-producing operations are conducted. These and other historical radiation measurements show that radiological doses to the public from NLVF activities are indistinguishable from background radiation (DOE 2009e). **Table 4–65** presents the total estimated radionuclide emissions from NLVF in 2007 and 2008. Based on the 2008 emission rate of 0.011 curies, the estimated radiation dose to the nearest offsite public access point to NLVF was 0.00006 millirem per year. This is well below the NESHAPs dose limit for the general public of no greater than 10 millirem per year. **Table 4–66** presents statistics on radiation exposure measurements taken once per quarter at the NLVF boundary and control locations. These results both include and are indistinguishable from doses from natural background radiation near NLVF.

Table 4–65 Estimated Annual Air Releases of Radionuclides at the North Las Vegas Facility

	Estimated Annual Emissions (curies)	
	2007	***2008***
Tritium	0.012	0.011
Reference	DOE 2008c	DOE 2009c

Note that parts of the Building A-1 basement were contaminated with tritium in 1995. The release led to a very small potential exposure (less than 0.001 millirem per year) to an offsite person; the NESHAPs dose limit for exposure of the public is 10 millirem per year (40 CFR Part 61, Subpart H). Tritium continues to be emitted at low levels (e.g., 5.3×10^{-4} curies in 2009 [NSTec 2010b]) from the parts of the building that were exposed to the initial release (DOE 2009d).

An accidental release also occurred at NLVF in 2004; this release involved the improper disposal of tritium-contaminated water into a public sewer system. These levels were also well below the level of concern. However, in response to this incident, the DOE/NNSA NSO has developed several procedures to prevent this type of accidental discharge in the future (DOE 2005b).

4.3.8.4 Climate Change

This section describes the affected environment in terms of current and anticipated trends in greenhouse gas emissions and climate. The effects of emissions on the climate involve very complex processes and interact with natural cycles, complicating the measurement and detection of change. Recent advances in the state of the science, however, are contributing to an increasing body of evidence that anthropogenic greenhouse gas emissions affect climate in detectable and quantifiable ways.

For information on greenhouse gas emissions in the United States, please see Section 4.1.8.4.1. Greenhouse gas emissions at NLVF are discussed in the next section. Details on the methodology used to determine these emissions are discussed in Appendix D, Sections D.2.3.1.1, D.2.3.2.1, and D.2.3.3.1.

Table 4–66 Average Annual Average and Maximum Annual Average Radiation Levels Among the North Las Vegas Facility Boundary Monitors and Control Monitors Operating in a Given Year

	Radiation Level (millirem per year)											
	1997	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***
Maximum annual average	0.0808	0.0624	0.0619	0 (no data)	0 (no data)	0 (no data)	0.0640	0.0700	0.0740	0.0700	0.0740	0.0920
Annual average for all monitors	0.0610	0.0500	0.0536				0.0635	0.0653	0.0690	0.0660	0.0697	0.0917
Reference	DOE/NV 1998d, pp. 4-32 and 4-33	DOE/NV 1999, p. 4-32	DOE/NV 2000c, p. 4-31	DOE/NV 2001c, p. 1-11	DOE/NV 2002b, p. 1-11	DOE/NV 2003a, p. 1-10	DOE/NV 2004a, p. B-11	DOE/NV 2005f, p. B-11	DOE/NV 2006a, p. A-11	DOE/NV 2007d, p. A-10	DOE/NV 2008a, p. A-9	DOE/NV 2009d, p. A-8

Note: These radiation measurements are taken once per quarter year (DOE 2009e).

4.3.8.4.1 Greenhouse Gas Emissions

Table 4–67 provides greenhouse gas emissions due to NLVF-related activities for 2008. The greenhouse gas emissions are presented in carbon-dioxide-equivalent form and are partitioned by various mobile and stationary source types. These emissions were derived from fuel use, vehicle activity, and power consumption data. The greenhouse gas emissions were calculated using the EPA Climate Leaders Simplified Greenhouse Gas Emissions Calculator (EPA 2010b). These emissions were compared with a reference amount of 25,000 metric tons (27,558 tons), which is the threshold for which a quantitative assessment may be meaningful (CEQ 2010).

Electricity consumption is by far the largest single source of greenhouse gas emissions related to NLVF activities, emitting approximately 8,392 carbon-dioxide-equivalent tons of greenhouse gases, or 63 percent of the NLVF-related greenhouse gas emissions total. Stationary sources altogether emitted about 8,563 carbon-dioxide-equivalent tons of greenhouse gases. Mobile sources emitted about 4,792 tons, so that overall, NLVF-related activities created about 13,355 carbon-dioxide-equivalent tons of greenhouse gas emissions in 2008, which is about 52 percent below the threshold reporting level.

Table 4–67 Carbon-Dioxide-Equivalent Emissions of Greenhouse Gases from North Las Vegas Facility Activities in 2008

Source Type	*Carbon-Dioxide-Equivalent Emissions (tons per year)*	*Fraction of Reference Point of 25,000 Metric Tons* [a]
STATIONARY SOURCES		
Power generation	8,392	0.30
Natural gas heating	157	0.01
All stationary sources, except air conditioning/refrigeration and natural gas heating	15	0.00
All Stationary Sources	*8,563*	*0.31*
MOBILE SOURCES		
Commuting	3,896	0.14
Hazardous waste transport (nongoverment)	7	<0.01
Commercial vendors	889	0.03
All Mobile Sources	*4,792*	*0.17*
Total	***13,355***	***0.48***

[a] 25,000 metric tons are equal to about 27,558 short tons.

4.3.8.4.2 Current Changes in Climate

For a discussion of climate change impacts in the region, please see Section 4.1.8.4.2.

4.3.9 Visual Resources

The area around NLVF is highly developed, primarily with commercial and warehouse facilities. The visual environment comprises infrastructure, such as buildings, roadways, and utilities. **Figure 4–43** shows the locations from which photographs of the area around NLVF were taken and the sensitivity levels of the roadways in the area (see Section 4.1.9). Vegetation in the area is limited to street landscaping, such as palm and evergreen trees and various shrubs (see **Figure 4–44**, View 1).

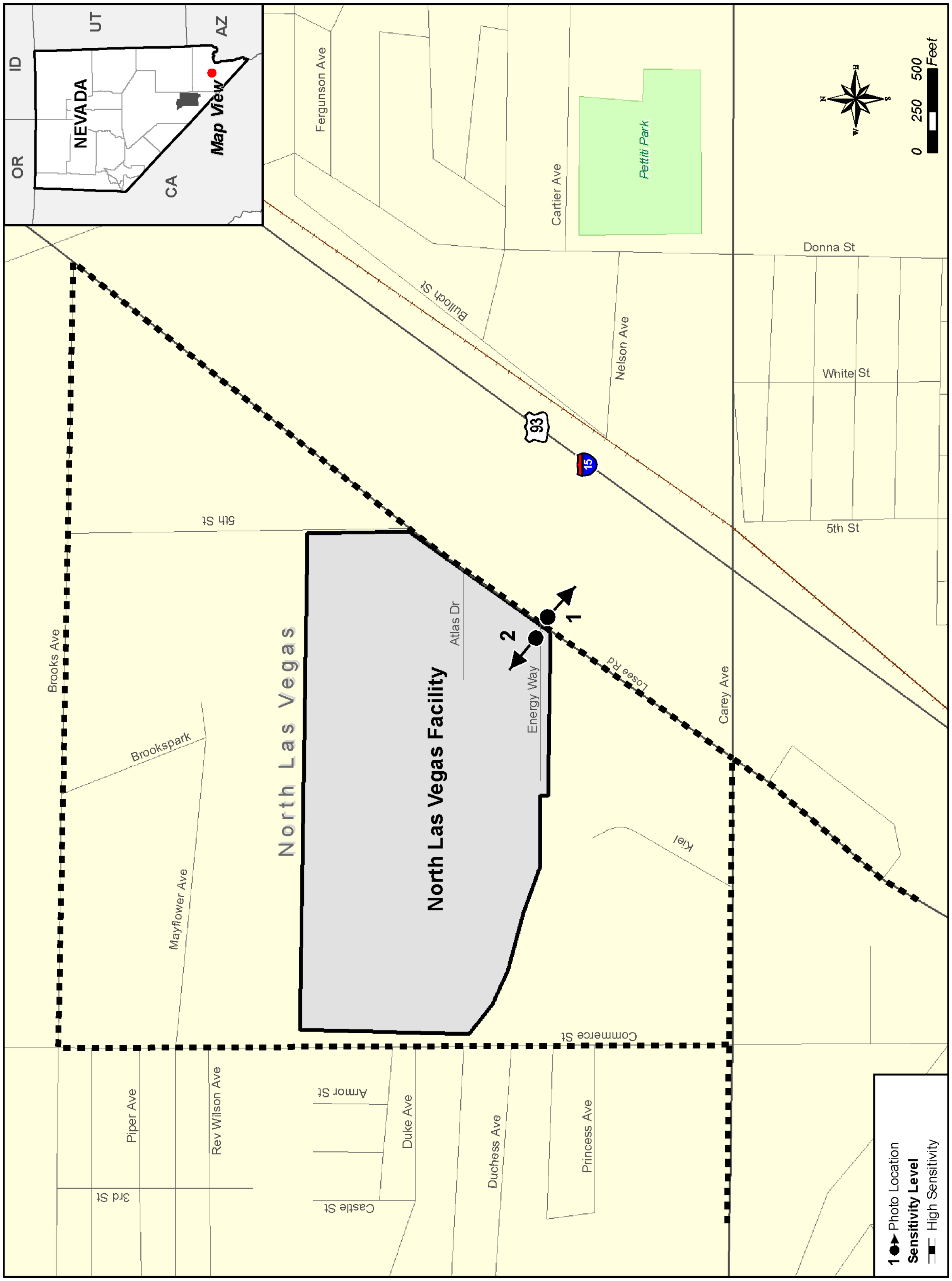


Figure 4–43 Photograph Locations and Sensitivity Levels near the North Las Vegas Facility

View 1

View 2

Figure 4–44 Landscape Photographs near North Las Vegas Facility

The areas surrounding NLVF are developed, with warehouse and commercial facilities; visual access to these areas is limited to views from public roadways and sidewalks in the area. On local streets, such as near NLVF, speed limits are lower, yet surrounding development is dense and there is much more traffic. These elements combine so views are not focused on a specific facility that is visually similar to its surroundings, but on driving and views immediate to the road corridor. There is no public visual access to the interior of NLVF (see Figure 4–44, View 2). The area is primarily visible from Losee Road and may have limited views from Commerce Street, Brooks Avenue, and 5th Street. Visible portions of the area are considered to have a Class C scenic quality rating (see Section 4.1.9 for information on the visual impact rating system) due to the developed nature of the landscape, as described above, combined with high intrusion of manmade elements and lack of elements that help to improve aesthetics, such as landscaping.

4.3.10 Cultural Resources

For introductory information regarding cultural resources, see Section 4.1.10.

NLVF is located in northern Las Vegas Valley, within the center region of the Las Vegas Valley Hydrographic Basin, an intermountain basin within the Basin and Range Physiographic Province of the United States (NDWR 2006). NLVF consists of an 80-acre complex of 30 buildings and 1 trailer located in a highly developed area zoned for generalized industrial activity. It was built on cleared, previously disturbed land that now consists of an urban setting comprising buildings, pavement, and ornamental landscaping. The area of influence at NLVF includes the entire footprint of the facility.

4.3.10.1 Recorded Cultural Resources

There are no recorded cultural resources within the boundary of NLVF.

4.3.10.2 Sites of American Indian Significance

No sites of American Indian significance have been identified within the boundary of NLVF. As part of the preparation of this SWEIS, DOE/NNSA consulted with CGTO to determine whether sites of American Indian significance exist within NLVF.

4.3.11 Waste Management

DOE/NNSA operations do not generate LLW, MLLW, or TRU waste at NLVF. DOE/NNSA does generate, however, water that is slightly contaminated with tritium and collected as air conditioning condensate from the basement sump of one of the buildings. The water is either disposed by evaporation at NLVF or transported in tanker trucks to the NNSS for disposal by evaporation in NNSS sewage lagoons (DOE/NV 2011; NSTec 2009c).

The quantities of hazardous waste that were generated at NLVF and disposed or recycled during CYs 2005 through 2008 are listed in **Table 4–68** (Duke 2009). This waste includes recycled oil and antifreeze, other hazardous waste, such as universal waste, and waste that is regulated under other regulatory authorities, such as TSCA. Hazardous wastes include universal wastes, i.e., materials such as computer equipment, batteries, and fluorescent lamps. (The Regulated Management Program for universal waste is streamlined compared to that for other hazardous wastes and emphasizes material reuse or recycle.) All hazardous and toxic wastes are disposed or recycled at offsite facilities.

Table 4–68 Annual Hazardous and Toxic Waste Disposal or Recycle Quantities for the North Las Vegas Facility (tons)

Waste	*Calendar Year*			
	2005	*2006*	*2007*	*2008*
Recycled oil and antifreeze	a	0.21	a	7.4
Other hazardous waste [b]	0.57	0.98	0.34	1.36
Other waste [c]	a	a	a	0.26

[a] Not reported for this year.
[b] Hazardous waste, including universal wastes such as computer equipment, batteries, and fluorescent lamps that are generated in a wide variety of settings; are not solely industrial; are generated by a large community; and are present in significant volumes in nonhazardous management systems. The Regulated Management Program for universal waste is streamlined compared to that for other hazardous wastes and emphasizes material reuse or recycle.
[c] Waste regulated under the Toxic Substances Control Act or statutory authorities other than the Resource Conservation and Recovery Act.
Source: Duke 2009.

Most hazardous waste comes from the machine shop. Routine hazardous waste streams include lead- and solvent-contaminated rags and lead metal shavings and debris. Nonroutine hazardous waste streams include non-empty aerosol cans; lab-packs of unused, out-of-date chemicals from various locations; and wastes from occasional demolition activities. Universal waste, such as light bulbs and batteries, come from facility maintenance and cleanup activities. Recycled materials include used oil and antifreeze. The used oil is typically generated by draining or replacing quenching or cooling oils at the machine shop and is occasionally generated as part of draining equipment or replacing hydraulic fluid, as well as from facility maintenance projects (Duke 2009).

Finally, NLVF generates sanitary solid waste, which is generally collected and disposed by a municipal waste service. For security reasons, however, some solid waste is collected by the DOE/NNSA NSO and sent for disposal at the NNSS Area 23 Landfill (see Section 4.1.11.2.3).

In the future, waste may be generated as part of decommissioning unneeded structures.

4.3.12 Human Health and Safety

NLVF provides calibration and other services using specialized radiation fields for a variety of instrument packages in support of NNSS operations. The radiation fields are provided by sealed sources containing cobalt-60, cesium-137, or plutonium-239 that are stored in heavily shielded configurations in the below-grade portion of Building A-1. Because these are sealed sources, they do not release radioactive material that could pose a risk to the workers or the public. There is no direct exposure to the public as a result of the shielding provided by the engineered structure and the location below ground level. Worker exposure is managed by the shielding and administrative controls that limit access to the below-grade area where the sealed sources are stored.

An accident in 1995 resulted in the release of more than 1 curie of tritium into the basement area of Building A-1. The release occurred when a container of tritium-aluminum foils was improperly opened in the Atlas Facility in NLVF. The tritium release was cleaned up, but residual tritium continues to emanate from the basement floor. In 2008, the estimated dose to a hypothetical MEI near NLVF was 0.0006 millirem. Since the accident, the highest annual dose to the MEI was 0.0018 millirem in a year; since 2005, the dose has been less than 0.0001 millirem per year. This dose is magnitudes less than the 10 millirem annual limit under NESHAPs (40 CFR Part 61, Subpart H). A detailed discussion of the radiation environment, including radionuclide releases and associated potential doses to an MEI, is presented in the *Nevada Test Site National Emission Standards for Hazardous Air Pollutants – Radioactive Emissions, Calendar Year 2008* (DOE 2009d).

Chemical exposure pathways to NLVF workers during normal operations may include inhaling the workplace atmosphere, drinking NLVF potable water, and possible other contact with hazardous materials associated with work assignments. The potential for health impacts varies from facility to facility. Workers are protected from hazards specific to the workplace through appropriate training, protective equipment, monitoring, and management controls. NLVF adheres to Occupational Safety and Health Administration and EPA occupational standards (see Chapter 9) that limit atmospheric and drinking water concentrations of potentially hazardous chemicals. Appropriate monitoring, which reflects the frequency and amounts of chemicals utilized in the operational processes, ensures that these standards are not exceeded.

In August 2003, beryllium was found in NLVF Buildings B-1, B-2, and B-3. It was determined that the material was from copper-beryllium alloys milled in Building B-1 during the 1980s. Buildings B-1 and B-2 were demolished in 2004.

The greatest contributor to background noise at NLVF is vehicular traffic, as the facility is located near Interstate 15 (just east of the site) and is buffered on the north, south, and east by general industrial zoning. No environmental noise data are available at NLVF; however, because of its proximity to an interstate and the common occurrence of traffic congestion in the surrounding area, it is estimated that background noise levels range from 60 to 70 decibels, A-weighted (EPA 1974).

4.3.13 Environmental Justice

As seen in Figure 4–39, there are numerous block groups to the south and east of the NLVF where the low-income population is between 11 and 20 percent, and several additional block groups in the 21–30 and greater-than-30 percent range further to the south. The NLVF is located in an area where the majority of block groups have minority populations exceeding 50 percent (see Figure 4–40).

4.4 Tonopah Test Range

This section describes the existing environmental conditions found at the TTR. The TTR comprises approximately 280 square miles (179,200 acres) and is surrounded on three sides by the Nevada Test and Training Range. The Nevada Test and Training Range is located approximately 30 miles from the town of Tonopah, Nevada. The TTR, which is operated by Sandia National Laboratories, offers a unique test bed for DOE and DoD weapons systems. The primary mission of DOE/NNSA at the TTR is to ensure that the Nation's nuclear weapons systems meet the highest standards of safety and reliability.

4.4.1 Land Use

TTR is located in Nye County, Nevada, near the northwestern corner of the Nevada Test and Training Range, approximately 12 miles north of the nearest NNSS boundary. The TTR is 22 miles east of Goldfield and 140 miles north of Las Vegas. The TTR is located in a remote, broad, flat valley with scattered former lake beds between the Cactus Range to the west and Kawich Range to the east.

The main operational area for the TTR is within the Cactus Flat Valley, which has outcrops of low hills in the south and consists of hundreds of buildings, structures, and equipment. Many of these buildings and structures are prefabricated; only a handful are permanent structures or buildings. An airport is located just north of the built-up complex, and an additional airstrip is located just south of the built-up complex. The airport and airstrip are not open for public use.

Adjacent Land Use. The TTR is located within a portion of the 1,302,000-acre Nevada Wild Horse Range, which extends across the northern portions of the Nevada Test and Training Range and southward to the NNSS. The Nevada Test and Training Range is primarily used for weapons development and flight training. BLM manages the wild horses on the Nevada Test and Training Range; management of wild horses is a secondary use of these lands. Visitor access is not permitted due to security reasons.

Sparsely populated public lands north of the TTR boundary are jointly administered by BLM and the U.S. Forest Service and are currently used for cattle grazing, recreation, and other uses. The nearest population to the TTR is approximately 22 miles west of the site, in the town of Goldfield.

Historical Use. The TTR was used extensively between 1956 and 1989. It was one of the primary test facilities during the Cold War era due to its isolation and size. The Atomic Energy Commission began testing weapons systems, research rockets, and artillery on the TTR in 1957. TTR capabilities evolved to include nonnuclear field-testing of nuclear weapons design, stockpile surveillance, and research.

Current Use. Principal DOE/NNSA activities at the TTR include stockpile reliability testing; research and development; and support for a variety of testing, including arming, fusing, and firing systems testing. No nuclear devices are tested at the TTR (DOE 2008k).

DOE/NNSA activities at the TTR are conducted through the DOE/NNSA Sandia Site Office under a land use permit from the USAF. Principal activities are conducted within a smaller area (176,000 acres) known as the "Permitted Premises." Revisions to the TTR boundary and the land use permit area for the Sandia Site Office operations area at the TTR would need to be coordinated with the USAF. The current land use permit granting DOE/NNSA use of this portion of the TTR extends through 2019 (USAF 2002).

Characterization and remediation of industrial sites at the TTR are ongoing, and the majority of the industrial sites have been closed (DOE 2008f).

4.4.1.1 Public Land Orders and Withdrawals

The following Memorandum of Understanding, Withdrawal Act, and land permit are applicable to the TTR.

Memorandum of Understanding. The Memorandum of Understanding, signed in 1956, designated approximately 370,000 acres to support research related to the weapons development program.

Military Lands Withdrawal Act of 1999, Public Law 106-65. Enacted on October 5, 1999, this act extended the withdrawn lands set aside by previous public land orders (about 3 million acres in total) for defense use as part of the Nevada Test and Training Range, including the TTR, for another 20 years. Although no nuclear devices are tested at the TTR, this land is an integral part of DOE/NNSA operations within the Nevada Test and Training Range.

Sandia Land Permit. This permit, effective from April 26, 2002, until October 5, 2019, grants DOE/NNSA permission for use, operation, and occupancy of a portion of the Nevada Test and Training Range at the TTR. This permit is re-evaluated at 5-year intervals to review the requirements that established the need for this permit. This permit does not allow activities that significantly interfere with the Nevada Test and Training Range and requires both entities to work cooperatively to accomplish their respective missions. Activities that occur on this leased land must comply with applicable laws and regulations related to the environment, occupational health and safety, handling and storage of hazardous materials, and disposal of hazardous materials.

4.4.2 Infrastructure and Energy

4.4.2.1 Infrastructure and Utilities

This section discusses the TTR buildings and transportation infrastructure; potable water, wastewater, and communications utilities; and support services, including law enforcement and security, fire protection, and health care. Further transportation-related information is discussed in Section 4.4.3. Solid waste collection is discussed in Section 4.4.11. Energy systems (electricity, natural gas, and liquid fuels) are discussed in Section 4.4.2.2.

4.4.2.1.1 Infrastructure

Facilities. The TTR contains 105 major buildings, providing approximately 161,500 square feet of floor space, and approximately 90 smaller buildings, including towers and small sheds (DOE 1996c).

Transportation Systems. See Section 4.4.3.1 for a discussion of the onsite transportation infrastructure at the TTR.

The USAF maintains an active base and airport on the TTR in support of its missions. This airport building is approximately 10,000 square feet. The existing 12,000-foot runway and navigation aids are open to DOE on an as-needed basis. The Mellan Airstrip is located on the southern portion of the TTR. This airstrip supports DOE and USAF training programs and is used sporadically. There are no support facilities associated with the Mellan Airstrip.

4.4.2.1.2 Utilities

Water Supply. The PWS at the TTR is registered with NDEP as a Nontransient, Noncommunity PWS (see text box in Section 4.1.6.2 for PWS definitions).

The following are three active water wells used by the TTR: (1) Production Well 6, (2) Well 7, and (3) the Roller Coaster Well. The most active are Production Well 6 and the Roller Coaster Well. Production Well 6 supplies drinking water to the TTR Main Compound in Area 3; this well is routinely sampled and analyzed per NDEP requirements to demonstrate conformance with primary drinking water standards. Outlying areas and buildings without potable water service use bottled water (DOE 2009a). Nonpotable wells, particularly the Roller Coaster Well, service the TTR for construction and industrial activities. Some impoundments at the TTR are used to store water during activities. Annual water usage at the TTR is approximately 6 million gallons for the entire range, including water used by the USAF at the TTR (DOE 2008l). See Section 4.4.6 for more information on the water supply.

Wastewater Collection and Treatment Systems. Industrial (primarily discharge from an oil-water separator) and sanitary wastewater generated at the TTR is collected and pumped to a USAF facultative sewage lagoon treatment unit located approximately 1.5 miles southwest of the main gate. The industrial flows are combined with sanitary flows for final treatment using biological processes in two lined aerated ponds, which are permitted by NDEP and operated by the USAF under an NPDES permit (Permit Number NEV20001) (DOE 2009a). Five active septic tank systems are used in remote areas of the TTR for domestic sanitary sewage treatment; there is also one inactive septic tank system in one area (DOE 2009a). Annual wastewater samples are taken at the point where wastewater leaves the TTR property and enters the USAF system (DOE 2009a).

Communication Systems. Communications at the TTR are supported by a regional system. The TTR telecommunication system employs digital telephone switching, fiber optic transmission, microwave, two-way radio, voice privacy, data transmission systems, general- and special-purpose data communications, and teleconferencing services. The TTR also has a ground-to-air communication system that supports all air-to-ground testing programs. The VHF [very-high-frequency] and UHF [ultra-high-frequency] communication capability is reliable within a 200-mile radius of the TTR, depending on the altitude, while high-frequency communication can be reliable for thousands of miles.

4.4.2.2 Electrical Energy

Power to DOE/NNSA facilities at the TTR is supplied by NV Energy. NV Energy has two supply lines to the TTR: the primary line is 120 kilovolts, and a backup line is 60 kilovolts. NV Energy transformers step the voltage down to 13.8 kilovolts for the DOE/NNSA distribution system. The remaining power line supplies the USAF facilities. All remote operations are supplied with electrical power by portable generators.

4.4.2.2.1 Natural Gas

There is no infrastructure for natural gas supply at the TTR.

4.4.2.2.2 Liquid Fuels

The TTR uses various types of liquid fuel for its energy needs, including gasoline, diesel, and propane. There are currently no aboveground storage tanks at the TTR requiring registration with the State of Nevada (DOE 2009a); however, there are a number of fuel storage tanks that are listed as non-permit equipment in the TTR NDEP Class II Air Quality Operating Permit (AP8733-0680.02). The Non-Permit

Equipment List indicates that the TTR maintains diesel-fired generators, gasoline generators, and propane-fired boilers. The TTR has onsite propane storage tanks, as presented in **Table 4–69**, with a permitted collective storage capacity of 23,563 gallons (NDEP 2007).

Table 4–69 Tonopah Test Range Propane Storage Tank Capacities

Equipment	*Quantity*	*Size*
Propane Storage Tanks	22	1 × 119 gallons 1 × 250 gallons 5 × 495 gallons 2 × 500 gallons 5 × 1,000 gallons 1 × 1,050 gallons 3 × 1,150 gallons 1 × 1,500 gallons 1 × 2,000 gallons 1 × 3,000 gallons 1 × 3,219 gallons

Source: NDEP 2007.

4.4.3 Transportation

4.4.3.1 Onsite Transportation

The TTR's onsite roadway network consists of 118 miles of primary paved roads, 23 miles of secondary paved roads, 113 miles of primary compacted dirt roads, and 39 miles of secondary compacted dirt roads (DOE 1996c). The two primary paved roads on the TTR (one traversing north–south and one east–west) support the majority of the daily traffic, as well as traffic during operations. See **Figure 4–45** for primary paved roads. Traffic within the TTR mainly occurs on Main Road South. Dirt roads are used for secondary daily travel, but are primarily used during experimental activities.

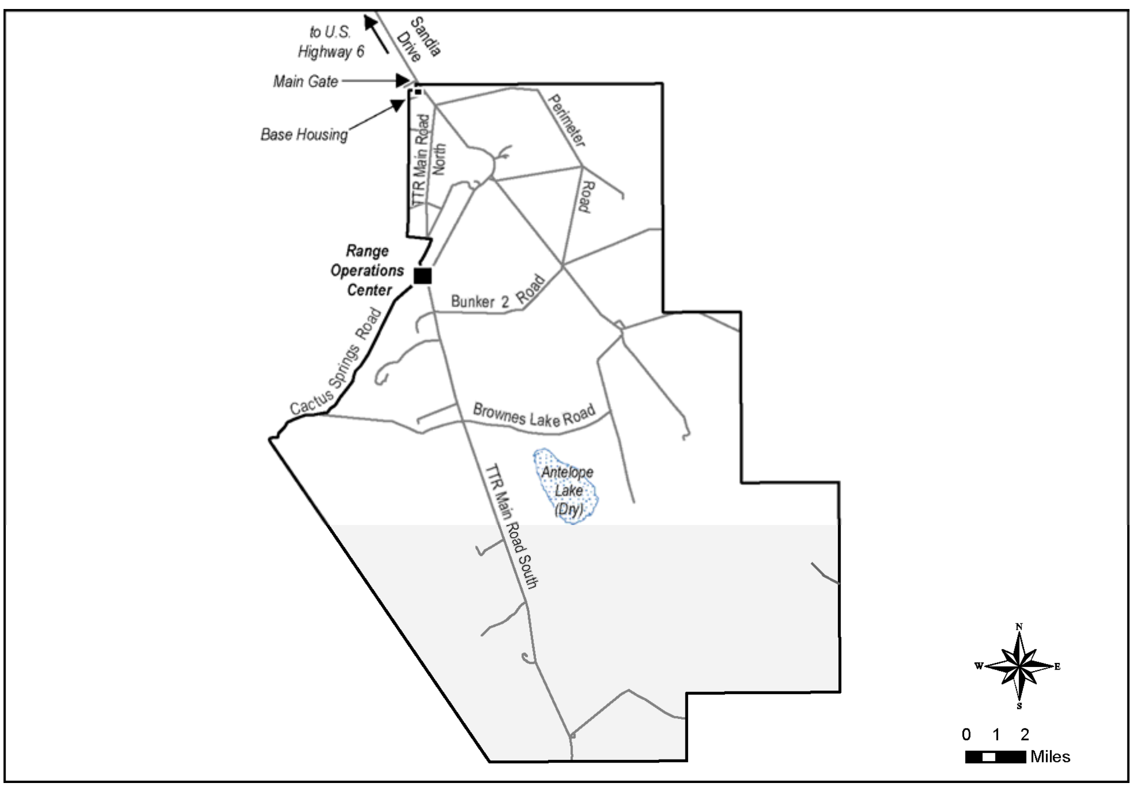


Figure 4–45 Tonopah Test Range Roadways

The roadway system on the TTR is jointly maintained by DOE/NNSA and the USAF. Generally, no privately owned vehicles are permitted on the site; however, privately owned vehicle passes are occasionally issued to offsite personnel and visitors that temporarily reside in the housing area located near the main entrance. Workers either drive government-supplied vehicles from the main entry of the TTR or ride government-supplied bus transportation to the work site. The majority of the onsite traffic is attributed to security support and facility operations (DOE 1996c).

4.4.3.2 Regional Transportation

The TTR is bounded by the Nevada Test and Training Range on the east, west, and south. Although there are access points to areas of the Nevada Test and Training Range through other gates, access to the site is normally through the Main Gate at the northern boundary. North of the Main Gate, Main Road North becomes Sandia Drive (also known as State Route 504), which connects to U.S. Route 6 about 20 miles to the north. Traffic volumes and levels of service on roadways in Nye County, including those near the TTR, are discussed in Section 4.1.3.2.2. Because the TTR is located in an isolated, rural area, traffic volumes on nearby public roadways are low. Daily traffic volumes on U.S. Route 6 are presented in Table 4–11; this roadway is currently operating at level of service B near the TTR.

4.4.4 Socioeconomics

General existing socioeconomic conditions within the ROI of the TTR (Nye County) are presented in Section 4.1.4.

Police Protection. Law enforcement for the TTR is provided by the Nye County Sheriff's Department. Onsite security is provided by Advanced Security, Inc.

Fire Protection. Fire protection services for the TTR are provided by Sandia National Laboratories and the USAF.

Health Care. Currently Sandia National Laboratories provides the TTR with the following emergency operations (fire, rescue, and medical) personnel: 1 registered nurse, 4 emergency medical technicians (intermediate), and 2 emergency medical technicians (basic). If serious care is required, the patient would be either transferred to the town of Tonopah or airlifted to Las Vegas, depending on the medical needs.

4.4.5 Geology and Soils

4.4.5.1 Physiography

The TTR is also located within the southern section of the Great Basin, as described in Section 4.1.5.1. The TTR is located in the lowest sections of Cactus Flat and Stonewall Flat, which are separated by Cactus Range. The TTR is bounded by Stone Cabin Valley to the north, by the Kawich Range to the east and northeast, by Goldfield Hills to the west, and by Stonewall Mountain to the south. Elevations vary dramatically throughout the TTR, from 8,000 feet above sea level at the top peak of the Kawich Range and 8,275 feet above sea level at Stonewall Mountain to 5,400 feet above sea level at the base of Cactus Flat (DOE 1996c). Other features in the area include Gold Flat, which is separated to the south of Cactus Flat by the hills around Gold Mountain.

Within the basins, the topography is flat to gradually sloping. Cactus Flat is a closed basin, so salts and playa deposits form in the deepest sections of the basin. Stonewall Flat is open, so water flows to the west, although playas may form in depressions as well. Because of the high salt concentration in the playa deposits, little vegetation grows in the valleys.

4.4.5.2 Geology

Geologic deposits at the TTR primarily consist of volcanic rocks and alluvium. Alluvial fans composed of eroded volcanic bedrock and ash from the surrounding mountain ranges fill the flats with unconsolidated deposits. Although the total depth of the alluvial deposits is unknown, exploratory wells have determined that basin sediment thickness is at least 1,000 feet (DOE 1996c).

The mountain ranges are primarily composed of Tertiary volcanic rocks, in a sequence of welded and nonwelded ash-flow tuffs and associated basalts, andesites, dacites, and rhyolites. The southern edge of the TTR comprises the Southwestern Volcanic field described in Section 4.1.5.2. The Cactus Range is an exception to the basic volcanic sequences, as it is a fault block bounded by a sequence of elliptical rings, suggesting that it is the center of a major collapsed volcanic cauldron. Basalt dikes and sills have infiltrated the fractures, which cut through Paleozoic sedimentary rocks, granite intrusions, and other Tertiary rocks. The rocks associated with the eruption sequence are approximately 6 million years old. A sequence of small hills to the south and southeast of the range are made up of lavas and tuff valleys and capped by weathered breccias (DOE 1996c).

4.4.5.2.1 Structural History

The Walker Lane shear zone transects the TTR from the northwest to southeast and eventually connects to the Las Vegas Valley shear zone to the southeast (DOE 1996c). The shear zone is a series of transcurrent faults that connect volcanic centers, such as the Cactus Range and Stonewall Mountain.

The main fault sequences at the TTR include the Cactus Flat, Stonewall Mountain, and Gold Flat Faults and a few unnamed Cactus Faults located between Cactus Flat and Gold Flat. The Cactus Flat Fault strikes mostly north, with west-facing scarps. The fault is estimated to have moved within the last 130,000 years (Anderson 1998d). In addition, there are several scattered and unnamed faults in the western section of Cactus Flat (Anderson 1998e).

The Stonewall Mountain Fault forms the structural border between Stonewall Flat and Stonewall Mountain. These faults appear to connect to a fault block sequence and also may have moved within the Late Quaternary period (Anderson 1998f).

4.4.5.2.2 Faulting and Seismic Activity

The TTR is included within the seismic activity review found in Section 4.1.5.2.3, which identified at least 11,988 seismic events within 120 miles of the NNSS. Most of the earthquakes immediately around the TTR have been in the magnitude 2.0 to 3.0 range. Two earthquakes had magnitudes of 4.2 and 4.5. The closest earthquake with a magnitude over 5.0 was the 1992 earthquake near Little Skull Mountain, which is described in Section 4.1.5.2.3. Seismic design requirements are discussed in Section 4.1.5.2.3.

4.4.5.2.3 Geotechnical Hazards

The geologic hazards at the TTR are very similar to those outlined in Section 4.1.5.2.4, specifically surface instability. The geotechnical hazards do not generate extreme constraints on construction in the TTR. In addition, the high concentration of salts in the soils may affect concrete, as discussed in Section 4.3.5.2.3.

4.4.5.2.4 Geologic Resources

Economic geologic resources in and around the TTR include metallic ore and aggregate. Several historic mining districts are located at the TTR, including Silver Bow, Antelope Springs, Cactus Springs, Wilsons, and Mellan (SAIC/DRI 1991). The TTR is also adjacent to a number of other mining districts, most notably the Goldfield Gold Crater, Stonewall, Gold Reed, and Jamestown districts (SAIC/DRI 1991). The Silver Bow district has produced appreciable quantities of silver and gold, while the Antelope Springs district has produced silver and minor amounts of gold. Cactus Springs produced small quantities of silver, although turquoise, gold, and copper are also mined in the area. The Wilsons district produced small quantities of gold and silver in the early 1900s. Minor production of gold and silver came from the Mellan district. Of the mining districts, only the Silver Bow mine is classified as having high potential for economic mineral ores (DOE 1996a).

There is low potential for oil, gas reserves, or other petroleum products at the TTR or adjacent areas on the Nevada Test and Training Range (SAIC/DRI 1991). No geothermal resources have been identified at the TTR (SAIC/DRI 1991). Aggregate used for construction is present at the TTR in the form of sand

and gravels; however, it can be mined from multiple alluvial fans throughout the Basin and Range area; therefore, the resources at the TTR are not considered unique (SAIC/DRI 1991).

4.4.5.3 Soils

Soils at the TTR form in the alluvial fans, ephemeral washes, valley floors, and dry lake beds. The parent material of the soils is the igneous tuff and sedimentary rocks eroded from the surrounding ranges. A major feature of the soils is a silica-cemented duripan, precipitated from the silica-rich igneous parent materials (DOE 1996c).

In 1977, a high-level soil survey was performed at the TTR. Soils were mapped to the soil series throughout the area. Three main soil orders were found at the TTR: (1) mollisols, (2) aridisols, and (3) entisols (DOE 1996c). Mollisols are found in semiarid environments and have well-developed organic horizons. Aridisols are more typical in arid environments, and have little organic matter. Entisols are younger soils that have little or no development in soil horizons. The soils at the TTR would be categorized into three main categories based on their physiographic position in the local topography: (1) playas in valley bottoms and dry lake beds; (2) alluvial fans, the upper alluvial fans; and (3) mountains and hills. **Table 4–70** presents the soil families that were identified at the TTR during the 1977 soil inventory.

Table 4–70 Soil Families Identified in the Tonopah Test Range

Soil Families	*Example Soil Series*	*Physiographic Position*	*General Description of Soils in Physiographic Position*
Typic Salorhids	Saltair	Valley bottom and dry lake beds	Very deep, poorly drained fine-grained soils with concentrated salts and alkali deposits. Shallow groundwater table. Shrink-swell properties from high percentage of clays. Cement corrosion potential from salt concentration.
Typic Haplaquolls	Hutton	Valley bottom and dry lake beds	
Typic Torriorthents	Fang and Cliffdown	Alluvial fan	Deep to very deep, well-drained, sand to sandy loam/loam and gravelly soils on 2 to 4 percent slopes up to 8 to 15 percent slopes. Soils with higher concentrations of gravel are located in ephemeral washes.
Typic Camborthids	Alcorn and Dun Glen	Alluvial fan	
Calciorthids	Puddle	Alluvial fan	
Xerollic Durothids	Ursine	Upper erosional alluvial fan	Very shallow to moderately deep, moderately to well-drained, very coarse to sandy loam/loam and gravelly soils. Some soils may contain an old, rich concentrated clay horizon. Duripan present below the surface. Slopes range from 4 to 8 percent to 15 to 30 percent.
Xerollic Durargids	Ratto, Olson, Indian Creek, and Deer Lodge	Upper erosional alluvial fan	

Source: DOE 1996c.

The upland mountains and hill primarily consist of exposed rock outcrops, cobble or pebble pavement, or steep slopes with thin layers of alluvial deposits. These soils are typically very thin, young, and have little to no horizon definition.

4.4.5.4 Radiological Sources as a Result of Testing

4.4.5.4.1 Soils

Soils have been contaminated by radioactivity from testing at the TTR. Safety tests were performed at the NNSS and the TTR from 1954 to 1963. Section 4.1.5.4 describes the safety tests and the resulting contamination of the soils. Three safety tests were conducted on the TTR as part of the Clean Slate experiments under Project Roller Coaster. The Clean Slate 1, 2, and 3 experiments used open detonation on a concrete pad and detonation in igloo-like structures with varying amounts of earth cover to simulate accidents in open storage and weapon magazines (DOE 1996c). Depleted uranium and plutonium were used as tracers for the tests. Each test location has a concentrated center where the test occurred and a tail of decreasing contamination to the southeast of each test site. As a result of these tests, approximately 670 acres were contaminated, with an estimated plutonium contamination of 65 curies (DOE 1996c). An initial cleanup of each Clean Slate site was conducted shortly after each test (DOE 2009a). Test-related debris was buried at the test ground zero. Each location where radioactive contamination has exceeded 1,000 micrograms per square meter of plutonium has been fenced off and posted as radioactively contaminated. Although the Clean Slate 1 site is still fenced and posted, contamination above about 400 picocuries per gram of soil or higher was remediated. Further remediation at the Clean Slate sites is pending. Figure 4–13 depicts the areas of the Clean Slate sites that are fenced and posted. Further studies of the ground contamination were performed to determine the extent of the wind-carried contamination (DOE 2009a). Further remediation of the contaminated soil will be completed under the Soils Project. Section 4.1.5.4.1 describes the Soils Project in more detail.

Soils have been routinely tested for pollutants deposited from air or contaminants transported and deposited from moving water. Nonradiological sampling of the soils is periodically conducted at the TTR. In 2010, soil samples were collected from 26 offsite, 10 perimeter, and 13 onsite locations. The soil samples were compared to the Target Analyte List metals with no anomalies identified (DOE 2011b).

4.4.6 Hydrology

4.4.6.1 Surface Hydrology

Five hydrographic basins are within the boundaries of the TTR, including most of Cactus Flat and parts of Stone Cabin Valley, Ralston Valley, Stonewall Flat, and Gold Flat (see **Figure 4–46**). In terms of land area, Cactus Flat is the most extensive hydrographic basin within the TTR. These basins are typically internally drained—runoff collects in playas at the low points of valleys (USAF 1999).

Surface-Water Features. No perennial streams exist on the TTR. There are numerous washes that drain upland areas that occasionally convey ephemeral flow. The ephemeral flows pond in playa areas, which collect and dissipate runoff from these basins. Water typically only exists in the playas for periods of hours following summer storms and weeks following winter storms. Little water is recharged to the groundwater system due to a high rate of evaporation (USAF 1999).

There are three small springs within the TTR's boundaries: (1) Cactus Springs, (2) Antelope Springs, and (3) Silverbow Springs. Water from these springs does not travel more than several tens of yards before it dissipates through evaporation and infiltration (DOE 2009a).

Surface-Water Characteristics. No site-specific water quality data are available for surface waters on the TTR. In general, water quality of the ephemeral waters is poor because of naturally high sediment loads and dissolved solids. The water quality of springs and seeps is primarily controlled by the physical and chemical characteristics of the rocks through which the groundwater flows prior to discharge to the surface. Once the water reaches the surface, other environmental factors affect water quality, such as precipitation, evapotranspiration, erosion, and chemical characteristics of the underlying rock or soil (USAF 1999).

In July 2007, 71 wild horses died at the TTR. The horses were from a herd that frequently drank from a manmade depression on a dry lake bed controlled by DOE/NNSA through Sandia National Laboratories. Initial sampling and necropsy results indicated that high nitrate levels may have caused the deaths. Subsequently, the Desert Research Institute was commissioned by BLM, the USAF, and DOE/NNSA to sample water and soil on the TTR to determine the source of the nitrates that may have caused the deaths. This sampling was conducted in February of 2008. The conclusion of the report reinforced the original theory, specifying that the nitrate most likely came from natural sources concentrated by evaporation of the water within the depression during the heat of the summer (DOE/NV 2008a). In July of 2008, BLM gathered the horses within range of the TTR. During 2008 and 2009, DOE/NNSA drained the manmade depression and filled it with clean soils (SNL 2010b).

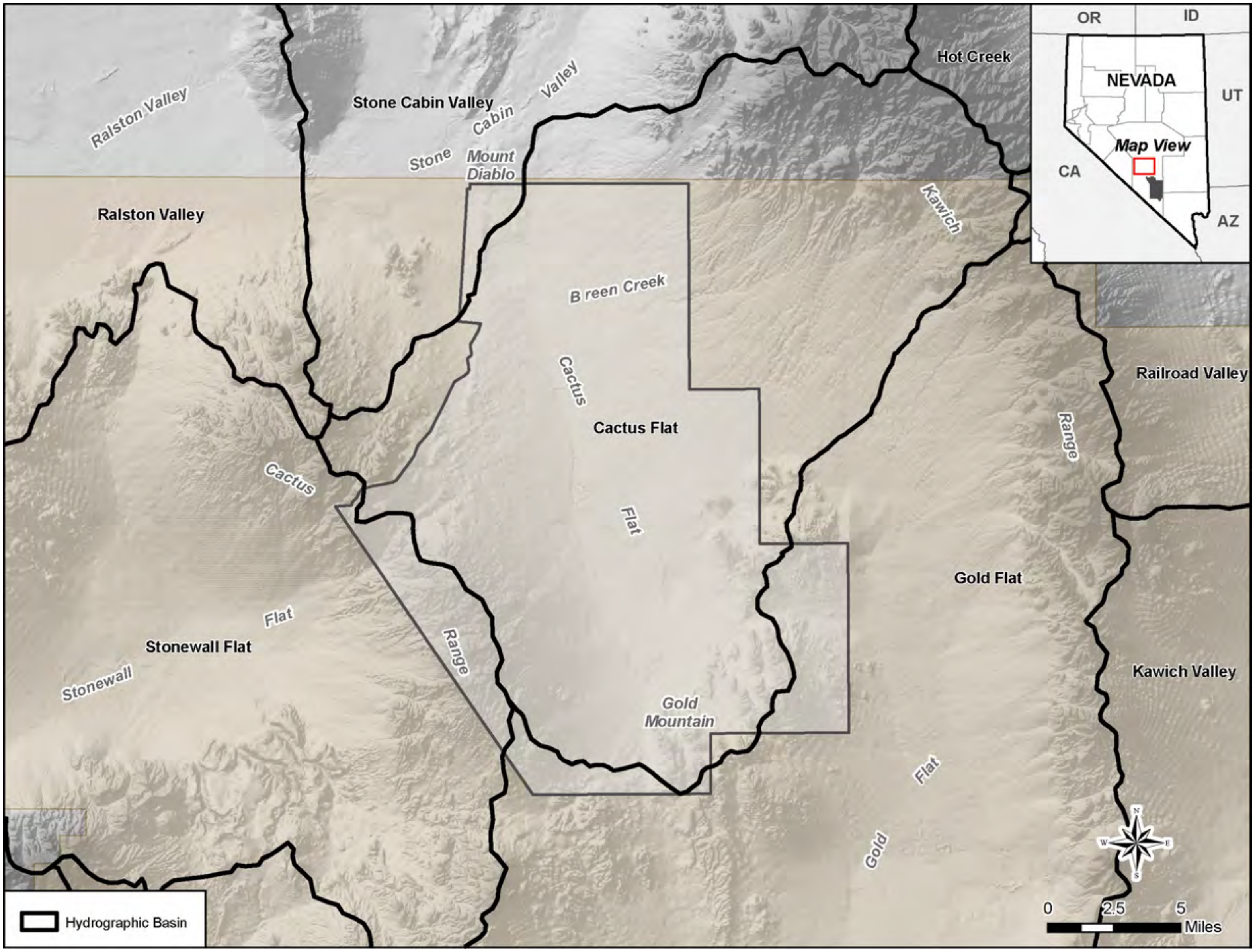


Figure 4–46 Hydrographic Basins on the Tonopah Test Range

Flood Hazards. The USAF has identified and mapped floodplain areas throughout the TTR, thus resulting in the delineation of potential 100-year flood event locations associated with playas, alluvial fans, and valley collectors (i.e., valleys that have relatively large drainage areas or several smaller tributaries that discharge to the main collector). On the TTR, floodplains are associated with two playas near the middle portion of the range (Main Lake and Antelope Lake) and a valley connector running north to south between the two playas, which roughly parallels the main access road on its eastern side. In addition, there are three valley connector floodplains and one alluvial fan floodplain that drain to the Main Lake and Antelope Lake playa system from the east and the south (USAF 1999).

Water Discharges and Regulatory Compliance. Wastewater discharges from TTR activities conducted at facilities in the main compound of Area 3 are conveyed to the USAF facultative sewage lagoon for treatment. The USAF holds an NPDES permit for the facultative sewage lagoon (Permit Number NEV20001) (DOE 2009a). Combined sanitary and pretreated industrial wastewater flows into two lined aerated ponds with treatment by biological processes. This is a zero-discharge treatment facility, by which water is lost through evaporation. For the period from June 2007 through June 2008, effluent water quality was within permitted limits and averaged 33 ppm carbonaceous biochemical oxygen demand, 49 ppm total suspended solids, and 0.4 ppm total petroleum hydrocarbon, and one metal was detected (barium at 0.019 ppm) (Kaminski 2008). All analytical results for wastewater sampled at Area 3 were within regulatory limits from 2008 through 2010 (DOE 2009a; SNL 2010b, 2011). No NPDES stormwater permitting is required at the TTR due to the lack of significant stormwater runoff discharging into waters of the United States (DOE 2009a).

4.4.6.2 Groundwater

Hydrogeologic Setting. The TTR lies between two Great Basin mountain ranges, the Cactus Range to the west and the Kawich Range to the east. The valley is typical of the high desert of the Basin and Range Physiographic Province. The north–south axis of the valley, known as Cactus Flat, consists of a string of playas at an elevation of approximately 5,300 feet above mean sea level. Cactus Flat is a closed basin; surface runoff following precipitation flows toward the playas, with no discharge off of the TTR (SNL 1992). Stonewall Flat is bounded on the south by Stonewall Mountain and on the west by Goldfield Hills. On the valley floors of both Cactus and Stonewall Flat, the dominant features are a number of small playas and the many washes that drain the upland areas (see Section 4.4.6.1 for more information) (DOE 2006d).

The TTR encompasses portions of five hydrographic basins (Cactus Flat, Gold Flat, Stonewall Flat, Ralston Valley, and Stone Cabin Valley) that make up portions of two regional groundwater systems. Past DOE operations have been concentrated in two areas: Stonewall Flat and the lowland portions of Cactus Flat (DOE 2008l).

Groundwater that originates as precipitation over the Kawich Range flows west and then southwest under the TTR, ultimately discharging in Death Valley through springs and evapotranspiration. Some groundwater may flow northwest off the TTR and into the Southern Marshes flow system, with discharge at Mud Lake, Alkali Flat, and Clayton Valley. The generalized directions of regional groundwater flow are shown in **Figure 4–47**. Groundwater in Cactus Flat is derived from precipitation over the upland areas, and there is no subsurface recharge from neighboring basins. The total recharge has been estimated at only 600 acre-feet per year. Depth to groundwater ranges from 90 to 450 feet below the land surface. Groundwater under Stonewall Flat is derived from recharge over the upland areas and is estimated at 100 acre-feet per year. Depth to groundwater ranges from 100 to 275 feet below the land surface (DOE 1996c).

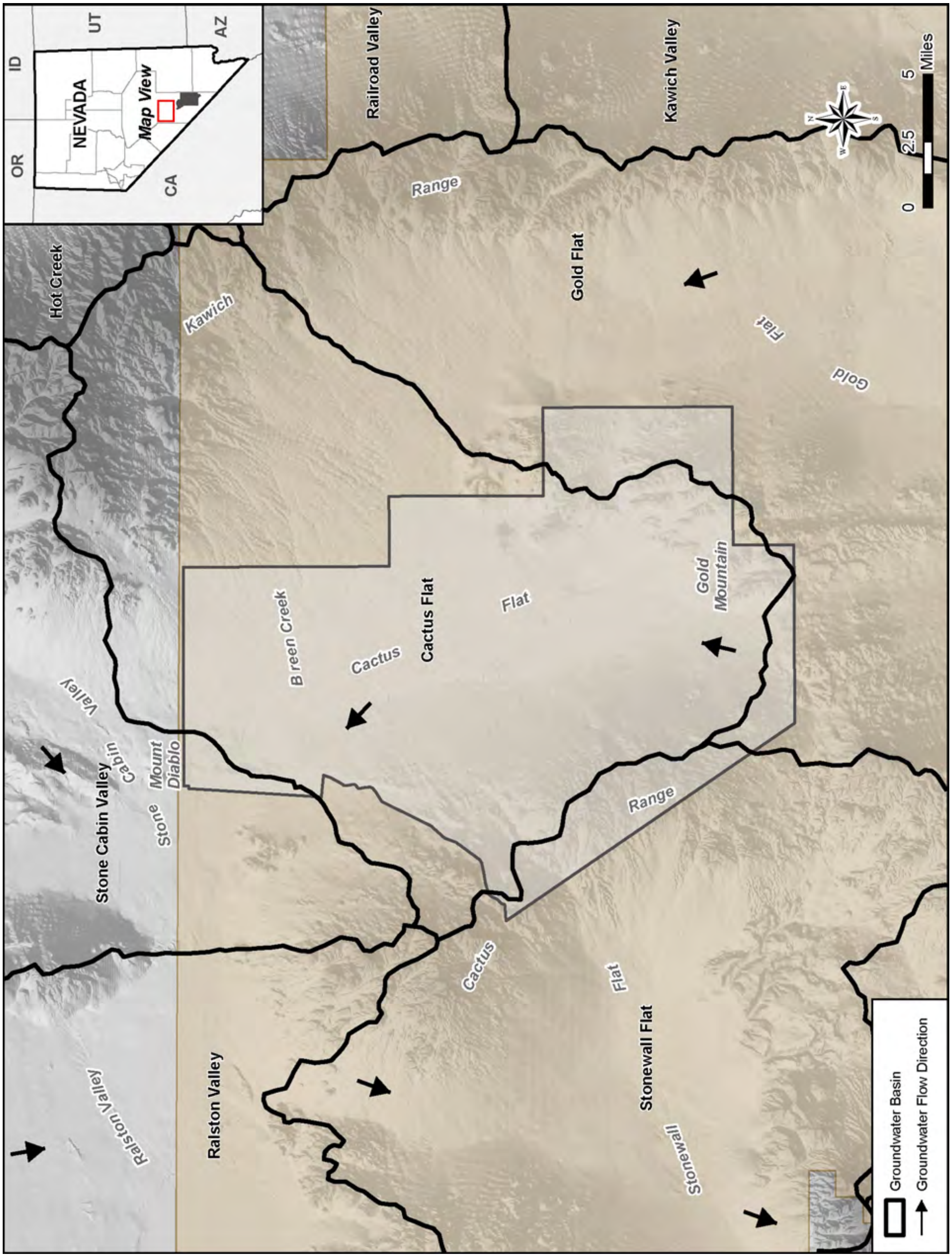


Figure 4–47 Groundwater Basins and Flow at the Tonopah Test Range

Groundwater Supply. Groundwater at the TTR has been used for domestic, industrial, and construction purposes. Groundwater is pumped from a number of wells, depending on the location of range activities and the total demand for water. The following three active wells are used at the TTR: (1) Production Well 6, (2) Production Well 7, and (3) the Roller Coaster Well.

Production Well 6 supplies drinking water and fire water distribution systems at the TTR Main Compound in Area 3 and is the only well that has been sampled for contaminants. It pumps water to an elevated water tank in Area 3 that holds 200,000 gallons (Lacy 2011). In June 2008, a new carbon dioxide (pH) adjusting treatment system for arsenic removal became operational in Area 3 of the TTR (Lacy 2011). Outlying areas and buildings without water service use bottled water. Production Well 7 and Roller Coaster Well are used only for nonpotable purposes (construction and dust suppression), and there is no regulatory sampling requirement. The water use (for the entire TTR, including the USAF) for operations is approximately 6 million gallons per year (DOE 2008l). The static water level at Well 6 is approximately 350 feet (SNL 2010b).

The water conservation plan for the TTR complies with State Water Resources Division regulations requiring a water conservation plan for permitted water systems and major water users in Nevada. An updated Water Conservation Plan for the TTR (SNL 2011) was approved by the Nevada Division of Water Resources in January 2011 and can be found at http://water.nv.gov/programs/planning/plans.cfm.

There are about 15,000 acre-feet per year of water rights in the five hydrographic basins associated with the TTR. Approximately 10,300 acre-feet per year of this total are surface-water rights (see Section 4.4.6.1); the remainder (almost 4,700 acre-feet) represents groundwater rights. Currently, defense-related water appropriations total 1,775 acre-feet per year, 148 acre-feet of which are surface-water rights. **Table 4–71** lists the water yield and resources for each of the basins that encompass portions of the TTR.

Water appropriations are limited to two basins: (1) Cactus Flat and (2) Stone Cabin Valley, and total 200 acre-feet (65,170,200 gallons) per year. Both basins are over-appropriated (i.e., the appropriations exceed the perennial yield in each basin). It is unlikely that additional water rights can be obtained in the area without groundwater mining (the removal of groundwater from storage) (DOE 2008l).

Table 4–71 Water Rights Status for Hydrographic Basins at the Tonopah Test Range

Hydrographic Basin	*Hydrographic Basin Number*	*Perennial Yield (acre-feet per year)*	*Total Committed Groundwater Resources (acre-feet per year)*	*TTR water rights/use (acre-feet per year)*
Cactus Flat	148	300	619	Estimated TTR water rights 160
Gold Flat	147	1,900	95	Estimated TTR water rights 40
Stonewall Flat	145	100	12	No TTR water rights
Ralston Valley	141	6,000	1,917	No TTR water rights
Stone Cabin Valley	149	2,000	2,033	Estimated TTR water rights 240

TTR = Tonopah Test Range.
Source: DOE 2008l; NDWR 2010c.

Groundwater Monitoring and Quality. The lithology of the rocks controls the water chemistry observed in the wells. Potential sources of groundwater contamination existing on the TTR include French drains, septic tanks and leach fields, underground storage tanks, landfills, and sewage lagoons (DOE 2008l). The quality of water at the TTR is generally good and is suitable for domestic purposes, livestock, and wildlife use (DOE 1996c). The nuclear safety tests conducted at the Clean Slate sites on the TTR have resulted in surface soil contamination; however, groundwater contamination has not been detected at the TTR (see Section 4.4.5.4.1 for soil contamination). Infiltration is limited by the depth to groundwater (90 to 150 feet), low rainfall, and high evaporation rate. The small quantities of liquid water that may have been disposed or released will, therefore, attenuate in the soil and are unlikely to affect groundwater. Soil was sampled for explosive residues from unexploded ordnance remedial activities; however, no reference can be found for groundwater sampling for perchlorate (DOE 2008l).

Water analyses are conducted at various times at several locations throughout the TTR to characterize water quality. None of the constituents that have been analyzed have exceeded the recommended health standards set by the Nevada Division of Health, with the exception of pH. Although the pH values slightly exceeded the standard, the waters do not pose health problems. The Roller Coaster Well is classified as a sodium-bicarbonate-chloride-type water, while the remaining wells are classified as sodium-bicarbonate-type waters (DOE and U.S. Air Force 1988).

4.4.7 Biological Resources

The following description of vegetation was taken from EG&G Energy Measurements (1995), unless otherwise stated. The scientific names of plants and animals mentioned in this section are given in Section 4.1.7.

The TTR is within the Great Basin Desert. The lowest elevation on the TTR is approximately 5,250 feet; the highest elevation is approximately 7,550 feet.

The DOE/NNSA Sandia Site Office has an Ecology Program that serves to conserve flora and fauna at the TTR (NNSA/SSO 2010). The primary objectives of the Ecology Program include:

- Collect ecological resource inventory data to support site activities, while preserving ecological resources, and maintaining regulatory compliance
- Collect information on plant and animal species present to further the understanding of ecological resources on site
- Collect biota contaminant data on an as-needed basis in support of site projects and regulatory compliance
- Assist Sandia organizations in complying with regulations and laws
- Provide information to employees regarding ecological resource conservation
- Support Sandia organizations with biological surveys in support of site activities

Enhancement measures that have been utilized in the past include installing artificial nest platforms, boxes, and perches.

In 2010, an Avian Protection Plan was adopted and implemented at the TTR (Lacy 2011). The Avian Protection Plan was developed to describe procedures that would be taken by DOE/NNSA at the TTR to address potential impacts of its associated transmission and distribution lines on avian species that are known to occur in the area (NNSA/SSO 2010).

4.4.7.1 Flora

There are four general vegetation types on the TTR: dwarf shrubland, shrubland, woodland, and bare or disturbed areas (see **Figure 4–48**). The dominant flora of the valley bottoms on the TTR include shadscale, budsage, winterfat, and galleta grass (*Pleuraphis* Torr.). Less-common plant species are horsebrush, greasewood, desert globemallow (*Sphaeralcea ambigua*), and desert prince's plume (*Stanleya pinnata*). Big sagebrush occurs in wash bottoms and near the playa on the southwestern corner of the site. On the bajadas above the valley floor, Nevada jointfir, green rabbitbrush, shadscale, budsage, winterfat, and Indian ricegrass are dominant. At higher elevations, greasewood, wolfberry, hopsage, and desert prince's plume are common. Pinyon-juniper woodlands occur at the highest elevations.

4.4.7.2 Fauna

Animal species on the TTR include all species found in the Great Basin Desert on the NNSS. Some of the most common animal species include side-blotched lizards, desert-horned lizards, horned larks, chisel-toothed kangaroo rats, little pocket mice, and wild horses (Bradley and Moor 1975). State-designated game animals that occur on the TTR include mule deer, bighorn sheep, pronghorn, mountain lions, desert and Nuttall's cottontails, chukar, and mourning dove. The gray fox and bobcat are species known to occur at the TTR that are listed by the state as furbearers (SNL 2010a).

Bird species typically found in the valley floor of the TTR are those associated with the sagebrush community and include sage thrasher (*Oreoscoptes montanus*), sage sparrow (*Amphispiza belli*), horned lark, and common raven. Less-frequently observed species include the green-tailed towhee (*Pipilo chlorurus*), western meadowlark (*Sturnella neglecta*), mourning dove, greater roadrunner (*Geococcyx californianus*), and common nighthawk (*Chordeiles minor*) (NNSA/SSO 2010).

Bird species diversity increases with elevation at the TTR, to include birds such as loggerhead shrike, mourning dove, black-throated sparrow, and juniper titmouse (*Baeolophus ridgwayi*). Scott's orioles (*Icterus spurius*), western kingbirds, and ash-throated flycatchers (*Myiarchus cinerascens*) are occasionally observed nesting in the Joshua trees. In the rocky slopes of the steep terrain, chukars (introduced into the area) and rock wrens (*Salpinctes obsoletus*) are sometimes encountered (NNSA/SSO 2010).

Raptor species are present throughout the TTR and include red-tailed hawk, golden eagle, prairie falcon, American kestrel, common barn owl, great horned owl, Swainson's hawks, and ferruginous hawks (*Buteo regalis*). Known nesting raptors include red-tailed hawk, golden eagle, and great horned owl (NNSA/SSO 2010).

The Nevada Wild Horse Range and other wild horse land use areas constitute a significant portion of the Nevada Test and Training Range, including the TTR, with herds common in Cactus and Gold Flats, Kawich Valley, Goldfield Hills, and the Stonewall Mountains (SNL 2010a). The Nevada Wild Horse Range is managed by BLM, but wild horse and burro management does not affect national security activities at the TTR to a great extent, as the USAF mission still has precedence over BLM management (USAF 2007e). The draft *Integrated Resource Management Plan for Nellis Air Force Base and the Nevada Test and Training Range* (USAF 2007e) recommended that BLM continue annual censuses of the wild horse population and conduct wild horse gathers as necessary to maintain the current appropriate management level for the Nevada Wild Horse Range of 300 to 500 horses. Hundreds of wild horses graze freely throughout the TTR, and activities on site have had little effect on the horse population or their grazing habits. BLM routinely rounds up a portion of the herds for auction through the Wild Horse and Burro Adoption Program (SNL 2010a).

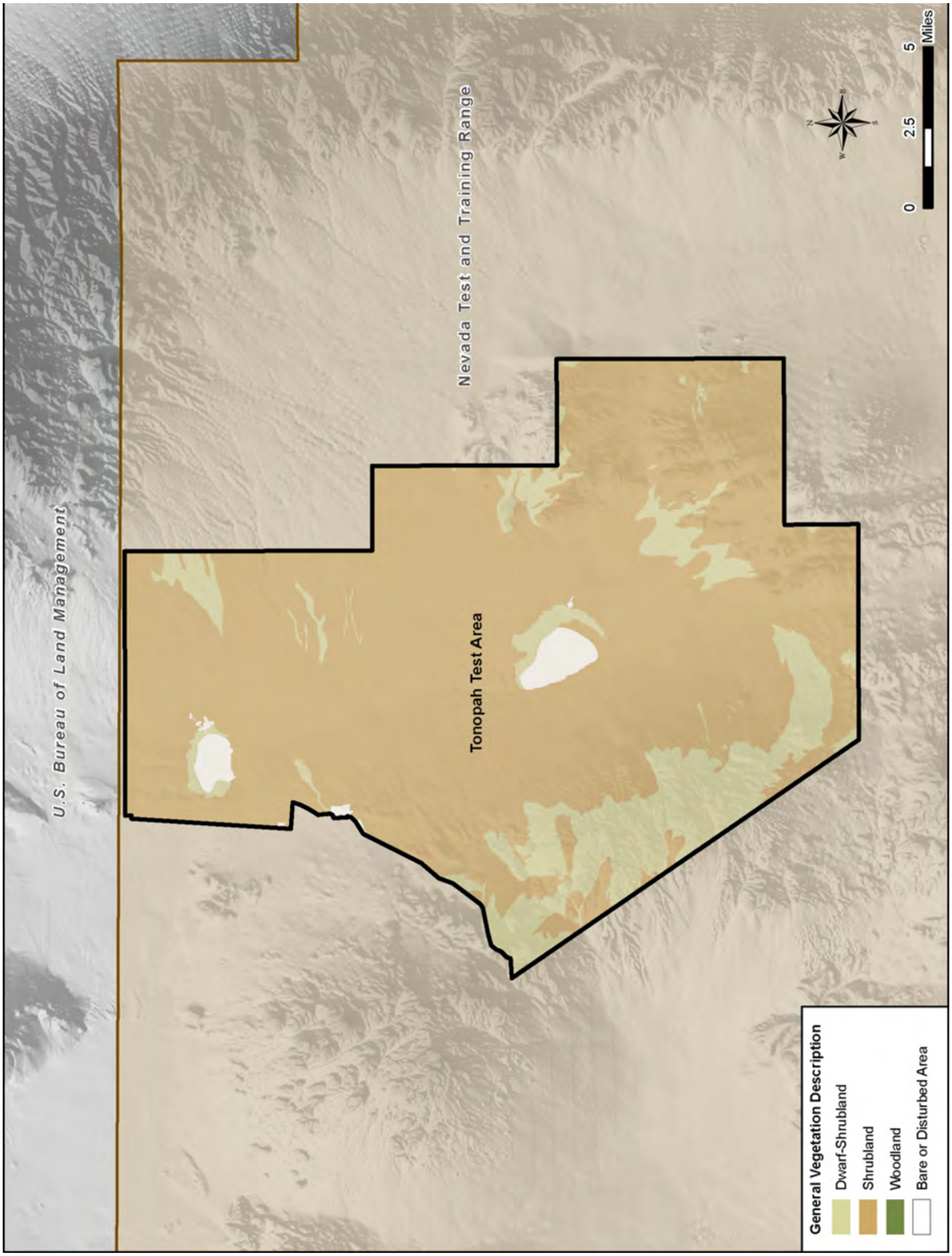


Figure 4–48 Vegetation Types on the Tonopah Test Range

Wild horses have altered the TTR and Nevada Test and Training Range vegetation composition and production where they graze, and compete with native species, such as mule deer, pronghorn, and bighorn sheep, for water and vegetation. An extreme example of the potential negative impacts of wild horse grazing may be seen in the Kawich Valley. Where wild horses are present in this area, the Great Basin scrub vegetation has been uniformly cropped over many acres to less than 8 inches high. It is clear that the closely cropped plants in the Kawich Valley do not represent the condition of the vegetation before the horses were introduced (USAF 2007c). On the TTR, the Clean Slate 1, 2, and 3 environmental remediation sites have been fenced for other purposes, but the fences also serve to prevent grazing by wild horses. These excluded areas have regrown with abundant native vegetation, which is not affected by wild horse grazing (USAF 2007c).

4.4.7.3 Threatened and Endangered Species

No current federally listed threatened, endangered, or candidate plant or animal species are known to occur on the TTR.

4.4.7.4 Other Species of Concern

The western burrowing owl, a state-protected bird, is known to occur on this site. No other species of concern are known to inhabit the TTR.

4.4.7.5 Effects of Past Radiological Tests and Project Activities

Vegetation samples were collected on the TTR in 1973 and again in 1990 and 1991 (EG&G/EM 1993). These studies found that plutonium levels in samples of vegetation ranged from 4.0×10^{-5} to 3.9×10^{-2} nanocuries per gram of dry vegetation, and the plutonium levels had not changed substantially over the past 25 years. Many studies in arid and semiarid environments (Francis 1973; Hakonson 1975; Hanson 1975; Price 1973; Romney and Wallace 1977) have shown that most of the plutonium remains in the soil and is not readily transported. Very little of the contamination is incorporated into the biological components of the ecosystem in similar arid areas (Hakonson and Nyhan 1980). Plutonium contamination of vegetation at the TTR and the NNSS is concentrated mainly on the surface of vegetation and is generally not taken up by the roots and concentrated internally. Small mammals were collected from the TTR for plutonium contamination analyses from 1974 through 1975 (Bradley and Moor 1975) and from other contaminated areas on the NNSS and off site (Gilbert et al. 1988). From these studies, the following general conclusions can be made: very low levels of contamination (from undetectable levels to a few hundred femtocuries [10^{-15} curies] per gram) were found in animals; desert rodents (which represent the primary consumer trophic level) have very low plutonium levels; most of the radioactivity in rodents is associated with the pelt and gastrointestinal tract and not internal organs or carcasses; and the plutonium contamination does not appear to bioaccumulate in the food chain.

4.4.8 Air Quality and Climate

4.4.8.1 Meteorology

As with the NNSS, the TTR is located in the southwestern corner of the Great Basin and in the rain shadow (lee) of the southern Sierra Nevada mountain range. The TTR has the general climatic characteristics of a mid-latitude desert area, with relatively little precipitation and low humidity, large diurnal and seasonal temperature ranges, and intense solar radiation in the summer. The generally dry desert conditions specific to the TTR are occasionally modified by the southwestern monsoon and convective thunderstorms during the summer months and Eastern Pacific tropical storm remnants in the late summer and fall. The dry conditions can be further modified from time to time during strong *El Niño* cycles, which generally bring more rainfall to the area.

Significant climate differences within the TTR stem largely from differences in elevation. The TTR is generally characterized by a broad, flat valley bordered by two north–south mountain ranges: the Cactus Range to the west and the Kawich Range to the east. Elevations range from 5,347 feet above mean sea level in the valley floor to about 7,484 feet above mean sea level at Cactus Peak (DOE 2009a). Wind flows are strongly affected by the surrounding topographical influences. Temperatures are coolest at the higher elevations and warmest in the valley floor. Precipitation is generally sparse, with about 4 inches of annual average rainfall in the valley floors, though as much as about 12 inches of frozen and liquid precipitation can occur on mountain ridges (SORD 2002).

At the Tonopah Test Range Airport in the north-central portion of the TTR (at an elevation of about 5,548 feet above mean sea level), a long-term meteorological station operates. The average daily maximum temperature typically ranges from about 85 to 90 °F in the summer and from about 40 to 50 °F in the winter; likewise, average minimum temperatures tend to be about 50 to 60 °F in the summer and about 15 to 25 °F in the winter (SORD 2002). The annual average temperature is 52 °F. The Desert Research Institute began operating a meteorological station in July 2008 at the northern edge of the Clean Slate 3 site.

Precipitation falls most often during the spring period (due to passing East Pacific storms) and during the mid- to late-summer period (due to convective thunderstorms, monsoons, and occasional tropical storms). Nevada on the whole has been in a long-term drought for most of the last 100 years, with precipitation amounts below normal. However, much of the 1980s and 1990s were wetter than normal (DOE 2008j). For more information regarding precipitation patterns at the TTR, please see Appendix D, Section D.1.4.1.

Wind conditions are perhaps the most complex of the meteorological conditions on the TTR. The surface winds show strong diurnal variations with distinct drainage in the valley and mountain slopes. The Cactus Range is to the west of the Tonopah Test Range Airport and is closer to the airport than the Kawich Range; as the Cactus Range is oriented north-northwest to south-southeast, these nighttime drainage winds tend to be from the northwest at the airport (DOE 2009a). Localized terrain gradients that are not north to south modify this nighttime wind flow, as do occasional low overcast conditions or conditions with extensive nighttime vertical mixing. **Figure 4–49** shows wind direction and speed data for the TTR. For more information regarding the wind patterns at the TTR, please see Appendix D, Section D.1.4.1.

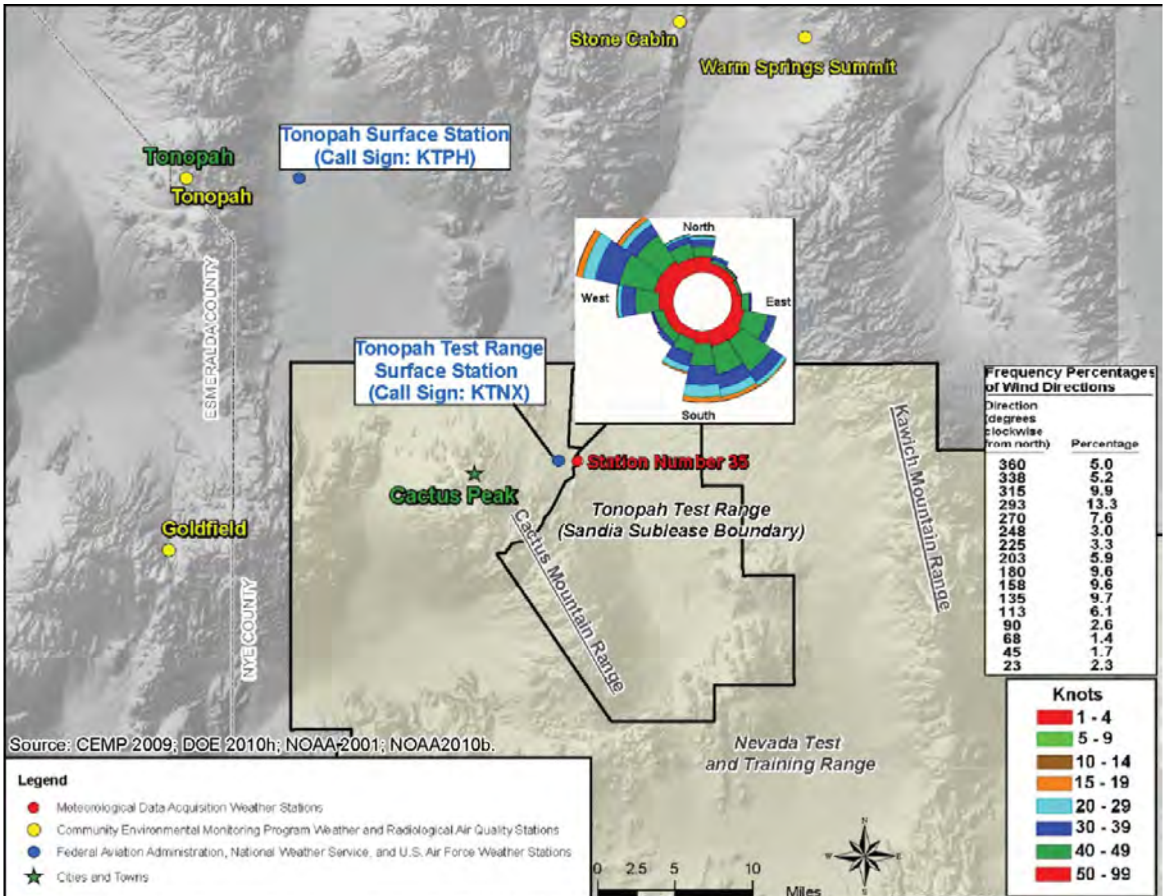
4.4.8.2 Ambient Air Quality

4.4.8.2.1 Region of Influence

The TTR is located about 15 to 40 miles northwest of the NNSS. The ROI for air quality and climate for TTR operations comprises north-central Nye County, with prevailing downwind impacts extending into western Lincoln County. Historic data on pollutant emissions inventories and the compliance status for the State of Nevada are calculated at the county level; these data provide a basis for determining both existing air quality in the ROI and a metric for emission comparison assessments.

4.4.8.2.2 Existing Air Quality

Ambient Air Quality Standards. See Section 4.1.8.2.2 for a discussion on the national and Nevada ambient air quality standards. The TTR is within the Nevada Intrastate Air Quality Region 147. All of the TTR is within Nye County, for which there are insufficient data to determine attainment status, so the TTR is designated as an unclassified area. However, EPA treats unclassified areas as if they are in attainment for regulatory purposes. See Section 4.1.8.2.2 for more information on nearby NAAQS nonattainment areas. No ambient air quality data have been measured on the TTR; however, the ambient air quality characteristics are anticipated to be better than or similar to those of the NNSS, given the lower vehicle and stationary source activity levels.



Note: To convert knots to meters per second, multiply by 0.5144. To convert knots to miles per hour, multiply by 1.151. The percentage rings indicate frequency of occurrence. Wind directions are from which the wind is blowing.

Figure 4–49 Wind Rose for Tonopah Test Range Airport Surface Station, 2004–2008

Emissions Due to TTR Operations. Title V of CAA gives states the authority to use air quality permits to regulate stationary source emissions of criteria pollutants. At the TTR, there is one Class II Air Quality Operating Permit. Class II permits are issued for "minor" sources and limit annual emissions in one of the following ways: (1) annual emissions of any one criteria pollutant must not exceed 100 tons; (2) annual emissions of any one hazardous air pollutant must not exceed 10 tons (including lead); or (3) annual emissions of any combination of hazardous air pollutants must not exceed 25 tons (including lead). The emissions limits associated with the TTR's Class II Air Quality Operating Permit are occasionally re-evaluated and reissued—most recently in 2009. The TTR facilities regulated by this permit include screening plants and maintenance shops (including those for painting, welding, and carpentry).

From 2001 through 2008, the TTR reported total annual emissions of less than 1 ton from permitted facilities (DOE 2002a, 2003a, 2004a, 2005a, 2009a; SNL 2007). In 2008, the TTR reported a total of only 0.21 tons of criteria and hazardous air pollutants. As of 2007, when operating at maximum permitted capacity, stationary sources on the TTR are allowed to emit as much as about 21 tons of emissions (comprising 3 tons from permitted facilities and 18 tons from nonpermitted facilities[31]) (NDEP 2007). For more details on how these maximum allowed emissions were determined, see Appendix D, Section D.1.4.2. The Class II permit also requires that the best practical method be used to limit the resuspension of soil dust into the air during construction, repair, demolition, work, or the use of

[31] *A nonpermitted source is a stationary source that, by regulation, does not require an air operating permit. Examples include emergency stationary generators that operate for less than 500 hours per year and propane storage tanks.*

unpaved or untreated areas without applying the measures described in the dust control plan (NDEP 2007).

Table 4–72 shows the onsite emissions due to the stationary sources, as well as emissions due to government-owned vehicles on the TTR, TTR commuters, and commercial vendors servicing the TTR. These emissions are partitioned into Clark County and Nye County (both on the TTR and off the TTR), where appropriate. See Appendix D, Section D.1.4.2, for further detail on the methodology for determining the emissions from commuter and vendor activities.

4.4.8.3 Radiological Air Quality

Radiation monitoring from 1996 through 1997 indicated a concentration of 1.6×10^{-18} microcuries per milliliter of plutonium-238, 9.5×10^{-19} microcuries per milliliter of plutonium-239 and -240, and 4.10×10^{-18} microcuries per milliliter of americium-241. These radiation levels would cause an MEI (either on site or off site) to receive an effective dose equivalent of 0.024 millirem per year (DOE/NV 1997a, 1997b; DOE 2009a). This dose level is approximately 400 times less than the EPA NESHAPs standard of 10 millirem per year (DOE 2009d). These results are indistinguishable from the natural background radiation level on or near the TTR.

Ambient air quality radiation monitoring had not been performed at the TTR since 1997 because operations at the TTR do not involve activities that release radioactive emissions into the air from point sources or from diffuse sources such as outdoor testing. However, the Desert Research Institute began monitoring air quality for radioactive contaminants at the TTR in July 2008 (DOE 2009c) to address concerns about fugitive radioactive emissions from the possible resuspension of americium and plutonium present at the Clean Slate environmental restoration sites. One site is located near the Range of Operations Center and the other at the northwestern end of the Clean Slate 3 site. Since May 2009, neither site has detected any anthropogenic gamma-emitting radionuclides, which would potentially indicate the presence of americium and/or plutonium. Other environmental restoration sites with minor radioactive contamination, such as depleted uranium, do not produce significant air emission sources from resuspension (DOE 2009a).

4.4.8.4 Climate Change

This section describes the affected environment in terms of current and anticipated trends in greenhouse gas emissions and climate. The effects of emissions and the corresponding processes that affect climate involve very complex processes with considerable variability, complicating the measurement and detection of change. Recent advances in the state of the science, however, are contributing to an increasing body of evidence that anthropogenic greenhouse gas emissions affect climate in detectable and quantifiable ways.

For information on greenhouse gas emissions in the United States, please see Section 4.1.8.4.1. Greenhouse gas emissions at the TTR are discussed in the next section. Details on the methodology used to determine these emissions are discussed in Appendix D, Sections D.2.4.1.1, D.2.4.2.1, and D.2.4.3.1.

Table 4–72 Estimated 2008 Air Emissions of Criteria Pollutants and Hazardous Air Pollutants Due to Tonopah Test Range Activities

	Annual Air Emissions (tons per year)											
	Stationary Sources	***Government-Owned Vehicles***	***TTR Commuters***			***Commercial Vendors***			***Total***			
	Nye County	***Nye County***		***Nye County***			***Nye County***			***Nye County***		
Pollutant	***On-TTR***	***On-TTR***	***Clark County***	***On-TTR***	***Off-TTR, Off-NNSS***	***Clark County***	***On-TTR***	***Off-TTR, Off-NNSS***	***Clark County***	***On-TTR***	***Off-TTR, Off-NNSS***	***Total***
PM_{10}	<3.7	0.065	0.0087	0.0010	0.037	0.12	0.0066	0.54	*0.13*	*<3.8*	*0.58*	*<4.5*
$PM_{2.5}$	<3.7	0.050	0.0048	0.00061	0.021	0.11	0.0061	0.5	*0.12*	*<3.8*	*0.52*	*<4.4*
CO	<2.9	3.6	0.91	0.047	4.1	0.49	0.027	2.2	*1.4*	*<6.6*	*6.3*	*<14.3*
NO_x	<13.3	0.97	0.22	0.030	1.0	1.1	0.058	4.7	*1.3*	*<14.4*	*5.7*	*<21.4*
SO_2	<0.91	0.0071	0.0024	0.00028	0.0095	0.002	0.00011	0.0087	*0.0044*	*<0.92*	*0.018*	*<0.94*
VOCs	<0.96	0.10	0.018	0.0022	0.075	0.16	0.0088	0.72	*0.18*	*<1.1*	*0.80*	*<2.0*
Lead	<0.01	<0.01	<0.01	<0.01	<0.01	0.0000019	0.00000011	0.0000089	*<0.01*	*<0.03*	*<0.01*	*<0.05*
Criteria Pollutant Total	*<21.8*	*4.7*	*1.2*	*0.08*	*1.2*	*1.9*	0.10	*8.2*	*3.1*	*<26.7*	*9.4*	*<39.2*
HAPs	<1.1	0.0097	0.0014	0.00019	0.0063	0.021	0.0012	0.095	*0.022*	*<1.1*	*0.10*	*<1.2*

CO = carbon monoxide; HAP = hazardous air pollutant; NNSS = Nevada National Security Site; NO_x = nitrogen oxides; PM_n = particulate matter with an aerodynamic diameter less than or equal to *n* micrometers; SO_2 = sulfur dioxide; TTR = Tonopah Test Range; VOC = volatile organic compound.

4.4.8.4.1 Greenhouse Gas Emissions

Table 4–73 provides greenhouse gas emissions due to TTR-related activities for 2008. The greenhouse gas emissions are presented in carbon-dioxide-equivalent form and are partitioned by various mobile and stationary source types. These emissions were derived from fuel use, vehicle activity, and power consumption data. The greenhouse gas emissions were calculated using the EPA Climate Leaders Simplified Greenhouse Gas Emissions Calculator (EPA 2010b). These emissions were compared with a reference amount of 25,000 metric tons (27,558 tons), which is an indicator for when a quantitative assessment may be warranted (CEQ 2010).

Commercial vendors are by far the largest single source of greenhouse gas emissions related to TTR activities, emitting approximately 2,210 carbon-dioxide-equivalent tons of greenhouse gases, or 53 percent of the TTR-related greenhouse gas emissions total. Mobile sources altogether emitted about 3,396 carbon-dioxide-equivalent tons of greenhouse gases, which is 88 percent less than the threshold reporting level. Overall, TTR-related activities created about 4,166 carbon-dioxide-equivalent tons of greenhouse gas emissions in 2008, an amount well below the threshold level.

Table 4–73 Carbon-Dioxide-Equivalent Emissions of Greenhouse Gases Due to Tonopah Test Range Activities in 2008

Source Type	*Carbon-Dioxide-Equivalent Emissions (tons per year)*	*Fraction of Reference Point of 25,000 Metric Tons* [a]
STATIONARY SOURCES		
Power consumption	275	0.01
Natural gas heating	0	0.00
All stationary sources, except air conditioning/refrigeration and natural gas heating	495	0.02
All Stationary Sources	*771*	*0.03*
MOBILE SOURCES		
Onsite government vehicles	454	0.02
Commuting	732	0.03
Commercial vendors	2,210	0.08
All Mobile Sources	*3,396*	*0.12*
Total	***4,166***	***0.15***

[a] 25,000 metric tons are equal to about 27,558 short tons.

4.4.8.4.2 Current Changes in Climate

For a discussion of climate change impacts in the region, please see Section 4.1.8.4.2.

4.4.9 Visual Resources

The TTR is visually similar to areas of the NNSS with higher elevations and is only visible from an access road off U.S. Route 6 (DOE 1996c). The portion of the area visible from U.S. Route 6 is considered to have a Class B scenic quality rating (see Section 4.1.9 for information on the visual impact rating system) due to the lack of visual intrusions and picturesque views of the natural landscape that vary throughout the day and seasonally, combined with the commonality of these views to the region.

4.4.10 Cultural Resources

For introductory information regarding cultural resources, see Section 4.1.10. Unless otherwise noted, the information in this section is derived from the *1996 NTS EIS* (DOE 1996c). Additional information regarding cultural resources on the TTR was obtained from the Desert Research Institute (DOE 2010a), which provides Cultural Resources Program support to the DOE/NNSA NSO and to the USAF. Information sources provided by the Desert Research Institute include short report summaries, lists of recorded sites on the TTR and their NRHP eligibility status, and excerpts from cultural resources studies conducted on the TTR.

The TTR lies within the Southern Great Basin physiographic region and encompasses portions of five hydrographic basins (Cactus Flat, Gold Flat, Stonewall Flat, Ralston Valley, and Stone Cabin Valley) (NDWR 2010a) (see **Figure 4–50**). The TTR area possesses a long history of American Indian occupation and more-recent European-American settlement and American military use. Archaeological research indicates humans have used the area within the TTR for the last 10,000 years. When European-American explorers first entered this area in the mid-nineteenth century, groups of Western Shoshone occupied the region. Historic period activity consisted of mining and ranching; more-recent activity has focused on military use of the TTR area.

The area of influence for the TTR is defined as all ground areas that would experience direct or indirect impacts of construction, maintenance, or operations of program facilities and activities occurring on the TTR. Based on current knowledge of cultural resources within the TTR, all areas have the potential to contain cultural resources. Therefore, the area of influence for this SWEIS includes the entire area within the TTR boundary.

4.4.10.1 Recorded Cultural Resources

Current knowledge about cultural resources on the TTR is largely the result of project-specific cultural resources studies completed for DOE activities. Cultural resources studies that included large portions of the TTR include Bergin et al. 1979 and DuBarton and Johnson 1996. Past DOE operations have been concentrated in two areas: (1) the lowland portions of Cactus Flat and (2) Stonewall Flat (DOE 2008l). As a result, these areas of the TTR have been intensively surveyed for cultural resources (Pippin 2005). One area in particular, along the Breen Creek drainage at the southern end of Cactus Flat, is highly sensitive for prehistoric and historic cultural resources (DuBarton and Johnson 1996). Other areas, however, have undergone little or no cultural resources inventory. Consequently, there is no overarching archaeological cultural resources overview for the TTR (Pippin 2005). Cultural resources sites from all chronological periods and site types have been recorded on the TTR. However, the greatest number of recorded sites consists of prehistoric extractive and processing localities, as well as historic mining and ranching sites. One historic building survey resulted in the development of a comprehensive Cold War era historic context and 59 properties recommended for eligibility for the NRHP as a historic district (Ullrich et al. 2005).

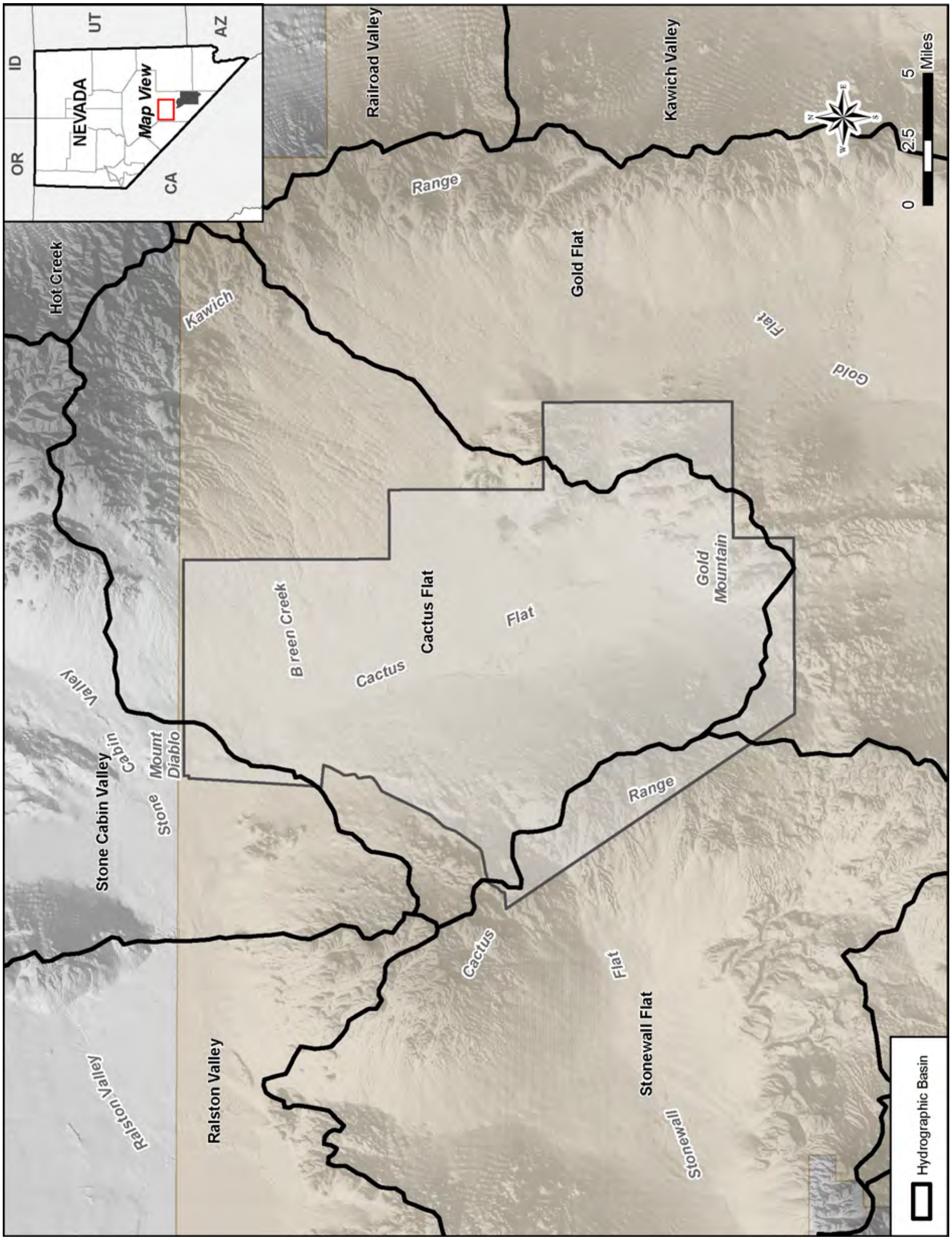


Figure 4–50 Hydrographic Basins Within the Tonopah Test Range Boundary

Less than 4 percent of the TTR has been surveyed for cultural resources. Seventy-one cultural resources studies have been completed on the TTR, and 330 cultural resources sites have been recorded. Prehistoric archaeological sites make up 87 percent, or 288 sites, of recorded sites on the TTR; the remaining 13 percent, or 42 sites, are historic archaeological sites and structures related to mining and ranching, and 1 site associated with military and scientific research (DOE 2010a). Sixty-seven percent, or 222 sites, are eligible for listing in the NRHP. Cultural resources are grouped by the five hydrographic basins located within the TTR (see **Table 4–74**).

Table 4–74 Tonopah Test Range Cultural Resources Sites by Site Type and Hydrographic Basin

Hydrographic Basin	***Prehistoric Site Types***							***Historic Sites***		***Untyped Sites***	***Total Sites***	***NRHP-Eligible***
	RB	***TC***	***EL***	***PL***	***LO***	***CA***	***STA***	***HI***	***NT***	***UT***		
Gold Flat	0	4	0	0	31	0	0	9	0	0	44	40
Stonewall Flat	0	0	0	0	3	0	1	9	0	0	13	13
Ralston Valley	0	2	0	0	36	0	0	2	0	0	40	38
Cactus Flat	0	19	0	3	93	0	0	18	1	0	134	68
Stone Cabin Valley	0	3	0	6	87	0	0	3	0	0	99	63
Total	**0**	**28**	**0**	**9**	**250**	**0**	**1**	**41**	**1**	**0**	**330**	**222**
Total Sites	**330**											**222**

CA = cache; EL = extractive locality; HI = historic site; LO = locality; NRHP = National Register of Historic Places; NT = nuclear testing; PL = processing locality; RB = residential base; STA = station; TC = temporary camp; UT = untyped.
Note: This table does not include isolated artifacts or features.

4.4.10.1.1 Gold Flat

While most of the Gold Flat Hydrographic Basin lies south of the TTR, a portion of Gold Flat lies in the southeastern corner of the TTR. Within the TTR, Gold Flat is divided from the Cactus Flat Hydrographic Basin by the Breen Creek drainage. Seven cultural resources studies have been conducted within the TTR portion of Gold Flat. Approximately 950 acres have been surveyed for cultural resources. To date, 44 cultural resources sites have been recorded, including 4 temporary camps, 31 uncategorized localities, and 9 historic sites associated with mining and ranching. Of these, 40 sites are eligible for listing in the NRHP.

4.4.10.1.2 Stonewall Flat

A small portion of the Stonewall Flat Hydrographic Basin lies within the southwestern TTR area. Stonewall Flat is separated from Cactus Flat by the Cactus Range. One cultural resources survey covering 215 acres has been completed on the TTR portion of Stonewall Flat. A total of 13 sites have been recorded, including 3 uncategorized localities, 1 station, and 9 historic sites associated with mining and ranching. All 13 sites are eligible for listing in the NRHP.

4.4.10.1.3 Ralston Valley

Only the southeastern corner of the Ralston Valley Hydrographic Basin falls within the TTR boundary. The Monitor Hills separate Ralston Valley from the Stone Cabin Valley Hydrographic Basin. One cultural resources survey covering 170 acres has been completed on the TTR portion of Ralston Valley. A total of 40 sites have been recorded, including 2 temporary camps, 36 uncategorized localities, and 2 historic sites. To date, 38 of these sites are eligible for listing in the NRHP.

4.4.10.1.4 Cactus Flat

The majority of the Cactus Flat Hydrographic Basin lies within the TTR boundary. Cactus Flat is bounded by the Cactus Range to the west, the Kawich Range to the east, Gold Mountain to the south, and

Mount Diablo to the north. Cactus Flat is the location of the Tonopah Test Range Airport and support facilities and, therefore, has been intensively surveyed for cultural resources. Fifty-six cultural resources studies have been conducted within Cactus Flat. Approximately 14,057 acres have been surveyed for cultural resources. A total of 134 cultural resources sites have been recorded, including 19 temporary camps, 3 processing localities, 93 uncategorized localities, 18 historic sites associated with mining and ranching, and 1 site associated with nuclear testing. Of these, 68 sites are eligible for listing in the NRHP.

4.4.10.1.5 Stone Cabin Valley

The southern end of Stone Cabin Valley Hydrographic Basin extends into the northern portion of the TTR. The basin is bounded by the Monitor Hills to the west and the Kawich Range to the east. Six cultural resources surveys have been conducted within the TTR portion of Stone Cabin Valley. Approximately 420 acres have been surveyed for cultural resources. To date, 99 cultural resources sites have been recorded, including 3 temporary camps, 6 processing localities, 87 uncategorized localities, and 3 historic sites. Of these, 63 sites are eligible for listing in the NRHP.

4.4.10.2 Sites of American Indian Significance

For a general description of consultation efforts between DOE/NNSA and CGTO, see Section 4.1.10.

DOE/NNSA consultation with CGTO included a site visit to Cactus Flat in 1997 by members of CGTO. The goal of the visit was to provide recommendations for DOE/NNSA site restoration activities in relation to potential sites of American Indian significance (Stoffle et al. 2001). This and other ongoing consultation efforts have resulted in a better understanding of the cultural significance these sites and locations possess in relation to traditional cultural landscapes (Zedeno et al. 1999; Stoffle et al. 2001).

4.4.11 Waste Management

A variety of wastes are generated during TTR operations in support of DOE/NNSA's Weapons Ordnance Program, as well as during environmental restoration activities at the TTR and the Nevada Test and Training Range. Although most wastes so generated are shipped off site for disposal, some sanitary solid waste and construction debris are disposed in onsite landfills.

Waste Generation. Hazardous waste from TTR operations that was disposed or recycled off site during CYs 2006 through 2008 is listed in **Table 4–75** (Schade 2010). Hazardous waste sent off site for disposal includes waste regulated under RCRA; asbestos- and PCB-contaminated waste regulated under TSCA; and waste regulated under other authorities, such as liquids or medical waste. This waste was accumulated and shipped off site for disposal at permitted disposal facilities.[32]

TTR pollution prevention and waste minimization activities include programs to recycle and recover materials such as antifreeze, Freon®, solvents, electronic components, oil, batteries, fluorescent and sodium bulbs, and mercury-containing equipment. Antifreeze is recycled and Freon® is recovered at an onsite unit. Other materials were sent off site for recycling, as shown in Table 4–75.

[32] *The TTR is a small-quantity generator of hazardous waste.*

Table 4–75 Tonopah Test Range Operations Hazardous Waste Disposed or Recycled, Calendar Years 2006–2008 (tons)

Waste Type	Calendar Year		
	2006	2007	2008
Hazardous waste	0.354	1.17	0.765
TSCA waste (asbestos/PCBs)	(a)	0.0353	(a)
Non-RCRA- or TSCA-regulated waste [b]	0.864	3.01	2.01
Recycled waste [c]	3.80	0.465	4.35

PCB = polychlorinated biphenyl; RCRA = Resource Conservation and Recovery Act; TSCA = Toxic Substances Control Act.
Note: Data from the cited source were rounded to three significant figures.
[a] Not reported for this year.
[b] Includes liquids, medical wastes, and other toxic solids that are not regulated under RCRA or TSCA.
[c] Includes materials such as batteries, fluorescent lights, or electronic equipment that are regulated under RCRA or other statutory authorities and were shipped off site for recycling.
Source: Schade 2010.

Solid wastes from TTR operations disposed from 2006 through 2008 are summarized in **Table 4–76**. Construction debris and municipal solid waste may be disposed within TTR landfills operated by the USAF (see Table 4–76). Tires and scrap metal waste generated from cleanup of the TTR Salvage Yard were surveyed by radiation control technicians and disposed by shipment to the Apex Landfill near Las Vegas, Nevada. By disposing this waste at a commercial landfill, possible impacts on TTR or NNSS landfill capacity were avoided.

Table 4–76 Tonopah Test Range Operations Solid Wastes Disposed, Calendar Years 2006–2008 (tons)

Waste Type	Calendar Year		
	2006	2007	2008
Tires and scrap metal	63 [a, b]	47.5 [b]	290.2 [b]
Construction debris	21.5	4.87 [c]	1.6 [c]
Sanitary solid waste	25.6	19.9 [c]	23.9 [c]

[a] Measured in cubic yards.
[b] Generated from cleanup of the TTR Salvage Yard. After being surveyed by radiation control technicians and cleared for release, the waste was shipped to the Apex Landfill near Las Vegas, Nevada, for disposal.
[c] The construction debris was disposed at the USAF Construction Landfill at the TTR, while the sanitary landfill waste was disposed at the USAF Sanitary Landfill at the TTR.
Source: DOE 2009a; SNL 2007, 2008.

Table 4–77 presents a summary of the environmental restoration waste generated at the TTR and disposed during CYs 2006 through 2008 (DOE 2009a; SNL 2007, 2008). During these years, TTR environmental restoration activities generated no RCRA- or TSCA-regulated wastes and no TRU or mixed wastes. In 2006, the TTR generated a small quantity of solid waste, consisting of personal protective equipment, such as paper and plastic, that was transferred to the NNSS for disposal. In addition, in 2005, closure activities for CAU 489 (World War II unexploded ordnance sites) generated 75.5 tons of scrap metal that in 2006 was transported to and disposed at the NNSS. In 2006 and 2007, the TTR disposed materials consisting of unexploded ordnance and debris from an Honest John M-50 rocket. During these years, depleted uranium recovered from the rocket was disposed at the NNSS as LLW and included debris and soil, personal protective equipment, and some material from the rocket. In 2007, 17 tons of inert unexploded ordnance and metal debris were disposed by the USAF (6 tons of inert unexploded ordnance) or shipped to and disposed at a Nevada Test and Training Range unexploded ordnance pile (11 tons of metal debris). Also in 2007, three metal structures were dismantled, and the metal scrap (10.5 tons) was shipped to the NNSS Area 3 Sandia Salvage Yard for reuse or recycle.

In 2008, environmental restoration activities were focused on planning activities for CAU 408 (Bomblet Target Area) and a sampling effort on Main Lake. The sampling effort on Main Lake was conducted to support characterization of approximately 40 soil-filled plastic bags that were ultimately disposed as sanitary solid waste. In 2008, however, the TTR generated 24 tons of hydrocarbon-contaminated soil that was shipped off site for disposal at the NNSS hydrocarbon landfill in Area 6.

Table 4–77 Environmental Restoration Wastes Disposed or Recycled, Calendar Years 2006–2008 (tons)

Waste Type	*Calendar Year*		
	2006	*2007*	*2008*
Scrap metal	75.5	(a)	(a)
Inert UXO and metal rocket debris	142	17.0	(a)
Nonradioactive solid waste	0.244 [c]	(a)	(b)
Recycled metal debris	(a)	10.5	(a)
Hydrocarbon-contaminated soil	(a)	(a)	24.0
Low-level radioactive waste (DU-contaminated)	742	407	(a)

DU = depleted uranium; UXO = unexploded ordnance.

[a] Not reported for this year.

[b] This material consisted of approximately 40 bags of soil that were sampled and ultimately disposed as sanitary solid waste.

[c] Consists of nonimpacted personal protective equipment (plastic, paper, Tyvek®, gloves, etc.) transported to the NNSS for disposal.

Source: DOE 2009a; SNL 2007, 2008.

Landfills. At the TTR, the USAF operates a landfill for disposal of construction debris, as well as an expanded Class II sanitary landfill for disposal of municipal solid waste (DOE 2009a). The original sanitary landfill was transferred from DOE to USAF operation in 1992, and was recently expanded. The landfill is authorized to receive no more than 20 tons of municipal solid waste per day, and is projected to have a total license expectancy of 30 years (USAF 2007a).

4.4.12 Human Health and Safety

The health and safety of the general public and workers at the TTR are discussed in this section. Environmental health risks from TTR activities include the effects of environmental noise and acute and chronic exposures to ionizing radiation and hazardous chemicals. Regular programs are administered to monitor releases and evaluate associated potential health impacts. Additionally, studies have been conducted to assess the exposure pathways and potential risks of radionuclide and toxic chemical releases during past TTR operations. These studies focused on the impacts of releases in terms of health risks to the general public and workers at the TTR. Results of current assessments and historic studies indicate (1) there is little risk of enhanced carcinogenesis due to radionuclide and chemical releases during site operations; (2) exposures to site radionuclide releases tend to be far lower than those due to natural background radiation; and (3) chemical exposures are well within established guidelines. In keeping with the goal of optimal protection of vulnerable populations, DOE maintains a comprehensive Emergency Management Program that features hazard-specific plans, procedures, and controls (DOE Order 151.1C).

4.4.12.1 Public Radiation Exposure and Safety

4.4.12.1.1 General Site Description

Major sources of background radiation and average doses from background radiation exposure to individuals in the TTR vicinity are the same as those for the NNSS (see Table 4–52). The average annual dose from background radiation is approximately 670 millirem. About half of the annual dose is from ubiquitous, natural background sources (355 millirem) that can vary depending on geographic location, individual buildings in a geographic area, and age, but essentially all comes from space or naturally occurring sources in the Earth. About half of the dose is from medical exposure to radiation (300 millirem), including computed tomography, interventional fluoroscopy, x-rays and conventional fluoroscopy, and nuclear medicine (use of unsealed radionuclides for diagnosis and treatment). Another approximately 14 millirem per year are from consumer products and other sources (nuclear power, security, research, and occupational exposure) (NCRP 2009). Average annual background radiation doses to individuals are expected to remain fairly constant over the time period of the proposed actions. Background radiation doses identified in Table 4–52 are unrelated to TTR operations.

Releases of radionuclides to the environment from TTR operations provide another source of radiation exposure to individuals in the vicinity of the TTR. The only sources of radionuclide emissions from the TTR consist of the resuspension of plutonium and americium from past test activities (DOE 2009a). Doses to the public estimated from historic monitoring at the TTR are presented in **Table 4–78**. These doses fall within the limits established in DOE Order 458.1 and are much lower than those due to background radiation.

Table 4–78 Radiation Doses to the Public from Tonopah Test Range Operations in 2008 (Total Effective Dose Equivalent)

Members of the Public	*Atmospheric Releases* [a]	*Liquid Releases* [b]	*Total* [c]
Maximally exposed individual (millirem)	0.024	0	0.024
Population within 50 miles (person-rem) [d]	<1	0	<1
Average individual within 50 miles (millirem) [e]	<0.024	0	<0.024

rem = roentgen equivalent man.

[a] Clean Air Act regulations in 40 CFR Part 61, Subpart H, establish a compliance limit of 10 millirem per year to a maximally exposed individual.

[b] There is no dose to the public from surface-water or groundwater pathways.

[c] DOE Order 458.1 establishes a dose limit of 100 millirem per year to individual members of the public exposed through all pathways.

[d] A population dose was not reported in the *Calendar Year 2008 Annual Site Environmental Report for Tonopah Test Range, Nevada and Kauai Test Facility, Hawaii* (DOE 2009a). The estimated population within 50 miles of the Tonopah Test Range was only about 5,000 in the year 2008; if every member of that population received the same dose as the Tonopah Test Range maximally exposed individual, the population dose would be much less than 1 person-rem.

[e] The dose to the maximally exposed individual was based on an exposure location at the Tonopah Test Range Airport. Members of the population are further away from the sources of airborne radioactive material and are exposed to lower concentrations; therefore, the average dose to an individual of the 50-mile population is significantly lower than that to the maximally exposed individual.

Source: DOE 2009a; SNL 2009a.

Using a risk coefficient of 600 cancer deaths per 1 million person-rem (0.0006 LCFs per person-rem) (DOE 2003c), the risk of an LCF to the MEI due to radionuclide releases from TTR operations in 2008 was estimated to be 1.4×10^{-8}. That is, the probability of this person dying of cancer at some time in the future as a result of a radiation dose associated with emissions from 1 year of TTR operations is about 1 in 70 million. The hypothetical MEI is a person whose place of residence and lifestyle make it unlikely that any other member of the public would receive a higher radiation dose from TTR releases. This person was assumed to be exposed to radionuclides in the air and on the ground from TTR emissions and was assumed to be located at the Tonopah Test Range Airport (DOE 2009a).

No members of the public receive direct gamma radiation exposure that is above background levels as a result of past or present TTR operations. Gamma radiation exposure rates measured at areas accessible to the public are comparable to natural background rates from cosmic and terrestrial radiation. Radioactively contaminated areas at the TTR are isolated from members of the public, given the considerable distances between these areas and the TTR boundary.

In regard to groundwater monitoring programs, there is no TTR radiation dose incurred by the public from the groundwater pathway. Annual monitoring indicates that no contaminated groundwater has migrated beyond the TTR boundary into surrounding water supplies used by the public (DOE 2009a).

Operations at the TTR do not involve activities that release radioactive emissions from either point sources (stacks/vents) or diffuse sources (outdoor testing). However, diffuse radioactive emissions are produced from the resuspension of americium and plutonium present at sites of previous testing activities. Other locations at the TTR with minor radioactive contamination, such as depleted uranium, are not significant sources of radioactive air emissions from resuspension (DOE 2009a).

4.4.12.2 Occupational Radiation Exposure and Safety

Workers at the TTR receive the same dose as the general public from background radiation, but they potentially receive an additional dose from working in or around areas with radioactive material. No worker dose data have been reported since the year 2002, and no workers received a measurable dose between 1998 and 2002. The average annual worker dose measured between 1991 and 2002 was 12 millirem (DOE 2009i).

Worker occupational risks at the TTR are generally associated with activities such as waste management, environmental restoration, terrestrial surveillance, and environmental monitoring. DOE's Computerized Accident/Incident Reporting System provides statistics on worker injury and illness information, including accidents involving government-owned vehicles. There were no reportable occurrences in 2008 at the TTR. A reportable occurrence is defined as an unanticipated event that leads to a near-miss, injury, or death of an occupational worker.

4.4.12.3 Chemical Exposure and Risk

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, through which people may come in contact with hazardous chemicals. Hazardous chemicals can cause cancer and non-cancer-related health effects.

Because of the TTR's remote location and large size, there is no risk of chemical exposure to the surrounding public population resulting from normal site operations. Nevertheless, monitoring efforts and baseline studies are regularly performed. However, certain TTR workers may be at risk to chemical exposure depending upon their job function and proximity to various sources.

Common sources of chemical pollutants and RCRA materials at the TTR include solvents, fuels and oil, pesticides, septic sludge, heavy metals, various munitions materiel, lead-acid batteries, and mercury-containing items. Particulate matter from the TTR portable screen and the TTR maintenance shops (which include painting, welding, and carpentry activities) was released in limited quantities in 2008. The portable screen was operated for 220 hours during 2008 and contributed 0.01 tons of particulate matter emissions. Maintenance shops operated for 282 hours or less in 2008 and contributed less than 0.2 tons of emissions (from particulate matter, hazardous air pollutants, and volatile organic compounds) in total (DOE 2009a).

As for monitoring potential chemicals released to TTR drinking water and wastewater systems, a single well (Well 6) supplies the drinking water needs to TTR workers and visitors, and is monitored annually for potability and purity. Water samples from this well continue to meet all national primary and secondary drinking water standards. In addition, the TTR sewage lagoon systems are tested for biochemical oxygen demand, pH, and total suspended solids, as well as for a suite of toxic chemicals. In the two most recent years for which results have been reported, all wastewater measurements were found to be within permit limits (DOE 2009a; SNL 2010b).

To manage risks from handling toxic or hazardous chemicals, TTR worker safety programs are established to comply with Federal and state laws, DOE Orders, Occupational Safety and Health Administration requirements, and EPA guidelines. Sandia National Laboratories plans and procedures for performing work ensure worker protection through training, monitoring, use of personal protective equipment, and administrative controls. Although chemical inventories have varied to a limited extent over recent years, administrative controls continually ensure that quantities do not approach levels that pose undue risk due to storage, concentration, bulk quantity, or logistical factors. Any amounts that potentially exceed threshold planning quantities require reporting under Federal regulations.

4.4.12.4 Health Effects Studies

To date, apart from the NNSS-related studies described in Section 4.1.12.4, no studies have analyzed potential epidemiological effects resulting from past TTR operations. There are no studies that indicate adverse health effects in populations near the TTR as a result of activities or operations supporting current TTR missions.

4.4.12.5 Accident History

The only significant incident on record to have occurred at the TTR in recent years is the following: Five USAF personnel were killed when a Beechcraft 1900C crashed at the Tonopah Test Range Airport. It was determined that the incident was due to the pilot undergoing cardiac arrest during landing maneuvers (ASN 2004).

4.4.12.6 Emergency Preparedness

Each DOE site has established an Emergency Management Program, developed in accordance with DOE Order 151.1C, *Comprehensive Emergency Management System*, that would be activated in the event of an accident. This program has been developed and maintained to ensure adequate response for postulated 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 TTR 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. DOE/NNSA coordinates emergency response planning and training with local governments. In accordance with the National Incident Management System, the coordination ensures that communications systems and equipment are interoperable and that personnel and equipment can be effectively deployed in the event of an emergency. The DOE/NNSA manager is responsible for managing, countering, and recovering from an emergency occurring at the TTR.

The plan provides for identification and notification of personnel for any emergency that may develop during operational and nonoperational hours. DOE/NNSA receives warnings, weather advisories, and any other communications that provide advance warning of a possible emergency. The plan is based upon current DOE/NNSA vulnerability assessments, resources, and capabilities regarding emergency preparedness.

4.4.12.7 Environmental Noise

The acoustic environment adjacent to the TTR is similar to that described for land areas adjacent to the NNSS. The nearest residents are located in the towns of Goldfield, approximately 22 miles west of the site boundary, and Tonopah, approximately 30 miles northwest of the site. The main sources of noise at the TTR include air- and ground-launched rockets, gun firing, and explosives experiments. An airbase is located within the TTR in support of Nevada Test and Training Range activities. Because of access restrictions and lack of a nearby population, public exposure to these noise sources is limited to occasional sonic booms produced by supersonic overflights of military aircraft. Principal sources of noise to residents of nearby towns include vehicular traffic on U.S. Routes 6 and 95 and aircraft operations.

4.4.13 Environmental Justice

There are no block groups in Nye County (the county the TTR is located within) with minority populations greater than 50 percent. Within the ROI, the closest block group to the NNSS with a minority population greater than 50 percent is more than 60 miles to the southeast of the TTR, near the southeastern corner of the NNSS (see Figure 4–36). Additional block groups with minority populations greater than 50 percent are found further to the southeast in the Las Vegas metropolitan area, closer to the RSL and NLVF facilities (see Sections 4.2.13 and 4.3.13).

Census data were available for the number of households with an income less than $15,000 and those with an income between $15,000 and $24,999. DOE used the combined number of households with incomes less than $24,999 as the poverty threshold for Nye County. Analysis of the data (see Figure 4–36) illustrates that there are numerous census block groups with low-income populations between 11 and 20 percent (that is, at or above the state-wide average) distributed throughout the ROI, including large (but sparsely populated) block groups adjacent to the TTR.

4.5 Former Yucca Mountain Site Affected Environment

DOE analyzed a proposed action to construct, operate, monitor, and eventually close a geologic repository for the disposal of spent nuclear fuel and high-level radioactive waste at Yucca Mountain in Nye County, Nevada, in the *Final Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada* (*Yucca Mountain EIS*) (DOE/EIS-0250F) (DOE 2002e), and in the *Final Supplemental Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada* (DOE/EIS-0250F-S1) (DOE 2008g). The area evaluated for the repository is an approximately 150,000-acre area of land that comprises land administered by DOE (79,000 acres of the NNSS); the USAF (24,000 acres of the Nevada Test and Training Range); and BLM (44,000 acres), as well as private land (a 200-acre Cind-R-Lite Patented Mining Claim). The Nevada Test and Training Range is closed to public access and use. The BLM-administered land outside of the Nevada Test and Training Range is open to public use, with the exception of approximately 4,250 acres. A number of unpatented mining claims are located on the BLM land.

The area evaluated for the repository is in the southern part of the Great Basin, which is characterized by generally north-trending, linear mountain ranges separated by intervening valleys or basins. Within this setting, Yucca Mountain is part of the southwestern Nevada volcanic field, a volcanic plateau that formed between about 14 and 11.5 million years ago. Yucca Mountain is a product of both volcanic activity and faulting. The crest of Yucca Mountain reaches elevations from 4,900 feet to 6,300 feet above sea level. Crater Flat is located on the BLM-administered land to the west of Yucca Mountain and contains four prominent volcanic cinder cones.

Thirty-six species of mammals have been recorded in and around Yucca Mountain. None of these mammals are classified as threatened or endangered by the USFWS. Twenty-seven species of reptiles have been found at and near Yucca Mountain. The desert tortoise (*Gopherus agassizii*) is listed as threatened under the Endangered Species Act. Yucca Mountain is at the northern edge of the range of the desert tortoise. The western chuckwalla (*Sauromalus obesus*) and the western red-tailed skink (*Eumeces gilberti rubricaudatus*) are classified as sensitive species in Nevada by BLM. More than 120 species of birds have been recorded at Yucca Mountain and the surrounding region, including 15 species of raptors. Several bird species are classified as sensitive species in Nevada by BLM. Native plants at Yucca Mountain below an elevation of about 4,000 feet are typical of the Mojave Desert. Above 4,000 feet is a vegetation transition zone between the Mojave Desert and the colder Great Basin Desert. About 30 invasive, nonnative plant species also occur in the Yucca Mountain region.

There are no perennial streams, natural bodies of water, or naturally occurring wetlands in the area evaluated. Solitario Canyon Wash collects drainage from the west side of Yucca Mountain and runs through the Nevada Test and Training Range and BLM-administered lands. Drill Hole Wash and Busted Butte (Dune) Wash collect drainage from the east side of Yucca Mountain and drain into Fortymile Wash on the NNSS. Fortymile Wash drains to the south. The washes only carry water during intense rain and rapid snowmelt. These washes drain into the ephemeral Amargosa River, which terminates in the Badwater Basin in Death Valley.

More than 530 archaeological sites and over 550 isolated artifacts have been discovered at or near Yucca Mountain. Collectively, they indicate that the Yucca Mountain region has been occupied by American Indian populations for at least 12,000 years. According to American Indians, the Yucca Mountain area is part of the holy lands of the Western Shoshone, Southern Paiute, and Owens Valley Paiute and Shoshone people.

BLM assigns visual resource values to the lands it manages on a scale of Class I to Class IV, with Class IV representative of the lowest visual values. DOE has previously determined that the lands to the west and south of Yucca Mountain, which are visible from portions of U.S. Route 95, are Class III and Class IV lands, which are common to the region.

The air quality in the area is characterized as unclassifiable due to limited air quality data. However, data collected by DOE indicate that the air quality is within applicable NAAQS.