

SITE-WIDE ENVIRONMENTAL IMPACT STATEMENT FOR THE **CONTINUED OPERATION OF SANDIA NATIONAL LABORATORIES, NEW MEXICO**

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COVER SHEET

RESPONSIBLE FEDERAL AGENCY: U.S. Department of Energy (DOE)/National Nuclear Security Administration (NNSA)

COOPERATING AGENCIES: The U.S. Department of Agriculture Forest Service, Southwestern Region, and the Department of the Air Force, Kirtland Air Force Base

COLLABORATING ENTITY: The Pueblo of Isleta

TITLE: *Site-Wide Environmental Impact Statement for Continued Operation of Sandia National Laboratories/ New Mexico* (SNL/NM SWEIS) (DOE/EIS-0556) (SAND2025-07080R)

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1.0 INTRODUCTION, PURPOSE, AND NEED FOR AGENCY ACTION

1.1 INTRODUCTION

The U.S. Department of Energy (DOE) National Nuclear Security Administration (NNSA) prepared this *Site-Wide Environmental Impact Statement for Continued Operation of Sandia National Laboratories, New Mexico* (DOE/EIS-0556) (SNL/NM SWEIS) in accordance with Section 102(2)(C) of the National Environmental Policy Act of 1969 (NEPA), Title 42 of the *United States Code* (U.S.C.), Section 4321 et seq. (42 U.S.C. § 4321 et seq.), and DOE's NEPA Implementing Procedures (DOE 2026). The purpose of an environmental impact statement (EIS) prepared pursuant to NEPA Section 102(2)(C) is to ensure agencies consider the environmental impacts of their actions in decision-making. NNSA prepares SWEISs, if not otherwise required, for certain large, multiple-facility sites such as Sandia National Laboratories/New Mexico (SNL/NM).

NNSA, a semi-autonomous agency within DOE, is responsible for meeting the national security requirements established by the President and Congress to maintain and enhance the safety, reliability, and performance of the U.S. nuclear weapons stockpile (NNSA 2024a; 50 U.S.C. § 2401 et seq.). Other major NNSA missions include nonproliferation (reducing global nuclear and radiological terrorism threats, preventing nuclear weapons development and spread of materials or knowledge needed to create them); counterterrorism and counterproliferation (preventing, countering, and responding to terrorists or adversaries with nuclear or radiological devices); providing the U.S. Navy with safe and militarily effective nuclear propulsion; and responding to nuclear and radiological emergencies in the United States and abroad. NNSA also supports national security imperatives to protect against cyber, space, biological, and chemical threats.

Stockpile Stewardship and Management Program

DOE/NNSA's annual Stockpile Stewardship and Management Plan has two primary purposes:

- Document DOE/NNSA's plans to:
 - Maintain the current stockpile;
 - Modernize the stockpile as necessary to respond to evolving deterrent needs;
 - Advance science that enables stockpile stewardship to enhance the potential performance and understanding of the stockpile's aged, modified, and modernized nuclear weapons;
 - Maintain and modernize supporting infrastructure; and
 - Sustain DOE/NNSA's highly skilled workforce.
- Provide DOE/NNSA's formal response to statutory and administrative reporting requirements:
 - The annual life extension program (LEP) reporting requirement; and
 - Actual or potential risks to, or specific gaps in, any industrial base element that supports nuclear weapons components' subsystems or materials, and any mitigation actions needed.

Sandia National Laboratories (SNL) is a multi-mission National Laboratory owned by DOE/NNSA and operated by National Technology & Engineering Solutions of Sandia, LLC (NTESS), pursuant to a Management and Operating (M&O) contract awarded by NNSA. SNL's original mission, to provide engineering design, systems engineering, and integration of non-nuclear components of the Nation's nuclear arsenal, continues today. SNL functions as a nuclear weapons research, development, and engineering laboratory. Continued operation is critical to

NNSA’s Stockpile Stewardship and Management Program (SSMP) (NNSA 2024a) to prevent spread and use of nuclear weapons worldwide. SNL engages in strategic areas that impact national security and global stability, in accordance with 50 U.S.C. §§ 2521–2545 (refer to Chapter 2 for more details on SNL’s programs, portfolios, capabilities, and support of NNSA missions). SNL is an NNSA-sponsored Federally Funded Research and Development Center (FFRDC), as defined by the Federal Acquisition Regulations at Title 48 of the *Code of Federal Regulations* (48 CFR) 35.017. SNL includes operations at multiple locations in New Mexico (SNL/NM), and in Livermore, California; Utqiagvik (formerly Barrow), Atkasuk, and Oliktok, Alaska; Kauai, Hawaii; Tonopah, Nevada; Amarillo, Texas; and Shoreview, Minnesota.

Terminology Used in This SNL/NM SWEIS

Missions refer to DOE and NNSA’s major responsibilities (refer to Section 2.2). DOE and NNSA assign activities to their laboratories, production facilities, and other sites to accomplish missions.

Portfolios are long-term efforts with broad goals or requirements. Five portfolios (refer to Section 2.3) organize SNL/NM to achieve mission success. DOE and NNSA program offices, such as DOE’s Office of Science or NNSA’s Office of Defense Programs, fund and direct SNL/NM portfolio activities.

Programs focus efforts on management of day-to-day operations within a given SNL/NM portfolio.

Capabilities refer to facilities, equipment, infrastructure, and expertise necessary to undertake activities and implement mission assignments directed by DOE and NNSA program offices. Line organizations within SNL/NM divisions own and operate capabilities, which often support multiple missions/portfolios.

Projects are activities with a clear beginning and end that meet a specific goal or need. Projects vary from small (e.g., one experiment, a series of small experiments) to major (e.g., construction and start of a new nuclear facility). Usually a primary program office sponsors a project, which is a relatively short-term effort and can cross multiple missions and portfolios. In this SWEIS, “project” usually describes construction activities, including facility modifications (e.g., constructing a new office building, establishing and demonstrating a new capability), and operations.

Activities are physical actions used to implement missions, portfolios, capabilities, or projects.

This SWEIS focuses solely on SNL/NM operations and analyzes potential environmental impacts of reasonable alternatives for continued SNL/NM operations through the next 15 years (2025–2040). While SNL has operations outside New Mexico, this SWEIS’s scope is limited to activities within the state of New Mexico, primarily at SNL/NM within Kirtland Air Force Base (KAFB) and leased properties within and near the Albuquerque area.¹ In this SWEIS, “SNL” refers to all of SNL, while “SNL/NM” refers to only SNL’s New Mexico operations.

NNSA reviewed comments received and adjusted this SNL/NM SWEIS as appropriate. This SWEIS details how operations will be conducted at SNL/NM under different alternatives, including construction and operation of new facilities, modernization/upgrade of existing facilities and utilities, modification of operations, and/or demolition of excess and aging facilities. The Record of Decision (ROD), issued concurrently with this SWEIS, documents NNSA’s decision regarding the selected alternative(s).

¹ Other DOE and NNSA entities have permits or leases or own several facilities in the Albuquerque area that are not within the scope of this SWEIS because they are not part of SNL/NM operations. Additionally, SNL manages leases, licenses, or permits for facilities outside of New Mexico that support SNL/NM operations.

1.2 BACKGROUND

SNL/NM, then known as Z Division, dates to World War II. Z Division was part of Los Alamos National Laboratory (LANL) during the Manhattan Project Era. In 1948, Z Division moved to the Albuquerque area and became known as Sandia Laboratory (now SNL), which focused on nuclear weapons engineering and production coordination, moving toward an emphasis on weapons design research and development (R&D). In the 1960s and early 1970s, an emphasis on engineering applications resulted in mission lines and programs involving energy research and safeguards and security to address international concerns (e.g., the energy crisis, terrorism). Currently, generation and growth of new portfolios continue in nuclear energy, nuclear weapons engineering, security (global, homeland, weapons), bioscience, and robotics (SNL 2022a).

SNL/NM is located within KAFB to the southeast of Albuquerque. KAFB spans about 51,588 acres located at the foothills of the Manzanita Mountains (Figure 1-1). Albuquerque borders KAFB to the north, northeast, west, and southwest. The Albuquerque International Sunport (an airport; Sunport) and Mesa del Sol (a 12,800-acre mid-use urban area under development) are west of KAFB. KAFB is bordered to the east by U.S. Department of Agriculture Forest Service (Forest Service) land, and the southern boundary is shared with the Pueblo of Isleta (SNL 2022a).

This SWEIS analyzes SNL/NM operations on NNSA-owned land, NNSA-permitted land or land withdrawn from other federal agencies, and state-owned and privately owned leased/licensed properties in the state of New Mexico, primarily near the Albuquerque area (Figure 1-2). SNL/NM-managed lands² include about 16,000 acres and contain over 900 buildings with about 7 million square feet (SNL 2022b). NNSA-owned land comprises 2,913 acres and includes five technical areas (TAs). NNSA-permitted land, on which SNL/NM operates, consists of about 6,300 acres from the Department of the Air Force (DAF) and a portion of land withdrawn³ by the Forest Service (4,595 acres) (34 FR 1139). NNSA leases about 2,687 acres from the New Mexico State Land Office (La Semilla Buffer Zone) west of the KAFB boundary, which serves as a safety and sound buffer for testing operations (SNL 2022a).

NTESS has been the M&O contractor for SNL since 2017. SNL employs over 14,000 regular employees at all of its locations, with about 13,080 at SNL/NM. Its total budget is about \$4.6 billion per year. The NNSA Sandia Field Office (SFO) administers the contract with NTESS and oversees the SNL/NM M&O contractor. As shown on Figure 1-2, SNL/NM and NNSA SFO operations include five TAs, the Eubank Corridor, the Sandia Science & Technology Park (SSTP), KAFB-permitted areas, a “Withdrawn Area,” and the La Semilla Buffer Zone (refer to Table 1-1).

² The term “SNL/NM-managed lands” refers to all lands owned by NNSA, permitted lands from the DAF, and Forest Service land that has been withdrawn for DOE purposes related to SNL/NM.

³ In this context, “withdrawn” describes federal land that is withheld from settlement, sale, location, or entry, under some or all general land laws, for the purpose of limiting activities under those laws (43 U.S.C. § 1702(j)).

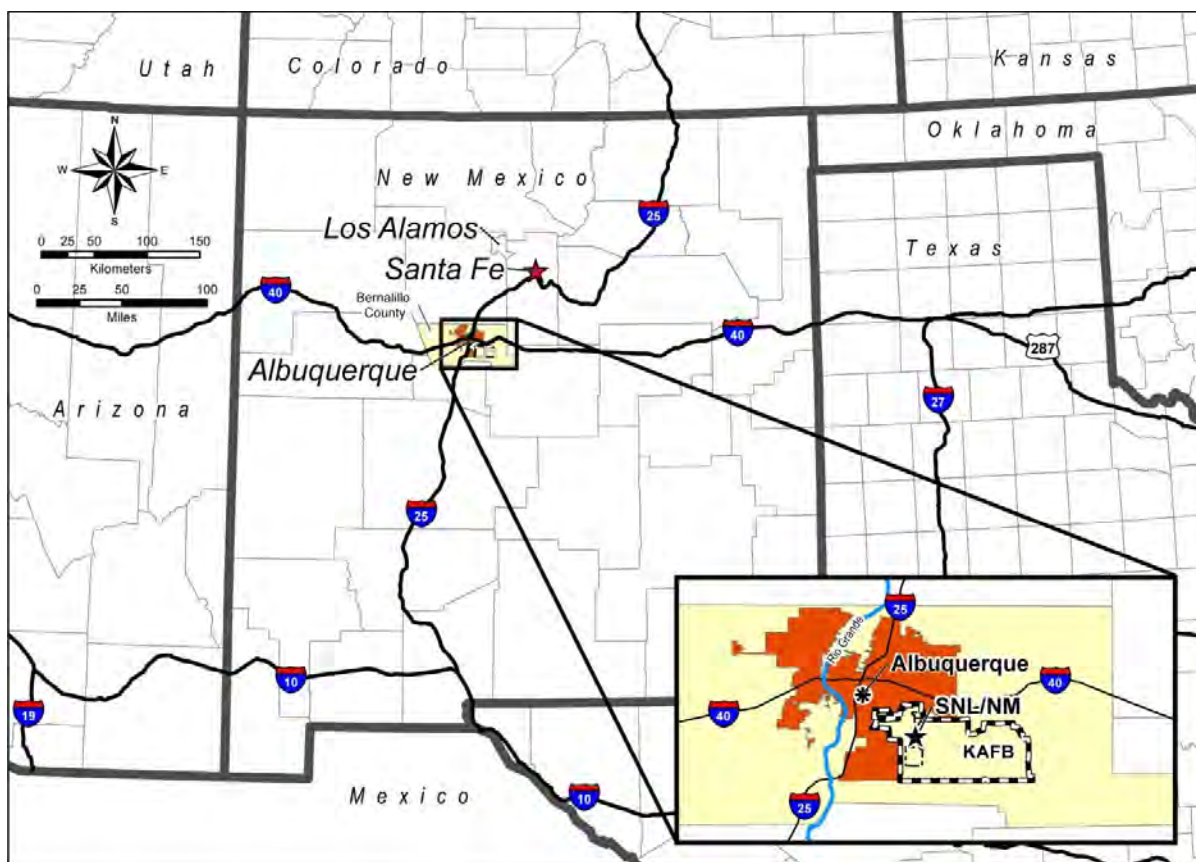


Figure 1-1. Location of the SNL/NM Site

Table 1-1. TAs and Other Areas Addressed in This SNL/NM SWEIS

Area	Description
TA-I	Includes the main SNL/NM administration and site support area, several R&D laboratories, and production/manufacturing facilities.
TA-II	Consists primarily of support service facilities, the Explosive Components Facility, battery testing, and waste management facilities.
TA-III	Includes primarily physical testing and waste management.
TA-IV	Primarily houses high-energy physics facilities, including several accelerators.
TA-V	Includes several radiological test facilities, including two research reactor facilities.
KAFB-permitted land to NNSA	Includes areas such as the Coyote Test Field (CTF) sites for explosive testing and ranges, remote testing sites, R&D facilities, and storage bunkers.
Withdrawn Area	Established by Public Land Order 4569 from the Forest Service to DOE for 4,595 acres as a safety buffer for testing in Lurance Canyon.
Onsite NNSA-owned facility	John A. Gordon Albuquerque Complex, used for headquarters administrative offices, located in the Eubank Corridor.
Offsite NNSA-owned facility	Center for Integrated Nanotechnologies (CINT), used for science, technology, and engineering research in nanotechnology, located in the Eubank Corridor.
Offsite leased facilities and areas	Includes La Semilla Buffer Zone (Figure 1-2 lower left); Advanced Materials Laboratory at the University of New Mexico (Figure 1-2 Offsite Lease 1); and SSTP (Figure 1-2 Offsite Lease 3), which includes the Innovation Parkway Office Center (IPOC), Cyber Engineering Research Laboratory (CERL), Center for Global Security and Cooperation (CGSC), Center for Advanced Manufacturing and Innovation (CAMINO), and Computer Science Research Institute (CSRI).

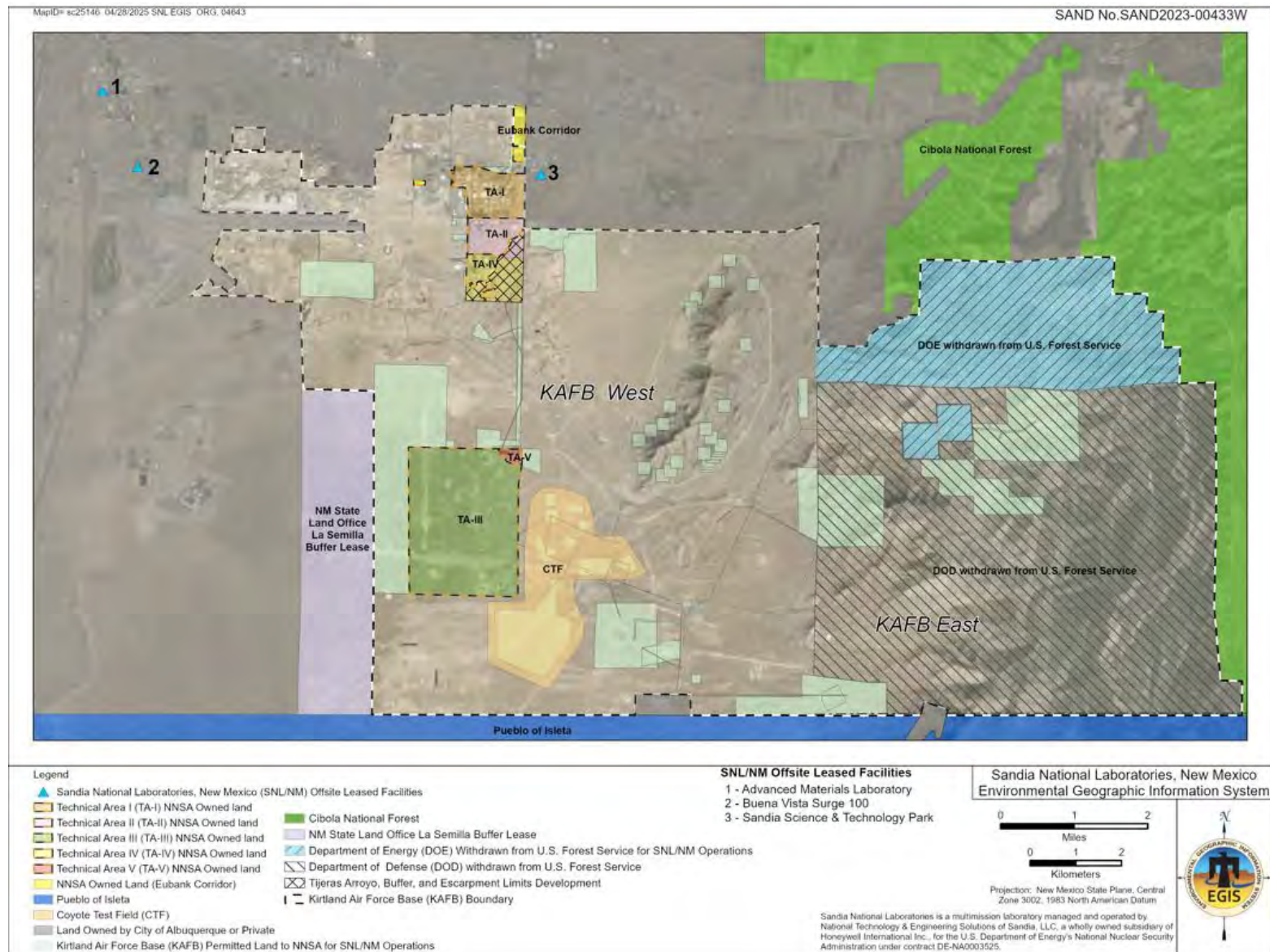


Figure 1-2. Locations of SNL/NM TAs, Other Permitted Properties, Withdrawn Area, and Selected Offsite Leased Facilities

In 1999, DOE issued the first SWEIS for SNL (1999 SWEIS) (DOE 1999), which analyzed the potential impacts of continued operations and resource management at SNL/NM to meet evolving DOE missions. The analysis included three alternatives – No-Action, Expanded Operations, and Reduced Operations – that supported existing and potential program-related activities at SNL/NM. The ROD for the 1999 SWEIS selected the Expanded Operations Alternative for implementation (64 FR 69996).

SNL/NM operates in accordance with the 1999 ROD, supplement analyses (SAs) (DOE 2001a; DOE 2002a; DOE 2004; and DOE 2006), and other project-specific NEPA prepared documents. This SWEIS describes facilities and activities on a mission/portfolio basis and organizes the alternatives consistent with the planning areas in the Site-Wide Master Plan (SNL 2022b), which also identifies potential future major development at SNL/NM (refer to Chapter 3).

1.3 PURPOSE AND NEED FOR AGENCY ACTION

The purpose and need for continued operation of SNL/NM is to support NNSA's mission as directed by Congress and the President (refer to Chapter 2 for more details on DOE/NNSA missions supported by SNL). NNSA has an obligation to ensure a safe, secure, and reliable nuclear stockpile, which requires NNSA to continue weapons R&D, surveillance, computational analysis, components manufacturing, and non-nuclear above-ground experimentation. Currently, many of these national security functions are conducted solely at SNL/NM. Curtailment or cessation of these activities would run counter to national security policy.

SNL/NM plays vital roles in NNSA missions, including enhancing U.S. national security through military application of nuclear energy and maintaining and enhancing safety, reliability, and effectiveness of the U.S. nuclear weapons stockpile. This includes the ability to design, produce, and test for meeting national security requirements; promoting international nuclear safety and nonproliferation; reducing global danger from weapons of mass destruction (WMDs); and supporting U.S. leadership in science and technology.

SNL/NM also provides non-weapons research and science services in multiple areas, including waste management, environmental restoration (ER), hazardous and radioactive material transportation, energy efficiency, nuclear energy, fossil energy, magnetic fusion, basic energy sciences, supercomputing, and biological and environmental research. SNL/NM capabilities support strategic partnership projects under which SNL/NM oversees national security-related research, development, and testing programs and conducts work for other federal and state government agencies, industry, and academic institutions.

1.3.1 National Security Considerations and Requirements

To accomplish the peace through strength defense priorities outlined in *National Security Strategy of the United States of America 2025*, the Nuclear Security Enterprise must be effective, responsive, and resilient. This will be achieved by revitalizing the U.S. defense industry for nuclear deterrence (White House 2025). Deterrence, assurance, and hedging against adverse developments discourage adversary interest in arms competition. SNL/NM supports advancement of these capabilities by modernizing nuclear forces, countering threats, bolstering

cyber-defense, and by driving innovation and technological advancement necessary for revitalizing the U.S. defense industry.

As detailed in the *National Defense Strategy 2026*, nuclear, aerial, and cyber attacks continue to threaten the U.S. homeland. Core elements of the U.S. strategy to counter these attacks, include (1) improving forensic capabilities to identify the origin of material outside of regulatory control or used in a nuclear device and (2) maintaining an incident response posture to detect, interdict, and defeat nuclear threats or minimize the consequences of nuclear events (DoW 2026). SNL/NM engages in several initiatives to support the National Security Strategy including forensic capabilities for weapons of mass destruction, incident response, and advanced cybersecurity solutions. Additionally, SNL/NM certifies the safety, reliability, and performance of nuclear weapons to prevent the United States from being vulnerable to nuclear blackmail.

NNSA prioritizes strengthening the strategic deterrent through nuclear arsenal modernization, accelerated weapons production, cultural reform, and advanced computing. Additionally, NNSA aims to cultivate a sense of urgency in addressing national security challenges and foster scientific breakthroughs. These breakthroughs leverage advanced computing, including artificial intelligence, to drive innovation in science and engineering, enhance deterrence, validate stockpile reliability, and develop next-generation weapon concepts. With over 70 years of expertise, SNL/NM supports these priorities as the engineering laboratory responsible for the research, design, development, and integration of non-nuclear components in nuclear weapons. As one of three national nuclear weapons laboratories, SNL/NM is crucial to the SSMP for assessing and certifying safety, reliability, and performance of nuclear weapons, and for producing critical components for the stockpile.

1.3.2 Other SNL/NM Program Considerations and Needs

Scientific progress drives research at SNL/NM. Consistent with the National Nuclear Security Administration Act (50 U.S.C. § 2401 et seq.), NNSA is responsible for supporting U.S. leadership in science and technology. SNL/NM supports other government entities by the advancement of science and industry through its Strategic Partnership Projects and Laboratory Directed Research and Development and supports science and industry through the transfer of technology. Additionally, SNL mission activity includes, in part, national security, energy security, and breakthroughs in fundamental sciences and applied technology (refer to Chapter 2).

SNL/NM facilities⁴ comprise about 900 real property assets, including structures with an average age of 36 years. Fifty-one percent of SNL/NM assets are in fair condition, while about 24 percent are in poor condition. Condition issues primarily result from old/outdated assets with increasing repair needs. Asset condition can risk mission success and bound the growth of mission activities (SNL 2022b). Although SNL maintains assets and conducts operations safely with appropriate environmental and safety controls, modern infrastructure investment is needed for the future.

⁴ “Facilities” refers to land, buildings, and other structures; their functional systems and equipment; and other fixed systems and equipment installed therein, including site development features outside the plant, such as landscaping, roads, walks, parking areas, outside lighting and communication systems, central utility plants, utility supply and distribution systems, and other physical plant features. These include any of the NNSA-owned, -leased, or -managed facilities, and they may or may not be furnished to a contractor under a contract with NNSA.

1.4 PROPOSED ACTION AND ALTERNATIVES

NNSA's Proposed Action is to decide how to continue operations at SNL/NM to meet mission requirements. To inform that decision, this SWEIS analyzes three alternatives for continued operations, including the: (1) No-Action Alternative, (2) Modernized Operations Alternative, and (3) Expanded Operations Alternative. For all alternatives, this SWEIS also considers notable changes that have occurred at SNL since the 1999 SWEIS. Potential future projects from the Site-Wide Master Plan and internal planning are included in the evaluation of each alternative. NNSA expects that this SWEIS will support implementation decisions for any or all of the specific projects proposed. Nevertheless, before implementing future projects, NNSA will determine whether this SWEIS remains adequate or if appropriate further NEPA review is required in accordance with NEPA, as amended, and the DOE Implementing Procedures.

The alternatives are summarized in the following sections and described in detail in Chapter 3. This SWEIS presents direct, indirect, and reasonably foreseeable effects of the three alternatives. Refer to Section 3.6 for alternatives that were considered but eliminated from detailed study.

1.4.1 No-Action Alternative

The No-Action Alternative continues operations throughout SNL/NM and supports currently assigned missions. NEPA regulations require analysis of the No-Action Alternative to provide a benchmark for comparison with alternatives' environmental effects. The No-Action Alternative reflects continuation of ongoing operations and implementation of projects for which NEPA analysis/documentation and required consultations already exist. The No-Action Alternative includes ongoing operations and the currently assigned mission scope: (1) minor construction (currently under \$34 million)⁵ of replacement facilities, (2) upgrades to existing facilities and infrastructure, and (3) decontamination, decommissioning, and demolition (DD&D) projects.

The No-Action Alternative includes 22 projects (refer to Section 3.2) for which the NEPA process has been completed. These projects represent a development footprint (estimated square footage of a project/facility plus any required construction laydown areas; refer to Section 3.2) of about 309,660 square feet (7.1 acres), with a dedicated site-wide laydown area of about 5 acres to support SNL/NM construction activities and construction of a 1-acre electrical substation. Ten buildings and other assets (total footprint of 117,172 square feet [2.7 acres]) are scheduled to undergo DD&D. No-Action Alternative projects include replacements for some existing, aging facilities.

1.4.2 Modernized Operations Alternative

The Modernized Operations Alternative aims to enhance existing programs and activities through facility modernization. This alternative would not expand capabilities at SNL/NM beyond those that currently exist. This alternative includes the No-Action Alternative scope, plus additional modernization activities: (1) additional replacement facility construction, (2) existing facility and infrastructure upgrades, and (3) DD&D projects. Under this alternative, NNSA would replace facilities approaching end of life, upgrade facilities to extend their lifetimes, and

⁵ In February 2024, NNSA adjusted the minor construction threshold from \$30 million to \$34 million to account for inflation (89 FR 9141). The minor construction threshold could change in the future.

improve work environments to increase efficiencies while still meeting operational requirements. Proposed DD&D of older facilities would eliminate excess facilities and reduce costs and risk.

As detailed in Section 3.3, this alternative proposes 38 facility projects and 20 upgrade, utility, and infrastructure projects (total development footprint of 1,656,580 square feet [38 acres]). In addition, 4 acres could be disturbed for infrastructure. More than 40 buildings and support facilities (total footprint of 538,000 square feet [12.4 acres]) would undergo DD&D.

1.4.3 Expanded Operations Alternative

The Expanded Operations Alternative includes the actions in the Modernized Operations Alternative, plus actions that would expand operations and mission activities to respond to future national security challenges. This alternative includes (1) construction and operation of new facilities and (2) upgrades to existing facilities that may result in changing their nature and capabilities. This alternative would expand current capabilities at SNL/NM.

Thirty projects, totaling about 1,557,200 square feet (35.7 acres) of facility development and 1,464 acres of other infrastructure, would be constructed under the Expanded Operations Alternative (in addition to the Modernized Operations Alternative projects; refer to Section 3.4). Of these 30 projects, seven utility/infrastructure projects are proposed, including expanded energy projects that would require about 1,441 acres; infrastructure, utility lines, and roads that would disturb 20 acres; and fences that would disturb 3.3 acres. In addition, 52 facilities and other support facilities (total footprint of 566,000 square feet [13 acres]) would undergo DD&D. Section 3.4 identifies other actions that could expand operations at SNL/NM.

1.4.4 Decisions to Be Supported by This SWEIS

This SWEIS will be used to inform NNSA decisions regarding the manner of continued and proposed operations at SNL/NM. Based on analysis in this SWEIS and supporting documentation, NNSA prepared a ROD detailing the selected alternative. The ROD summarizes mitigation measures, monitoring, or other conditions adopted as part of NNSA's decision.

1.5 RELATIONSHIPS TO OTHER NEPA INFORMATION SOURCES

NEPA analyses related to activities at SNL/NM have been undertaken since the 1999 SWEIS and its associated ROD. They include programmatic EISs that have been completed for actions across the NNSA complex that affect SNL/NM and several environmental assessments (EAs) with their respective Findings of No Significant Impact (FONSIs). Information from those documents provides additional context for understanding the current NEPA compliance, which forms the initial foundation in preparing this SWEIS. Table 1-2 identifies DOE and NNSA programmatic and site-specific NEPA documents and other documents relevant to this SWEIS. Descriptions of these documents are presented in Section A.1.5 in Appendix A.

Table 1-2. Relevant/Related NEPA Documents and Other Documents

No.	Document Type	Document Title
1	Programmatic NEPA Document	<i>Final Environmental Impact Statement for the Waste Isolation Pilot Plant</i> (DOE/EIS-0026, October 1980) (DOE 1980)

No.	Document Type	Document Title
2	Programmatic NEPA Document	<i>Programmatic Environmental Impact Statement for Stockpile Stewardship and Management</i> (DOE/EIS-0236, July 1996) (DOE 1996)
3	Programmatic NEPA Document	<i>Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste</i> (DOE/EIS-0200, May 1997) (DOE 1997a)
4	Programmatic NEPA Document	<i>Final Complex Transformation Supplemental Programmatic Environmental Impact Statement</i> (DOE/EIS-0236-S4, October 2008) (NNSA 2008a)
5	Site-Specific NEPA Document	<i>Final Site-Wide Environmental Impact Statement for Sandia National Laboratories/New Mexico</i> (DOE/EIS-0281, October 1999) (1999 SWEIS) (DOE 1999)
6	Site-Specific NEPA Document	<i>Environmental Assessment for the Microsystems and Engineering Sciences Applications Complex</i> (DOE/EA-1335, September 2000) (DOE 2000a) and FONSI (DOE 2000b)
7	Site-Specific NEPA Document	<i>Supplement Analysis; Site-Wide Environmental Impact Statement for Sandia National Laboratories/New Mexico, Reestablishing Long-Term Pulse Mode Testing Capability at the Annular Core Research Reactor, Sandia National Laboratories, New Mexico</i> (DOE/EIS-0281-SA-01, May 2001) (DOE 2001a)
8	Site-Specific NEPA Document	<i>Supplement Analysis; Site-Wide Environmental Impact Statement for Sandia National Laboratories/New Mexico, Isentropic Compression and Flyer Plate Experiments Involving Plutonium at the Z and Saturn Accelerators</i> (DOE/EIS-0281-SA-02, September 2002) (DOE 2002a)
9	Site-Specific NEPA Document	<i>Final Environmental Assessment for the Test Capabilities Revitalization at Sandia National Laboratories, New Mexico</i> (DOE/EA-1446, January 2003) (DOE 2003a) and FONSI (DOE 2003b)
10	Site-Specific NEPA Document	<i>Final Environmental Assessment for the Center for Integrated Nanotechnologies at Sandia National Laboratories, New Mexico</i> (DOE/EA-1457, March 2003) (DOE 2003c) and FONSI (DOE 2003d)
11	Site-Specific NEPA Document	<i>Supplement Analysis; Site-Wide Environmental Impact Statement for Sandia National Laboratories/New Mexico, Installation of a Petawatt Laser System in TA-IV</i> (DOE/EIS-0281-SA-03, August 2004) (DOE 2004)
12	Site-Specific NEPA Document	<i>Final Environmental Assessment for the Proposed Consolidation of Neutron Generator Tritium Target Loading Production</i> (DOE/EA-1532, June 2005) (DOE 2005)
13	Site-Specific NEPA Document	<i>Final Environmental Assessment for Proposed Construction and Lease of New Facilities for the Department of Energy, National Nuclear Security Administration, Office of Secure Transportation (Albuquerque Transportation and Technology Center), Albuquerque, New Mexico</i> (July 2006) (GSA 2006)
14	Site-Specific NEPA Document	<i>Final Supplement Analysis for the Final Site-Wide Environmental Impact Statement for Sandia National Laboratories/New Mexico</i> (DOE/EIS-0281-SA-04, August 2006) (DOE 2006)
15	Site-Specific NEPA Document	<i>Final Environmental Assessment for the Expansion of Permitted Land and Operations at the 9940 Complex and Thunder Range at Sandia National Laboratories, New Mexico</i> (DOE/EA-1603, March 2008) (DOE 2008a) and FONSI (DOE 2008b)
16	Site-Specific NEPA Document	<i>Final Environmental Assessment for Removal Actions at the Technical Area III Classified Waste Landfill, Sandia National Laboratories, New Mexico</i> (DOE/EA-1729, August 2010) (DOE 2010a) and FONSI (DOE 2010b)
17	Strategic Other	<i>Nuclear Posture Review</i> (October 2022) (2022 NPR) (DoD 2022)
18	Strategic Other	<i>Fiscal Year 2025 Stockpile Stewardship and Management Plan – Report to Congress</i> (November 2024) (NNSA 2024a)

1.6 PUBLIC INVOLVEMENT

During scoping, the public and stakeholders comment directly to the federal agency on the environmental issues and alternatives considered in an EIS. Publication of a Notice of Intent (NOI) in the *Federal Register* (FR) begins this process. On April 21, 2023, NNSA published its NOI to prepare this SNL/NM SWEIS (88 FR 24607) and announced a 45-day SWEIS public scoping period that ended on June 5, 2023.

NNSA held one in-person public scoping meeting with online (virtual) listening capabilities and one online (virtual) meeting. NNSA held the in-person meeting at the New Mexico Veterans Memorial, Museum, and Conference Center in Albuquerque, New Mexico, on May 9, 2023, and the virtual meeting on May 11, 2023, to receive comments on the potential scope of this SWEIS. NNSA also provided other methods (i.e., email or postal mail) to submit comments on the scope.

NNSA received no verbal comments at the in-person meeting. At the virtual meeting, four individuals spoke (some more than once) and two used the virtual chat box. A court reporter transcribed spoken comments. NNSA also received 17 written comments, with two comment documents included as references. NNSA considered all comments in developing this SWEIS, including comments received just after the comment period ended. Where possible, NNSA grouped similar or related comments. Appendix B to this SWEIS summarizes the comments, including how NNSA addressed the comments and a discussion of the public scoping process. Meeting transcripts and all comment documents received are in this SWEIS's Administrative Record. The Final SWEIS and ROD will be posted on the DOE NEPA website (<http://energy.gov/nepa/nepa-documents>).

1.7 COOPERATING AGENCIES AND COLLABORATING ENTITY

NNSA activities proposed in this SWEIS could impact resources and lands on KAFB, the Forest Service, and the Pueblo of Isleta. NNSA invited these entities to participate in SWEIS development along with sharing their expertise and knowledge. The DAF and Forest Service are participating as cooperating agencies, and the Pueblo of Isleta is participating as a collaborating entity. Cooperating agencies may use this SWEIS or portions of it in accordance with their own NEPA procedures including adopting to evaluate NEPA actions.

2.0 SANDIA NATIONAL LABORATORIES/NEW MEXICO: MISSIONS, PORTFOLIOS, PROGRAMS, CAPABILITIES, AND MAJOR FACILITIES

2.1 INTRODUCTION

This chapter describes SNL/NM missions, portfolios, programs, and capabilities implemented for DOE, NNSA, and other federal and non-federal entities. Section 1.3 also outlines national security considerations and requirements that provide the essential foundation for work at SNL/NM. SNL plays a significant role in programs that extend nuclear weapons' lifetimes. Currently, in support of the Nuclear Deterrence portfolio, SNL's top-priority objectives are to sustain and modernize the current stockpile. SNL/NM further supports national security through other portfolios, programs, and capabilities, such as energy security and long-term energy needs, transportation R&D, homeland infrastructure security, and advanced science and technology. Much of the same infrastructure that supports national security also supports these portfolios.

2.2 OVERARCHING DOE AND NNSA MISSIONS

2.2.1 U.S. Department of Energy

The mission of DOE is to ensure America's security and prosperity by addressing our energy, environmental, and nuclear challenges through transformative science and technology solutions:

- **Energy.** Catalyze and support the timely and efficient transformation of the Nation's energy system and secure U.S. leadership in energy technologies.
- **Science and Innovation.** Maintain a vibrant U.S. effort in science and engineering as a cornerstone of our economic prosperity with clear leadership in strategic areas.
- **Nuclear Safety and Security.** Enhance nuclear security through defense, nonproliferation, and environmental efforts.
- **Management and Operational Excellence.** Establish an operational and adaptable framework that combines the best wisdom of all Department stakeholders to maximize mission success (DOE 2023a).

2.2.2 National Nuclear Security Administration

The missions of NNSA, a semi-autonomous agency within DOE, include:

- **Enhancing** U.S. national security through the military application of nuclear energy;
- **Maintaining and Enhancing** the safety, reliability, and performance of the U.S. nuclear weapons stockpile, including the ability to design, produce, and test weapons components, to meet national security requirements;
- **Providing** the U.S. Navy with safe, militarily effective nuclear propulsion plants and ensuring the safe and reliable operation of those plants;
- **Promoting** international nuclear safety and nonproliferation;

- **Reducing** global danger from WMDs; and
- **Supporting** U.S. leadership in science and technology (50 U.S.C. § 2401).

As shown on Figure 2-1, NNSA's Nuclear Security Enterprise consists of laboratories, production facilities, and sites. As one of only three nuclear weapons laboratories in the United States, SNL contributes significantly to the Nation's core intellectual and technical competencies related to nuclear weapons, embodying more than 75 years of knowledge and experience. SNL/NM maintains core competencies in activities associated with research, development, design, and surveillance of nuclear weapons; supports the assessment and certification of their safety, reliability, and performance; and produces components for the stockpile. These core competencies support other national security and energy applications. The continued operation of SNL/NM is critical to NNSA's ability to meet its varied priorities and missions.



Source: NNSA 2022.

Figure 2-1. NNSA's Nuclear Security Enterprise

2.3 SNL/NM PORTFOLIOS AND PROGRAMS

There are five overarching SNL/NM portfolios, and each includes associated programs and capabilities. Each portfolio, program, and capability is consistent with, and supportive of, the DOE missions and fulfilling NNSA mission priorities. These portfolios are:

- **Nuclear Deterrence Portfolio.** Provide nuclear weapons R&D, design, qualification, testing, certification, and systems integration of all components, subsystems, and systems to arm, fuze, and fire a weapon to military specifications, while ensuring safety and security.
- **Global Security Portfolio.** Protect the Nation from strategic/WMD threats, at home and abroad, by developing and deploying integrated technical solutions to monitor and assess

emerging threats; protect materials and critical assets; and mitigate effects through rapid identification, characterization, response, and recovery.

- **National Security Programs Portfolio.** Provide trusted, threat-informed technologies to the U.S. Department of Defense (DoD) and the intelligence community. Support systems, science, technology, and expertise for national deterrence, defense, and security objectives.
- **Advanced Science and Technology Portfolio.** Leverage fundamental and unique scientific and engineering capabilities to support scientific priorities for DOE’s missions. Perform world-class scientific research and achieve national and international impact while mitigating science and technology surprises.
- **Energy and Homeland Security Portfolio.** Secure the Nation’s critical infrastructures and environment against attacks and threats by performing world-class R&D.

Appendix A, Section A.2.3, provides details on each of the five SNL/NM portfolios.

In addition to these portfolios, SNL/NM provides technical resources and expertise to other federal agencies; the intelligence community; Special Access Programs; and non-federal entities such as state and local governments, universities, and U.S. and foreign industries through Strategic Partnership Projects. The Laboratory Directed Research and Development program invests in financially high-risk and potentially high-payoff research that broadly enables SNL’s national security missions and advances the frontiers of science and engineering.

2.4 SNL/NM CAPABILITIES AND EXAMPLE MAJOR FACILITIES OVERVIEW

SNL/NM includes over 900 buildings (totaling about 7 million square feet), which include office space and laboratories for SNL/NM programs. Table 2-1 identifies examples of major existing facilities and their hazard classifications at the time of writing this SWEIS. These facilities (1) have infrastructure and capabilities unique to the complex, (2) represent facilities that have potentially hazardous operations or material inventories, including all Hazard Category (HC)-2 and HC-3 nuclear facilities (DOE 2019a), or (3) are related to waste management activities. Appendix A, Section A.2.4, describes the capabilities that support SNL/NM’s portfolios and programs. Appendix A, Sections A.2.5 and A.2.6, describe example facilities, general activities, and an overview of infrastructure at SNL/NM. Appendix H provides additional operational information.

Table 2-1. Overview of Example Major Existing Facilities at SNL/NM

Facility ^a	Facility Location	Industrial Facility Hazard Classification ^{b, c}	Nuclear Facility Hazard Categorization ^{b, d}
Advanced Manufacturing Processes Laboratory	TA-1	Low	Less than HC-3
Aerial Cable Facility	KAFB-East	Moderate	Less than HC-3
Annular Core Research Reactor (ACRR)	TA-V	N/A ^e	HC-2
Auxiliary Hot Cell Unit (AHCU)	TA-V	N/A ^e	HC-3

Facility ^a	Facility Location	Industrial Facility Hazard Classification ^{b, c}	Nuclear Facility Hazard Categorization ^{b, d}
Battery Test Facility	TA-II	Low	No radiological inventory at this time*
Drop Tower Test Complex	TA-III	Low	Less than HC-3
Environmental Test Laboratory**	TA-I	Low	Less than HC-3
Explosive Components Facility	TA-II	Low	Less than HC-3
Explosives Assembly Building	KAFB-West Coyote Test Field (CTF)	Low	Less than HC-3
Facility for Acceptance, Calibration & Testing (FACT) Site	KAFB-East	Low	No radiological inventory at this time*
Facility for Antenna and Radar Cross-Section Measurements (FARM)	KAFB-West	Low	No radiological inventory at this time*
Gamma Irradiation Facility (GIF)	TA-V	Low	Less than HC-3
Hazardous Waste Handling Unit	TA-III	Low	No radiological inventory at this time*
High-Energy Radiation Megavolt Electron Source (HERMES) III	TA-IV	Accelerator	Less than HC-3
Ion Beam Laboratory	TA-I	Low	Less than HC-3
Light-Initiated High Explosive Facility (LIHE)	TA-III	Low	Less than HC-3
Lurance Canyon Burn Site	KAFB-East	Low	No radiological inventory at this time*
Mechanical Shock Complex (also known as Dynamic Shock Facility)	TA-III	Low	Less than HC-3
Microsystems Engineering, Science and Applications (MESA) Complex	TA-I	Moderate	No radiological inventory at this time*
National Solar Thermal Test Facility (NSTTF)	KAFB-West	Low	No radiological inventory at this time*
Neutron Generator Enterprise+ (NGE+)	TA-I	Low	Less than HC-3
Power Sources Technology Group Capabilities**	TA-I	Low	No radiological inventory at this time*
Radioactive and Mixed Waste Management Unit (RMWMU)	TA-III	Low	Less than HC-3
Rocket Sled Test Complex	TA-III	Moderate	Less than HC-3
Sandia Pulsed Reactor (SPR) Facility	TA-V	N/A ^e	HC-2
Saturn Accelerator	TA-IV	Low	Less than HC-3
Shock Thermodynamics Applied Research Facility (STAR)	KAFB-West CTF	Low	Less than HC-3

Facility ^a	Facility Location	Industrial Facility Hazard Classification ^{b, c}	Nuclear Facility Hazard Categorization ^{b, d}
Site 9920	KAFB-West CTF	Low	Less than HC-3
Site 9930/9939	KAFB-West CTF	9930 and 9939 = Low	9930 and 9939 = Less than HC-3
Site 9940	KAFB-West CTF	Low	Less than HC-3
Site 9990	KAFB-West CTF	Low	No radiological inventory at this time*
Solid Waste Collection and Recycling Center	TA-II	Low	Less than HC-3
Strategic Defense Facility	TA-IV	Low	Less than HC-3
Superfuge Complex	TA-III	Low	Less than HC-3
Terminal Ballistics Facility	TA-III	Low	Less than HC-3
Thermal Test Complex	TA-III	Low	Less than HC-3
Thermal Treatment Unit	TA-III	Low	No radiological inventory at this time*
Thunder Range	KAFB-West CTF	Low	Less than HC-3
Z-Machine	TA-IV	Low	Less than HC-3

* The facility would have to update documentation and/or permits to work with radiological inventory.

** Work for this capability uses only portions of the hosting buildings.

- a. All facilities have potential other hazards mitigated by appropriate controls and regulations, including biological materials, beryllium, standard chemical storage, explosives, hazardous waste collection, accelerators, x-ray machines, lasers (including class 3 and 4 lasers), electrical, and collection and storage of compressed gas cylinders.
- b. Categories (Industrial Facility Hazard Classification and Nuclear Facility Hazard Classification) represent designation at time of writing and could change with appropriate documentation and permissions.
- c. Industrial Facility Hazard Classification is part of the Safety Basis process. The consequences of unmitigated hazards are evaluated as required by Integrated Safety Management and the SNL/DOE Non-Nuclear Safety Basis Framework, which are implemented through Safety Basis chapters in the Environment, Safety, and Health Manual (SNL 2024a; SNL 2024b; SNL 2024c; and SNL 2024d). Industrial facilities are classified into the following levels based on potential impacts to receptors: (1) High (Offsite): the analysis of hazards shows the potential for significant offsite consequences from unmitigated hazards, (2) Moderate (Onsite): the analysis of hazards shows the potential for significant onsite consequences from unmitigated hazards, and (3) Low (Local): the analysis of hazards shows the potential for significant only localized, worker consequences from unmitigated hazards.
- d. Nuclear Facility Hazard Classification is part of the Safety Basis process. The consequences of unmitigated releases of radioactive materials are evaluated as required by 10 CFR Part 830, and DOE-STD-1027-92, Change Notice No. 1 (DOE 1997b), defines and categorizes the radiological hazards of DOE/NNSA nuclear facilities. An HC-1 facility has a potential for significant offsite consequences; an HC-2 facility has a potential for significant onsite consequences beyond localized consequences; an HC-3 facility has a potential for only local significant consequences; and a Below HC-3 facility (also referred to as a “Less than HC-3 Facility”) has a potential for only consequences less than those that provide a basis for categorization as an HC-1, -2, or -3 nuclear facility.
- e. N/A: Non-Applicable; facilities with an HC-1, HC-2, or HC-3 nuclear designation cannot also have an Industrial Facility Hazard Classification.

3.0 PROPOSED ACTION AND ALTERNATIVES

3.1 INTRODUCTION/DEVELOPMENT OF THE SNL/NM SWEIS ALTERNATIVES

NNSA's Proposed Action is to consider alternative ways to continue operations at SNL/NM to meet mission requirements. This chapter describes the three alternatives: (1) the No-Action Alternative (Section 3.2); (2) the Modernized Operations Alternative (Section 3.3); and (3) the Expanded Operations Alternative (Section 3.4). To evaluate alternatives' potential environmental impacts, NNSA developed construction and operational parameters for each alternative, as described in Section 3.5. This chapter also discusses alternatives that were considered but eliminated from detailed assessment (Section 3.6), identifies NNSA's preferred alternative (Section 3.7), and compares potential consequences of the three alternatives (Section 3.8). After completion of the Final SWEIS, NNSA will prepare a ROD for the selected alternative.

2022 Site-Wide Master Plan. This comprehensive site development plan (SNL 2022b), with a 10+-year planning horizon, informs SNL's decision-making on operations and enhanced mission development, summarizes infrastructure issues and capacities, illustrates investments needed to pursue long-range opportunities, and provides an infrastructure development framework for the proposed alternatives. SNL/NM's current facilities have an average age of 36 years with a range from new (i.e., less than a year old) to more than 70 years. The oldest real estate assets require modernization for safety and energy efficiency. Decisions on the future of aging facilities are critical to mission outcomes and growth. The Site-Wide Master Plan considers modernization and expanded mission capabilities and associated infrastructure needs. This Plan, in conjunction with projects in the SNL Infrastructure Investment Database (SIID), provides the foundation for the alternatives developed and analyzed in this SWEIS.

2024 NNSA Enterprise Blueprint. NNSA's Enterprise Blueprint "outlines a 25-year plan to align the delivery of specialized infrastructure with demands across the nuclear stockpile, global security, and naval nuclear propulsion missions" and "prioritizes capabilities for mission delivery and takes a practical approach to becoming a more balanced, responsive, and resilient enterprise" (NNSA 2024a). The alternatives in this SWEIS are aligned with this forward-looking blueprint.

SNL/NM SWEIS Alternatives Overview. The three alternatives build on one another, resulting in increased operations to support higher requirements for the two action alternatives. The No-Action Alternative encompasses the current level of operations, reflecting the use of existing facilities and projects within existing NEPA assessments and determinations. The Modernized Operations Alternative includes the scope of the No-Action Alternative plus construction and operation of replacement facilities, implementation of facility upgrades and utility/infrastructure projects, and DD&D of excess and aging facilities. Consequently, this alternative may include an increased level of operations of existing capabilities and would support additional requirements above the No-Action Alternative. The Expanded Operations Alternative would include actions considered in the Modernized Operations Alternative in addition to expanded capabilities and operations, to respond to future national security challenges. Figure 3-1 shows the comparative level of operations for the three alternatives. Previously Analyzed Projects and Proposed Projects include new facility construction, operational changes, modernization/upgrade of existing facilities and infrastructure, and DD&D.

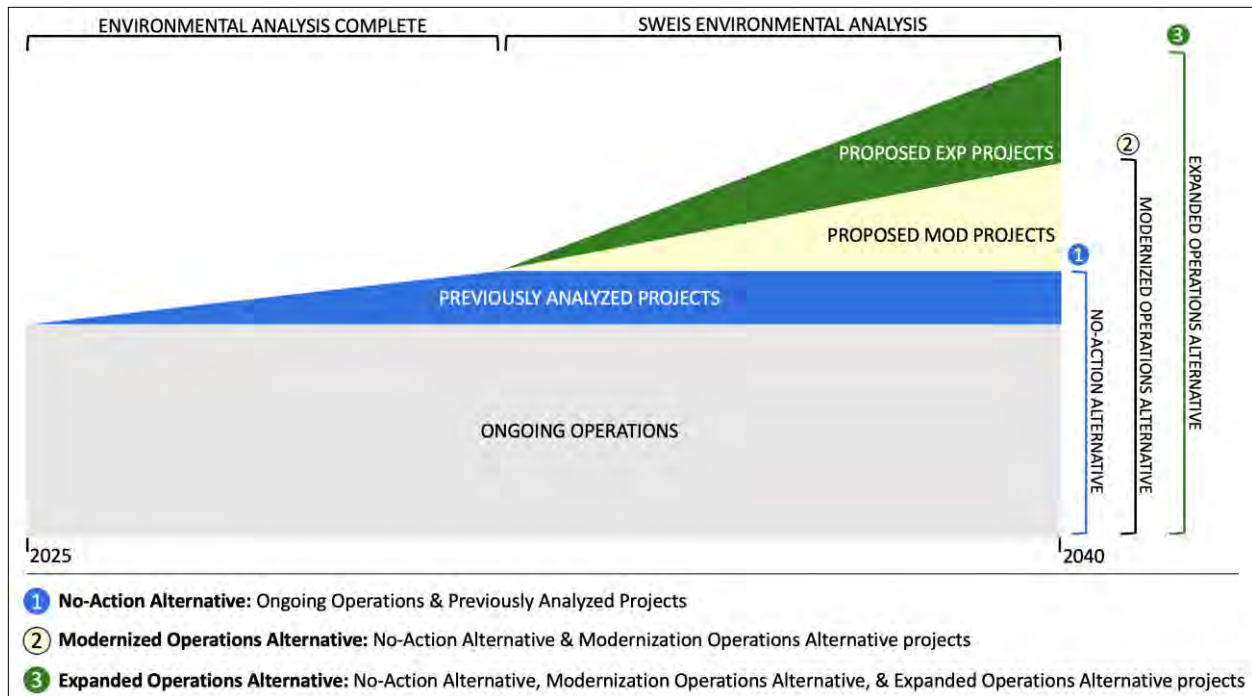


Figure 3-1. Level of Operations for the SNL/NM Alternatives

This SWEIS considers ongoing and proposed activities that could occur over approximately the next 15 years (2025–2040). NNSA developed site-wide estimates of construction and operational parameters and incorporated these estimates with information on ongoing and future activities into analysis of each alternative’s potential environmental impacts. For example, NNSA used estimated areas of land disturbance for proposed activities to determine impacts on resources such as soils, cultural resources, and biological resources.

3.2 NO-ACTION ALTERNATIVE

3.2.1 Description of the No-Action Alternative

Under the No-Action Alternative, NNSA will continue ongoing operations and the use of existing facilities at SNL/NM to support NNSA missions/programs (refer to Chapter 2; Appendix A, Sections A.2.6 and A.3.2; and Appendix H for more details on this alternative and ongoing SNL/NM operations). NNSA analyzed the No-Action Alternative to provide a baseline to compare against action alternative impacts. As Figure 3-1 shows, the No-Action Alternative reflects continuation of ongoing operations and implementation of projects for which NEPA analysis/documentation and required consultations already exist. New activities not analyzed in the 1999 SWEIS were independently assessed under NEPA, including appropriate application of

categorical exclusions.¹ DOE categorical exclusions are codified in appendices to 10 CFR Part 1021. Several EAs were also prepared (refer to Table 1-2).

Table 3-1 identifies No-Action Alternative projects expected to be implemented at SNL/NM in the near term. These include limited construction of replacement facilities, upgrades of existing facilities and utility/infrastructure projects, and DD&D of excess and aging facilities. These activities were previously reviewed consistent with 10 CFR Part 1021, and a determination was made that the activities will not result in significant impacts (e.g., routine maintenance, remediation actions, a range of R&D activities performed within existing SNL/NM facilities). Figure 3-2 provides a general map for the major replacement facility projects included in the No-Action Alternative, the Modernized Operations Alternative, and the Expanded Operations Alternative.

As shown in Table 3-1, 22 projects (not including DD&D) representing a development footprint² of about 309,660 square feet and 6 acres of land for infrastructure have been approved and will be constructed under the No-Action Alternative. In addition to those projects, 10 buildings and other support facilities with a total building footprint of 117,172 square feet (2.7 acres) are also scheduled to undergo DD&D under the No-Action Alternative. In terms of square footage, most (87 percent) of this DD&D will occur in TA-I. Some hazardous construction materials may be present in these aged buildings, such as asbestos, lead-based paint, and chemical contamination. NNSA has conservatively estimated that about 30 percent of the total waste from DD&D could be hazardous. Building-specific characterization to determine the amount of hazardous material is performed prior to DD&D activities. Any hazardous waste will be disposed of at a permitted offsite treatment, storage, and disposal facility (TSDF). No radiological contamination is expected from DD&D activities under the No-Action Alternative (SNL 2023a).

Baseline environmental data for Chapter 4 were collected from available data in the 5-year period between 2017–2021. For some environmental resource areas, available data for a 6-year period (2017–2022) are used to establish the baseline. Construction and operational parameters associated with the No-Action Alternative are presented in Appendix A, Tables A-2 and A-3. Operational impacts associated with the No-Action Alternative are estimated in Chapter 5.

¹ DOE NEPA regulations identify classes of actions that DOE has categorically excluded from the need to prepare an EA or EIS because the actions normally would not have a significant effect on the human environment. Examples of activities that could receive categorical exclusions include routine maintenance activities and shop operations; activities in support of environmental management, including monitoring and small-scale remediation actions; and a range of R&D activities and constructing support buildings.

² The term “development footprint” represents the estimated square footage of a project/facility plus any construction laydown areas and temporary parking and access areas that may be required. After construction, laydown areas, temporary parking, and access areas may be converted to permanent parking areas, landscaped areas, or restored to a pre-construction state. To be conservative, this SWEIS assumes that the development footprint represents the maximum amount of land that could be disturbed.

Table 3-1. No-Action Alternative – Planned New Facilities, Upgrade/Utility/Infrastructure Projects, and DD&D Actions

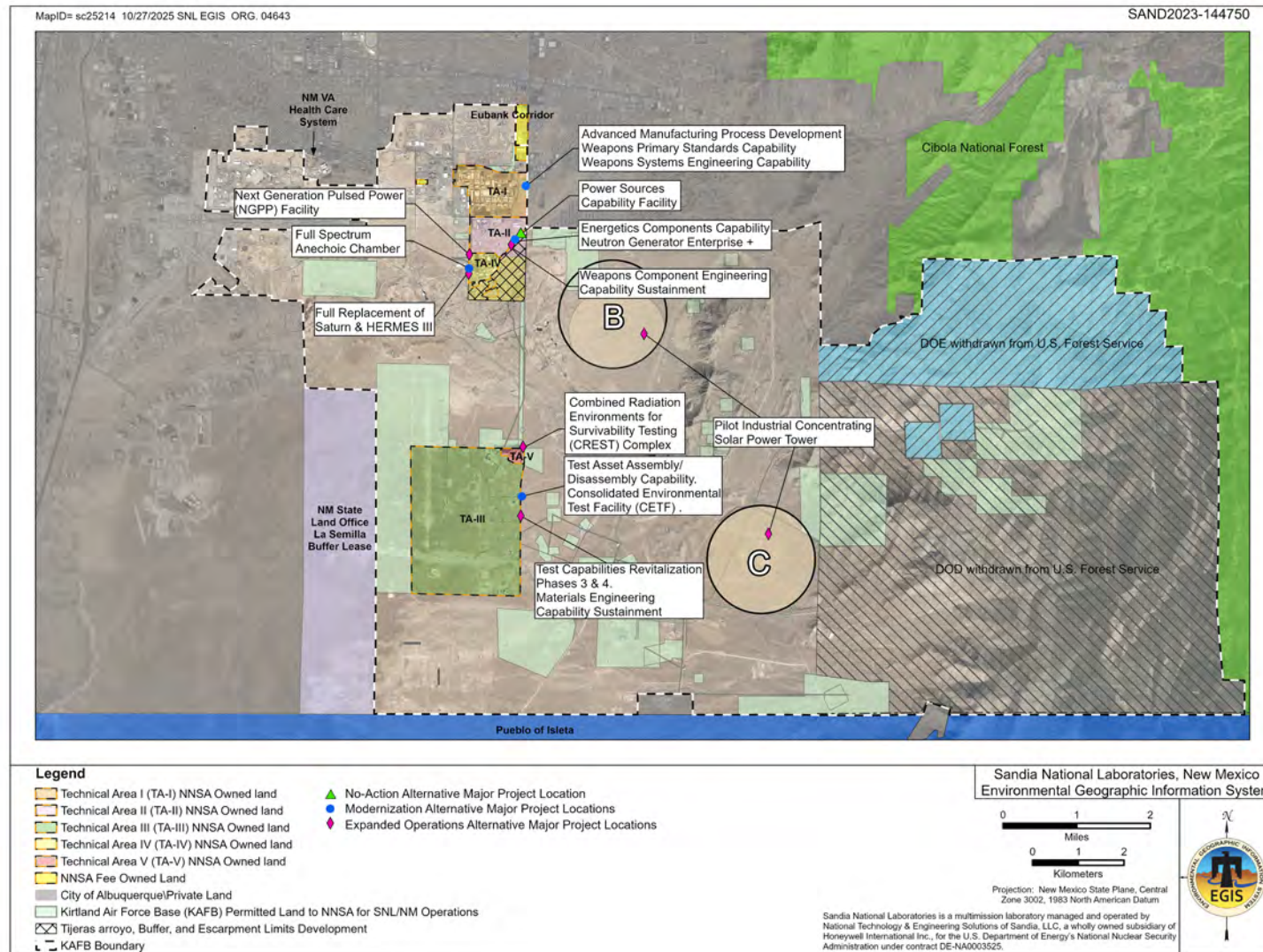
Project Number	Project Name ^a	Project Type/ Date Operational	Size (ft ²) ^b	Location ^c	Description
Major (Line Item) ^d Project					
NA-1	Power Sources Capability Facility	Replacement Facility/2030	135,000	TA-II	This facility will be in TA-II and replaces an aging and outdated facility, by providing dedicated laboratory and testing spaces. The replacement facility will maintain capabilities comparable to those in the existing facility and have similar operational parameters. The existing facility is 110,000 square feet (ft ²), and the replacement will be 135,000 ft ² . Due to energy efficiencies and Leadership in Energy and Environmental Design (LEED) standards, utility demand will not increase. Once the replacement facility is operational, the existing facility will undergo DD&D. Site development started in 2024.
Minor ^e Construction Projects – New Facilities					
NA-2	Dedicated Construction Staging Area	Infrastructure Upgrade/2025	217,800 (5 acres)	TA-I	A dedicated 5-acre staging area for SNL/NM-owned equipment and supplies to support SNL/NM's in-house design and construction services is planned in TA-I. This in-house capability focuses on small projects to enable external subcontractors to be more effective and efficient on larger projects, which would still require dedicated laydown yards adjacent to projects.
NA-3	Light-Initiated High Explosives Expansion	Addition/2025	4,000	TA-III	This facility expansion will support growth of testing and research activities currently conducted in an existing building.
NA-4	Energetic Manufacturing Science and Technology Facility	Support Facility/2025	10,500	TA-II	This facility will support expertise in explosive materials and component design, evaluation and production, performance and exploratory tests of explosives and explosive components, explosive diagnostics testing, and non-explosive machining operations.
NA-5	Trans-Shipment Facility	Replacement Facility/2025	8,000	KAFB-West (6000 Igloos)	This facility will handle and stage shipments of non-hazardous and hazardous materials, including explosives and radioactive material, in preparation for storage, transfer, or offsite shipment.
NA-6	Building Addition	Addition/2025	2,500	TA-I	A high-security laboratory will be added to the current building.
NA-7	Multi-Building Infrastructure Resiliency, Phase II	Infrastructure Upgrade/2025–2026	65,400	TA-IV	Above-ground storage tanks for 300,000–500,000 gallons (gal) of fuel storage will be installed.
NA-8	Geosciences Laboratory	Replacement Facility/2025	15,000	TA-I	This facility will replace two of the 70+ year-old Geosciences Complex buildings.

Project Number	Project Name ^a	Project Type/ Date Operational	Size (ft ²) ^b	Location ^c	Description
NA-9	Thunder Range Complex	Replacement Facility/2026	9,360	KAFB-West Coyote Test Field (CTF)	This office will replace aging trailers and accommodate operations.
NA-10	Quality-Compliant Storage Facility	Support Facility/2027	9,700	TA-I	This facility in TA-I will provide compliant storage for both hazardous and non-hazardous items.
NA-11	General Storage Facility	Support Facility/2028	10,000	TA-II	This support facility will help meet storage requirements for R&D, equipment, supplies, etc.
NA-12	New Surtsey High Bay Office	Replacement Facility/2028	15,000	TA-III	The facility is a modern, energy-efficient high bay and office space to support the Surtsey test vessel and provide a safe and secure facility for fabrication and R&D.
NA-13	Quality-Compliant Operations Area	Support Facility/2029	11,700	TA-I	The facility provides secure warehouse storage space.
Minor^e Construction Projects – Upgrades/Utility/Infrastructure					
NA-14	Geothermal System for Geosciences Laboratory	Infrastructure Upgrade/2025–2030	N/A	TA-I	This infrastructure upgrade will enable the operations at this facility.
NA-15	Electric vehicle (EV) Infrastructure Upgrade to Support EV Fleet Expansion	Infrastructure Upgrade/2025	N/A	Site-wide	To support the growing battery electric and plug-in hybrid fleet, NNSA will install hundreds of EV charging stations across the site. The specific locations will be selected based on fleet vehicle needs and available infrastructure. Some of these chargers will be centralized hubs with multiple stations and may require new or upgraded transformers and electrical conduits. This will be the first phase of EV charging station construction.
NA-16	Energy Exchange/Conversion (Waste Heat Reuse)	Infrastructure Upgrade/2025	N/A	TA-I	This project creates infrastructure to use waste heat from an existing building's data center to serve other buildings.
NA-17	Sulfur Hexafluoride (SF ₆) Emissions Reductions	Infrastructure Upgrade/2025	N/A	Site-wide	These infrastructure projects will reduce SF ₆ emissions to the air by improving leak detection and upgrading supply and abatement systems including repairs, new piping, tanks, etc.
NA-18	Generation 3 Particle Pilot Plant (G3P3) at the National Solar Thermal Test Facility (NSTTF)	Infrastructure Upgraded Tower/2025	NA	KAFB-West	The G3P3 is a temporary integrated high-temperature, particle-based system for concentrating solar power. A new 194-foot steel-framed tower was constructed in 2024 to support the G3P3 operations at NSTTF.
NA-19	Power Substation TA-II	Infrastructure Upgrade/2026	3,000 ft ² building on 1 acre site	TA-II	A new substation 34 provides additional power needed for future development in TA-II.

Project Number	Project Name ^a	Project Type/ Date Operational	Size (ft ²) ^b	Location ^c	Description
NA-20	Radiation Protection Instrument Calibration Facility	Replacement Facility/2027–2028	10,500	TA-III	This project relocates radiation calibration functions currently performed in TA-I, enhancing capability to perform higher range calibrations.
NA-21	Microsystems Engineering, Science and Applications (MESA) Complex Extended Life Program (ELP)	Infrastructure Upgrades/2023–2040	N/A	TA-I	This infrastructure project will upgrade electrical, communication, plumbing, tanks, etc.
NA-22	Foxtail Flats Solar and Energy Storage Project	Electricity Supply/2026	NA	NA	In July 2024, NNSA entered a partnership with Los Alamos County to provide LANL and SNL/NM with electricity produced from Los Alamos County’s new Foxtail Flats solar and energy storage project located in the Four Corners region of New Mexico. That project, which is expected to be operational by March 1, 2026, will provide approximately 170 megawatts (MW) of solar energy and 320 megawatt hours (MWh) of battery storage to LANL and SNL/NM (NNSA 2024b).
Total Size of Support/Replacement Facilities and Upgrades: 309,660 ft² + 6 acres of infrastructure (5 acres for dedicated staging area and 1 acre for electrical substation)					
NA-23	DD&D of Multiple Facilities	DD&D	102,572 11,000 3,600	TA-I TA-III KAFB-West	Refer to description in this section (Section 3.2.1).
Total Size of DD&D: 117,172 ft²					

- NNSA acknowledges that facility names used throughout this SWEIS are subject to change in the future.
- “Size” reflects both the development footprint and the project/facility square footage, as applicable.
- Figure 3-2 shows the location of the No-Action Alternative major project facility (Power Sources Capability Facility).
- As used in this SWEIS, “line-item projects” are defined as “construction projects with a cost that exceeds the minor construction threshold (currently \$34 million)” and are directly authorized and funded by Congress.
- As used in this SWEIS, “minor construction projects” are defined as “construction projects with a cost below \$34 million.”

Source: SNL 2023a.



Source: SNL 2023a.

Figure 3-2. Major Project Locations for all Alternatives

3.2.2 Attributes of the No-Action Alternative

Table 3-2 shows a net increase in facility square footage at SNL/NM under the No-Action Alternative; facility construction will be larger than facility DD&D actions. Overall, net facility area will increase by about 192,488 square feet (i.e., 309,660–117,172). The largest facility construction footprint will occur in TA-II, because of the Power Sources Capability Facility.

Table 3-2. Summary of Construction and DD&D – No-Action Alternative

Area	Facility/Development Footprint ^a (ft ²)	Additional Infrastructure Footprint (acre)	DD&D Footprint (ft ²)
TA-I	38,900	5-acre staging area	102,572
TA-II	158,500	1-acre substation	0
TA-III	29,500	0	11,000
TA-IV	65,400	0	0
TA-V	0	0	0
Other (KAFB-West)	17,360	0	3,600
TOTALS	309,660 ft² (7.1 acres)	6 acres	117,172 ft² (2.7 acres)

- a. Data in this column include facility square footage plus any required construction laydown areas. After construction, laydown areas may be converted to parking or landscaped areas, or restored to pre-construction state. To be conservative, this SWEIS assumes values in this column represent the maximum amount of land that could be disturbed. In terms of land use, facility footprint represents development footprint.

Source: SNL 2023a.

Regarding facility operation under the No-Action Alternative, DOE nuclear facilities are categorized as HC-1,³ HC-2, HC-3, or Below HC-3 based on the amount of radioactive materials (“threshold quantities” [TQs]) authorized to be within that facility. NNSA Supplemental Directive Guidance 1027 defines radioactive material TQ values (NNSA 2011a), and NNSA operates its SNL/NM nuclear facilities in accordance with those values. Appendix A, Table A-1, identifies the HC designation for specific SNL/NM facilities. Appendix D, Section D.3.2, discusses potential accidents associated with No-Action Alternative projects.

HC-2 facility operations are conducted in accordance with the Documented Safety Analysis (DSA). Under the No-Action Alternative, NNSA plans to increase the provisional experiment material-at-risk (MAR) limit for the Annular Core Research Reactor (ACRR) Facility to match the limit evaluated in the 1999 SWEIS (DOE 1999) for the alternative selected in the 1999 ROD (64 FR 69996). The ACRR Facility is, and would remain, an HC-2 facility. The 1999 SWEIS evaluated the increase in the provisional experiment MAR limit (expressed as a plutonium-239 [Pu-239] equivalent) for ACRR experiments involving fissile material. Potential consequences of an accident involving an experiment with this higher limit were evaluated in the 1999 Safety Analysis Report for ACRR and were included in the 1999 SWEIS (SNL 1999 and DOE 1999). Accidents involving ACRR experiments presented in Appendix D, Section D.3.5, of this SWEIS

³ DOE-STD-1027 defines HCs based on the potential consequences that could result from a facility accident. Section 5.14 of this SWEIS discusses HCs. An HC-2 nuclear facility would have potential for significant onsite consequences. An example would be a facility with sufficient hazardous material and energy that an unmitigated release would require an emergency plan for onsite evacuation.

include this higher provisional experiment MAR limit. Implementation of this higher limit would occur only after revision and approval of the ACRR Facility DSA (SNL 2024e).

3.3 MODERNIZED OPERATIONS ALTERNATIVE

The Modernized Operations Alternative enhances existing programs and activities through facility modernization. It includes the scope of the No-Action Alternative (refer to Section 3.2), plus additional modernization activities, such as expanding the aged facility replacement projects and modernizing existing facilities and utility/infrastructure projects, with associated DD&D actions. Under this alternative, NNSA would replace facilities approaching their end of designed life, upgrade facilities to extend their lifetimes, and improve work environments enabling NNSA to meet operational requirements. The Modernized Operations Alternative also includes proposed project energy efficiencies with commensurate emissions reductions. Proposed DD&D of older facilities under this alternative eliminates excess facilities and reduces costs and risk without expanding capabilities and operations at SNL/NM beyond those that currently exist.

3.3.1 Modernized Operations Alternative Portfolios

Operation of SNL/NM would evolve through modernized facilities and infrastructure but would not expand capabilities in the Modernized Operations Alternative. Appendix A, Section A.3.3, provides supplemental information on the Modernized Operations Alternative. Table 3-3 identifies proposed facilities, upgrades/infrastructure/utility projects, and DD&D projects associated with the Modernized Operations Alternative. Figure 3-2 provides a general map for the new major projects included in the Modernized Operations Alternative, the No-Action Alternative, and the Expanded Operations Alternative.

Table 3-3 shows 38 facility projects and 20 upgrade/utility/infrastructure projects, with a total development footprint of 1,657,580 square feet (38 acres), proposed under the Modernized Operations Alternative. In addition, 4 acres of land for infrastructure (3 acres for the 20th Street Utility Corridor and 1 acre for a new electrical substation) could be disturbed. In addition to the facility projects and upgrades/utility/infrastructure projects, more than 40 buildings and other support facilities, with a total footprint of 538,000 square feet (12.4 acres), would be scheduled for DD&D. Appendix A, Tables A-2 and A-3, present construction and operational parameters associated with the Modernized Operations Alternative.

Table 3-3. Modernized Operations Alternative – New Facilities, Upgrade/Utility/Infrastructure Projects, DD&D Actions

Project Number	Project Name ^a	Project Type/ Date Operational	Size (ft ²) ^b	Location ^c (Proposed)	Description
Major (Line Item) Projects					
MA-1	Advanced Manufacturing Process Development	Facility & Infrastructure Upgrades/2030	N/A	TA-I	The project would replace flooring; air handlers; and water, sanitary, and fire protection systems, and reconfigure space to include high bay laboratory, offices, and conference rooms to support classified and unclassified computing and video teleconferencing capabilities.
MA-2	Consolidated Environmental Test Facility (CETF)	Replacement Facility/2032	100,000	TA-III	CETF would replace and consolidate Environmental Test Lab facilities constructed in the 1950s that are beyond design life and focus on component- and subsystem-level test facilities specializing in vibration, weather, acceleration, impact, shock, aero science, and non-destructive evaluation environments.
MA-3	Energetics Components Capability ^d	Replacement Facility/2035	140,000	TA-II	Refer to description in Section 3.3.1.
MA-4	Weapons Primary Standards Capability	Addition & Facility Upgrades/2035	6,000	TA-I	This project would add 6,000 ft ² and upgrade the Primary Standards Laboratory (PSL), constructed in 1993 with an estimated life through 2035. This lab develops and maintains precision measurement standards and techniques traceable to national standards and calibrates and certifies customer reference standards. Current work is near capacity, growing at about 10 percent annually.
MA-5	Neutron Generator Enterprise + (NGE+)	Replacement Facility/2035	321,000	TA-II	Refer to description in Section 3.3.1.
MA-6	Full Spectrum Anechoic Chamber	Replacement Facility/2036	25,000	TA-IV	The Full Spectrum Anechoic Chamber would replace existing facilities and modernize electromagnetic radiation testing capabilities. Portions of current facilities, about 14,000 ft ² , lack heating and cooling, and building systems no longer comply with Energy Code requirements. Utility demands would be expected to increase compared to current usage.
MA-7	Weapons Systems Engineering Capability	Replacement Facility/2036	210,000	TA-I	This replacement facility would consolidate weapons systems engineering capabilities in existing buildings, which would reach end of life by 2036 and are scheduled for DD&D. The project includes co-located office and collaboration spaces.
MA-8	Test Asset Assembly/Disassembly Capability	Replacement Facility/2037	57,000	TA-III	The facility would replace two aging buildings and facilitate their DD&D.

Project Number	Project Name ^a	Project Type/ Date Operational	Size (ft ²) ^b	Location ^c (Proposed)	Description
Minor Construction Projects – New Facilities					
MA-9	Facility for Antenna & Radar Cross Section Measurement (FARM) Modular Facility	Replacement Facility/2026	1,600	KAFB-West, KAFB-East	The FARM is a remote facility currently housed in several small, old buildings without disability compliant access. The modular office building would replace these structures, with a comprehensive office and project space, a small conference room, and space for non-high-security visitors and staff.
MA-10	New MESA Flexible Facility	Support Facility/2028	2,500	TA-I	This facility would support contractor fabrication, storage, and laydown yard needs associated with the MESA ELP.
MA-11	New Storage Facility	Support Facility/2026	7,500	KAFB-West (CTF)	The facility would provide for storage of training aids used at the 9940 complex along with vault-type room (VTR).
MA-12	Port of Entry Shipping and Receiving	Replacement Facility/2029	70,000	TA-I	This project would replace aged shipping and receiving space by constructing a 65,000–75,000 ft ² warehouse building.
MA-13	Building Replacement	Replacement Facility/2026	8,000	KAFB-West (CTF)	The replacement facility is to consolidate and accommodate existing explosives assembly operations.
MA-14	Parking Structures/Facilities	Infrastructure Upgrade/2026–2029	100,000	TA-I, TA-IV	Refer to description in Section 3.3.1.
MA-15	Above-ground Storage at Igloos	Replacement Facility/2027	8,000	KAFB-West (6000 Igloos)	An above-ground storage facility would replace dated bunker storage.
MA-16	Fleet Services Facilities	Replacement Facilities/ 2029, 2033	35,000	TA-II	Current facilities are 1950 metal butler buildings with low bays that do not support safety lifts or new transport truck design; replacement would improve safety and efficiency.
MA-17	VTR Production Laboratory Building	Support Facility/2027	23,000	TA-I	This support facility would provide office, storage, and lab spaces along with VTR.
MA-18	TA-I Agile Laboratory Facility II	Support Facility/2028	8,000	TA-I	The support facility would provide generic high-bay lab space for various mission operations.
MA-19	Building Expansion	Addition/2027	20,000	TA-I	This addition would enhance mission capabilities, efficiency, effectiveness, and safety. Physical limitations and outdated configuration impact tool and utility infrastructure replacements/upgrades. Capability is at risk due to facility age, equipment, and infrastructure.
MA-20	New SNL/NM TA-II Explosive Production and Development Facility	Support Facility/2027	8,000	TA-II	This support facility would meet explosives production and development needs.
MA-21	New Nuclear Deterrence VTR/Laboratory	Support Facility/2027	20,200	TA-I	This support facility would enhance the growing nuclear deterrent capabilities and would include a high bay, light electrical laboratory, and centralized hardware storage space.

Project Number	Project Name ^a	Project Type/ Date Operational	Size (ft²) ^b	Location ^c (Proposed)	Description
MA-22	Tester Engineering and Product Realization Lab	Support Facility/2027	18,700	TA-I	This support facility would provide lab space to enhance testing, at both the system and component/material levels.
MA-23	Thermal Spray Production Facility	Replacement Facility/2027	3,300	TA-III	The existing facility is aged and suboptimal for critical development and production activities. The replacement facility would consolidate and optimize a limited area space, critical development, and production capabilities. This project includes DD&D of current structures (about 8,000 ft ² , included in the DD&D list at the end of this table).
MA-24	Center for Advanced Manufacturing and Innovation (CAMINO)	Replacement Facility/2028	100,000	SSTP	This replacement facility would include current activities and capabilities including handling and use of metal powders performed at an offsite facility.
MA-25	Modular National Security Facility 2 (MNSF2)	Support Facility/2029	10,000	TA-I	MNSF2 would provide additional agile, high-security space that programs across SNL/NM could use. The facility would support activities from computing work to electronics assembly and testing .
MA-26	Geosciences Laboratory Addition	Addition/2028	23,000	TA-I	This addition would increase efficiencies at the Geosciences Lab.
MA-27	High Rigor Non-Proliferation Facility	Replacement Facility/2029	50,000	TA-I	This replacement facility would support NNSA's nonproliferation mission that is in aged facilities.
MA-28	Photovoltaic Systems Evaluation Laboratory (PSEL) Additional Lab/High Bay	Support Facility/2029	15,000	KAFB-West	The PSEL support facility would add a new high bay lab and solar furnace to enable current requirements and mission modernization.
MA-29	Secure and Adaptable Grid Engineering (SAGE)	Support Facility/2027	25,000	KAFB-West (NSTTF)	This new facility would consolidate and relocate with Grid Modernization and Energy Resilience programs in a modern support facility with an appropriate security posture that can support R&D activities. Activities include battery material and storage R&D, a high bay for fabrication, administrative and office support, and large grid/microgrid simulation.
MA-30	Wind and Water Energy High Bay	Replacement Facility/2030	15,000	TA-III	This replacement facility would consolidate transportainers and substandard facilities while providing high bay space needed for assembly and testing of components.
MA-31	Energetics Office & Light Laboratories Building	Replacement Facility/2033	16,000	TA-III	The replacement facility would include office spaces, conferencing capabilities, and light laboratories.
MA-32	Cafeteria	Replacement Facility/2030	25,000	TA-I	This facility would replace the existing cafeteria.
MA-33	Medical Facility	Replacement Facility/2030	50,000	TA-I	The existing medical facilities located in two buildings would be consolidated in this replacement facility.

Project Number	Project Name ^a	Project Type/ Date Operational	Size (ft ²) ^b	Location ^c (Proposed)	Description
MA-34	Explosives Systems & Technologies Fabrication Facilities Collocation	Replacement Facility/2032	5,200	KAFB-West (CTF)	The replacement facility would have a high bay that would consolidate fabrication capabilities and allow for the potential DD&D of several existing buildings.
MA-35	Energetic Threats and Training Center	Replacement Facility/2032	22,400	KAFB-West	This replacement facility would consolidate and co-locate global security operations in a new training center to better support mission needs.
MA-36	Thunder Range Consolidated Fabrication, Training, and Assembly Facility	Replacement Facility/2035	8,000	KAFB-West (CTF)	A replacement facility would accommodate and enhance training capabilities, assembly, and fabrication needs.
MA-37	Laser Application (LAZAP) Office and Control Room Building	Replacement Facility/2035	6,150	TA-I	This replacement facility would consolidate office space and the Control Room building, which are aged infrastructure, to support existing operations.
MA-38	New NGE Explosive Operations Facility	Replacement Facility/2035	11,000	TA-II	This replacement facility would modernize existing explosives capabilities.
Minor Projects – Modernization/Upgrades/Infrastructure					
MA-39	9920 Aerosol Facility Upgrade	Facility & Infrastructure Upgrade/2027	23,600	KAFB-West (CTF)	This project would expand the building footprint, add environmental controls and high-efficiency particulate air (HEPA) filters, seal the floor, and integrate real-time environmental sensing to the building.
MA-40	Sustainment of Large-Scale Testing Capabilities	Facility & Infrastructure Upgrade/2026	500	KAFB-East (Lurance Canyon Burn Site)	Upgrades would include infrastructure and a new trailer to provide an adequate working environment for operators and testers and replacement of the existing single-wide trailer.
MA-41	Terminal Ballistics Facility Power and Communication Upgrade	Infrastructure Upgrade/2027	N/A	TA-III	This project would extend power/communication lines from an existing building to outdoor test locations.
MA-42	Trailer Removal and Replacement	Infrastructure Upgrade/2027	N/A	KAFB-West (6000 Igloos)	This project would remove and replace three trailers located near the 6000 igloos that are beyond their useful life.
MA-43	Hydrogen Systems Upgrade; Hydrogen Supply Replacement	Infrastructure Upgrade/2026	N/A	TA-I	This project would upgrade the hydrogen systems that are nearing their end of useful life in several buildings.
MA-44	Smart Labs Upgrade	Facility Upgrade/2026	N/A	TA-I	This project aligns space consistent with Smart Lab principles, reducing vulnerability of cross contamination between labs and increasing energy savings.
MA-45	Primary Standards Laboratory (PSL) Addition	Facility Upgrade/2027	5,800	TA-I	The project is an addition to the southeast corner of PSL for Mechanical Calibration Lab and Mass Lab facility relocation.

Project Number	Project Name ^a	Project Type/ Date Operational	Size (ft²) ^b	Location ^c (Proposed)	Description
MA-46	Miscellaneous Facility Modernization/Upgrades	Infrastructure Upgrades/2027	N/A	Site-wide	This project would refurbish NSTTF passenger elevators and upgrade heating, ventilation, and air conditioning (HVAC); plumbing; electrical; external; or communication in several buildings. Additionally, chilled water service would be extended to Saturn and HERMES, replacing existing evaporative cooling with HVAC.
MA-47	Z Sustainment – Oil System Modernization	Infrastructure Upgrade/2027	N/A	TA-IV	This project would repair/replace 3 above-ground 250,000-gal oil tanks and associated infrastructure from 1985.
MA-48	9th Street Pavement Replacement and Pedestrian Improvements; Building Project Pavement Removal and Reconstruction	Infrastructure Upgrade/2026	N/A	TA-IV	The 9th Street project would remove and repave existing 40-year-old roadway with secondary roadway section along with improve sidewalks.
MA-49	Compact Disc Media and Paper Shredding Relocation	Addition/2028	1,200	TA-III	This addition would accommodate an area for compact disc shredding and VTR.
MA-50	Solid Waste Collection and Recycling Center (SWCRC) Office Trailer Replacement	Replacement Facility /2028	20,000	TA-II	This project would replace the SWCRC office trailer with a new purpose-built trailer to serve operations with additional footprint to enhance operation activities.
MA-51	New Aerosol Facility	Support Facility/2032	9,200	KAFB-West (CTF)	This project would enhance capability by constructing a 50-foot-radius dome and entry building with staging entry area and decontamination/air lock and accessory support spaces.
MA-52	20th Street Utility Corridor	Infrastructure Upgrade/2033	3 acres	TA-I	Refer to description in Section 3.3.1.
MA-53	Electrical Upgrades	Infrastructure Upgrade/2027–2037	7,000 ft ² facilities + 1 acre new substation	Site-wide	This project would replace substations across the site with new substations. The remote 5 kilovolt feeder upgrade would also occur.
MA-54	EV Infrastructure Upgrade to Support EV Fleet Expansion	Infrastructure Upgrade/2026–2040	N/A	Site-wide	This infrastructure upgrade would continue additional EV charging stations (Phase 2).
MA-55	Miscellaneous Utility/ Infrastructure Modernization/Upgrades	Infrastructure Upgrades/2027–2040	N/A	Site-wide	Refer to description in Section 3.3.1.
MA-56	Explosives Assembly Building Addition and Modernization/ Upgrades	Addition & Facility Upgrade/2027	3,000	KAFB-West (CTF)	This project would increase explosives assembly capabilities by renovating and adding more office space.

Project Number	Project Name ^a	Project Type/ Date Operational	Size (ft ²) ^b	Location ^c (Proposed)	Description
MA-57	New SNL/NM Quality-Compliant Storage Facility	Support Facility/2027	9,730	TA-I	This support facility adds specialty storage space in TA-I near Neutron Generators operations.
MA-58	Test Capabilities Revitalization & Life Extension Planning, locations include Thermal Test Complex, Lurance Canyon Burn Site, Aerial Cable Facility, TA-III Radiography Facility, Rocket Sled Track Complex, Centrifuge Complex, Water Impact Facility & Drop Tower Complex, and Vibration, Acoustic, Modal Facilities	Facility & Infrastructure Upgrades/2027–2032	10,000	Site-wide (TA-III, KAFB-West (CTF), KAFB-East)	Thermal Test Complex: Refurbish equipment, upgrade building systems including electrical, add warehouse space and outdoor lab. Lurance Canyon Burn Site: Upgrades and sustainment. Aerial Cable Facility: Improve access and fire breaks, refurbish equipment. Rocket Sled Track: Mitigate stormwater drainage, refurbish tracks and equipment, improve infrastructure. Centrifuge Complex: Upgrade and sustain existing buildings, add more office space. Water Impact Facility & Drop Tower Complex: Refurbish equipment, upgrade building systems including electrical. Vibration, Acoustic, Modal Facilities: Upgrade building systems including electrical, add office and high bay space.
Total Size of New/Replacement Facilities: 1,657,580 ft² + 4 acres for infrastructure (3 acres for 20th Street Utility Corridor and 1 acre for electrical substation)					
MA-59	DD&D of Multiple Facilities	DD&D/2027–2040	538,000	Site-wide	Refer to description in Section 3.3.1.
Total Size of DD&D: 538,000 ft²					

- a. NNSA acknowledges that facility names and operational dates used throughout this SWEIS are subject to change in the future.
- b. “Size” reflects both the development footprint and the project/facility square footage, as applicable.
- c. Figure 3-2 shows locations of new major projects.
- d. Bolded projects are described in more detail in this section (Section 3.3.1).

Source: SNL 2023b.

A description of notable activities under the Modernization Operations Alternative follows.

- **Advanced Manufacturing Process Development Laboratory.** This laboratory is about 136,000 square feet and is used to explore new and accelerated design, development, and manufacturing techniques for non-nuclear weapon products. The existing facility requires upgrades to replace flooring; air handlers; and water, sanitary, and fire protection systems. The project would also reconfigure space to include high bay laboratory space.
- **Energetics Components Capability.** NNSA manages and operates a critical energetics capability integral to systems arming, fuzing, and firing functions. The investment would replace the existing Explosive Components Facility, which would reach end of life by 2035. The replacement facility includes updated office, machine shop, chambers/pads, storage, gas gun facility, and all laboratory testing. The current building is 114,200 square feet. The replacement is estimated at 140,000 square feet. A size increase would be expected to commensurately increase utility demand compared to current usage. Staffing would increase by about 20 people (SNL 2023b).
- **Neutron Generator Enterprise+ (NGE+) Facility.** Neutron generators are a limited life component of nuclear deterrence systems, requiring high reliability. Currently, facilities for NGE are spread across all or part of nine buildings, with existing manufacturing operations requiring more product travel and handoffs, which is inefficient and increases possible quality impacts. Additionally, the facilities and infrastructure are aging, presenting risks to mission work. The consolidated NGE+ facility would add about 321,000 square feet of new facilities to consolidate and modernize functions to improve workflow and efficiency. Appendix A, Section A.3.3.7, provides more details.
- **Parking Structures/Facilities.** This project would include parking structures in TA-I and TA-IV. The structures would include lighting, drainage, ventilation, bicycle and pedestrian circulation, and personal electric vehicle (EV) charging stations to support workforce and mission function. Each parking structure would consolidate ground parking to a smaller footprint by constructing approximately four stories high and 260 feet long by 180 feet wide, with capacity to support 400 vehicles (SNL 2023b).
- **20th Street Utility Corridor.** NNSA has 34 acres of vacant, developable land in the northeast of TA-I, east of 20th Street, and west of the KAFB boundary. This land is a potential growth area for SNL/NM operations and would potentially serve a range of site support and research missions. At present, infrastructure to this part of TA-I is either nonexistent or insufficient to meet future development and would require utility expansion. A new utility corridor at 20th Street would consist of extending natural gas, chilled water, high-voltage power, telecommunications/technical security, water (potable and fire supply), stormwater, the sanitary sewer, and some modifications to transportation. The utility corridor would be approximately 2,000 feet long and 60 feet wide. While new roads would not be built, there would be several access points constructed off 20th Street. Some portions of 20th Street (depending on utility alignment) would be removed and replaced (SNL 2023b).
- **Utility/Infrastructure Modernization Upgrades.** An integrated utility infrastructure network supports SNL/NM's facilities and is tied to sustaining and modernizing these facilities. SNL/NM has progressively leveraged utility infrastructure design coincident

with facility upgrades to meet critical mission needs. As a result, water systems, sanitary sewer, storm drainage, electrical power, natural gas, and communications have existing and near-term design margin and obsolescence issues. In addition to the projects in Table 3-3, NNSA proposes site-wide utility infrastructure modernization to address aging, obsolescence, and progression of degraded design margins. Modernization would occur in existing utility corridors and/or previously disturbed areas (SNL 2023b).

- **DD&D Projects.** Over 40 buildings and other support facilities, with a total footprint of 538,000 square feet (12.4 acres), would be scheduled to undergo DD&D under the Modernized Operations Alternative. About one-half of the facilities are considered uncontaminated. Some hazardous material such as asbestos, lead-based paint, and chemical contamination could be present. One building is known to have extensive chemical contamination. NNSA has conservatively estimated that about 30 percent of the total waste from DD&D could be hazardous. Building-specific characterization is performed to determine the type of DD&D required (SNL 2023b). Any hazardous waste would be disposed of at a permitted offsite TSDF. No radiological contamination is expected from Modernized Operations Alternative DD&D activities (SNL 2023b).

3.3.2 Modernized Operations Alternative – Enhancing Existing Capabilities

This section identifies changes in or modernization of existing capabilities operations that may or may not be associated with facility, utility, or infrastructure construction. These changes enhance existing capabilities and may affect potential environmental impacts of SNL/NM operations under the Modernized Operations Alternative (refer to Appendix E for transportation details):

- **Annular Core Research Reactor (ACRR) Fuel Recladding.** ACRR fuel recladding would support ACRR operations until that facility is replaced. This project could increase worker dose and radiological wastes compared to the No-Action Alternative. Projections for worker dose and radiological wastes are shown in Appendix A, Table A-13, and account for these increases.
- **Post-Experiment Unirradiated Plutonium Isentropic Compression Experiment (Pu-ICE) Material.** Current Pu-ICE experiments at Z-machine are conducted under an agreement with LANL, with resulting material being returned to LANL for management. In the future, SNL/NM may also accept experiments from Lawrence Livermore National Laboratory (LLNL); however, a disposal pathway (for Pu-ICE material from such LLNL experiments) is pending. SNL/NM could ship Pu-ICE material to Idaho National Laboratory (INL) for processing and volume reduction and on to the Waste Isolation Pilot Plant (WIPP) or directly from SNL/NM to WIPP if those disposal pathways are approved.⁴ SNL/NM does not currently have a transuranic (TRU) certification program for shipping TRU waste to WIPP. WIPP's Central Characterization Program may, however, allow direct shipment of Pu-ICE material from SNL/NM in the future. To

⁴ This potential path for material is being evaluated in the SWEIS because it would allow for SNL/NM to conduct experiments for LLNL, which cannot be accommodated with the current material and waste processing path from SNL/NM to LANL and on to WIPP. In addition, INL may be a desirable location to ship material from SNL/NM because it is possible they will be able to process material in a manner to decrease waste volume sent on to WIPP.

support possible Pu-ICE tests from LLNL, this SWEIS conservatively analyzes potential transportation impacts associated with Pu-ICE material shipments between LLNL and SNL/NM, Pu-ICE material from SNL/NM shipped to INL, and/or Pu-ICE material from SNL/NM shipped directly to WIPP.

- **Other Special Nuclear Materials (SNM)/Nuclear Materials.** Small quantities of SNM and other unique nuclear materials may be also shipped from SNL/NM to NNSA sites, DOE sites, and a potential private commercial entity (refer to Appendix E, Table E-1).

3.3.3 Attributes of the Modernized Operations Alternative

This section identifies attributes associated with the Modernized Operations Alternative. Table 3-4 shows there is potential for a net increase in facility square footage at SNL/NM under the Modernized Operations Alternative, as facility construction would be larger than the projected facility DD&D actions. The net effect would be an increase in facilities by about 1,118,580 square feet (25.76 acres). Most facility construction would occur in TA-I and TA-II in disturbed areas. Of new constructed facilities (1,657,580 square feet), the major (Line Item) projects (859,000 square feet) would account for about 52 percent of the total new construction.

Table 3-4. Summary of Construction and DD&D – Modernized Operations Alternative ^a

Area	Facility/Development Footprint ^b (ft ²)	Additional Infrastructure Footprint (acre)	DD&D Footprint (ft ²)
TA-I	608,080	3-acre utility corridor	400,500
TA-II	535,000	1-acre substation	114,500
TA-III	192,500	0	8,000
TA-IV	75,000	0	0
TA-V	0	0	1,000
Other (KAFB-West, KAFB-East, SSTEP, Site-wide)	247,000	0	14,000
TOTALS	1,657,580 ft² (38.0 acres)	4 acres	538,000 ft² (12.4 acres)

- Values in this table are associated with the projects in Table 3-3 and are incremental additions to the values associated with the No-Action Alternative, the benchmark against which the action alternatives are compared.
- Data in this column include facility square footage plus any required construction laydown areas. After construction, laydown areas may be converted to parking or landscaped areas, or restored to pre-construction state. To be conservative, this SWEIS assumes values in this column represent the maximum amount of land that could be disturbed. In terms of land use, facility footprint represents development footprint.

Source: SNL 2023b.

Due to increase in overall size of SNL/NM facilities, some site-wide operational parameters (e.g., number of workers, electricity and natural gas usage) would increase (refer to Appendix A, Table A-3). DD&D activity wastes would also increase. Chapter 5 presents these impacts.

3.4 EXPANDED OPERATIONS ALTERNATIVE

The Expanded Operations Alternative includes the scopes of the No-Action Alternative and the Modernized Operations Alternative plus actions that would expand or add operational capacity, capabilities, and missions to respond to future national security challenges and increasing requirements. This alternative includes construction and operation of new facilities, new utility and infrastructure, and DD&D. Table 3-5 identifies proposed new facilities; upgrades, utility, and infrastructure projects; and DD&D actions associated with the Expanded Operations Alternative. Figure 3-2 provides a general map for locating proposed new major projects for the Expanded Operations Alternative, the No-Action Alternative, and the Modernized Operations Alternative. Construction and operational parameters associated with the Expanded Operations Alternative are in Appendix A, Tables A-2 and A-3.

3.4.1 Expanded Operations Alternative Portfolios

Supplemental information on the Expanded Operations Alternative is presented in Appendix A, Section A.3.4. Table 3-5 shows 30 new projects, totaling about 1,557,200 square feet (35.7 acres) of facility development and an additional 1,464 acres of other infrastructure proposed under the Expanded Operations Alternative (in addition to the Modernized Operations Alternative projects described in Section 3.3.1). Of these 30 projects, seven utility/infrastructure projects are proposed under the Expanded Operations Alternative, including expanded energy projects that would require approximately 1,441 acres of land (241 acres on SNL-managed lands); infrastructure, utility lines, and roads that would disturb 20 acres of land; and fences that would disturb an additional 3.3 acres. In addition to the new facility projects and upgrade, utility, and infrastructure projects, approximately 52 facilities and other support facilities with a total footprint of 566,000 square feet (13 acres) would be scheduled to undergo DD&D.

Table 3-5. Expanded Operations Alternative – New Facilities

Project Number	Project Name ^a	Project Type/ Date Operational	Size (ft ²) ^b	Location ^c Proposed	Description
Major (Line Item) Projects					
EA-1	Combined Radiation Environments for Survivability Testing (CREST) Complex ^d	New Facility/2033	150,000	TA-V	Refer to description in Section 3.4.2.
EA-2	Engineering Computation & Information Laboratory (ECIL)	New Facility/2032	120,000	TA-I	Refer to description in Section 3.4.2.
EA-3	Test Capabilities Revitalization Phase 3 and Phase 4 (TCR 3 and TCR 4)	New Facility and Upgrades/2033–2036	100,000	TCR 3: TA-III; TCR 4: Site-wide (TA-III and KAFB-East)	Refer to description in Section 3.4.2.
EA-4	Engineering-Data Analytics Facility (EDAF)	New Facility/2034	60,000	TA-I	Refer to description in Section 3.4.2.
EA-5	Next Generation Pulsed Power (NGPP) Facility	New Facility/2035	480,000	TA-II and TA-IV	Refer to description in Section 3.4.2.
EA-6	MC2 (MESA Annex)	New Facility/2035	50,000	TA-I	Refer to description in Section 3.4.2.
EA-7	Materials Engineering Capability Sustainment	New Facility/2036	70,000	TA-III	This facility would support the broad materials science mission, with adequate space and capabilities to support expanding mission demands and new and upgraded equipment and tools.
EA-8	Full Replacement of Saturn & HERMES III	New Facility/2037	105,000	TA-IV	Refer to description in Section 3.4.2.
EA-9	Weapons Component Engineering Capability Sustainment	New Facility/2038	210,000	TA-II	NNSA's nuclear weapon program requires increased office and laboratory space. The project may be a combination of a new facility and renovation of existing facilities.
Minor Construction Projects					
EA-10	Ammonia (NH ₃) Capability Bulk Delivery System Installation	New Facility/2026	1,000	TA-I	This project would expand NH ₃ system capacity to improve efficiency, install a new gas bunker, and deliver NH ₃ to more facilities.

Project Number	Project Name ^a	Project Type/ Date Operational	Size (ft ²) ^b	Location ^c Proposed	Description
EA-11	New Physical Security Agile/Flex (PSA) Facility	New Facility/2032	7,900	TA-III	No interior sensor testing facilities exist at current sensor testing and evaluation sites. The facility includes two critical programmatic spaces: a high bay area and training support area.
EA-12	Explosive Assembly Bay	New Facility/2026	2,600	TA-III	This facility would expand explosives assembly/disassembly operations to include bay space that meets safety requirements.
EA-13	Off Grid Facility	New Facility/2026	1,000	TA-III	This facility would pilot a support building that uses geothermal energy for heating/cooling and solar power as proof of concept.
EA-14	Strategic Wireless/ Radiofrequency R&D Facility	New Facility/2026	15,000	TA-I	This new facility would enable the expansion of multiple classification levels to support wireless/radiofrequency R&D efforts.
EA-15	NEST Emergency Response Facility (NERF)	New Facility/2030	25,000	TA-II	A new integrated emergency response capability and center would expand emergency response capabilities to support remote technical work not currently occurring.
EA-16	Computer Security Analysis Center (CSAC)	New Facility/2027	25,000	TA-II	This new facility would enable a computer modeling analysis center to perform real-time modeling not currently happening.
EA-17	New TA-III Classified Advanced Manufacturing (CAM) Facility	New Facility/2027	15,000	TA-III	The new facility would co-locate advanced manufacturing capabilities across SNL/NM in one new facility along with expanding capabilities that are not currently occurring.
EA-18	Digital Engineering Information Lab – ECIL 2	New Facilities/ 2027	20,700	TA-I	This new facility would double capabilities along with integration of computing R&D across SNL/NM.
EA-19	Battery Abuse Testing Lab in TA-II	New Facility/2027	5,000	TA-II	The current abuse testing lab is limited to small-capacity batteries to maintain safety basis. This facility would alleviate risk and support testing larger/broader battery types/systems.
EA-20	Electromagnetic and Sensor Technologies	New Facility/2028	15,000	KAFB-West (FARM)	Expanded FARM capabilities would facilitate large-scale radiofrequency/microwave data acquisition, processing, and analysis to evaluate test article response when exposed to electromagnetic environments and provide data for validating modeling/simulation software. New equipment and supporting infrastructure would integrate engineering and design activity and provide a low electromagnetic interference environment.
EA-21	NSTTF High Bay Lab Facility	New Facility/2028	23,000	KAFB-West (NSTTF)	A new high bay lab facility would meet the needs of the new energy R&D capabilities.
EA-22	Intermediate Centrifuge	New Facility/2028	3,500	TA-III	This facility would expand capability beyond small centrifuges (component level) and large centrifuges (system level).
EA-23	On Sun Solar Thermo-Chemical Demonstration Modular Units	New Facility/2029	10,000	KAFB-West (NSTTF)	The new facility would expand capabilities by having modular test units for hydrogen that would be utilized by the existing G3P3 tower at NSTTF.

Project Number	Project Name ^a	Project Type/ Date Operational	Size (ft ²) ^b	Location ^c Proposed	Description
Upgrades/Utilities/Infrastructure					
EA-24	Radioactive and Mixed Waste Management Unit (RMWMU)	Facility Upgrades/2032	8,500	TA-III	This project would provide upgrades and ventilation and reconfigure space to accommodate additional personnel and expanded waste processing areas.
EA-25	Robotic Vehicle Range (RVR) Multipurpose Staging Facility	Facility Upgrades/2027	4,000	KAFB-West	RVR space is at capacity, limiting staff growth and testing capabilities. Existing footprint expansion with a fence line extension and multipurpose staging addition would enhance current testing capabilities; expand the number of robotic tests, types, and sizes; and increase operational efficiencies.
EA-26	TA-II Infrastructure Lines & Road Installation	New Infrastructure/ 2027	20 acres	TA-II	This project includes removal of undersized, sprawled, and aged infrastructure and installation of new, robust utilities (water, sewer, storm drainage, natural gas, communications, chilled water). A new utility and roadway corridor (about 4,100 feet by 100 feet) is planned for efficient and economical development.
EA-27	Center for Integrated Nanotechnologies (CINT) 4th Wing	Facility Upgrades/ 2027	30,000	Eubank Corridor	A new fourth wing at CINT will support expanding semiconductor initiatives with a cleanroom, light lab, and office/collaborative space.
EA-28	Expanded Energy Projects	New Infrastructure/ 2029	1,441 acres	Site-wide, KAFB-West (NSTTF)	Refer to description in Section 3.4.2.
EA-29	Energy Innovation Projects	New Infrastructure/ 2027–2040	0	Site-wide	Refer to description in Section 3.4.2.
EA-30	Forest Service Land Transfer to NNSA	Land Exchange or Acquisition	3.3 acres for fence	Refer to Figure 3-2	Refer to description in Section 3.4.2.
Total Size of New/Replacement Facilities and Upgrades: 1,557,200 ft² + 1,441 acres (expanded energy projects) + 20 acres (roads/infrastructure) + 3.3 acres (fence)					
Total: 1,557,200 ft² + 1,464.3 acres (expanded energy projects, infrastructure, and fence)					
EA-31	DD&D of Multiple Facilities	DD&D	566,000	Site-wide/by 2040	Excess facilities would undergo DD&D by approximately 2040.
Total Size of DD&D: 566,000 ft²					

- a. NNSA acknowledges that facility names and operational dates used throughout this SWEIS are subject to change in the future.
- b. “Size” reflects both development footprint and project/facility square footage, as applicable. Larger areas are described in acres instead of square feet.
- c. Figure 3-2 shows locations of the major projects.
- d. Bolded projects are described in more detail in Section 3.4.2.

Source: SNL 2023c.

3.4.2 Expanded Operations Alternative Project Descriptions

Proposed Expanded Operations Alternative facilities and utility/infrastructure projects follow:

- **Combined Radiation Environments for Survivability Testing (CREST) Complex.** The CREST Complex would include an open-pool reactor and accelerator to provide an enhanced replacement facility for the ACRR. This is mission-critical capability currently supports radiation environment testing in TA-V and is an HC-2 water-moderated, pool-type research reactor capable of continuous and pulsed operations. The current ACRR facility is over 60 years old. The CREST Complex would combine ACRR and independent gamma irradiation capabilities and place reactor operations in a facility that meets modern codes and standards. The complex would be in TA-V and include an office/light laboratory building and a CUB/Central Alarm Station facility (SNL 2023c). Appendix A, Section A.3.4.8, discusses the need for the CREST Complex and describes TA-V flood control; pre-conceptual design; geotechnical study; operations, including fuel options; and alternatives associated with the CREST Complex that were considered but eliminated from detailed analysis. On a unit basis, waste stream quantity and worker dose reductions and safety improvements are expected in a new and modernized CREST Complex. However, these improvements cannot be quantified definitively until detailed design occurs. This SWEIS assumes operational parameters and characteristics would be similar to those of existing operations, but at a higher degree of throughput due to CREST's increased testing capabilities (SNL 2023c).
- **Engineering Computation and Information Laboratory (ECIL).** This project would facilitate collaboration between computer and data scientists, designers, engineers, and analysts allowing experts to fuse data-driven models with traditional computational models through software using machine-learning and artificial intelligence, enhancing data mining and analytics and making effective use of data. About 70 personnel would work at this 120,000-square-foot facility sited in TA-I. High-performance computers would require approximately 300,000 kilowatt-hours (kW-hr) per year and cooling water usage is estimated at approximately 500,000 gallons per year (SNL 2023c).
- **Test Capabilities Revitalization Phases 3 and 4 (TCR 3 and TCR 4).** These projects would support system-scale mechanical environmental testing capabilities, including shock, vibration, thermal, pressure, climatic, and non-destructive testing (e.g., x-ray computed tomography and operational support). TCR 3 would replace, consolidate, and expand environmental testing assets capabilities and accommodate new technology and changes to operations. TCR 3 would replace and expand the Mechanical Shock Facility and Large-Scale Vibration and Acoustics Facilities and would accommodate emerging modal and mass properties characterization and environmental test support operations. TCR 4 would revitalize existing facilities, include additions and support structures to sustain Nuclear Security Enterprise capabilities, and address emerging sub-capability. TCR 4 would occur at Thermal Test Complex, Lurance Canyon Burn Site, Aerial Cable Facility & Test Arena, Area III Radiography Facility, Rocket Sled Track Complex, Large Centrifuge Complex, Water Impact Facility, and 185-foot Drop Tower. Due to current facility age, emissions, energy performance, and safety improvements are expected in

proposed facilities but cannot be confidently quantified until detailed design occurs. This SWEIS assumes operations would be like existing operations (SNL 2023c).

- **Engineering-Data Analytics Facility (EDAF).** This 60,000-square-foot data center sited in TA-I would support data collection, storage, and analysis capabilities and contain high-performance computers, scalable data enclave, and extreme-speed network backbone. About five personnel would work in the EDAF, which annually could draw 1.3 million kW-hr electricity usage and require up to 500,000 gallons of cooling water (SNL 2023c).
- **Next Generation Pulsed Power (NGPP) Facility.** This is the largest proposed facility (480,000 square feet) and would be sited in TA-II and TA-IV. The NGPP facility would replace the Z-machine complex, address critical nuclear weapon primary and secondary physics questions, and produce large x-ray and neutron outputs on larger test objects than possible today. Refer to Appendix A, Section A.3.4.9, for more details.
- **MC2 (MESA Annex).** NNSA provides strategic radiation-hardened microsystems for the Nation’s nuclear weapons. The proposed Microsystems Engineering, Science and Applications (MESA) Complex Annex, sited in TA-I next to the existing MESA, would be approximately 50,000 square feet and would provide state-of-the-art cleanroom space and capabilities to support current and expanding missions. Due to the expanded operations, approximately 50% increase is expected for utility demands such as electricity and water usage when compared to the existing MESA (SNL 2023c).
- **Full Replacement of Saturn and HERMES III.** These unique, pulsed-power-based, high-current/high-energy accelerators produce x-ray and gamma ray radiation environments used to conduct survivability studies. Both facilities housing Saturn and High-Energy Radiation Megavolt Electron Source (HERMES) III need replacement due to age and to accommodate new configurations of programmatic equipment. The new facilities would maintain their nuclear facility hazard classification of “less than HC-3” (HERMES-III as an “accelerator” and Saturn as a “low” hazard industrial facility) and would be about the same size as the existing facilities. The replacement facilities would generally reduce utility demands, which may be offset by increased operations. Wastes and workforce requirements would be like those for existing operations. A new technology platform is proposed for warm x-ray development and testing, but no additional hazards external to the facility are expected. Small quantities of very short half-life radiological gases would be emitted during normal operations, which is similar to existing operations (SNL 2023b).
- **Expanded Energy Projects.** Expanded energy projects would enable SNL/NM to increase energy production. Up to about 1,441 acres of land could be disturbed, mostly from photovoltaic (PV) projects part of the Advanced Solar Generation and Resiliency Deployment (ASGARD) initiative and shown as Pilot Industrial Concentrating Solar Power (CSP) Tower locations on Figure 3-2. Other PV projects would integrate into existing and new covered parking lots, and three projects would be stand-alone solar arrays. These projects would aid SNL/NM energy management when power outages occur due to high energy demands or emergencies. As part of these projects, NNSA is proposing, via a public/private partnership, an Energy Sales Agreement and/or an Energy Savings Performance Contract for energy storage and microgrid on KAFB-permitted land

at the National Solar Thermal Test Facility (NSTTF) (SNL 2023c). Refer to Appendix A, Section A.3.4.13 for more details.

- **Energy Innovation Projects.** These projects, currently in R&D, include next-generation nuclear systems and geothermal systems, which have the potential to be implemented as small-scale pilot projects at SNL/NM. This SWEIS considers potential environmental impacts for these energy projects. Should these energy technologies be viable, further NEPA assessment may be required before large-scale implementation:
 - The wind energy R&D activities pilot project would evaluate technology alternatives, location, wind patterns, bird migration routes, and compatibility with surrounding areas and mission activities.
 - Next generation nuclear systems could be deployed on SNL/NM-managed lands at smaller-than-commercial scales to meet existing and future energy needs. This would be achieved by a type of advanced reactor concept referred to as a microreactor. This concept is being developed to supply energy demands at much smaller scales than the traditional large power reactors. Factory manufactured, fully assembled, and pre-fueled microreactor(s) between 5 and 10 megawatts electric (MWe) would arrive at SNL/NM and would be connected to the electric grid. Based on current conceptual designs, a microreactor could be as small as a semi-truck. Microreactors have several features that enable them to achieve high levels of safety. They are generally considered to have highly reliable safety functions that enable them to achieve the control of reactor power, cooling of the reactor fuel/core, and containment of radiological material with very high safety margins because of the use of inherent and/or passive safety to achieve various safety functions. More information on microreactors is in Appendix A, Section A.3.4.10.
 - Geothermal systems are closed-loop and would be explored as pilot R&D projects at TA-I and TA-III. Potential systems would have two to three wells (400 feet to 1,000 feet in depth) for direct use (heating and cooling) for up to four buildings in the TA. The system could be scaled up to satisfy the heating and cooling needs of several buildings. Appendix A, Section A.3.4.13, discusses additional geothermal projects.
 - Electrification of Central Utility Buildings (CUBs) that provide chilled and hot water loops to buildings would be considered. The CUB designs would include geothermal exchange and other thermal exchange systems and may connect buildings to above ground shaded solar walkways.
 - Existing facilities and equipment would be upgraded from gas-fired systems to electricity where feasible.
 - Geo-exchange systems are also being considered at all TAs as pilot scale projects. This technology rejects excess heat via well field by using the ground as a heat sink and eliminates water losses from cooling towers. The wells would be located adjacent to the chiller plants and typically under parking lots. The geo-exchange field size could be approximately 2–6 acres; this depends on chiller plant location, loads, and soil type. These systems would be considered at up to six locations.
 - Sanitary sewer exchanges are like geothermal systems, where heat recovery chillers and heat exchangers can reject heat from the condenser water or ambient water

system to the sanitary sewer or irrigation systems. Main lines flowing to different basins allow for the greatest heat rejections due to large size and flow rate. These pilot projects would evaluate sanitary sewer or irrigation system exchanges at TAs where the technology is viable.

- **Land Transfer or Acquisition.** This SWEIS evaluates a complete transfer of withdrawn land from the Forest Service to DOE (4,595 acres) or a partial land transfer to NNSA with the Forest Service retaining up to 315 acres of the withdrawn lands (Figure 3-2). Both agencies currently hold joint title to the land that would be transferred, which complicates land management. This would be an administrative action, and no significant changes in land management are proposed. If the land is transferred, a construction boundary fence would deter public trespassing and improve site security; this is evaluated as part of this SWEIS. During construction of the 14,500-foot-long fence, land disturbance would be expected to occur within a 10-foot width along the fence line.⁵ A maximum of 145,000 square feet (about 3.3 acres) of land could be disturbed.
- **DD&D Projects.** Approximately 52 facilities and other support facilities with a total footprint of 566,000 square feet (13 acres) would be scheduled to undergo DD&D under the Expanded Operations Alternative. About 75 percent of those facilities are considered uncontaminated. Some hazardous material, such as asbestos, lead-based paint, and other chemical contaminants, could be present in DD&D facilities. Five buildings are known to contain asbestos contamination, and one building is known to contain chemical contamination. Some facilities conduct or have conducted radiological operations and approximately 295 cubic meters of low-level radioactive waste (LLW) would be expected from DD&D. In addition, the DD&D of facilities at TA-V would generate approximately 188 metric tons (MT) of hazardous waste and approximately 4,200 MT of non-hazardous waste. Lastly, the DD&D of HERMES III would generate approximately 15 cubic meters of LLW. Building specific characterization to determine the amount of hazardous material would be performed prior to DD&D activities (SNL 2023c). Any hazardous waste would be disposed of at a licensed offsite TSDF. LLW would be disposed of at Nevada National Security Site (NNS) or any commercial facility accredited by the Department of Energy Consolidated Audit Program (DOECAP).

3.4.3 Expanded Operations Alternative – Operational Changes

This section identifies changes in operations that may or may not be associated with facility, utility, or infrastructure construction. These changes could affect the potential environmental impacts of SNL/NM operations under the Expanded Operations Alternative:

- **Open Burning/Open Detonation (OB/OD).** SNL/NM treats certain Resource Conservation and Recovery Act (RCRA) explosive hazardous wastes by open burning at the Thermal Treatment Unit (TTU) in the northern part of TA-III just west of TA-V. The U.S. Environmental Protection Agency (EPA) regulations promulgated under RCRA authorize permitting of OB/OD units for “waste explosives” treatment. NNSA assessed alternatives to its open burn of waste explosives, consistent with EPA guidance and the

⁵ Because of the terrain and topography where the fence would be built, it is unlikely that heavy machinery would be used during construction, which would reduce the width of land disturbance.

RCRA facility operating permit for the TTU (SNL 2023d). NNSA identified three technologies for further evaluation: two thermal treatment methods (Flashing Furnace and Tunnel Furnace) and one chemical treatment method (reaction with aqueous sodium thiosulfate pentahydrate). Based on further evaluation, NNSA concluded that additional development and testing is required before any methods could be implemented. Although none of the alternative treatment technologies are currently suitable, for the purposes of analysis, this SWEIS assumes that, after further development, one or more of the above technologies would be implemented under the Expanded Operations Alternative. The potential footprint of each unit would be greater than 1,000 square feet and would likely be in TA-III. More information regarding OB/OD is in Appendix A, Section A.3.4.12.

- **Wildland Fire Risk Reduction Treatments.** Wildfire presents a persistent threat to SNL/NM personnel, structures, infrastructure, and adjacent communities. In its Annual Wildland Fire Management Plan, KAFB identified dangerous fuel accumulation within KAFB-West and KAFB-East lands withdrawn from the Forest Service to DoD and DOE use. SNL/NM would partner and collaborate with KAFB to mimic and complement the KAFB Wildland Fire Management Plan while improving, expanding, and integrating its own Wildland Fire Management Plan (KAFB 2022). In the near term, most fuel treatment work would use manual or mechanical thinning, limbing and selective removal, or application of approved herbicides and prescribed burning (KAFB 2022). This SWEIS analysis focuses on these near-term actions and long-term planning. Appendix A, Section A.3.4.11, provides more details on wildland fire risk reduction.
- **Legacy Material Storage and Disposition.** SNL/NM stores legacy nuclear material and proposes to transport some to INL for characterization, waste reduction, recycling, and disposition. About two shipments would be made to INL annually. As a result of this proposal, some TRU waste could be transported from INL to WIPP. This SWEIS analyzes transport of nuclear material and waste (refer to Appendix E for more details).
- **Z-machine Operations.** Z-machine operations support many SNL/NM portfolios (including Nuclear Deterrence, Global Security, National Security, Advanced Science and Technology, and Energy and Homeland Security) and other national laboratory activities. Under the Expanded Operations Alternative, SNL/NM proposes to increase the number of experiments at the Z-machine by about 50 percent, which would increase workforce requirements, transportation routes, and disposal pathways. The increased experiments involving Pu-ICE SNM would have similar transportation pathways as described in the Modernized Operations Alternative. One or two additional TRU material shipments could be made annually. It is important to note the NGPP Facility is a proposed replacement for the Z-machine; as such, Z-machine operations might not be expanded if NNSA decides to proceed with the NGPP, depending on timing. LLW shipments to NNSS or any DOE/CAP-accredited commercial facility could increase from two to four annually to two to six annually (SNL 2023b). Appendix E provides more details on radiological shipments.
- **Unmanned System (UxS) Operations.** UxS broadly refers to unmanned aircraft systems (UAS), unmanned ground systems (UGS), unmanned underwater systems (UUV), and unmanned surface systems. SNL/NM develops and deploys intelligent systems to detect, characterize, and mitigate evolving threats to critical national assets, military forces, and

the public. In addition, it works to address threats posed by proliferation of UxS, and it develops and deploys UxS solutions for the benefit of U.S. national security. NNSA proposes to expand operations to include the use of swarms in UAS flights, beyond visual line of sight flights, and dropping of explosives for research and testing purposes on sited explosives ranges, within the requirements of host facilities and other applicable locations within the state of New Mexico (refer to Appendix A, Section A.3.4.7, for additional details).

- **Integrated Natural and Cultural Resources Management Plan (INCRMP).** NNSA proposes to develop and implement an INCRMP or individual plans (Integrated Natural Resources Management Plan [INRMP] and Integrated Cultural Resources Management Plan [ICRMP]) for SNL/NM. SNL/NM would partner with KAFB and adapt the KAFB INRMP and ICRMP to address SNL/NM-specific activities and personnel. The SNL/NM INCRMP would provide management strategies, best management practices (BMPs), and mitigation measures to foster the effective management of natural and cultural resources (refer to Appendix A, Section A.3.4.14, for additional details).
- **Expanded Site-Wide Operations.** This SWEIS addresses potential operations at SNL/NM through a planning period ending in 2040. NNSA acknowledges that uncertainties associated with future operations increase the further one looks down the planning period. For example, mission requirements for the next 5 years are more definitive than requirements in 2040. Nonetheless, to provide a reasonable bounding analysis, this SWEIS assumes that operational levels in 2040 could be higher than current operations and those of the operational levels assumed for the No-Action Alternative and the Modernized Operations Alternative. Consequently, this SWEIS assumes that operations could increase by 30–50 percent for some programs and facilities. This would increase utility demands, personnel requirements, and operational parameters such as air emissions, doses to workers, and wastes. The operational parameters in Appendix A, Table A-3, account for these potential increases in operational parameters, and the analysis in Chapter 5 addresses the potential environmental impacts of these increases.

3.4.4 Attributes of the Expanded Operations Alternative

This section identifies attributes associated with the Expanded Operations Alternative. Table 3-6 shows incremental values associated with projects in Table 3-5, and Table 3-7 shows total values for the Expanded Operations Alternative, which includes projects associated with the Modernized Operations Alternative. Table 3-6 shows facility square footage at SNL/NM would increase, as facility construction would be larger than DD&D action by about 991,200 square feet (22.7 acres). Most facility construction (about 33 percent) would occur in TA-II. Of the 1,557,200 square feet of new facilities that would be constructed, the major (Line Item) projects (1,345,000 square feet) account for about 86 percent of incremental new construction.

Table 3-6. Incremental Construction and DD&D Associated with Projects in Table 3-5 ^a

Area	Facility/Development Footprint ^b (ft²)	Additional Infrastructure Footprint (acre)	DD&D Footprint (ft²)
TA-I	266,700	19 acre expanded energy projects	191,000
TA-II	505,000	20 acre roads/infrastructure + 8 acre expanded energy projects	0
TA-III	108,500	0	58,000
TA-IV	345,000	4 acre expanded energy projects	238,000
TA-V	150,000	0	68,000
Other (KAFB-West, KAFB-East, Eubank Corridor, Site-wide)	182,000	1,410 acre expanded energy projects + 3.3 acre fence	11,000
INCREMENTAL TOTALS	1,557,200 ft² (35.7 acres)	1,464.3 acres	566,000 ft² (13.0 acres)

- a. The values in this table are associated with the projects listed in Table 3-5. These values are incremental additions to the values associated with the Modernization Alternative. Table 3-7 provides the total values associated with the Expanded Operations Alternative (i.e., the values for all projects listed in Table 3-3 and Table 3-5).
- b. Data in this column include facility square footage plus any required construction laydown areas. After construction, laydown areas may be converted to parking or landscaped areas, or restored to pre-construction state. To be conservative, this SWEIS assumes values in this column represent the maximum amount of land that could be disturbed. In terms of land use, facility footprint represents development footprint.

Source: SNL 2023c.

Table 3-7. Total Construction and DD&D – Expanded Operations Alternative ^a

Area	Facility/Development Footprint ^b (ft²)	Additional Infrastructure Footprint (acres)	DD&D Footprint (ft²)
TA-I	890,380	19 acre expanded energy projects + 3 acre utility corridor	591,500
TA-II	1,040,000	20 acre roads/infrastructure + 8 acre expanded energy projects + 1 acre substation	114,500
TA-III	301,000	0	66,000
TA-IV	420,000	4 acre expanded energy projects	238,000
TA-V	150,000	0	69,000
Other (KAFB-West, KAFB-East, Eubank Corridor, Site-wide)	412,400	1,410 acre expanded energy projects + 3.3 acre fence	25,000
TOTALS	3,213,780 ft² (73.8 acres)	1,468.3 acres	1,104,000 ft² (25.3 acres)

- a. The values in this table are for all projects listed in Table 3-3 and Table 3-5.
- b. Data in this column include facility square footage plus any required construction laydown areas. After construction, laydown areas may be converted to parking or landscaped areas, or restored to pre-construction state. To be conservative, this SWEIS assumes values in this column represent the maximum amount of land that could be disturbed. In terms of land use, facility footprint represents development footprint.

Source: SNL 2023c.

Because some Expanded Operations Alternative facilities would support new missions or expand capabilities, operational parameters (e.g., emissions, utility demands, workers, accident risks or consequences) associated with those facilities could be expected to change compared to those of

existing operations. Appendix A, Table, A-3, accounts for these changes and estimates the operational parameters for the Expanded Operations Alternative. Wastes associated with DD&D activities would also increase, which are accounted for in Appendix A, Table A-3, and would include construction debris and both radiological and hazardous/asbestos-contaminated wastes. Chapter 5 of this SWEIS presents the impacts associated with these changes.

3.5 ANALYTICAL PARAMETERS FOR THE ALTERNATIVES

As discussed in Sections 3.2 through 3.4, all alternatives encompass multiple discrete projects/actions that could give rise to environmental impacts. By addressing all these projects/actions in a site-wide analysis, NNSA can consolidate impact analyses and public participation activities, which streamline the NEPA process; present comprehensive impact information so decisionmakers and the public clearly understand the totality of impacts through reasonably foreseeable future activities at a site; avoid segmentation (division of actions with significant impacts into smaller actions, thereby minimizing significance); and efficiently respond to stakeholders by presenting information on past, present, and future activities at SNL/NM to better understand the impacts on health, safety, and environmental quality.

A primary challenge in preparing a site-wide analysis is to address the impacts of the individual projects/actions while also addressing the totality of impacts. To accomplish those dual goals, NNSA defined and accumulated data relative to defined projects/actions proposed within alternatives. For each project/action, NNSA consulted with subject matter experts from SNL/NM to quantify key parameters. Once key construction and operational parameters were developed, resource experts used those parameters to conduct the impact analysis presented in Chapter 5. More information on the process used, parameters identified, and examples is provided in Appendix A, Section A.3.1.

3.6 ALTERNATIVES CONSIDERED BUT ELIMINATED FROM DETAILED STUDY

In determining the range of alternatives in this SWEIS, NNSA considered public input and comments received during scoping, reasonable alternatives that would meet the purpose and need identified in Section 1.3, and alternatives that were considered in developing this SWEIS but were eliminated from detailed analysis because they do not allow NNSA to fulfill its mission requirements. Specific reasons for elimination are detailed as follows:

- **Complete closure of SNL/NM.** This alternative is inconsistent with the SNL/NM mission defined by NNSA. Such a possibility was considered as recently as 2008 when NNSA prepared the *Final Complex Transformation Supplemental Programmatic Environmental Impact Statement* (SPEIS) (NNSA 2008a). NNSA concluded that, “as a result of the continuing challenges of certification [of nuclear weapons] without underground nuclear testing, the need for robust peer review, benefits of intellectual diversity from competing physics design laboratories, and uncertainty over the details [of] future stockpiles, NNSA does not consider it reasonable to evaluate laboratory consolidation [or elimination] at this time” (NNSA 2008a). That conclusion has not changed. In addition, as one of only three nuclear weapons laboratories, SNL/NM contributes significantly to core intellectual and technical competencies of the United States related to nuclear weapons. These competencies embody over 50 years of weapons

knowledge and experience. The laboratories perform basic research; design; system engineering; development testing; reliability and assessment; and certification of nuclear weapon safety, reliability, and performance. From a broader national security perspective, core intellectual and technical competencies of SNL/NM (and those of LLNL and LANL, NNSA's other nuclear weapons laboratories) provide the technical basis for the pursuit of U.S. arms control and nuclear nonproliferation objectives.

- **Transfer of current missions/operations from SNL/NM to other sites.** NNSA has not identified any new proposals for current missions/operations that are reasonable for transfer to and/or from SNL/NM (NNSA 2008a and 88 FR 24607).

3.7 PREFERRED ALTERNATIVE

The preferred alternative would fulfill NNSA statutory missions and responsibilities, considering economic, environmental, technical, and other factors. This SWEIS discusses potential environmental impacts under the No-Action Alternative and the two action alternatives. NNSA prepares cost, schedule, and technical analyses separately and will consider all relevant factors in the selected alternative in its ROD.

3.8 COMPARISON OF THE POTENTIAL CONSEQUENCES OF THE ALTERNATIVES

Chapter 5 contains identified potential consequences for each alternative. A comparison of the potential consequences is presented in Chapter 6 and Appendix A, Section A.3.5.

4.0 SANDIA NATIONAL LABORATORIES: EXISTING ENVIRONMENT

4.1 INTRODUCTION

This chapter describes the potentially Affected Environment, including the current environmental conditions at SNL/NM and adjacent areas. This information is the environmental baseline and context from which NNSA evaluated the potential direct, indirect, and reasonably foreseeable environmental effects of the proposed alternatives in Chapters 5 and 6. NNSA determined the existing conditions for each environmental resource from information in previous environmental studies, reports, and databases from 2017 through 2024.

This SWEIS evaluates the potential impacts of the alternatives within defined regions of influence (ROIs) for each identified resource. An ROI is the geographical area where potential impacts on a resource could occur. Table 4-1 lists the resources analyzed in this SWEIS and summarizes their associated ROIs. For some resources, such as infrastructure, the ROIs are limited primarily to locations within or near SNL/NM, including leased or permitted property within KAFB jurisdictional boundaries and associated offsite facilities. For other resources, such as human health, transportation, and air quality, the ROIs are larger. Offsite facilities also include any federal, state, county, and private location with controlled or limited controlled access within the state of New Mexico for the testing of UxS.

Table 4-1. ROIs for Potentially Affected Resources

Resource	Region of Influence
Land Use and Airspace	SNL/NM, KAFB, and adjacent ^a locations
Visual Resources	SNL/NM, KAFB, and adjacent locations
Geology and Soils	SNL/NM, KAFB, and adjacent locations
Water Resources and Hydrology	SNL/NM, KAFB, and adjacent/down-gradient surface water bodies and groundwater
Air Quality	SNL/NM, KAFB, and offsite areas; 50 miles (80 kilometer [km]) for cumulative effective radiological dose to populations
Noise	SNL/NM, KAFB, and adjacent locations, including residential areas and the La Semilla Buffer Zone
Biological Resources	SNL/NM, KAFB, and adjacent locations
Cultural and Paleontological Resources	SNL/NM, KAFB, and adjacent locations
Socioeconomics	Bernalillo County
Traffic and Transportation	SNL/NM, KAFB, and adjacent site access routes; waste/materials transportation corridors between SNL/NM and offsite locations in New Mexico and other states where radiological or chemical exposures could occur
Infrastructure	SNL/NM, KAFB
Waste Management and Materials Management	SNL/NM
Human Health and Safety	SNL/NM, KAFB, and adjacent locations; 50 miles (80 km) for collective radiological impacts

a. In this context, “adjacent” means next to or very near. Refer to descriptions of each analyzed resource for details and context for the ROI.

4.2 LAND USE AND AIRSPACE

Land use refers to the human use of land, including current uses, plans, and programs that guide the future use and development of an area. This section discusses existing land uses at both SNL/NM and leased and permitted lands. Owners and managers of private, federal, tribal, state, and local government land may experience impacts from SNL/NM.

This review used the following categories of land use: agricultural, commercial, industrial, military, mixed-use, natural, recreational, and residential. No comprehensive federal regulations define land use categories. Land uses in the vicinity of SNL/NM were identified through a review of existing federal, state, county, and community-level land use plans and zoning codes. City and county organizations have no planning jurisdiction at KAFB or SNL/NM because they are federally owned lands.

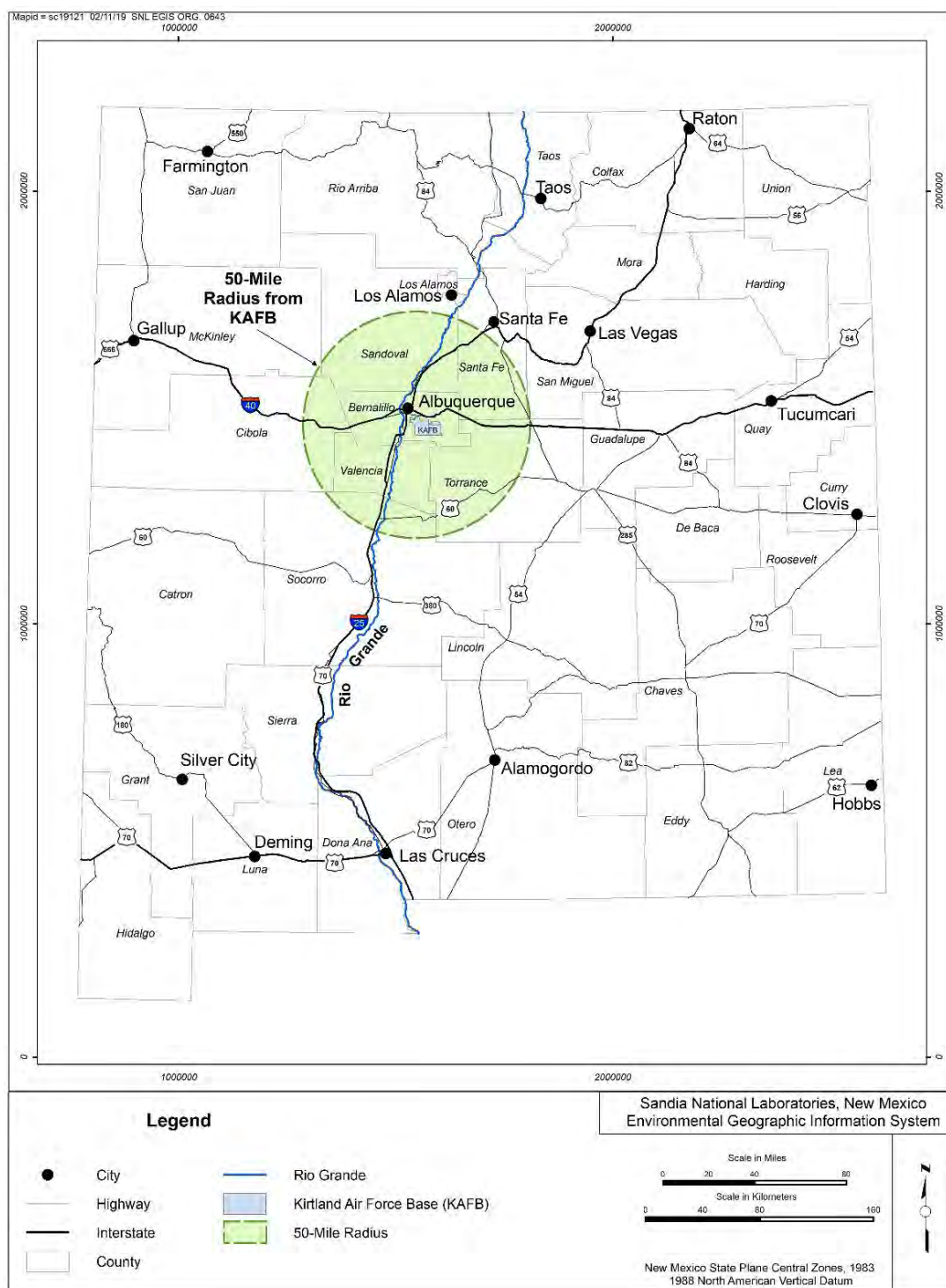
Given SNL/NM's location within KAFB and adjacent to the Sunport, a discussion of airspace is included here to complement the land use analysis. Land use data gathered for this analysis were also used in the presentation of the visual environment (Section 4.3).

4.2.1 Regional Context and SNL/NM Siting

4.2.1.1 Albuquerque

Albuquerque lies within the Mexican Highland Section of Basin and Range Physiographic Province, situated in the high desert region of central New Mexico (Figure 4-1). Bordered by mountains to the east and plateaus to the west, this area has diverse geological, hydrological, ecological, and climatic settings. The Sandia Mountains are on the eastern periphery of the city, spanning 13 miles, and characterized by steep cliffs, pinnacles, and narrow canyons. The “Crest” is 10,678 feet in elevation. The Manzano Mountains lie to the south of the Sandias. The Tijeras Canyon separates the Sandia and Manzano Mountain ranges to the east of the city.

The City of Albuquerque covers about 190 square miles (mi²). It is New Mexico's largest city, with a metropolitan area population of more than 900,000. Regional land use is diverse and managed to accommodate urban development while preserving natural landscapes. The city's land use encompasses residential areas, commercial zones, industrial spaces, and open green spaces. Efforts are made to balance growth with conservation to preserve the desert environment (CABQ 2017).



Source: SNL 2022c.

Figure 4-1. New Mexico State, Albuquerque, and KAFB

4.2.1.2 Kirtland Air Force Base

KAFB was originally established in the late 1930s as the Albuquerque Army Air Base. In 1942, KAFB evolved into a training ground for bomber aircraft crews during World War II. KAFB occupies 51,588 acres southeast of Albuquerque, with an average elevation of 5,384 feet and an apex elevation of 7,986 feet along the eastern edges. KAFB is surrounded by the Cibola National Forest (CNF) to the northeast and east, the Pueblo of Isleta to the south, the City of Albuquerque to the west and north, the Veterans Affairs Medical Center to the northwest, and the Sunport to the northwest, with the Sunport and KAFB sharing runways that jointly serve civilian and military aviation.

KAFB is the sixth largest installation in the DAF, operating under the 377th Air Base Wing and overseeing diverse partners and mission activities. Its functions span research, development, and testing of cutting-edge weaponry, space and missile technologies, and laser warfare. The Air Force Nuclear Weapons Center, Air Force Research Laboratory, Air Force Operational Test and Evaluation Center, United States Space Force, Defense Threat Reduction Agency, and SNL/NM exist or operate facilities within the boundaries of KAFB (DAF 2019).

4.2.1.3 Sandia National Laboratories/New Mexico

SNL/NM's site development began in 1946–1947, with the first four buildings in what is now TA-I, followed by 14 more permanent structures in 1948. Expansion continued with an explosives assembly area in TA-II, located about a half mile south of TA-I, and with plans for outdoor testing facilities in TA-III by 1952. These facilities became operational in 1953. Subsequent development included TA-IV and TA-V for pulsed power and high-energy experiments. To facilitate testing activities away from the public, in 1957 NNSA obtained Forest Service land withdrawn for SNL/NM use and various permitted parcels of land from KAFB.

Today, SNL/NM operates in a total footprint of 16,532 acres across several land ownership and usage designations shown in Figure 4-2 and summarized in Table 4-2. Eighty-three percent (13,766 acres) of SNL/NM's total footprint is situated within KAFB's secure boundary; this analysis classifies these lands as "onsite." Of these onsite lands, 6,321 acres are permitted from KAFB, and 4,595 acres are withdrawn Forest Service lands; the remaining lands are NNSA owned. The 2,756 acres of SNL/NM-managed lands outside of KAFB's secure boundary are classified as "offsite." Most are leased from the State of New Mexico and lie either directly adjacent to or near KAFB, with a few outliers dispersed within the greater Albuquerque metropolitan area.

SNL/NM's historical and present land use and land use planning (refer to Table 4-2) have been shaped by this combination of NNSA-owned lands and various land use agreements that define exclusive and non-exclusive use by SNL/NM within defined areas.

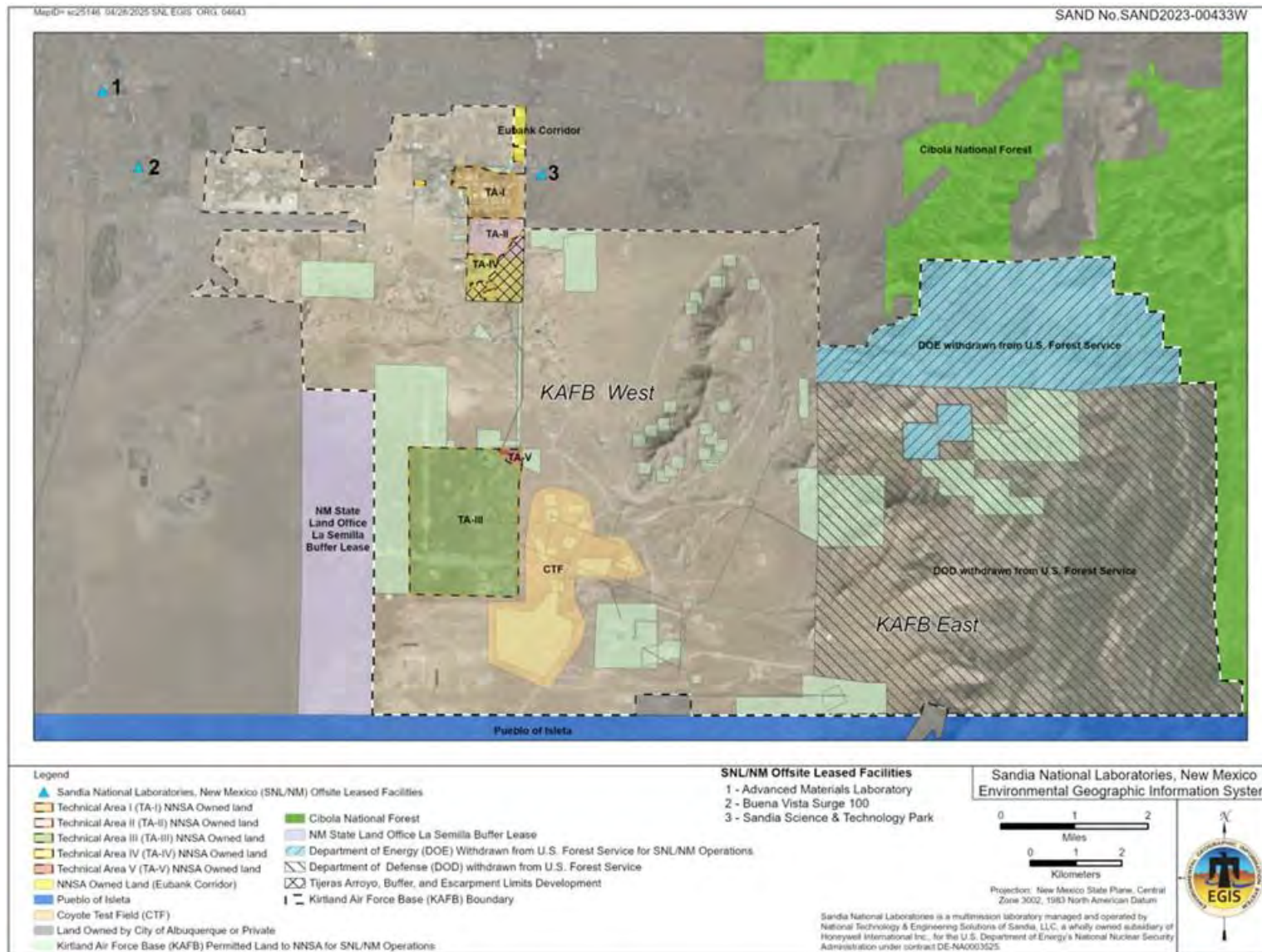


Figure 4-2. KAFB and SNL/NM-Managed Lands

Table 4-2. NNSA and SNL/NM Owned and Managed Lands (in acres)

Land Type on Figure	Onsite or Offsite	Total Area	Developed	Undeveloped
NNSA-owned ^a	Onsite	2,850	839	2,011
Permitted from KAFB ^b	Onsite	6,321	1,896	4,425
Withdrawn from Forest Service	Onsite	4,595	460	4,135
Total onsite		13,766	3,195	10,571
NNSA-owned ^c	Offsite	63	42	21
Leased from NM ^d	Offsite	2,687	0	2,687
Licensed offsite ^e	Offsite	6	1	5
Total offsite		2,756	43	2,713
Total		16,522	3,238	13,284

a. Includes all TAs, parcel land outside of TAs, and Eubank Corridor located within KAFB's security boundary.

b. Acreages may change when permits are renewed.

c. Eubank Corridor is owned by NNSA Headquarters; this portion is located outside of KAFB's security boundary adjacent to KAFB's east security boundary.

d. La Semilla Buffer Zone is adjacent to KAFB's west security boundary.

e. Belen Alexander Regional Airport.

SNL/NM currently operates over 900 facilities of various sizes totaling about 7.0 million square feet (ft²). Much of the built environment is nearing the end of its designed life, with an average structure age of 36 years. A recent facility condition survey found that 25 percent of facilities are in poor or very poor condition, and 24 percent are in good or very good condition (SNL 2022b). The remaining 51 percent of the structures at SNL/NM are in fair condition.

As the building portfolio ages, SNL/NM assesses each structure for renovation or replacement and conducts DD&D to remove structures that are past the end of their useful life. More information regarding DD&D since 2005 is in Appendix A, Table A-14.

4.2.2 Onsite SNL/NM-Managed Lands

SNL/NM operations generally take place in five TAs on NNSA-owned lands plus operations on permitted and withdrawn Forest Service lands (refer to Figure 4-2). The amount of developed land in each area varies (refer to Table 4-3). Present development at SNL/NM has followed historical development, with TA-I housing the greatest overall concentration and density of facility space (more information on TA development density is in Appendix A, Table A-15).

Table 4-3. Overview of Onsite Lands (in acres)

Onsite Lands	Ownership	Total Area	Developed	Undeveloped
Tech Area I	NNSA-owned	356	317	39
Tech Area II ^a	NNSA-owned	256	74	182
Tech Area III ^b	NNSA-owned	1,865	336	1,529
Tech Area IV ^a	NNSA-owned	316	79	237
Tech Area V	NNSA-owned	28	17	11
Former NNSA Headquarters Complex Land ^c	NNSA-owned	6	6	0
Eubank Corridor	NNSA-owned	86	65	21
KAFB-West & KAFB-East	Permitted from KAFB	6,321	1,896	4,425

Onsite Lands	Ownership	Total Area	Developed	Undeveloped
KAFB-East	Withdrawn from Forest Service	4,595	460	4,135

- A portion of the undeveloped land is due to Tijeras Arroyo and its escarpment, which will not be developed.
- The undeveloped land in TA-III is based on existing explosive arcs.
- Current facilities on this land will undergo DD&D in 2024/2025, which will allow future development.

SNL/NM acquires land use permits to provide additional land to meet SNL mission needs outside of NNSA-owned land. Permits are effectively the same type of agreement as a land lease. However, the term “permit” is used when the agreement is between two federal agencies. Most permits are for land only, although some include facilities.

The following subsections describe onsite land uses and development for SNL/NM.

4.2.2.1 Technical Area I (TA-I)

TA-I at SNL/NM covers 356 acres near the northern boundary of KAFB on NNSA-owned property. It is bounded by Wyoming Boulevard on the west and Eubank Boulevard on the east. Both F and G Streets form the northern border, and Hardin Boulevard defines the southern boundary.

TA-I hosts the primary administrative center and a closely clustered collection of laboratories and offices. The area encompasses assembly and manufacturing zones; environmental testing facilities; and diverse specialized laboratories, including the Ion Beam Laboratory, Advanced Manufacturing Processes Laboratory, Neutron Generator Facility, Processing and Environmental Technology Laboratory, Joint Computational Engineering Laboratory, Sandia Tomography and Radionuclide Transport (START) Laboratory, and the Microsystems and Engineering Sciences Applications Complex.

This is the oldest and most heavily developed portion of SNL/NM, with a development density of 12,250 square feet per acre and holding 62 percent of SNL/NM’s entire built environment.

4.2.2.2 Technical Area II (TA-II)

TA-II is located directly south of TA-I in the north-central portion of KAFB. It includes 336,000 square feet of both technical facilities and infrastructure support. Current activities in TA-II include explosives storage and testing and certain waste management activities. Facilities include the Explosive Components Facility, the Hazardous Waste Handling Unit (HWHU), the Solid Waste Collection and Recycling Center (SWCRC), the Construction and Demolition Recycle Center, and the National Infrastructure Simulation and Analysis Center.

TA-II is partially developed, with a development density of 1,313 square feet per acre, less than the site average. Most of the available land is planned for future development.

Undeveloped NNSA-owned lands to the southeast of TAs-II and -IV constitute an escarpment leading to the Tijeras Arroyo. Floodplains and topography restrict development of these lands.

4.2.2.3 Technical Area III (TA-III)

TA-III, located in the south-central part of KAFB, is the largest (1,865 acres) and most remote of the TAs. It houses expansive outdoor test spaces and indoor testing facilities for engineering tests demanding substantial safety and security parameters. These encompass collision-testing sled tracks, centrifuges, vibration test facilities, and impact test complexes. Outdoor test areas include the Rocket Sled Test Complex, Drop Towers/Water Impact Test Complex, and Terminal Ballistics Facility. Indoor test facilities include the Superfuge Complex, Mechanical Shock Complex, and Thermal Test Complex. Additionally, TA-III hosts the Radioactive and Mixed Waste Management Unit (RMWMU), the TTU, Chemical Waste Landfill (CWL), and Corrective Action Management Unit (CAMU).

With only 18 percent of its land area developed, TA-III has the lowest development density at 150 f² per acre. The remaining 1,529 acres are undeveloped. The potential for future development is significantly restricted by the presence of explosive arcs due to operations at existing test facilities, landfills, and ER sites.

4.2.2.4 Technical Area IV (TA-IV)

TA-IV is south of TA-II and covers 316 acres. It houses R&D facilities dedicated to inertial confinement fusion, pulsed power, and nuclear particle acceleration. Accelerators within TA-IV include the Radiographic Integrated Test Stand (decommissioned in 2015 and undergoing DD&D), HERMES III, and Short-Pulse High Intensity Nanosecond X-Radiator. These facilities comprise buildings and structures designed specifically for x-ray, gamma-ray, and particle beam fusion accelerator tests.

About 47 acres in TA-IV are fenced for security purposes. Although about three-quarters of TA-IV lands are undeveloped, the TA is largely deemed built-out because the remaining lands are preserved as open space, conservation areas, and floodplains. Floodplains and topography restrict development of the NNSA-owned lands southeast of TA-IV (refer to in Section 4.2.2.2).

4.2.2.5 Technical Area V (TA-V)

TA-V is the smallest of the TAs in acreage (28 acres) and buildings (28). It is located northeast of TA-III and houses facilities engaged in experimental research involving radioactive materials. These capabilities encompass reactor technology, radiation transport techniques, material radiation damage assessment, and vulnerability assessments to radiation. TA-V serves as a remote research area dedicated to experimental and engineering nuclear reactors. Facilities within TA-V include the Gamma Irradiation Facility (GIF), ACRR, Sandia Pulsed Reactor (SPR), and Auxiliary Hot Cell Unit (AHCU), (also known as the “Auxiliary Hot Cell Facility” in safety basis documents).

Although largely developed, with a density of 7,429 square feet per acre, forecasted construction, particularly the CREST facility, would consolidate operations to a smaller building footprint within the previously disturbed land in TA-V.

4.2.2.6 Withdrawn Lands

NNSA manages 4,595 acres withdrawn from the Forest Service as a safety buffer for testing in Lurance Canyon. Figure 4-2 shows these lands north of KAFB-East and surrounded on the north and east by CNF. This withdrawn area was established by Public Land Order 4569 and is closed to public entry. The withdrawn lands are jointly managed with the CNF in fulfillment of agency missions and to improve wildlife habitat diversity, protect cultural resources, and provide for wildfire safety. The area will remain under the joint control of the Forest Service and NNSA until released from the public land order withdrawing the area. The SNL/NM-managed lands within the withdrawn area constitute the northern segment of a larger federally withdrawn tract (refer to Figure 4-2). The majority of land (15,891 acres) within the KAFB-East withdrawal is under DoD management.

4.2.2.7 Permitted Lands in KAFB-West and KAFB-East

NNSA currently has over 90 permits with KAFB that are going to be consolidated into about 14 permit areas including non-exclusive common use area permits to cover SNL/NM utilities, roads, and infrastructure above and below ground. About 6,300 acres of land have been permitted on remote locations on KAFB for SNL/NM testing, training, and research activities.

In this SWEIS, KAFB has been divided into the western and eastern portions, as shown in Figure 4-2, due to the amount of acreage. KAFB-West encompasses the west-central part of KAFB and includes facilities such as the Manzano Mountain area, the Sled Track Extension, and a group of KAFB permitted lands used for explosive ranges called Coyote Test Field (CTF). Activities in this area include violent physics testing operations that require large land areas and unusual terrain and storage of LLW, mixed waste, TRU material, and inert materials in earth-covered magazines (i.e., bunkers/igloos).

KAFB-East consists of a large area within the eastern portion of KAFB that contains a variety of remote testing sites and facilities. KAFB-East encompasses the withdrawn land from the Forest Service, the Lurance Canyon Burn Site, and the Aerial Cable Facility.

Both KAFB-West and KAFB-East are used for environmental and developmental testing, including explosive ordnance testing, impact testing, rocket firing experiments, and open-burn thermal testing (SNL 2021a). KAFB-East features rugged terrain with smaller structures and mobile offices and is less utilized than KAFB-West.

4.2.2.8 Eubank Corridor

The Eubank Corridor, owned by NNSA, comprises 86 acres along Eubank Boulevard; about 63 acres are considered offsite while 23 acres are within the KAFB security boundary. The Eubank Corridor is situated between KAFB to the west and south and privately owned land with varied zoning to the east and north. Within this corridor lie two facilities that are considered offsite: (1) the Center for Integrated Nanotechnologies (CINT), established in 2006 and covering 96,000 square feet, and (2) the National Museum of Nuclear Science & History, built in 2009 and spanning 30,000 square feet, which is managed per an exclusive land use agreement with the National Atomic Museum Foundation issued in 2006 for 20 years. One onsite facility within the

KAFB boundary is the John A. Gordon Albuquerque Complex, an office building and data center constructed in 2022 and totaling 330,000 square feet.

4.2.2.9 Onsite Land Use Plans and Programs

SNL/NM's land use planning is guided by the Site-Wide Master Plan developed in 2022 (SNL 2022b). The Site-Wide Master Plan is a comprehensive vision used by NNSA to make informed choices on the best use of land and infrastructure to support and improve mission activities.

4.2.3 Offsite SNL/NM Properties and Managed Lands

As shown in Table 4-2, SNL/NM operates several facilities on properties owned, leased, or licensed by NNSA within the Albuquerque metropolitan area. SNL/NM holds about 21 lease agreements offsite, totaling about 450,000 square feet.

4.2.3.1 Sandia Science and Technology Park

About 280,000 square feet of offsite leased floor space is in the SSTP. The SSTP, established in May 1998, is a 340-acre planned technology hub adjacent to KAFB and the Eubank Corridor. It functions as a conduit for collaboration between SNL/NM and private industry, facilitating access to industry science and technology. The park is industrially zoned and juxtaposed with adjacent office, commercial, and residential areas. SNL/NM leases several facilities within the SSTP. The co-location of SNL-affiliated entities within the technology park fosters collaborations, optimizing resource utilization and technological advances (Kolberg 2022).

4.2.3.2 La Semilla Buffer Zone

As shown in Figure 4-2, NNSA leases 2,687 acres of state-owned land directly west and abutting KAFB known as the La Semilla Buffer Zone. This Buffer Zone is undeveloped land that provides a physical and sound buffer from operations of the Rocket Sled Test Complex in TA-III.

4.2.3.3 Other Offsite Lands

The broader Albuquerque metro area, such as the downtown, university, and airport areas, houses an additional about 70,000 square feet of space for SNL/NM operations. SNL/NM leases outside of the Albuquerque metro area but still in New Mexico include office and laboratory space in Carlsbad, totaling about 20,000 square feet; a Mobile Gun Storage lease for warehouse and office space totaling about 6,000 square feet at the New Mexico Institute of Mining and Technology (New Mexico Tech) Energetic Materials Research and Testing Center; and a land license covering 6.3 acres within the premises of Alexander Municipal Airport in Belen, about 30 miles southwest of the Sunport. The Belen Airport license operates under a non-exclusive agreement granting rights for access and occupation. It has facilities housing several field-placed radar reflectors used for conducting aircraft testing and evaluations during flight operations. The balance of SNL/NM leased space is located outside of the State of New Mexico and is not included in this analysis.

SNL/NM may also conduct activities such as testing UxS at other locations within New Mexico. Unmanned surface vessels (USV), and UUV may be operated at the following locations: Cochiti

Lake, managed by the U.S. Army Corps of Engineers (USACE); and Caballo Lake, Elephant Butte, Heron Lake, Navajo Lake, and Santa Rosa Lake, all managed by the state of New Mexico.

UAS and balloons may be operated at any federal, state, county, and private location with controlled access / limited controlled access. Examples of these locations include:

- Federal sites: KAFB, Cannon Air Force Base, Holloman Air Force Base, Stallion Army Airfield, Condon Army Airfield, White Sands Space Harbor, White Sands Missile Range Army Base, WIPP, and LANL;
- State sites: Energetic Materials Research and Testing Center and the Playas Training Center at the New Mexico Institute of Mining and Technology; and
- Local sites: Alamogordo-White Sands Regional Airport, Andrew Othole Memorial Airport, Angel Fire Airport, Artesia Municipal Airport, Aztec Municipal Airport, Balloon Fiesta Park, Belen Regional Airport, Carrizozo Municipal Airport, Clayton Municipal Airpark, Conchas Lake Airport, Conchas Lake Seaplane Base, Crownpoint Airport, Deming Municipal Airport, Doña Ana County International Jetport, Estancia Municipal Airport, Fort Sumner Municipal Airport, Four Corners Regional Airport, Gallup Municipal Airport, Glenwood Airport, Grants-Milan Municipal Airport, Hatch Municipal Airport, Jewett Mesa Airport, Jicarilla Apache Nation Airport, Las Cruces International Airport, Las Vegas Municipal Airport, Lea County-Jal Airport, Lea County-Zip Franklin Memorial Airport, Lindrith Airpark, Lordsburg Municipal Airport, Los Alamos County Airport, Magdalena Airport, Maloof Air Park, Mid Valley Airpark, Moriarty Municipal Airport, Mountainair Municipal Airport, Navajo Lake Airport, Ohkay Owingeh Airport (was San Juan Pueblo Airport), Portales Municipal Airport, Questa Municipal NR 2 Airport, Raton Municipal Airport (Crews Field), Reserve Airport, Sandia Airpark Estates East Airport, Santa Rosa Route 66 Airport, Shiprock Airstrip, Sierra Blanca Regional Airport, Socorro Municipal Airport, Springer Municipal Airport, Taos Regional Airport, Tatum Airport, Truth or Consequences Municipal Airport, Tucumcari Municipal Airport, Vaughn Municipal Airport, and Whiskey Creek Airport.

4.2.4 Surrounding Land Uses, Plans, and Programs

Lands neighboring SNL/NM and KAFB have a mix of uses including heavily developed residential, commercial, and industrial lands of Albuquerque to the north; the CNF and Sandia Mountain Wilderness to the northeast and east; the largely undeveloped and grazing lands of the Pueblo of Isleta to the south; and the La Semilla Buffer Zone, Mesa del Sol, and the Sunport to the west and southwest (refer to Figure 4-2).

4.2.4.1 Surrounding Land Uses

The lands that abut the KAFB site fall into the following ownership categories:

- **Federal Lands:** CNF and Sandia Mountain Wilderness,¹ managed by the Forest Service;
- **New Mexico State and City Lands:** La Semilla Buffer Zone, Mesa del Sol, and the Sunport;
- **Pueblos (i.e., Indigenous American Lands):** Pueblo of Isleta; and
- **Private Lands:** City of Albuquerque residential, commercial, manufacturing, and industrial lands.

4.2.4.1.1 Federal Lands

The CNF and National Grasslands border KAFB to the northeast and east. The forest and grasslands are a disjointed collection of lands spanning 1.9 million acres across New Mexico, Texas, and Oklahoma. Management activities in the CNF offer a variety of uses including cattle grazing, logging, hiking, fishing, hunting, camping, skiing, and other recreational pursuits (USFS 2024). Land use planning for the CNF is established through land management plans. The Forest Service published the most up-to-date CNF Land Management Plan in 2022 (USFS 2022). This Plan provides forest-specific guidance, directing decisions on projects and activities for the next 10 to 15 years. It offers a strategy for the integrated management of resources to promote ecological, social, and economic sustainability within the forest and the broader landscape. The CNF near KAFB is overseen by the Sandia Ranger District.

4.2.4.1.2 New Mexico Lands

The State of New Mexico and City of Albuquerque lands form KAFB's western boundary. The state owns and controls an approximately 9,000-acre parcel on the western border, which includes the La Semilla Buffer Zone leasehold. Mesa del Sol, immediately to the west of the La Semilla Buffer Zone, is a master-planned, mixed-use community that is currently under development. The City of Albuquerque owns the approximately 2,900-acre plot that houses the Sunport. The Sustainable Airport Master Plan published in 2020 guides overall development, maintenance, and operation for the next 20 years at the Sunport (ABQ 2020).

4.2.4.1.3 Pueblos

Pueblo of Isleta. The Pueblo of Isleta is directly south of KAFB. The Pueblo is a federally recognized tribe with more than 270,000 acres of land. The Pueblo of Isleta Village constitutes the Pueblo's central historic and modern residential area, surrounding Saint Augustine Catholic Church, which was established in 1613. The traditional village has long been home to the Isleta people, and the village and its church are included in the National Register of Historic Places (NRHP), due to its historical significance to regional architecture (Isleta 2025). In addition to the Pueblo's central village, the Pueblo's residential areas include a number of smaller, outlying communities known as Oraibi, Chical, Ranchitos, Los Charcos, and Lohbom.

¹ The Sandia Mountain Wilderness is situated within and constitutes a portion of the broader CNF. The wilderness area does not directly border KAFB or SNL/NM-managed lands; it is located north of I-40, about 2 miles from KAFB.

The Pueblo of Isleta's lands also include commercial, agricultural, grazing, and traditional use zones. The Pueblo's commercial zones are presently located north of the Pueblo's Village and include the Isleta Resort & Casino, Isleta Eagle Golf Course, and the Isleta Lakes Recreational Complex. The Pueblo's agricultural lands are concentrated in the Rio Grande Valley, while rangelands extend eastward to the Manzano Mountains, westward to the Rio Puerco, and northward to the KAFB boundary.

The Pueblo's traditional use areas, which constitute important land use areas for Isleta Tribal Members' ongoing traditional, cultural, and religious practices. These traditional-use areas may contain sacred sites that are protected and preserved by the Pueblo and used for cultural purposes by Tribal Members and the Pueblo's traditional leadership. The traditional use areas are subject to use restrictions by the Pueblo. There are places within the Pueblo's northern region that are considered traditional use areas by the Pueblo of Isleta.

The Pueblo of Isleta's lands are managed consistent with its Range Grazing Management Regulations. The stated mission of these regulations is to "protect, preserve, and enhance the land, water, forage, wildlife, recreational, cultural, and sacred sites of the Pueblo rangelands through sound Rangeland Management and to improve, build-up, and rehabilitate these resources where they have deteriorated utilizing practices that are environmentally, socially, economical, culturally and traditionally acceptable so that these vital resources are available for future generations" (Isleta 2015). Other notable land planning documents directing land use on the Pueblo of Isleta include the Tribal Hazard Mitigation Plan (Isleta 2021a) and the Wildland Fire Management Plan (Isleta 2021b).

Puebloan Cultural Sites. Pueblo lands near KAFB include the Pueblo of Isleta, Pueblo of Laguna, Pueblo of Sandia, and Pueblo of Santa Ana. Puebloan cultural and archaeological sites are contained within the boundaries of KAFB, and others are nearby but offsite. Cultural and archaeological sites have historic significance and may be used for traditional and cultural practices that are central to Puebloan identity.

As identified in Appendix A, Section A.6.9, there are over 740 archaeological sites within KAFB and SNL/NM-managed lands, over 250 of which are eligible for the NRHP. Many are Puebloan sites of importance to Tiwa- and Piro-speaking peoples. Because of their importance to Pueblo culture, the specific locations and purposes of these traditional sites are confidential.

4.2.4.1.4 Private Lands

The City of Albuquerque's metropolitan area lies to the north and northwest of KAFB. It is the largest population center in New Mexico and features dense and high-intensity development. Albuquerque lands abutting KAFB are a mix of zoning and land uses typical for a city of Albuquerque's size, ranging from dedicated open space and single family residential to commercial, industrial, and manufacturing. Land planning for the broader Albuquerque and Bernalillo County is set by the 2017 Albuquerque & Bernalillo County (ABC) Comprehensive Plan. The Comprehensive Plan is used to analyze zone change requests and development proposals and to shape other planning efforts by the city (CABQ 2017).

4.2.5 Airspace

The Federal Aviation Administration (FAA) owns and regulates airspace in the National Air Space, including the airspace above KAFB. The joint development of the lands under this airspace for the purpose of testing and training has been negotiated between the organizations in good faith since the mid-20th century. The rapid evolution of UAS and SNL/NM's growing program in testing them has required additional access to lands managed by both organizations while maintaining the environment, safety, and security. FAA governs UAS access to the airspace through the granting of certificates of authorization (COAs), while SNL/NM and KAFB administer access to the land. Historically, the environmental impact of the UAS program has been assessed on a local site-by-site basis within this area. Figure 4-3 shows the current COA-authorized airspace (subject to biannual review and approval).

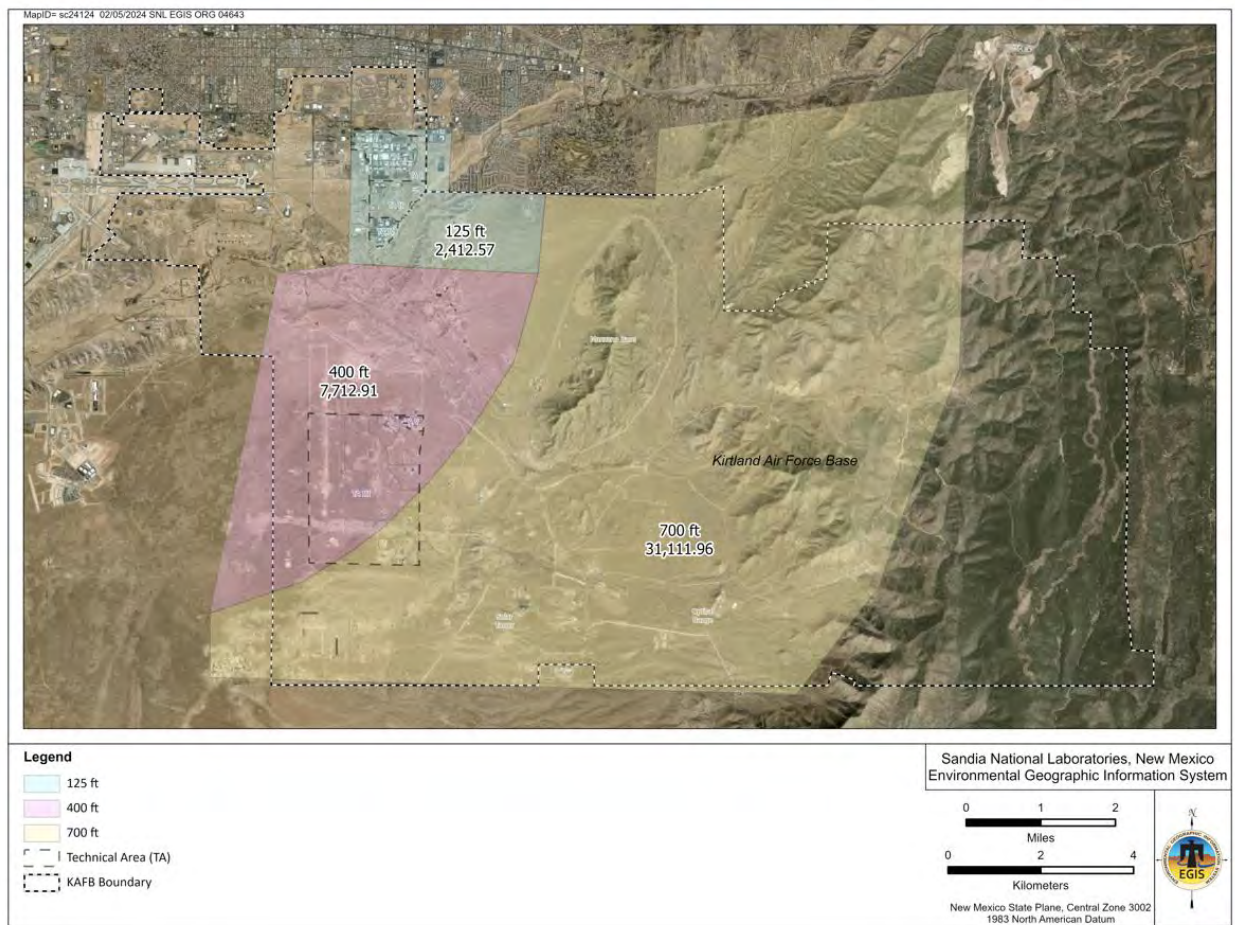


Figure 4-3. Current COA Granted to NNSA/SFO for UAS Operations over KAFB

4.3 VISUAL RESOURCES

Visual resources are natural and manmade features that give a particular “landscape” (visible features of an area of land) or “viewshed” (view of an area from a vantage point) its character and aesthetic quality. The natural environment in and surrounding SNL/NM-managed lands is

typical for an arid, high desert landscape. The Rio Grande runs north-to-south down the western periphery of the Albuquerque metro area and the Sandia Mountains rise sharply to the east. The expanse between the river and the mountains is relatively flat and hospitable to development.

The landscape includes scenic mountain views and evergreen forests. The SNL/NM-managed lands viewshed consists of grasslands and low shrublands in the west and pine and juniper forests as the elevation and topography rise in the east.

4.3.1 SNL/NM Visual Environment

SNL's mission requires developed areas and landscape modification. That development is primarily concentrated in the flat western portion of KAFB, while the rugged eastern portion remains largely in its natural state with few facilities and limited land management. This eastern rugged and undeveloped land serves as a buffer zone between SNL/NM and the adjacent CNF and nearby Sandia Mountain Wilderness.

Views from offsite areas to the developed portions of SNL/NM appear as semi-developed and semi-industrial with buildings, internal roadways and pathways, and open space; an example is provided in Appendix A, Section A.4.3. Views from SNL/NM to offsite areas are highly varied, depending on the location of the onsite viewer. They range from the City of Albuquerque to the natural areas of CNF and rangelands of the Pueblo of Isleta.

Land cover plays a role in visual resources. The U.S. Geological Survey (USGS) maintains the National Land Cover Database (NLCD), which inventories the existing character of a landscape, level of development, and degree of contrast. This SWEIS used the NLCD to determine that SNL/NM's footprint is marked by areas of both high- and medium-intensity development and undeveloped areas of evergreen forests, shrublands, and grasslands that serve as a security, safety, and visual buffer zone. The NLCD data highlight medium- and high-intensity development in TAs I, II, and III, while TAs IV and V, along with KAFB-West and KAFB-East, are characterized by low-density development. An NLCD Land Cover Map is presented in Appendix A, Section A.4.3.

4.3.2 Visual Resource Management Classifications

To rate the scenic quality of SNL/NM and the surrounding areas, the Bureau of Land Management's (BLM's) Visual Resource Management (VRM) Classification System was used. Although this classification system is designed for undeveloped and open land managed by BLM, the system is valid in the analysis of VRM and planning activities. Selecting the VRM system as the basis for this analysis is an established means for determining visual values based on a set of objectives (BLM 2007). Table 4-4 outlines the objectives of the four VRM classes.

Table 4-4. BLM VRM Class Objectives

Class	Objective	Change Allowed (relative level)	Relationship of Activities to the Casual Observer
I	Preserves the existing character of the landscape. This class provides for natural ecological changes; however, it does not preclude very limited management activity.	Very Low	Activities should not be visible and must not attract attention.

Class	Objective	Change Allowed (relative level)	Relationship of Activities to the Casual Observer
II	Retains the existing character of the landscape. Management activities may be seen but should not attract the attention of the casual observer. Any changes must repeat the basic elements of form, line, color, and texture found in the predominant natural features of the characteristic landscape.	Low	Activities may be visible but should not attract attention .
III	Partially retains the existing character of the landscape. Management activities may attract attention but should not dominate the view of the casual observer. Changes should repeat the basic elements found in the predominant natural features of the characteristic landscape.	Moderate	Activities may attract attention but should not dominate the view .
IV	Provides for management activities which require major modification of the existing character of the landscape. These management activities may dominate the view and be the major focus of viewer attention. However, every attempt should be made to minimize the impact of these activities through careful location, minimal disturbance, and repeating the basic elements.	High	Activities may attract attention, may dominate the view but are still mitigated .

Source: BLM 1986.

The degree to which development affects the aesthetic quality of a landscape depends on the contrast created between the project elements and the existing landscape. This SWEIS uses the BLM's degree of contrast criteria to assess the level of contrast between the proposed or existing element and the landscape in which it sits (Table 4-5). The four levels of contrast (i.e., none, weak, moderate, and strong) correspond to the VRM class objectives I, II, III, and IV, respectively. For example, a "moderate" contrast rating is generally acceptable in a Class III area but may also meet the VRM objectives for a Class IV area when there are accumulating elements.

Table 4-5. BLM Degree of Contrast Criteria

Degree of Contrast	Criteria
None	The element contrast is not visible or perceived.
Weak	The element contrast can be seen but does not attract attention.
Moderate	The element contrast begins to attract attention and begins to dominate the characteristic landscape.
Strong	The element contrast demands attention, will not be overlooked, and is dominant in the landscape.

Source: BLM 1986.

A sensitivity level analysis is an important component of the VRM. Sensitivity levels are a measure of public concern, and lands are assigned high, medium, or low sensitivity levels. A sensitivity analysis is conducted by evaluating the following factors: types of users, amount of use, public interest, adjacent land use, special areas, distance zones (foreground to midground, background, and seldom seen), and other dynamics.

Since there are no BLM classifications for KAFB or SNL/NM, the VRM class designations in the following sections were assigned using the methods and criteria described in this section.

The Proposed Action at SNL/NM includes lands both onsite and offsite. The visual ROI is the location of the facilities and actions outlined in the Proposed Action and views of the facilities

and actions from both onsite and public viewpoints offsite. Special consideration is given to actions within visually sensitive locations and viewpoints from visually sensitive locations.

The majority of land managed by SNL/NM onsite is largely undeveloped and isolated, consistent with a VRM Class I or II rating. The developed areas present a high level of contrast between the high desert landscape and the physical improvements to the land and are more consistent with VRM Classes III and IV. Given SNL/NM's immense footprint and diverse development, a single VRM class rating would not be appropriate; instead, a rating was assigned to distinct areas as shown in Table 4-6. Table 4-6 outlines SNL/NM's land areas by existing VRM class; the classes range from I to IV. Additional information describing the VRM class by each area is included in Appendix A, Section A.3.4.

Table 4-6. Existing VRM Class by Area Type

Area	Existing VRM Class	Degree of Contrast
TA-I, TA-II, TA-IV	IV	High
TA-III, TA-V	III	Moderate
KAFB-West	II-III	High
KAFB-East	II	Weak to None
La Semilla Buffer Zone	I	None
Offsite Locations in Albuquerque	IV	High

4.3.3 Visually Sensitive Locations

“Visually sensitive locations” refer to (1) areas that have significant scenic, aesthetic, or visual values, and (2) areas where visual impacts would be particularly noticeable or detrimental. This designation is based on factors such as unique geological formations, cultural significance, ecological value, recreational use, and public enjoyment.

The visual environment surrounding KAFB that includes SNL/NM-managed lands is an extension of the onsite landscape. Topography and vegetation throughout the viewshed are varied and generally mimic the makeup of the onsite lands with flat hospitable building sites in the west and mountainous areas in the east. Dense development in Albuquerque generally constrains sightlines, although vantage points exist in transportation corridors, in dedicated open areas, and with elevation increases in the mountainous east.

Of the identified neighboring properties, the CNF and Pueblo of Isleta are considered visually sensitive locations for the purposes of this analysis. The CNF near KAFB includes a large wilderness area, the Sandia Mountain Wilderness, located immediately north of I-40. SNL/NM operations adjacent to and near the forest and wilderness area are limited by the harsh topography of the eastern portion of KAFB. The topography of the forest and the Sandias offer long, sweeping vistas to recreational users, though there are few adverse visual effects from SNL/NM's built environment in the locations close to the CNF. High intensity development is in the northernmost TAs (I, II, and IV) and is an extension of the heavy development in neighboring Albuquerque.

Apart from a few small private land holdings, Pueblo of Isleta lands extend along the entire southern boundary of KAFB (refer to Figure 4-2). Most Pueblo of Isleta residents live in villages

along the Rio Grande. This places most Pueblo of Isleta inhabitants about 4.5 miles from the southwest corner of KAFB. The lands bordering KAFB are predominately used for cattle grazing.

Although SNL/NM's operations are primarily concentrated in the northern part of KAFB and the main population of the Pueblo of Isleta resides southwest of KAFB, visual impacts between SNL/NM facilities and the Pueblo of Isleta can exist. SNL/NM facilities and operations located in the southern portions of KAFB may be visible to Pueblo of Isleta inhabitants while tending to grazing animals or visiting culturally significant places on their lands.

4.4 GEOLOGY AND SOILS

Information in the following sections is consistent with the 1999 SWEIS, updated as applicable. This SWEIS describes the ROI for geologic conditions, such as faulting and seismicity, in a broader areal and regional extent since those parameters frequently occur over greater distances. This SWEIS describes more site-specific parameters, such as soils and mineral resources, as they relate to SNL/NM-managed lands. Section 4.4.3.2 includes recent soil-sampling results from SNL/NM's ongoing environmental terrestrial surveillance monitoring program.

4.4.1 Topography and General Geology

SNL/NM-managed lands consist of varied topography, ranging from rugged mountains on the east to flat plains on the west. The City of Albuquerque is adjacent to KAFB and SNL/NM. The main SNL/NM TAs are on a relatively flat plain (known as the East Mesa) and range in elevation from about 5,300 to 5,500 feet above mean sea level. A maximum elevation of about 8,000 feet occurs on the eastern edge of KAFB in the Manzanita Mountains (SNL 2022a). Tijeras Arroyo, a major topographic feature, is situated diagonally northeast to southwest through SNL/NM and KAFB properties. It originates in Tijeras Canyon and runs along the Tijeras Fault zone east of KAFB before crossing the northern portion of SNL/NM and KAFB properties and eventually discharging to the Rio Grande. The arroyo is normally dry except during heavy rainfall.

SNL/NM-managed lands lie within the Rio Grande Rift Zone, which is a continental rift (a long, narrow trough that occurs where tectonic plates in the Earth's crust move away from each other along fault zones). A rift allows molten rock to rise near the Earth's surface; volcanic processes are common features of rifts. SNL/NM-managed lands are in a geologic setting subjected to relatively recent episodes of basaltic volcanism; however, currently no active volcanoes are in New Mexico, with the youngest flows occurring about 3,000 to 5,000 years ago (NMT 2023).

SNL/NM-managed lands are more specifically situated in the east-central portion of the Albuquerque Basin, which is about 30 miles wide and 100 miles long. The Albuquerque Basin is about 3,000 mi² in area, extends from Cochiti Dam to the north to San Acacia to the south, and is one of a series of structural and topographic basins within the Rio Grande Rift formed due to subsidence during rift extension from south central Colorado to northern Mexico. The primary period of rift extension occurred between 30 million and 5 million years ago (USGS 1993a).

The Albuquerque Basin is bounded by the Sandia, Manzanita, and Manzano Mountains (east); Lucero Uplift and the Puerco Plateau (west); Nacimiento and Jemez Uplifts (north); and Socorro Basin (south). Tectonic activity resulting in uplift of the Sandia, Manzanita, and Manzano

Mountains was most prevalent from about 15 million to 5 million years ago. Several faults run approximately north-south in or near SNL/NM East Mesa and separate the Albuquerque Basin from mountains further to the east. Vertical displacement between rock units exposed at the Sandia Mountains' summit and equivalent units at the bottom of the basin is more than 6 miles.

4.4.2 Geologic Conditions

This section describes geologic conditions that could affect stability of buildings and infrastructure on SNL/NM-managed lands. It includes stratigraphy and ground stability and faulting and seismicity.

4.4.2.1 Stratigraphy and Ground Stability

The Albuquerque Basin is primarily filled with poorly consolidated sediments that have eroded beginning about 26 million years ago from mountains, both well north of Albuquerque and nearby. The upper part of the basin fill is composed of a complex sequence of gravel, sand, silt, clay, and caliche deposits of the Santa Fe Group and post-Santa Fe deposits. SNL/NM-managed lands are underlain by up to 9,800 feet of the Santa Fe Group consisting of non-marine alluvium made up of generally unconsolidated sand, gravel, and silt ranging in age from 1 to 35 million years. The Santa Fe Group is underlain by much older deposits of sand, silt, and limestones. Thin deposits (10 to 20 feet) of relatively recent (less than 10,000 years) alluvium consisting of non-marine sand and gravel and wind-blown sediments occur in the nearby arroyos (SNL 2003).

Most SNL/NM facilities are sited on level ground or gentle slopes. Steeper slopes occur along the arroyos especially where flash flooding has eroded channel embankments and in the Manzanita Mountains to the east and along Tijeras Arroyo south of TA-IV. The Manzanita Mountains are predominantly crystalline and marine carbonate bedrock and are not prone to landslides.

Liquefaction is a phenomenon in which loose and water-saturated sediments become liquefied by strong ground motion from a seismic event. Given the arid nature of the region, the relatively deep water table, and the lack of active floodplains on the local arroyos, liquefaction of soils is highly unlikely (SNL 2020a).

4.4.2.2 Faulting and Seismicity

The SNL/NM area is structurally complex, with several major regional faults traversing the area. These faults are mostly western-dipping normal faults that exhibit down-to-the-west displacement along the fault planes. The northeast-trending Tijeras Fault zone bisects the SNL/NM and KAFB area and exhibits a long history of strike-slip movement (SNL 2003). The zone consists of several regional normal faults including the Sandia, Hubbell Spring, and Manzano faults. The Hubbell Spring Fault is particularly important to the TA-III/TA-V areas because it has been active as recently as the 1930s when movement along the fault curtailed the water flow from nearby springs (SNL 2020a). The calculated maximum potential moment

magnitudes² (designated with an M) of earthquakes on several Quaternary and younger faults within a 62-mile radius of Albuquerque range from M 6.3 to 7.1 (Wong et al. 2004).

An examination of the records for the Albuquerque Basin shows that seismic activity has a relatively high occurrence rate, but typical earthquake magnitudes are low, on the order of less than or equal to 3.5 on the Richter scale (SNL 2024f). The USGS reported 62 minor earthquakes (ranging in magnitude from 2.5 to 4.7) within a 62-mile radius of TA-V from 1971 to 2023 (USGS 2023); however, none occurred within the KAFB site boundary. The closest earthquake within this time range occurred in Albuquerque on January 4, 1971, and had a magnitude of 4.7 on the Richter scale. SNL/NM buildings did not receive any appreciable damage (DOE 1999). Although historical seismicity levels in the Albuquerque area have been relatively low, with magnitudes (M) less than 6, large-magnitude earthquakes have occurred in the geologic past and could happen again (Wong et al. 2004).

Seismic hazards are related to the strength of ground-shaking during an earthquake, measured as horizontal acceleration and compared to the acceleration of gravity. The higher the horizontal acceleration in g^3 , the greater the likely damage to buildings and other structures. The latest USGS probabilistic peak ground acceleration (PGA) map, used to indicate seismic hazard for U.S. regional areas, shows a maximum PGA of about 0.1 to 0.2 g in the SNL/NM general area (USGS 2019a and USGS 2019b). The PGA values cited are based on a 2-percent probability of exceedance in 50 years, corresponding to an annual occurrence probability of about 1 in 2,500.

DOE requires a site-specific probabilistic seismic hazard analysis (PSHA) for design of critical facilities, including high-risk structures. A PSHA is applicable to a specific area or site for purposes of seismic design and construction of critical or high-risk facilities that may be sited in the area. The goal of a PSHA is to quantify the rate (or probability) of exceeding various ground-motion levels at a site given all possible earthquakes. Requirements for performing PSHAs are included in ANSI/ANS-2.29-2008, updated to 2020 (ANS 2020). Certain high-risk structures are assigned a specific HC and seismic design category (SDC) as defined in DOE-STD-1027 (DOE 1997b) and DOE-STD-1020-2016, respectively (SNL 2023e).

4.4.3 Soils

4.4.3.1 Soils Present at SNL/NM

Soils at SNL/NM are derived primarily from eroded bedrock in the Manzanita Mountains, transported downslope by water and other natural mechanisms. Most soils in the SNL/NM area consist of gravelly alluvial fan material, with wind-deposited material including fine sand, silt,

² Historically, a few different scales have been used to measure relative earthquake magnitudes. The most widely known is the Richter Scale, or Richter magnitude, which is best suited for magnitudes between 3 and 7. Several methods are in current use for determining earthquake magnitudes. All are designed to be generally consistent with Richter magnitude. Since 2002, USGS has been using the term “magnitude (M)” when reporting earthquakes regardless of the specific method used, although the term “moment magnitude” is the USGS preferred method.

³ g is a measure of the maximum horizontal acceleration (as a percentage of the acceleration due to Earth’s gravity) experienced by a particle on the surface of the Earth during an earthquake ground motion.

and calcium carbonate. The soils of the area are generally well drained, have moderate permeability, and have high potential for surface erosion (SNL 2020a).

The contiguous area of SNL/NM that contains TA-III and TA-V contains three soil units. Most of the area (68 percent) is covered by Madurez loamy fine sand with 1 to 5 percent slopes. Twenty-five percent of the area contains Tijeras gravelly fine sandy loam, also with 1 to 5 percent slopes, and the remaining 7 percent of soils consists of Tome very fine sandy loam within the arroyo in the lower one-third of the parcel (NRCS 2023a). TA-I, TA-II, and TA-IV to the north are much more developed than the parcel to the south and contain soils consisting mainly of Embudo gravelly fine sandy loam (0 to 5 percent slopes), Wink-Embudo complex of fine and gravelly sandy loam (0 to 5 percent slopes), and other less prevalent soils (NRCS 2023b). The SNL/NM-managed lands do not contain any prime farmlands as identified by the Natural Resources Conservation Service (NRCS) (NRCS 2023a and NRCS 2023b).

4.4.3.2 Soil Sampling and Other Environmental Monitoring

Soil samples are or may be collected under several programs at SNL/NM for regulatory requirements and BMPs, including the following:

- ER operations,
- long-term stewardship,
- terrestrial surveillance, and
- miscellaneous non-routine projects.

SNL/NM personnel sample surface soil and sediments; collect data from optically stimulated luminescent dosimeters at various onsite, perimeter, and offsite locations; and collect samples annually for radiological constituents, metals, and other site-specific parameters. In calendar year (CY) 2021, personnel collected samples at 18 onsite, 14 perimeter, and 5 offsite locations (SNL 2022a) and compared these results to available reference values. Radiological analyses for onsite locations were within historical ranges. Dosimeter results identified average annual dose rates below the local estimated value of 89 millirem (mrem) from natural background sources (SNL 2022a). Metal sampling results did not exceed onsite historical values or state regulatory soil screening levels. Three onsite soil sample locations were analyzed for explosive compounds with results indicating no detections above the method detection limit. The CY 2021 *Annual Site Environmental Report* (ASER) presents sampling results (SNL 2022a).

Non-routine projects may include collecting soil samples to determine baseline soil concentrations of metals prior to construction or project activities, responding to spills, or performing confirmatory sample collection after site cleanup or debris removal activity. Various SNL/NM reports, including ASERs, describe non-routine soil sample collection and results.

4.4.4 Mineral Resources

Historically, the Tijeras Canyon Mining District, partially within the KAFB-East area (KAFB-permitted land), produced gold, silver, lead, copper, and fluorite ores among others (Koschmann and Bergendahl 1968). Today, KAFB land produces no economically viable mineral resources. However, potential mineral resources on SNL/NM and KAFB properties consist of rock and soil for use onsite as backfill or borrow material for construction, landscaping, or remediation of

contaminated soil, if necessary. Sand and gravel are primarily used at SNL/NM for road building and other construction activities. The only borrow pit currently in use onsite is in the southeast corner of TA-III and is used for soil and rubble storage and retrieval (SNL 2022d).

4.5 WATER RESOURCES AND HYDROLOGY

4.5.1 Surface Water

4.5.1.1 Features

A watershed, also commonly referred to as a basin, is an area of land that drains all the streams and rainfall to a common outlet such as a stream flowing out of the watershed. Ridges and hills that separate two watersheds are called the drainage divide. The watershed consists of surface water—arroyos, lakes, streams, reservoirs, and wetlands—and all the underlying groundwater. Larger watersheds contain many smaller watersheds. Identification of a watershed depends on the outflow point; all of the land that drains water to the outflow point is the watershed for that outflow location.

Not all precipitation that falls in a watershed flows out and, in some instances, none of the precipitation flows out; in this case, the watershed is referred to as a closed basin. Rainfall returns to the atmosphere largely through evaporation. The amount of evaporation depends on temperature, solar radiation, wind, atmospheric pressure, and other factors. Transpiration by plants also occurs, with the root systems of plants absorbing water from the surrounding soil in various amounts. Most of this water moves through the plant and escapes into the atmosphere through the leaves. Transpiration is controlled by the same factors as evaporation, and by the characteristics and density of the vegetation.

The ROI for surface water includes (1) onsite arroyos and the watershed downstream from SNL/NM and KAFB, which consists of Tijeras Arroyo and extends from the western KAFB boundary to the Rio Grande; (2) the Rio Grande downstream from Tijeras Arroyo; and (3) floodplains and wetlands. Surface water flowing in arroyos that is subject to SNL/NM influences can affect KAFB and downstream resources and users. Surface water in Tijeras Arroyo intermittently flows after stormwater events through public and private lands west of KAFB before discharging into the Rio Grande.

At the regional scale, SNL/NM is located within the Albuquerque reach of the Rio Grande Basin. The Rio Grande is the major surface hydrologic feature in central New Mexico, flowing north to south through Albuquerque, about 6 miles west of the KAFB boundary. The Rio Grande originates in the San Juan Mountains of Colorado and terminates at the Gulf of Mexico, near Brownsville, Texas. The Rio Grande has a total length of about 1,900 miles and is the fifth longest river system in North America (Schmidt and Brand 2006).

SNL/NM is located within three separate watersheds (drainage areas):

- Tijeras Arroyo watershed,
- unnamed closed basin, and
- Hubbell Spring watershed.

The Tijeras Arroyo watershed encompasses the northernmost portion of KAFB, including SNL/NM TA-I, TA-II, and TA-IV, and Lurance Canyon. An unnamed closed basin encompasses the central portion of KAFB immediately south of the Tijeras Arroyo watershed which includes TA-V, the majority of TA-III, and portions of CTF. The Hubbell Spring watershed encompasses the southernmost portion of KAFB and includes some areas of CTF.

The major surface drainages at SNL/NM are Tijeras Arroyo and its tributary Arroyo del Coyote (BGW 2002). Both of these arroyos are located in the Tijeras Arroyo watershed. Tijeras Arroyo originates in Tijeras Canyon and runs coincident with the Tijeras Fault for several miles northeast of KAFB before deviating to the southwest and crossing SNL/NM TA-II and TA-IV. Additional information regarding the drainage areas is included in Appendix A, Section A.4.5.

Above the point where Tijeras Arroyo enters the KAFB boundary, it drains about 82 mi²; at the point where it exits KAFB land, the drainage area encompasses about 122 mi² (BGW 2002). Tijeras Arroyo is the only substantial outlet for surface water exiting KAFB; this arroyo joins the Rio Grande about 6 miles downstream of the KAFB boundary.

Arroyo del Coyote joins Tijeras Arroyo about 2 miles upstream of where Tijeras Arroyo leaves the KAFB boundary and drains about 39 mi². Except for two short sections (on the order of 100 feet) of spring-fed intermittent flow in the Arroyo del Coyote, flow in both Tijeras Arroyo and Arroyo del Coyote occurs only after heavy storm events and spring snowmelt. Most of the precipitation percolates into alluvial deposits or is lost to the atmosphere via evapotranspiration.

A 100-year floodplain encompasses both the Arroyo del Coyote and Tijeras Arroyo; these are the only two arroyos with a floodplain on the installation (refer to Appendix A, Section A.4.5, Figure A-19). All active SNL/NM facilities are located outside the 100-year floodplains of both Tijeras Arroyo and Arroyo del Coyote (SNL 2016a). During storm events, vegetation can obstruct channel flow, increasing flood potential and extent. Tijeras Arroyo and Arroyo del Coyote floods occur infrequently and are characterized by high peak flows, small volumes, and short durations (KAFB 2023a). Because all active SNL/NM facilities are located outside the 100-year floodplain, a 500-year floodplain analysis is not required.

Flow in the closed basin and in Hubbell Springs watershed occurs primarily as sheet flow in response to precipitation. Sheet flow is a type of runoff that occurs when water spreads out in a thin layer over a low gradient surface. It is characterized by low volume, velocity, and energy and is usually less than 1 inch deep. If sheet flow reaches a discernable flow conveyance feature, such as a gully or arroyo, it is no longer considered sheet flow but referred to as concentrated flow.

Most sheet flow in these two basins infiltrates into the ground before reaching an arroyo or discernable surface drainage feature. There are, however, several small unnamed washes that do collect storm runoff. These washes flow west and dissipate before directing runoff to an undeveloped low-lying and low-gradient area located west of KAFB and east of Mesa del Sol. Ponding of storm runoff in this area can occur following intense storm events.

Surface water cannot flow out of the closed basin and either infiltrates or evaporates. Based on topography, it is physically possible that surface water could flow out of the Hubbell Springs

watershed toward Hells Canyon Wash southwest of KAFB. However, based on inspection of aerial photographs, there are no discernable flow features (i.e., gullies or arroyos) leading from KAFB toward Hells Canyon Wash, and any runoff that does flow south from the low-lying area west of KAFB would likely occur as sheet flow and be of minimal quantities (Kay 2025). Sheet flow does not flow with enough volume or velocity to cause erosion.

Several springs on KAFB are associated with the uplifts in the Tijeras Fault Complex and in the Foothills and Canyons hydrogeologic areas: (1) Coyote Springs, Cattail Springs, and G Spring within Arroyo del Coyote; (2) Burn Site Spring in Lurance Canyon; and (3) Sol se Mete Spring within the Manzanita Mountains. Hubbell Spring (a perennial spring) is located just south of KAFB on the Pueblo of Isleta. Coyote Springs and Sol se Mete are perennial springs (continuously flowing), while the others are ephemeral springs. When flowing, the springs produce surface flows that only last for a short distance, on the order of tens or perhaps hundreds of feet. The springs do not contribute flow to Tijeras Arroyo.

4.5.1.2 Quantity

The surface water system at SNL/NM reflects the dry high-desert climate. The average annual rainfall in Albuquerque is about 9 inches, with about half of that occurring from July to October during heavy thunderstorms (KAFB 2010). Estimates of evapotranspiration for the SNL/NM area range from 95 to 99 percent of the annual rainfall (SNL 2005), so surface water is generally limited in quantity.

During heavy precipitation, stormwater within developed portions of the installation (small area to the north of the Tijeras Watershed, refer to Appendix A, Section A.4.5, Figure A-19) is collected via a series of storm drains, culverts, ditches, and small, mostly unnamed arroyos that eventually drain primarily to Tijeras Arroyo (KAFB 2019a). Stormwater in the northwestern part of the developed area drains northward toward Gibson Boulevard along the KAFB installation boundary where, in 2019, the Albuquerque Metropolitan Arroyo Flood Control Authority and KAFB completed a regional stormwater detention facility (KAFB 2019b).

Flow in Tijeras Arroyo occurs only during heavy rain events. There are no stream gauges located within Tijeras Arroyo or Arroyo del Coyote on or near KAFB, so quantification of flow frequency or volumes is not possible. Based on SNL/NM environmental staff experience, a rough estimate of 3–8 flow events occur in Tijeras Arroyo (and Arroyo del Coyote) per year. These typically last less than 1 hour. Due to the high infiltration capacity of the channel sediments, flow within the KAFB area will often not reach the Rio Grande.

Stormwater runoff in the less developed portions of the installation (closed basin and Hubbell Springs watershed) is limited by high rates of soil infiltration, low gradient, and high rates of evapotranspiration. Stormwater discharges to the mesa west of KAFB in these areas an estimated 1–3 times per year, sometimes not at all. Aerial photographs show there are no discernable flow features leading from KAFB toward Hells Canyon Wash, and any runoff that does flow south from the low-lying area west of KAFB would occur as sheet flow and be of minimal quantities. Sheet flow does not flow with enough volume or velocity to cause appreciable erosion. Above the top of Hells Canyon Wash (before a discernable flow feature is formed) is a manmade berm

that appears to have been created to retain stormwater. This berm appears to be the furthest extent to which stormwater from KAFB in the Hubbell Springs watershed flows.

4.5.2 Groundwater

The Santa Fe Group Regional Aquifer system is the principal source of water supply in the Albuquerque Basin (NMBGMR 2016). The system is made up of poorly cemented sands and gravels of the Santa Fe Group and overlying alluvial deposits associated with the Rio Grande and its tributaries. The Santa Fe Group has been subdivided into lower, middle, and upper hydrostratigraphic units and ranges in thickness from 2,400 feet near the basin margins to about 14,000 feet in the center of the basin (Hawley and Haase 1992). The most productive lithologies are channel deposits of the ancestral Rio Grande. Basin floor playa lake deposits of the lower part of the Santa Fe Group do not yield large quantities of water, and that water is assumed to be of poor quality (USGS 1993b). For this reason, only about the upper 2,000 feet of the aquifer system is used for groundwater withdrawals (USGS 2002).

Water enters the Santa Fe Group Regional Aquifer system in four main settings: mountain fronts and tributaries to the Rio Grande, the inner valley of the Rio Grande, the Rio Grande, and subsurface basin margins. Water entering the aquifer in the first three settings is usually termed “recharge,” whereas water entering the basin in the subsurface is typically termed “underflow” (USGS 2002). Mountain front recharge is likely the most important source of recharge to the basin (USGS 2001). Regional groundwater flow is to the south from the Albuquerque Basin to the Socorro Basin near San Acacia (USGS 2012). A minor amount of discharge occurs as groundwater moves out of the Albuquerque Basin into downgradient basins along the Rio Grande Rift as underflow or through discharge to the Rio Grande (SNL 2015a).

The principal sedimentary fill of the Albuquerque-Belen Basin is the Santa Fe Group, consisting of gravels, sands, silts, and clays. The KAFB property that includes SNL/NM-managed lands is divided into three distinct hydrogeologic areas primarily controlled by faults. Moving from west to east the areas are (1) the Albuquerque Basin, (2) the Tijeras Fault Complex, and (3) the foothills and canyons region. A map of these faults is included in Appendix A, Figure A-22. The Tijeras Fault Complex division that runs diagonally from northeast to southwest east of the SNL/NM-managed lands and across the central portion of KAFB marks the boundary between the Regional Aquifer and the fractured bedrock aquifer system. The Regional Aquifer under SNL/NM ranges in depth from near surface to 200 feet below ground surface (ft-bgs) in the eastern portion of the installation, and to depths of 350 to 500 ft-bgs west of the fault zone (KAFB 2018). Below the SNL/NM-managed lands, the Regional Aquifer primarily consists of unconsolidated sediments deposited by rivers and streams (i.e., alluvium). The ease with which groundwater will move through these deposits depends primarily on the grain size, which ranges from fine-grained and clay-rich material to more permeable coarse-grained sediments (Figure 5-10 in SNL 2003).

A localized Perched Groundwater System extends for about 4.4 mi² under the north-central portion of KAFB, including the vicinity of SNL/NM TA-I, TA-II, and TA-IV. Included in the ROI for groundwater are those water-bearing layers that could potentially be affected by contaminant release.

4.5.2.1 Groundwater Quality

Groundwater monitoring is conducted on KAFB by two agencies – DoD through KAFB Environmental Restoration Program (ERP) personnel and NNSA through SNL/NM personnel. The KAFB ERP has a large monitoring well network associated with several closed landfills and a former KAFB sewage lagoon system. Additional KAFB wells are sited to monitor and characterize several nitrate plumes (SNL/NM personnel monitor elevated nitrate levels in three locations; refer to Figure 4-4) and an aviation gasoline/jet fuel plume associated with the KAFB Bulk Fuels Facility. SNL/NM personnel monitor groundwater at specific locations associated with SNL/NM-managed lands. Figure 4-4 identifies the SNL/NM monitoring well network.

There are three groundwater areas of concern (AOCs) at SNL/NM that are undergoing corrective action in accordance with the New Mexico Environment Department (NMED) 2004 Consent Order (NMED 2004): TA-V Groundwater AOC, Tijeras Arroyo Groundwater AOC, and Burn Site Groundwater AOC (Figure 4-4). These areas are managed under SNL/NM ER Operations. Groundwater monitoring is required under the Long-Term Monitoring and Maintenance Plan (LTMMMP) (SNL 2012a) for the Mixed Waste Landfill (MWL) and under the Post-Closure Care Permit (NMED 2009) for the CWL. Appendix A, Section A.4.5, summarizes the groundwater quality, conceptual site models, and related activities being conducted at each of these five locations.

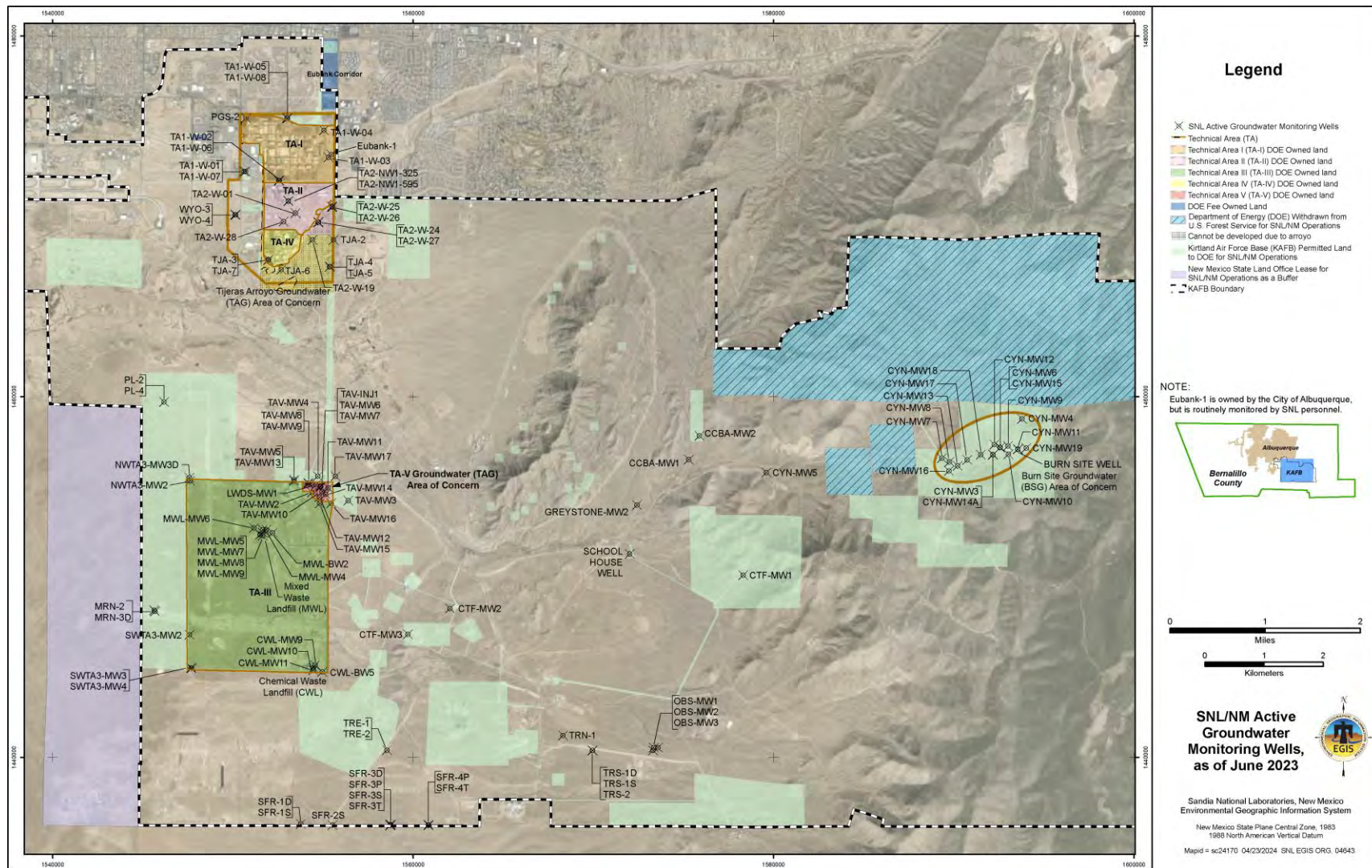


Figure 4-4. SNL/NM Monitoring Well Network and Groundwater Areas of Concern

4.6 AIR QUALITY

This section discusses air quality and climate conditions for the City of Albuquerque and Bernalillo County, New Mexico, as well as existing impacts on air quality from operations at SNL/NM.

4.6.1 Air Quality

Sources of air pollution can be human- or natural-made and include dust, fumes, gases, smoke, or vapors. These sources create emissions that are harmful to public health (humans) or public welfare (the environment). Examples of emissions include nitrogen oxides (NO_x), carbon monoxide (CO), sulfur dioxide (SO₂), volatile organic compounds (VOCs), particulate matter (PM), and hazardous air pollutants (HAPs). Air quality as a resource is managed by controlling the level of air contaminants within a region through a series of laws, regulations, and permits.

“Climate” is a description of the long-term state of the weather for a region. Some air pollution in the atmosphere reacts with other air emissions or atmospheric components to affect climate. For example, ozone is formed in an atmospheric photochemical reaction between VOCs and NO_x during warmer weather, causing smog. In the higher regions of the atmosphere, ozone protects life on Earth from the Sun’s ultraviolet radiation. In the lower regions of the atmosphere, ozone can harm human health and ecosystems. Air emissions, such as ozone, carbon dioxide (CO₂), nitrous oxide (N₂O), methane (CH₄), hydrofluorocarbons (HFCs), perfluorocarbons, nitrogen trifluoride, and sulfur hexafluoride (SF₆) are classified as greenhouse gases (GHGs) because they trap heat in our atmosphere, similar to a greenhouse. More heat in our atmosphere increases atmospheric instability and modifies our long-term weather patterns and climate.

4.6.1.1 Ambient Air Quality

The Clean Air Act of 1970, as amended (CAA) (42 U.S.C. § 7401 et seq.) assigns EPA the responsibility to prescribe National Ambient Air Quality Standards (NAAQS) for air emissions that are determined to impact public health and welfare (42 U.S.C. § 7409). The primary NAAQS protects public health, with an adequate margin of safety; the secondary NAAQS protects public welfare, including crops, forests, and the environment. To date, EPA has established NAAQS for 6 air emissions: CO, lead, NO_x, ozone, PM⁴, and SO₂.

Although a NAAQS has been issued for ozone, ozone is not emitted from industrial or commercial operations. Instead, ozone is formed in a photochemical atmospheric reaction between VOCs and NO_x. For this reason, agencies monitor the ambient air for ozone but develop regulations for VOC and NO_x, as they contribute to the formation of ozone.

The New Mexico Air Quality Control Act assigns NMED the responsibility to promulgate ambient air quality standards for the State of New Mexico, including implementing the NAAQS, and allows local governments to seek authority to manage air quality within their jurisdiction. The Albuquerque-Bernalillo County Air Quality Program, administered by the City of

⁴ There are NAAQS for two different types of PM: coarse PM less than 10 micrometers (PM₁₀) and fine PM less than 2.5 micrometers (PM_{2.5}).

Albuquerque Environmental Health Department (EHD), is the entity responsible for air quality within the Albuquerque/Bernalillo area.

Local ambient air quality monitoring is conducted by the EHD. SNL/NM conducts ambient air monitoring for radioactive materials onsite (SNL 2021b and EPA 2023a). The City of Albuquerque and Bernalillo County are part of the Albuquerque-Mid Rio Grande Intrastate Air Quality Control Region (AQCR) (40 CFR 81.83). EPA designates an AQCR, or portions of an AQCR, that meet a NAAQS or cannot be classified, as “attainment areas.”⁵ Areas of an AQCR that exceed the NAAQS are designated as “nonattainment areas.” Nonattainment areas that later meet the NAAQS are redesignated as “maintenance attainment areas” for a 20-year period. NMED designates nonattainment areas for state ambient air quality standards (SAAQS). Bernalillo County is designated as an attainment area for all NAAQS and SAAQS (EPA 2023b).

EPA currently designates 188 compounds as HAPs; these chemicals are known to cause or potentially cause cancer or other serious health effects. EPA and EHD manage HAP emissions through regulations and permits.

4.6.1.2 Air Emission Management

Stationary sources of air emissions that meet regulatory criteria must file for a Registration Certificate (20.11.40 New Mexico Administrative Code [NMAC]), apply for air quality construction permits (20.11.41 NMAC), or submit a permit waiver and an air quality notification (20.11.39 NMAC) prior to construction and/or operation of a stationary source. EHD issues air permits and related materials, such as open burning (20.11.21 NMAC) and surface disturbance/demolition activities (20.11.20 NMAC), within the City of Albuquerque and Bernalillo County. Permitted and registered sources are required to report actual annual emissions to EHD. Air permits establish emissions limits and air pollution controls contain operating, monitoring, recordkeeping, and reporting requirements. Currently, SNL/NM has more than 40 air quality construction permits, and registration certificates issued for sources of air pollution installed or modified after January 6, 1975.

Primary sources of regulated air emissions from SNL/NM are boilers and heaters, chemical use, emergency generators, and fire testing facilities. All boilers and heaters are fired with liquified petroleum gas or natural gas. Chemicals, including materials classified as VOCs and HAPs, are used throughout the SNL/NM complex. The research conducted in the SNL/NM fire testing facilities includes testing the integrity of materials and shipping containers by subjecting the container to environments that could develop in an accident. Fire testing facilities include open pools that vent directly to the atmosphere and several buildings where the products of combustion are vented to the environment via a stack with an air pollution control device.

NNSA and DOE applied for a CAA Title V operating permit on March 1, 1996, and updated the application on February 23, 1998. On July 22, 2002, NNSA and DOE applied for a plant-wide applicability limit (PAL) requesting establishment of site-wide allowable emissions limits of CO,

⁵ In an attainment area, a source in a listed category is classified as major when it has the *potential* to emit 100 tons per year (tpy) or more of any NAAQS air emission, 10 tpy for HAPs, or 25 tpy for all HAPs combined.

NO_x, and HAPs below Title V major source thresholds (SNL 1998). SNL/NM continues operating in compliance with the requirements of existing construction permits until the Title V permit or another type of operating permit is issued.

Average facility-wide air emissions for the period 2018 – 2022 are provided in Table 4-7; air emissions for each year are included in Appendix C, Table C-1. These estimates do not include reportable quantities of lead emissions or air emissions from mobile sources, such as employee commuting or construction of new facilities.

Table 4-7. Facility-Wide Air Emissions as a 5-year Average (tons per year [tpy])

Averaging Period	CO	NO _x	Filterable PM	SO ₂	VOC	HAP
2018–2022	11.5	9.4	1.7	0.3	3.9	9.3

Source: SNL 2018a; SNL 2019a; SNL 2020b; SNL 2021a; and SNL 2022a.

Open burning means the combustion of any substance not confined in a device where the combustion products are discharged into the open air without passing through a stack, duct, chimney, or vent. EHD manages an open burning permit program, and SNL/NM applies for multiple open burning permits annually. In 2023, SNL/NM was issued 17 open burning permits.

Fugitive dust is generated by construction, demolition, maintenance, and operating activities that disturb the soil surface. EHD manages fugitive dust emissions via a permit program for identified activities anticipated to cause fugitive dust. Fugitive dust permits specify control measures to reduce generation of fugitive dust, including Regulated Asbestos Containing Materials (RACM) associated with building demolition and renovation activities. Asbestos is any number of naturally occurring fibrous materials that were historically used in many common building materials. In the City of Albuquerque and Bernalillo County, EHD enforces regulations associated with the demolition or renovation of RACM (CABQ 2023a), that include inspection removal and disposal standards. In 2023, SNL/NM had five active fugitive dust permits. Both the open burning and fugitive dust permit programs are separate from the operating permit program for stationary sources.

Air emissions sources at SNL/NM are also subject to the following other federal air pollution control regulations, with more detail provided in Appendix A, Section A.4.6.

- New Source Performance Standards (NSPS) in 40 CFR Part 60.
- National Emissions Standards for Hazardous Air Pollutants (NESHAPs) in 40 CFR Parts 61 and 63.
- Protection of Stratospheric Ozone in 40 CFR Part 82.
- Phasedown of HFCs in 40 CFR Part 84.

NEPA charges federal agencies “to use all practicable means and measures...to foster and promote the general welfare, to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Americans.” Objective scientific data and information supports that GHGs have the potential to impact environmental conditions, impacting biospheres.

Each GHG absorbs a different amount of energy and exists in the atmosphere for a different length of time. These differences are addressed by assigning a reference factor by using CO₂ as the reference gas (i.e., 1) to each GHG over a 100-year timeframe. Reference factors for GHGs range from 28 for CH₄ and 265 for N₂O to hundreds or thousands for HFCs and PFCs with a maximum of 23,500 for SF₆. The relative thermal energy absorption for different GHGs can be compared by multiplying the reference factor by the amount of GHGs emitted. For example, 1 MT of SF₆ is equivalent to 23,500 MT of CO₂, or SF₆ has 23,500 MT of carbon dioxide equivalent (CO₂e) emissions (40 CFR Part 98).

GHG emissions are classified into three categories based on the source of the emissions:

- **Scope 1:** Direct GHG emissions from sources that are owned or managed by SNL/NM, including emissions from fossil fuels burned onsite, owned or leased vehicles, and other sources under direct control of SNL/NM.
- **Scope 2:** Indirect GHG emissions resulting from the generation of electricity, heating and cooling water, or steam generated offsite but purchased by SNL/NM (EPA 2023c).
- **Scope 3:** Indirect GHG emissions from sources not owned or directly managed by SNL/NM but related to activities conducted at SNL/NM; federal standards include employee travel and commuting, contracted solid waste disposal, and contracted wastewater treatment as Scope 3 GHG emissions (EPA 2023d).

Table 4-8 presents GHG emissions by scope category for the period 2017–2021.

Table 4-8. SNL/NM Annual GHG Emissions (in MT CO₂e)

Category	FY 2017 ^a	FY 2018	FY 2019	FY 2020	FY 2021
Scope 1 & 2	203,025.50	231,893.70	226,977.20	227,790.80	235,513.10
Scope 3	61,450.20	71,621.80	43,739.40	32,190.10	34,115.40

a. GHG emissions are presented by fiscal year (FY) (October 1 through September 30).

Source: SNL 2023f.

In fiscal year (FY) 2021, SNL/NM reduced GHG emissions in several categories:

- Reduction of 58.3% relative to its FY 2008 baseline for Scope 1 and 2 GHG emissions;
- Reduction of 29.3% relative to its FY 2008 baseline for all Scope 3 GHG emissions; and
- Reduction of 35.1% from its FY 2008 baseline for Scope 3 GHG emissions from commuting (SNL 2022e).

4.6.1.3 Radiological Air Quality

EPA regulates non-radon radionuclide air emissions from NNSA facilities in a NESHAP that establishes an effective dose equivalent limit of 10 mrem per year for maximum exposure to any member of the public resulting from all non-radon radionuclide air emissions from a NNSA facility. The NESHAP requires publication of an annual public report summarizing non-radon radionuclide air emission releases from NNSA facilities and an annual dose assessment.

All radionuclide emissions at SNL/NM are classified as point releases, (i.e., released to the atmosphere through an stack or vent). Tritium and radionuclides could potentially be released from experiments, waste processing, testing, and production operations. A list of potential sources of radionuclide air emissions is included in Table A-17 of Appendix A.

The potential impact to an individual from exposure to ionizing radiation is related to the dose, which is reported using the unit roentgen equivalent man (rem) or mrem (0.001 rem) (NRC 2021). Radiological emissions are measured in curies (Ci).

Continuous monitoring of radionuclide releases is required for sources with a potential effective dose to the maximally exposed individual (MEI) of 1 percent of the standard, (i.e., >0.1 mrem/year). All radionuclide releases from routine and normal operations at SNL/NM are below this regulatory threshold for continuous monitoring; however, radiological air monitoring is voluntarily performed as a BMP at the TA-I Neutron Generator Facility and TA-III RMWMU.

Airborne radionuclide emissions are incorporated into the CAA Assessment Package – Personal Computer (CAP88-PC) model to determine the total dose to the MEI for sources that emitted radionuclides within the CY (SNL 2021b). The CAP88-PC model is one of the identified models for demonstrating compliance with the requirement that the cumulative effective dose from all site-wide airborne radionuclide releases not exceed 10 mrem/year (40 CFR Part 61). The model calculates dose assessments using a plume rise based on parameters for each stack and exhaust vent, release and radionuclide parameters, meteorological and demographic information, and receptor location. Meteorological data used in the 2021 dose assessment were obtained from three onsite meteorological stations operated by SNL/NM, including hourly data on wind direction, wind speed, and atmospheric stability class. The onsite MEI with the greatest effective dose is 0.00264 mrem/year for 2022 at the Honeywell Systems Support Site; the public maximally exposed offsite individual (MOI) with the greatest effective dose is 0.00654 mrem/year for 2022 at the Eubank Gate area to SNL/NM. Both modeled MEI values are well below the NESHAP of 10 mrem/year for effective doses equivalent. For comparison purposes, 10 mrem is the dose received from a chest x-ray and 311 mrem/year is the dose the average person in the United States receives from background radiation (SNL 2023d). Table 4-9 includes the reported releases for the entire facility. Releases by radionuclide and location are provided in Table A-18 of Appendix A; the locations of vents and receptors are provided in Figure A-23 of Appendix A.

Table 4-9. Radionuclide Releases in Curies/Year

	2018	2019	2020	2021	2022
Facility-wide Total:	51.77	43.94	42.84	50.46	30.87

Source: SNL 2019a; SNL 2020b; SNL 2021a; SNL 2022a; and SNL 2023d.

The CAP88-PC model was also used to determine cumulative effective dose for the population in a 50-mile (80-kilometer [km]) radius surrounding the SNL/NM site. Since the site radionuclide sources are relatively close together when compared to the 50-mile model area, the population dose for each individual source was summed with all other sources to estimate the regional population dose. The highest effective dose for the collective regional population dose within the 50-mile model area is 0.0266 person-rem/year; within KAFB, it is 0.0158 person-rem/year (SNL 2021b).

No unplanned (non-routine) radionuclide released from SNL/NM in 2018, 2019, 2020, and 2022. In 2021, a higher-than-expected release of tritium occurred during maintenance operations on the Neutron Generator Facility. In total, 10.8 Ci of tritium were released during the event. This amount was part of the total annual radionuclide release reported by the Neutron Generator Facility, which was included in the radiological releases reported in Table 4-9. This event did not significantly increase radiological emissions from SNL/NM, as 2021 total radiological emissions were within the reported historical radiological emissions for the 5-year period 2018–2022.

4.6.2 Local Climate

Albuquerque, New Mexico, is characterized as a high-altitude, dry continental climate. The 30-year average climatic conditions for Albuquerque are as follows:

- Average daily high temperature is 91°F during the hottest month of July and average daily low temperature is 26°F in the coldest month of January (NOAA 2020);
- Average precipitation is 8.84 inches per year. The wettest month is July, with an average rainfall of 1.64 inches, and the driest month of the year is January, with an average precipitation of 0.36 inches (NOAA 2020); and
- Wind speed and direction are highly variable, with the strongest winds occurring in the spring. Monthly wind speed averages 10.3 miles per hour (mph) in the spring, with gusts reaching 50 mph (SNL 2020c).

Temperatures are typical of mid-latitude dry continental climates, with summer high temperatures in the basin around 90°F and winter high temperatures around 50°F. Daily low temperatures range from around 60°F in summer to around 20°F in winter. The dry continental climate also produces low average humidity in late spring and early summer before monsoon season. Daytime relative humidity can be between 10% and 20% in spring and early summer, with an average humidity near 30 percent. Winter relative humidity averages near 50 percent (SNL 2023d).

SNL/NM conducts meteorological monitoring onsite via a network of nine towers; tower locations are provided in Figure A-24 of Appendix A and tower monitoring parameters are provided in Table A-19 of Appendix A.

Climate projections indicate challenges to meet SNL/NM future needs of water supply, storm drainage, and electrical energy (SNL 2020c). For example, the frequency and intensity of droughts and heat waves are projected to increase, likely resulting in water supply shortages and a decline in water quality at SNL/NM. The need to increase the water supply may require expanding reuse and reclamation efforts for existing water sources, seeking alternative water sources, and the implementation of other measures (SNL 2022f).

In addition, a projected increase in the frequency and severity of storm events will challenge existing storm drainage systems at SNL/NM. Existing drainage systems are designed for a 100-year, 6-hour rain event of 2.24 inches; however, NNSA's Enterprise Risk Management model anticipates the 100-year, 6-hour rain event is expected to increase to 3 inches in the vicinity of TA-I, TA-II, and TA-IV. These areas currently experience limited flooding during some rain

events. Unless the drainage systems are improved, more frequent and severe weather events could result in temporary inability to access these areas by road (SNL 2020c).

Climate projections also indicate an increase in demand for electrical energy for cooling in future hotter summers, especially due to sustained heat waves. This will increase the potential for disruptions to the power supply (SNL 2020c). Energy demand increases under the Modernized and Expanded Operations Alternatives would further increase this potential.

4.7 NOISE

Sound is a physical phenomenon consisting of vibrations that travel as acoustic waves through a medium (e.g., air) and are sensed by the human ear. Noise is defined as sound that is undesirable because it interferes with communication, is intense enough to damage hearing, or is otherwise intrusive. Human response to noise varies depending on noise type and characteristics, distance between source and receptor, receptor sensitivity, weather conditions, and time of day. Certain sounds can cause pain, loss of hearing, and impacts to the environment (e.g., broken windows).

Sound varies by wavelength, frequency, and amplitude (intensity). Frequencies are measured in hertz (Hz) (the number of sound vibrations in 1 second). The human ear can detect sounds within a frequency range of about 20 Hz to 20,000 Hz (20 kilohertz [kHz]). Amplitude is the relative intensity of a sound and is perceived by the human ear as loudness or sound volume. Sound amplitude is quantified in decibels (dB) (a logarithmic unit that expresses the ratio of a sound pressure level to a standard reference level). The human ear can perceive sounds as low as 0 dB at 1 kHz; the upper limit of human sound perception is about 125 dB, as pain increases at higher amplitudes (NPS 2018a). Sound amplitude measurements are adjusted using sound curves to highlight different aspects of noise. The adjustments are known as weighted values. A-weighted values incorporate the perception of loudness in a human ear and are listed as dBA. C-weighted values incorporate rumble or noise-induced vibrations from demolitions and explosive events and are listed as dBC (OSHA 2022). Noise from explosives test operations may also be listed as sound pressure level (overpressure) converted to dB. Converting overpressure to dB is defined as 20 times the base 10 logarithm of the ratio of the sound pressure to a reference pressure. The reference pressure is defined as the quietest noise a healthy young person can hear (20 micropascals, 0.0000000292 pounds per square inch) (DDESB 2018).

This section discusses noise in the ROI, which comprises SNL/NM, KAFB, adjacent locations, including residential areas and the La Semilla Buffer Zone, and offsite locations within the state of New Mexico for conducting activities related to UxS.

4.7.1 Ambient Noise

Activities essential to a community's quality of life, such as construction or vehicular traffic, often generate noise. Weather conditions also impact noise, with temperature, humidity, and wind speed affecting sound propagation (Army 2007).

Civilian and military aircraft at the adjacent KAFB/Sunport significantly impact the ambient noise at SNL/NM, as aircraft arrivals and departures pass directly over SNL/NM-managed lands. The noise generated by aircraft is between 65 to 75 dB and extends into the TA-I and TA-II

sections of SNL/NM and the City of Albuquerque. Contours detailing KAFB/Sunport noise impacts on SNL/NM and adjacent areas are provided in Figure A-25 of Appendix A.

Additional ambient noise is generated by passenger and cargo transport vehicles traveling on I-40, Central Avenue, and Eubank Boulevard. SNL/NM vehicle use includes passenger, cargo delivery, security, and military vehicles, driving both on and off road. Industrial sources, such as generators and air comfort equipment at SNL/NM, also contribute to ambient noise. Most of the noise generated by vehicles and industrial equipment is between 50 to 70 dBA (DOE 2008a).

SNL/NM also generates noise from test programs, including use of explosives and testing of rocket motors and large caliber weapons. Open burn permits were obtained to allow up to 4,174 of these events annually. Noise generated by these tests will affect the surrounding community differently, depending on the loudness of the sound, intensity of associated vibrations, frequency of the event, and atmospheric conditions at the time of the event.

4.7.2 Noise Management

Test events at TA-III, CTF, Rocket Sled Track, and Aerial Cable Facility can generate noise levels that could impact adjacent populated areas. In most cases, “sonic booms” heard outside KAFB resemble a dull thud or short burst (less than 3 seconds). Test events may be coordinated with the KAFB meteorologist via the SNL/NM Weather Watch Program to ensure that tests are conducted when atmospheric conditions will minimize sound propagation (SNL 2021a). Most testing occurs in the southern and eastern part of KAFB where SNL/NM has permitted land with fewer residential areas and roadways that would be impacted by high noise levels (DOE 1999).

SNL/NM has adopted a Hearing Conservation Program to reduce exposure of SNL/NM personnel to noise. The program limits the amount of time personnel are exposed to noise and requires hearing protection equipment in high-noise areas (DOE 1999). Open detonation testing produces noise levels which can reach up to between 147 and 159 dB in operator occupied areas. To further reduce impacts to personnel at SNL/NM, explosive testing sites have delineated safety arcs to restrict personnel from potentially hazardous operations, reducing potential exposure to noise, air emissions, metal fragments, and other potentially hazardous conditions. Delineated safety arcs occur only within KAFB boundaries; do not extend offsite; and are defined and enforced by means of warning lights, signs, spotters, fences, barricades, and gates (DOE 2008b).

As part of the Hearing Conservation Program, SNL/NM uses sound measurement equipment to sample sound impacts from equipment and detonations onsite. These surveys identify high noise environments, confirm controls are mitigating excessive noise, and ensure workers are protected during onsite operations. SNL/NM does not conduct offsite noise monitoring (SNL 2022g).

For explosives not previously detonated, SNL/NM may use a Sound Intensity Prediction System Two-Dimensional (SIPS2D) model to predict sound levels created by onsite open detonations. The SIPS2D model estimates sound propagation through horizontal atmosphere layers using weather model forecasts to predict sound levels several days prior to a planned detonation. Location, date, time, planned meteorology, and TNT-equivalent weight are modeled for each planned detonation. Sound impacts are reviewed on a map of the surrounding area. Tests may be

adjusted to minimize perceived impacts to residential areas outside KAFB and SNL/NM and to reduce the instance of areas exceeding 140 dB onsite.

Title IV of the CAA states that the EPA Administrator can determine if the amount of noise generated by a federal agency is a public nuisance or otherwise objectionable. If so determined, the federal agency shall consult with EPA to determine possible means of abatement (42 U.S.C. § 7641). Separately, EPA established that noise levels greater than or equal to 70 dB can cause hearing loss, although EPA has not established an ambient noise standard, deferring to state and political subdivisions to establish ambient noise standards. (EPA 1974).

4.8 BIOLOGICAL RESOURCES

Biological resources include vegetation, fish and wildlife, special status species, and habitats and wetlands. The ROI for these resources includes all areas of SNL/NM-managed lands, KAFB, and adjacent areas. SNL/NM is at the juncture of four major North American biological provinces: Great Basin, Rocky Mountains, Great Plains, and Chihuahuan Desert. Although New Mexico has six Level II Ecoregions, the area potentially impacted by SNL/NM operations consists mainly of the Cold Deserts Ecoregion and Upper Gila Mountain Ecoregion (NMDGF 2019). The Cold Deserts Ecoregion has arid habitat with annual precipitation of less than 9.8 inches, hot summers, and cold winters due to high elevation. The Upper Gila Mountain Ecoregion has a semi-arid climate with localized microclimates that are wetter along streams and canyons, with vegetation ranging from desert scrubland to pinyon-juniper and ponderosa pine woodlands.

Vegetation consists mainly of grasslands, shrublands, and conifer woodlands. The grasslands of SNL/NM are part of the Arizona/New Mexico Plateau's Level III Ecoregion and are classified on a more discrete scale as part of the Albuquerque Basin Level IV Ecoregion by EPA. The woodland portions are part of the Arizona/New Mexico Mountains Level III Ecoregion, with the lower elevation woodlands classified as Conifer Woodlands and Savannas Level IV Ecoregion and the upper elevation woodlands as Rocky Mountain Conifer Forests (KAFB 2023b).

The SNL/NM Ecology Program oversees monitoring, re-vegetation, and wildlife surveillance and response (refer to Appendix A, Section A.2.6.7). Since 2005, ASERs report routine monitoring to understand local species population dynamics and temporal changes (SNL 2023d). The Ecology Program monitors SNL/NM-managed lands in KAFB. KAFB personnel monitor KAFB-owned land. To the extent that KAFB has developed an INRMP per the Sikes Act (16 U.S.C. § 670 et seq.), SNL/NM shares relevant monitoring and surveillance data.

4.8.1 Vegetation

SNL/NM's terrestrial vegetation exists within KAFB without differentiation. This percentage cover of vegetation communities summary includes KAFB land area data. Terrestrial vegetation consists of community types such as grasslands, shrublands, arroyo shrub, woodlands (mainly pinyon-juniper), and some scattered ponderosa pines at the highest elevations throughout SNL/NM- and KAFB-managed lands (Campbell et al. 2019; SNL 2022a; and SNL 2023d). Large contiguous woodland areas (mainly pinyon-juniper) exist, particularly to the east on nearly all the Forest Service withdrawn land (SNL 2020d). About 55.5 percent of the total SNL/NM

area including KAFB is woodlands; 37 percent is grassland, including scrub and shrublands; and approximately 7.5 percent is developed/impacted by human use (refer to Figure 4-5).

Over 300 plant species are documented in SNL/NM (SNL 2017a; KAFB 2023b; Appendix A, Section A.4.8). The National Vegetation Classification Standard, developed by the Federal Geographic Data Committee for uniform vegetation resource statistics, defines vegetation cover types (FGDC 2008). U.S. National Vegetation Classification System alliances define SNL/NM vegetation communities (32 vegetation types total 756 communities) (Campbell et al. 2019). Figure 4-5 shows vegetation cover type distribution in KAFB (SNL 2019a).

Table 4-10 shows vegetation survey plot information. Appendix A, Section A.4.8.2, describes ecology survey locations, results of wildlife surveys, and vegetation classifications of major developed areas.

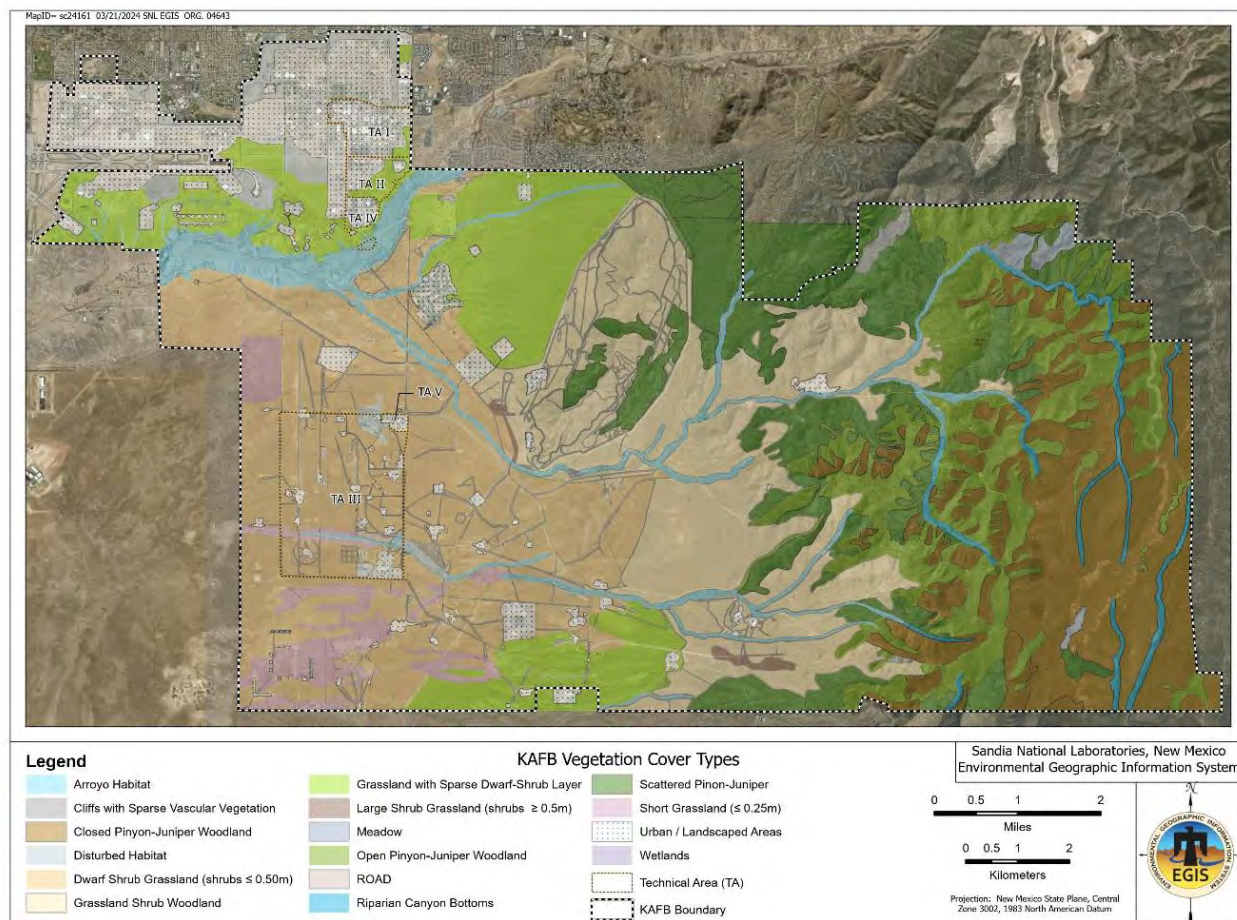


Figure 4-5. Vegetation Cover Types

Table 4-10. Plots for Vegetation Surveys 2017–2022

Plot Name	Vegetation Type	Survey Year
SG-004	Short Grassland	2017
Closed-033	Closed Pinyon-Juniper Woodland	2018
Closed-134	Closed Pinyon-Juniper Woodland	2023
Open-062	Open Pinyon-Juniper Woodland	2018
Open-093	Open Pinyon-Juniper Woodland	2023
Open-086	Open Pinyon-Juniper Woodland	2023
LSG-078	Large Shrub Grassland	2018
GrassSDS-032	Grassland with Sparse Dwarf Shrub Layer	2019
GrassSDS-037	Grassland with Sparse Dwarf Shrub Layer	2019
DSG-009	Dwarf Shrub Grassland	2021
DSG-012	Dwarf Shrub Grassland	2019
DSG-018	Dwarf Shrub Grassland	2021
SPJ-068	Scattered Pinyon-Juniper	2021
SPJ-077	Scattered Pinyon-Juniper	2019
GSW-052	Grassland Shrub Woodland	2022
GSW-060	Grassland Shrub Woodland	2022
Meadow-115	Meadow	2019

Source: SNL 2018a; SNL 2019a; SNL 2020b; SNL 2021a; SNL 2022a; and SNL 2023d.

4.8.1.1 Grasslands

Historic grasslands have largely recovered on SNL/NM and KAFB during the past approximately 75 years, partially due to the exclusion of intensive cattle grazing since the 1940s (SNL 2018b). Grasslands have become an extremely vulnerable habitat type throughout the U.S. Southwest, given the history of development, introduction or establishment of invasive species, improper grazing practices, fire suppression (allowing encroachment of shrublands), and desertification (Christensen et al. 2023 and SNL 2018b). Grasslands provide important habitat for declining grassland nesting birds, prairie dogs (*Cynomys spp.*), and other species, many of which depend on prairie dogs as keystone species (Miller et al. 2000 and Haun et al. 2024). Section 4.8.2 has more information on the wildlife that depends on SNL/NM grasslands. The five SNL/NM TAs are situated on grasslands, or sites that were grasslands prior to development. Grasslands include four vegetation cover types: (1) Short Grasslands, (2) Dwarf Shrub Grasslands, (3) Grasslands with Sparse Dwarf-Shrubs, and (4) Large Shrub Grassland (SNL 2015b). Appendix A, Section A.4.8.1, includes definitions of these vegetation classifications.

4.8.1.2 Pinyon-Juniper Woodlands

SNL/NM woodland habitats are at high elevations, east of grassland habitats, consisting mostly of pinyon-pine (*Pinus spp.*) and juniper (*Juniperus spp.*) mosaics (pinyon-juniper habitat). Some scattered ponderosa pines are at high elevations. Three major types comprise pinyon-juniper vegetation community: (1) Pinyon-Juniper Savanna (Shrub/Woodland/Grassland), (2) Pinyon-Juniper Shrubland (Open Canopy Woodland), and (3) Pinyon-Juniper Persistent Woodland (Closed Canopy Woodland) (SNL 2015b; KAFB 2023b; SNL 2020d; and NPS 2015). Appendix A, Section A.4.8.1, defines these vegetation classification types.

Pinyon-juniper woodlands represent a dominant vegetation type across the western United States, with some areas experiencing significant die-off or expansion (Redmond et al. 2023).

Pinyon-juniper habitats vary in structure and composition, supporting relatively high species diversity when compared to other habitats at the landscape scale (Bombaci and Pejchar 2016). This habitat type supports the largest number of nesting bird species in the western United States (Balda and Masters 1980 and Gillihan 2006). Pinyon-juniper habitat fragmentation/loss greatly threatens pinyon-juniper dependent wildlife, with large tracts of pinyon-juniper habitat in the interior forest having the highest ecological value (Harris 1988). Pinyon-juniper woodlands are frequently managed by thinning to reduce overall density and wildfire risk (Bombaci and Pejchar 2016 and Novak et al. 2021). At the same time, a history of fire suppression has led to increased fuel loading, with the risk of wildfires becoming more severe, more frequent, and more difficult to manage (Board et al. 2018 and KAFB 2023b). Bark beetles are one of the biggest threats to pinyon-juniper habitat in this region, especially when paired with drought stress (Robbins et al. 2021), as has occurred periodically since 2002 throughout New Mexico and Arizona.

Large contiguous tracts of pinyon-juniper woodlands, like those at SNL/NM, provide important habitat for many wildlife species and are important to several species in decline. For example, SNL/NM pinyon-juniper habitats (including in CTF – East) provide some of the best nesting habitat for gray vireo (*Vireo vicinior*), a threatened species in New Mexico (McMurry et al. 2020 and NMDGF 2024a). Section 4.8.3 has more information on special status species and habitats.

4.8.1.3 Riparian Vegetation

Riparian vegetation can occur with woodlands or grasslands. It comprises less than 5 percent of SNL/NM (SNL 2015b). Typical woodland riparian areas contain rocky ephemeral channels and sparse natural springs. Arroyos (gently sloping, sandy-bottomed, ephemeral waterways in desert grasslands) have a distinct riparian vegetation zone due to relatively large amounts of water stored in bottom sediments. Periodic surface-water runoff along drainages and subsurface flows provide water for shrubs along arroyo banks (SNL 2015b). Three riparian vegetation cover types occur in the ROI: (1) Arroyo, (2) Riparian Canyon Bottoms, and (3) Wetlands (only on KAFB, not SNL/NM-managed lands). Appendix A, Section A.4.8, defines vegetation classifications.

4.8.1.4 Invasive Vegetation

Non-native, invasive vegetation is of concern throughout the southwestern United States, where invasive grasses often out-compete native grasslands. The invasive plant of greatest concern at SNL/NM is cheatgrass (*Bromus tectorum*), a prolific seed producer that germinates in spring, giving it a competitive advantage over native warm season perennials. Cheatgrass burns much more readily than native grasses, allowing wildfires to spread readily (Balch et al. 2012). Associated with disturbance, Russian thistle (*Salsola tragus*) is abundant on disturbed lands of SNL/NM. Riparian invasives include saltcedar (or tamarisk, *Tamarix spp.*), Russian olive (*Elaeagnus angustifolia*), Siberian elm (*Ulmus pumila*) and tree-of-heaven (*Ailanthus altissima*).

Native species occur onsite, often on altered or disturbed lands: silverleaf nightshade (*Solanum elaeagnifolium*), three-awn grasses (*Aristida spp.*), and stickseed (*Lappula occidentalis*) (KAFB 2023b). Due to post-disturbance colonization, they are commonly considered as weedy species.

Executive Order (EO) 13112 (as amended by EO 13751) describes federal agencies' responsibilities regarding invasive species, including preventing introductions and the spread of

invasive species where practical, and providing restoration opportunities if possible. In 2004, KAFB initiated restoration work to target invasive vegetation (saltcedar) and continued through 2023 with rehabilitation of the native riparian plant communities at G-Spring wetland, Coyote Springs, and other riparian areas along Arroyo del Coyote adjacent to and upstream of the wetland pond constructed in 2004–2005 (Wickersham and Wickersham 2011; SNL 2012b; KAFB 2023b; and McMurry and Smith 2023). Invasive plant species at SNL/NM currently do not meet a threshold of concern for intervention. During routine surveillance and planning for ground disturbing activities, if invasive plant species are determined likely to harm or damage the native upland ecosystem, appropriate management strategies would be implemented.

4.8.2 Wildlife

The site provides habitat for a diverse wildlife community that includes species of birds, reptiles and mammals of conservation concern. Previous surveys have identified over 300 vertebrate species, including 201 bird (including 131 passerine, 4 hummingbird, and 7 woodpecker species) (SNL 2017a), 38 reptile and amphibian (KAFB 2013), and 61 mammal (including 26 small mammal, 7 predator, 3 ungulate, and 25 bat species) (Perry et al. 2012; SNL 2015b; SNL 2017a; Hauer et al. 2018; SNL 2020d; SNL 2023d; and KAFB 2023b). Over 225 insect species have also been identified (SNL 2016b). Appendix A, Section A.4.8.3, contains additional information regarding documented wildlife species at SNL/NM and KAFB. For a list of wildlife species, including locations observed within SNL/NM when available, refer to Appendix A, Table A-21.

4.8.2.1 Reptiles and Amphibians

Herpetological surveys at SNL/NM have identified 38 species of reptiles and amphibians (KAFB 2013; SNL 2017a; SNL 2020b; SNL 2022h; and KAFB 2023b). Dozens of additional species are likely to be present but have not been observed (KAFB 2013).

Species caught most often during monitoring vary considerably, perhaps due to variable climatic conditions and habitat shifts. The 2020 ASER [SNL 2021a] discusses relative abundance of reptiles and amphibians caught in drift traps annually. One turtle species is found onsite in low numbers: the Western or ornate box turtle (*Terrapene ornata*) (SNL 2022h). Few amphibians have been reported, with barred tiger salamander (*Ambystoma mavortium mavortium*), red-spotted toad (*Anaxyrus punctatus*), and New Mexico spadefoot toad (*Spea multiplicata*) observed more often, but in low numbers (Wickersham and Wickersham 2011 and SNL 2022h).

4.8.2.2 Birds

Birds are the most diverse group of vertebrates present on SNL/NM-managed lands (at least 201 species detected [SNL 2017a]), with species common in altered habitats found in the TAs, grassland species and raptors using the grassland/shrub habitats, and at least 110 woodland bird species using the pinyon-juniper woodlands (SNL 2015b; SNL 2017b; and SNL 2023d). Twenty species present at SNL/NM have been designated as conservation priorities on the Continental-Level Partners in Flight Watch List (Rosenberg et al. 2016), and 25 additional species have been designated as Species Conservation Level One or Two by the New Mexico Avian Conservation Partners (NMACP 2023). Section 4.8.3 contains information about protection for bird species.

At least 60 grassland bird species use SNL/NM grasslands, which provide valuable habitat for species that rely on grasslands in different seasons (Cruz-Carretero and Cruz-McDonnell 2015). As discussed in Appendix A, Section A.4.8.34.8.2.3.1, several bird species, including special concern species such as western burrowing owl, are associated with prairie dogs, which are declining in their range.

Pinyon-juniper provides breeding habitat for 19 bird species of conservation concern identified by Partners in Flight (Rosenberg et al. 2016), which has ranked the state's pinyon-juniper habitat as Priority A (Highest Level of Concern). The National Audubon Society has identified KAFB (which includes SNL/NM-managed lands) as an Important Bird Area, and BirdLife International recognizes KAFB as a valuable conservation area (Audubon 2025). Appendix A, Section A.4.8.3, has more on species dependent on grassland and pinyon-juniper habitats.

Wetlands are rare in the ROI and absent on SNL/NM-managed lands, but Coyote Springs, within KAFB, is important habitat for many bird species (at least 126, reported to eBird [eBird 2023]).

4.8.2.3 Mammals

SNL/NM is home to mammal species ranging from small rodents and bats to mesocarnivores, other larger predators, and large ungulates. At least 27 small mammal, 13 predator, 25 bat, and 3 ungulate species have been observed on SNL/NM (Perry et al. 2012; SNL 2023d; SNL 2020d; and KAFB 2023b). At SNL/NM, habitat connectivity is important especially for black bears (*Ursus americanus*, Cramer et al. 2022) and mountain lions (*Puma concolor*). GPS-collared mountain lions exhibit north-south ranges extending over 30 miles; east-west ranges vary from low elevation sites east of the mountain range to the Withdrawn Area and areas around Coyote Springs to the west (Cain et al. 2017; Cain 2019; KAFB 2023b; and McMurry and Smith 2023).

Passive surveillance of small-, medium-, and large-sized mammals, using remote sensor cameras, has been conducted annually since 2005. Long-term monitoring sites include two wildlife water guzzlers maintained by the SNL/NM Ecology Program, the Madera Canyon Guzzler and Range Guzzler (SNL 2022h). During monitoring, over 70 species have been recorded, including 20 mammalian species (Cain 2019 and KAFB 2023b). Additional monitoring efforts using remote sensor cameras are conducted opportunistically around the site.

4.8.2.3.1 Small Mammals

Prairie dogs are a keystone species, providing habitat for many other species (Miller et al. 2000). They also provide important ecosystem services, such as groundwater recharge, soil erosion regulation, soil carbon storage, productivity, and forage availability to grazers (Martinez-Estevéz et al. 2013). Since 2007, Gunnison's prairie dogs (*Cynomys gunnisoni*) have been monitored throughout SNL/NM (SNL 2018b). Section 4.8.3.2.3 discusses prairie dogs in more detail.

Other mammals listed as Species of Greatest Conservation Need (SGCN) by the New Mexico Department of Game and Fish (NMDGF) have been observed onsite: banner-tailed kangaroo rat (*Dipodomys spectabilis*), southern pocket gopher (*Thomomys umbrinus*), ringtail (*Bassariscus astutus*), and western spotted skunk (*Spilogale gracilis*) (Cain 2019; NMDGF 2024b; SNL 2022h; and SNL 2023d). Appendix A.4.8.3, Table A-21, lists more mammal sightings.

4.8.2.3.2 Bats

There are many threats to bats across the United States, of which the expansion of wind energy operations and white-nose syndrome (a fungal disease) are of particular importance. White-nose syndrome has decimated bat populations nation-wide, and precautions were urged to be implemented in New Mexico caves in 2018 (NPS 2018b). White-nose syndrome was confirmed to be one cause of death in bats in New Mexico during 2023 (BLM 2023).

Twenty-five species of bats from two families (*Vespertilionidae* and *Molossidae*) have been documented at SNL/NM using passive bio-acoustic monitoring and mist-netting (SNL 2011; Perry et al. 2012; Hauer et al. 2018; SNL 2022h; SNL 2023d; and KAFB 2023b). Two monitoring locations were established for continuous passive acoustic sampling: one at the Tijeras Arroyo Golf Course (TAGC) and one at Coyote Springs. Seasonal occurrences have been documented each year, often reflecting patterns of habitat use and migration of particular species (SNL 2020b; SNL 2021a; SNL 2022a; and SNL 2023d). Acoustic surveys conducted by DAF found that Kirtland had among the highest bat passes of 47 DAF installations during 2016–2018, particularly at the TAGC locations (Hauer et al. 2018). Bat diversity and activity rates are high at most SNL/NM acoustic monitoring sites (SNL 2018a; SNL 2019a; SNL 2020b; SNL 2021a; SNL 2022a; SNL 2023d; and Hauer et al. 2018). A maternal roost site study on SNL/NM-managed lands at the northernmost range of Southwestern myotis (*Myotis auriculus*) found that large diameter one-seed junipers were used as roost sites more than expected (Perry et al. 2012).

4.8.2.4 Insects

From 2003–2013, insect trapping was conducted using sticky and pitfall traps at six locations across SNL/NM-managed lands, yielding thousands of individual specimens. Collections ranged from 28 to 225 species, depending on the trapping site and year (SNL 2015c and SNL 2016b). Macroinvertebrate sampling was carried out in 2006–2010 as part of the Coyote Springs wetland monitoring, yielding dozens of macroinvertebrate taxa (Wickersham and Wickersham 2011).

Since 2009, 49 butterfly species have been observed at SNL/NM. Drought years have previously impacted survey results, with great variation in counts across years (SNL 2022h). Monarch butterflies (*Danaus plexippus plexippus*) have been observed onsite (SNL 2022h); this species is proposed for listing as threatened under the Endangered Species Act (ESA) (89 FR 100662). Additionally, habitat for Suckley's cuckoo bumblebee (*Bombus suckleyi*) may exist at SNL/NM, but no presence of the species has been confirmed. This species has recently been proposed as a federally endangered species and is found in certain prairies and grasslands (89 FR 102074).

4.8.2.5 Fish

Due to the arid nature of the site and lack of any significant perennial surface waterbodies, fish populations are not known to exist within KAFB except in TAGC ponds managed by KAFB (SNL 2015b). The only fish species at TAGC are catfish, sunfish, and carp (KAFB 2023b).

4.8.3 Other Special Status Species and Habitats

The ESA (16 U.S.C. §§ 1531–1544) authorizes the U.S. Fish and Wildlife Service (USFWS) to provide federal protection for threatened and endangered species. Under NEPA, both candidate

and proposed species require analysis to the same level of detail as listed species. However, federal candidates for listing as threatened or endangered do not receive legal protection under the ESA. Additionally, Species of Concern require further biological research to resolve their conservation status. While such species do not have legal protection under the ESA, USFWS seeks information on their status and cooperation in conserving them when possible.

NMDGF and the New Mexico Energy, Minerals, and Natural Resources Department's Forestry Division have authority to list threatened or endangered species and sensitive species under the New Mexico Wildlife Conservation Act (animals: NMWCA 1978; and plants: 19.21.2 NMAC). This statute does not apply to NNSA, but ecological services staff note presence of these species if identified during monitoring, as part of overall biological site management and baseline.

Table 4-11 lists species of concern, including federally listed or USFWS Birds of Conservation Concern known to occur or with potential to occur on SNL/NM-managed lands. A complete list of wildlife species observed on SNL/NM-managed lands is in Appendix A, Table A-21.

Table 4-11. Protected and Sensitive Species Known or with the Potential to Occur on SNL/NM-Managed Lands

Common Name	Scientific Name	Classification	Status	Habitat
Bald eagle	<i>Haliaeetus leucocephalus</i>	Birds	BGEPA	Grasslands, canyonlands, intermittent forests
Golden eagle	<i>Aquila chrysaetos</i>	Birds	BGEPA, BCC	Grasslands, canyonlands, intermittent forests
Western burrowing owl	<i>Athene cunicularia hypugaea</i>	Birds	BCC	Grasslands and open shrublands
Flammulated owl	<i>Otus flammeolus</i>	Birds	BCC	Ponderosa pine, mature woodlands
Long-eared owl	<i>Asio otus</i>	Birds	BCC	Dense coniferous woodlands, woodland edge
Clark's nutcracker	<i>Nucifraga columbiana</i>	Birds	BCC	Open coniferous woodlands
Lewis' woodpecker	<i>Melanerpes lewis</i>	Birds	BCC	Ponderosa pine
Olive-sided flycatcher	<i>Contopus cooperi</i>	Birds	BCC	Riparian forests, wetlands
Pinyon jay	<i>Gymnorhinus cyanocephalus</i>	Birds	PT, BCC	Pinyon-juniper woodlands
Southwestern willow flycatcher	<i>Empidonax traillii extimus</i>	Birds	FE	Riparian habitat, including willow, saltcedar, Russian olive
Black-chinned sparrow	<i>Spizella atrogularis</i>	Birds	BCC	Dry brushlands, sagebrush, rocky hillsides
Evening grosbeak	<i>Coccothraustes vespertinus</i>	Birds	BCC	High elevation coniferous forests
Grace's warbler	<i>Setophaga graciae</i>	Birds	BCC	Ponderosa woodlands
Virginia's warbler	<i>Leiothlypis virginiae</i>	Birds	BCC	Pinyon-juniper woodlands
Mexican wolf	<i>Canis lupus baileyi</i>	Mammals	ENE	Grasslands, forested areas, primarily coniferous trees

Common Name	Scientific Name	Classification	Status	Habitat
Tricolored bat	<i>Perimyotis subflavus</i>	Mammals	PE	Forested areas, primarily deciduous trees
Monarch butterfly	<i>Danaus plexippus</i> <i>Plexippus</i>	Insect	PT	Grasslands

BCC: USFWS Birds of Conservation Concern; BGEPA: Bald and Golden Eagle Protection Act; ENE: Experimental Non-Essential; FE: Federally Endangered; PE: Proposed Federally Endangered; PT: Proposed Federally Threatened; all birds listed in Table 4-11 also protected by Migratory Bird Treaty Act (MBTA).

Source: KAFB 2014; SNL 2015b; DAF 2014; Hauer et al. 2019; KAFB 2023b; SNL 2023d; eBird 2023; 87 FR 39348; 89 FR 100662; and USFWS 2024

4.8.3.1 Plants

No federal or state threatened or endangered plant species occur on SNL/NM (KAFB 2023b and NMDGF 2024a).

4.8.3.2 Animals

An informal USFWS Information for Planning and Consultation (IPaC) list for SNL/NM (IPaC 2023) contains seven species with potential to exist onsite: Mexican wolf (*Canis lupus baileyi*, experimental non-essential), New Mexico meadow jumping mouse (*Zapus hudsonius luteus*, endangered), Mexican spotted owl (*Strix occidentalis lucida*, threatened), southwestern willow flycatcher (*Empidonax traillii extimus*, endangered), yellow-billed cuckoo (*Coccyzus americanus*, threatened), Rio Grande silvery minnow (*Hybognathus amarus*, endangered, 50 CFR 17.11), and monarch butterfly (proposed threatened). Only the Mexican wolf, southwestern willow flycatcher, and monarch butterfly have been documented onsite, with the wolf and flycatcher considered uncommon and the flycatcher found onsite only during migration (SNL 2023d). All other ESA species identified by IPaC lack suitable habitat onsite and are therefore not expected. No critical habitats exist in the ROI. The following sections discuss these species, USFWS Sensitive Species, and state-listed species further.

4.8.3.2.1 Reptiles and Amphibians

No federally listed reptiles or amphibians are known to occur on SNL/NM-managed lands (KAFB 2013; McMurphy and Smith 2023; NMDGF 2024a). SNL/NM has observed various reptiles and amphibians onsite during regular observation and survey activities, including desert massasauga (*Sistrurus tergeminus edwardsii*), a species formally considered sensitive by USFS. (SNL 2019a and SNL 2023d). The desert massasauga is a rattlesnake that has been observed at SNL/NM and was previously proposed as a candidate species for listing on the Federal ESA (77 FR 47583; BLM 2019; and NMDGF 2024c). Surveys for desert massasauga used drift fences and road surveys. Thirty-eight individuals were pit-tagged in 2020–2023, a significant increase in captures over previous efforts (KAFB 2013; Latella et al. 2018 and 2019; and McMurphy and Smith 2023). Recent surveys expanded to focus trapping efforts on the southwest corner of SNL/NM-managed lands, with the highest densities observed at the west end of Magazine Road (McMurphy and Smith 2023) and in TA-III West (SNL 2019a and SNL 2023d).

4.8.3.2.2 Birds and Bats

In addition to the three federally identified IPaC species noted previously (Mexican spotted owl, southwestern willow flycatcher, and yellow-billed cuckoo) and the recently petitioned pinyon jay, the IPaC list for SNL/NM (IPaC 2023) includes 14 migratory bird species that could occur onsite and are USFWS Birds of Conservation Concern (USFWS 2021; refer to Table 4-11). Appendix A, Section A.4.8.3, Table A-21, includes Partners in Flight Conservation Concern Species (state and continental level) and New Mexico Avian Conservation Partners Species Conservation List. Table 4-11 provides a list of USFWS Birds of Conservation Concern.

Mexican Spotted Owl – Federally listed as Threatened: Sol se Mete Canyon habitat conditions for this species were investigated in 1993 (50 CFR 17.11). This investigation, which also included parts of the Lurance Canyon Burn Site, concluded that the existing habitat was not likely to support the Mexican spotted owl. Also in 1993, two nights of surveys for this species were conducted in Sol se Mete Canyon as part of threatened and endangered species surveys by the New Mexico Natural Heritage Program for SNL/NM. No evidence of the Mexican spotted owl was found during this survey or in surveys since (SNL 2015b and SNL 2023d).

Southwestern Willow Flycatcher – Federally listed as Endangered: This subspecies of flycatcher was listed as Endangered in 1995, but critical habitat does not exist on SNL/NM-managed lands (78 FR 34534, 50 CFR 17.11), and the subspecies has not been documented as breeding at SNL/NM (USFS 2022). Willow flycatchers (not confirmed as the subspecies) have been periodically observed during spring migration at SNL/NM, including occasional captures at the SC Dome monitoring location since the Monitoring Avian Productivity and Survivorship program has been underway (SNL 2017c; SNL 2018a; SNL 2019a; SNL 2020b; SNL 2021a; SNL 2022a; SNL 2023d; and KAFB 2023b). It is important to note that these species can breed in saltcedar (also known as tamarisk) and Russian olive, both invasive species (USFWS 2002); however, such trees are rare on SNL/NM-managed lands.

Western Yellow-Billed Cuckoo – Designated Critical Habitat for Distinct Population

Segment: On April 21, 2021, USFWS issued a final rule to list the western yellow-billed cuckoo (*Coccyzus americanus occidentalis*) in the western United States as a threatened distinct population segment under the ESA (86 FR 20798, 50 CFR 17.11). This species is found in riparian habitat, particularly cottonwood-willow riparian woodlands and has been reported in the Middle Rio Grande Valley and the Sandia Ranger District but has not been confirmed as breeding (USFS 2022). Riparian woodland vegetation on SNL/NM-managed lands is primarily limited to the upper reach of Arroyo del Coyote and the canyon drainages that feed into it and Tijeras Arroyo (CABQ 2014). This species has not been reported at SNL/NM (KAFB 2023b).

Pinyon Jay: Pinyon jays breed and winter on SNL/NM-managed lands, with breeding sites in withdrawn lands and wintering flocks documented around Starfire Optical Range and Manzano base (McMurray and Smith 2023). Defenders of Wildlife petitioned for the pinyon jay to be listed as an endangered or threatened species and critical habitat be designated under the ESA. On August 17, 2023 (88 FR 55991), USFWS issued a finding that the petition may be warranted but it will evaluate potential threats during a 12-month status review and issue findings to support whether petitioned actions are warranted, not warranted, or warranted but precluded.

Golden Eagles: The 1940 Bald and Golden Eagle Protection Act (BGEPA; 16 U.S.C. §§ 668–668d) protects bald and golden eagles, prohibiting the taking of adults and eggs or disturbance of nesting and feeding behaviors. Golden eagles have been observed recently on SNL/NM-managed lands, particularly in the Withdrawn Area, both as migrants and winter residents (SNL 2023d).

Migratory Birds: Birds found onsite, including those listed in Appendix A, Section A.4.8.3, also may enjoy protections under the Migratory Bird Treaty Act (MBTA) (16 U.S.C. §§ 703–712) and EO 13186. The MBTA, enacted in 1918, makes it unlawful without a waiver to pursue, hunt, take, capture, kill, or sell about 1,100 species of migratory birds.

Other Non-Federally Listed Birds of Conservation Concern: As previously stated, the Sikes Act provides a mechanism for DoD entities to develop resource management plans in consultation with USFWS. SNL/NM shares monitoring and surveillance data that are relevant to non-federally listed birds, such as state-listed threatened or endangered species like the peregrine falcon, gray vireo, and Bell’s vireo. Table 4-11 and Appendix A, Section A.4.8.3, Table A-21, give more information on species of conservation concern and their associated habitats.

Tricolored Bat: On September 13, 2022, the tricolored bat (*Perimyotis subflavus*) was proposed for listing under the ESA due to its vulnerability to white-nose syndrome (87 FR 56381). This species was possibly recorded in recent acoustic bat surveys at Coyote Springs and TAGC (SNL 2023d) but further confirmation is required due to the small number of recorded bat calls and potential call overlap with other closely related species.

Two other Forest Service Sensitive bat species have also been recorded in the Withdrawn Area: the spotted bat (*Euderma maculatum*) and the pale Townsend’s big-eared bat (*Corynorhinus townsendii*) (SNL 2020b).

4.8.3.2.3 Other Mammals

New Mexico Meadow Jumping Mouse – Federally listed as Endangered: On June 10, 2014, USFWS issued a final rule designating the New Mexico meadow jumping mouse (*Zapus hudsonius luteus*) as a federally endangered species (79 FR 33119, 50 CFR 17.11). The mouse is a small rodent associated with thick, tall grasses and sedges in wet areas. Researchers have observed a population at the Isleta Marsh south of SNL/NM-managed lands that appears to be isolated (USFWS 2020). Wetlands are very limited on SNL/NM-managed lands, as discussed in Section 4.8.4, and this species has not been reported at SNL/NM (KAFB 2023b).

Mexican Wolf – Federally listed as Endangered, Non-Essential Experimental: Mexican wolves were reintroduced in 1998 to part of their historic range, and in July 2022, revisions were made to their designation as Non-Essential Experimental (87 FR 39348, 50 CFR 17.11). For the purposes of consultation, Non-Essential Experimental populations are treated as threatened species on National Wildlife Refuge and National Park land (require consultation under Section 7(a)(2) of the ESA) and as a proposed species on private land (no Section 7(a)(2) requirements), but federal agencies must not jeopardize their existence (Section 7(a)(4)) (USFWS 2024). Mexican wolf recovery Zone 2, established in 2015, extends into the western portion of SNL/NM (USFWS 2022), but wolves have been observed only very rarely moving through SNL/NM-managed lands (Reynolds 2024).

Gunnison’s Prairie Dog – former Candidate Species: On February 5, 2008, USFWS assigned candidate status to Gunnison’s prairie dog in central and south-central Colorado, as well as north-central New Mexico, including SNL/NM (73 FR 6660). On November 14, 2013, USFWS announced that a 12-month review of data did not warrant listing Gunnison’s prairie dog as threatened or endangered. USFWS additionally decided to remove this species from its candidate list (78 FR 68660). Gunnison’s prairie dog colonies have been observed near TA-I and TA-II, on KAFB, and near the Eubank Corridor (SNL 2023d and McMurry and Smith 2023). However, prairie dogs have been experiencing population fluctuations on SNL/NM-managed lands in recent years, and extirpations have continued in residential areas and other parts of KAFB, with colonies disappearing from landfill grasslands, horse stables, and along Club Road (Chaon et al. 2020 and Conway and Locatelli 2021). Prairie dog management can be undertaken without removal, and relocations can be an effective strategy when human conflict arises. Additionally, prairie dogs can shift locations provided ample habitat is available. Prairie dog colonies were established in 2022 east of the landfill grasslands and in the southwest corner of KAFB, when a total of 281 individual prairie dogs were estimated on SNL/NM (McMurry et al. 2022).

4.8.4 Wetlands

EO 11990, as amended, and Section 404 of the Clean Water Act (CWA) (EPA 2024a) require federal agencies to minimize wetland destruction, loss, or degradation of wetlands and preserve and enhance natural and beneficial values of wetlands. While NNSA must comply with regulatory requirements of the CWA, no wetlands exist on SNL/NM-managed lands.

KAFB wetlands were designated as jurisdictional wetlands under Section 404 of the CWA, because their soils, hydrology, and vegetation met the regulatory definition (USACE 1987 and USACE 2018).

Natural spring-fed wetlands form a minor component of riparian habitat on KAFB, and wetlands cumulatively occupy about 9 acres according to the latest INRMP (KAFB 2023b). Surveys in 2006 determined that 10 jurisdictional wetlands exist at KAFB and are supplied by 15 springs or seeps, a reduction since the USACE 1995 survey (Table 1 in Marcus et al. 2006). The biggest wetland feature, Coyote Springs in Arroyo del Coyote, consists of several springs and seeps across an area of about 1 acre. Other wetlands on KAFB are much smaller with intermittent standing water. Coyote Springs and Sol se Mete Spring flow year-round, but all other springs within KAFB flow only intermittently. Sol se Mete, Lurance, and Burn Site Springs are in canyons of the DoD Withdrawn Area (Marcus et al. 2006). As noted in Section 4.8.2.2, Coyote Springs provides important habitat for at least 126 species of birds, including at least 18 wetland-dependent species (eBird 2023 and McMurry and Smith 2023).

No natural lakes or rivers are on KAFB, although there are several wetlands and springs. Since the delineations, additional springs and seeps have been encountered on KAFB-managed lands that require jurisdictional assessment. Six manmade ponds are on TAGC. (Marcus et al. 2006). Additional information regarding wetland and spring location is included in Appendix A, Section A.4.8.4.

Two artificial water sources (i.e., guzzlers) have been constructed on SNL-managed lands in woodland areas to provide water for wildlife. One of the wildlife water guzzlers is in Madera

Canyon, and the other is located about 1 mile northeast of Coyote Springs. Both guzzlers have a large apron collection area, and when precipitation falls on the apron, it is funneled directly into a covered water storage tank. The drinking troughs are then filled by underground gravity-fed hoses coming from the storage tanks; the flow is moderated by a float system at each guzzler (SNL 2015b and KAFB 2023b). Canyons with guzzlers, riparian, or wetland habitat are important to wildlife, providing food, water, and cover to many species. Water guzzlers have been placed near the Burn Site, in Sol se Mete Canyon, in the Four Hills area, and near the Facility for Acceptance, Calibration & Testing (FACT) Site (KAFB 2023b).

4.9 CULTURAL AND PALEONTOLOGICAL RESOURCES

This SWEIS analyzes cultural and paleontological resources within an ROI comprising SNL/NM, KAFB, and adjacent locations. Section 106 of the National Historic Preservation Act (NHPA) (54 U.S.C. §306108) requires federal agencies to consider the effects of their undertakings on historic properties. An “undertaking” is broadly defined in the NHPA as a project, activity, or program that has federal funds or permits or is approved by a federal agency (36 CFR 800.16(y)). An “adverse effect” means an alteration to the characteristics of a historic property qualifying it for inclusion in or eligibility for the NRHP (36 CFR 800.16(i)). A “historic property” is defined as any prehistoric or historic district, site, building, structure, or object included on, or eligible for inclusion on the National Register. This term includes artifacts, records, and material remains (54 U.S.C. §300308).

Cultural resources are physical manifestations of human behavior in time and space. They include expressions of human culture and history in the physical environment, which are important to culture and community. These resources are recognized as historic properties, which include prehistoric and historic archaeological sites, properties, structures, objects, and districts included in or eligible for inclusion in the NRHP at the national, state, or local level (NPS 1997 and NPS 1998). Historic properties of traditional religious and cultural importance to Indigenous Americans may be eligible for inclusion in the NRHP.

Before proceeding with any specific proposed undertaking (e.g., facility construction, DD&D project, other proposed actions), NNSA determines the Area of Potential Effect (APE) for the undertaking in accordance with NHPA. The APE is “the geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties” (36 CFR 800.16(d)). NNSA recognizes that its undertakings may have the potential to affect resources on adjacent lands as well, including those managed by KAFB, the Pueblo of Isleta, and the Forest Service. Accordingly, NNSA identifies consulting parties regarding cultural resources.

The NHPA does not mandate preservation of historic properties, but it does require that federal agencies consider adverse effects in their decision-making. As part of the SNL/NM Section 106 process, NNSA is required to consult with (1) the New Mexico State Historic Preservation Office (New Mexico SHPO) to “ensure that historic properties are taking into consideration at all levels of planning and development” (36 CFR 800.2(c)(1)), (2) tribal historic preservation offices and Indian tribes that attach religious and cultural significance to historic properties that may be affected by an undertaking (36 CFR 800.2(c)(2)), and (3) local governments with jurisdiction over the area in which the effects of an undertaking may occur (36 CFR 800.2(c)(3)). The

Advisory Council on Historic Preservation (ACHP) may consult regarding undertakings that affect historic properties (36 CFR 800.2(b)). Additionally, other stakeholders including local, state, and tribal entities and the public may be consulted, and NNSA plans to develop and coordinate with KAFB on a SNL/NM INCRMP or ICRMP.

Historic properties listed on the NRHP, or eligible for listing, have been documented and evaluated according to uniform standards from 36 CFR 60.4 and have been found to meet criteria of significance and integrity. Generally, cultural resources evaluated for eligibility are at least 50 years old, but there are exceptions to this standard for properties of exceptional significance (Criteria Consideration G, 30 CFR 60.4). Cultural resources that have undetermined eligibility are treated as eligible historic properties until a determination is made otherwise.

4.9.1 Cultural and Paleontological Context

As a federal agency, NNSA has a trust responsibility to recognized Indian tribes to protect tribal cultural resources and to consult with tribes if a federal action may impact such resources. Section 101(d)(6) of the NHPA provides that federal agencies consult with Indian tribes who either historically occupied a project area or may attach religious or cultural significance to historic properties. SNL/NM historic properties are influenced by four physiographic regions: the Southern Basin and Range to the west and south, the Colorado Plateau to the northwest, the Rocky Mountains to the north, and the Southern Plains to the east (Thelin and Pike 1991).

The New Mexico Historic Preservation Division (NMHPD), with guidance from the National Park Service (NPS), has developed six historic contexts for cultural resources in New Mexico: Precontact, Spanish Colonization, Mexican Period, Territorial Era, Statehood through the Great Depression, and Midcentury (NMHPD 2021). SNL/NM has developed its own Cold War historic themes specific to its cultural resources and historical context, such as Industry (e.g., Mining), Agriculture, Military, Transportation, Government, Water Control, and Other (e.g., Domestic). Only the historic contexts and themes relevant to SNL/NM are addressed hereafter.

Traditional Cultural Places (TCPs) are resources of traditional, religious, or cultural significance to tribes that can include architectural or archaeological resources, sacred sites, neighborhoods, geographic landmarks, flora or faunal habitats, mineral localities, or sites considered essential for the preservation of traditional culture (NPS 1998). If any TCPs are identified on SNL/NM-managed lands, SNL/NM considers the guidelines for evaluation and documentation in draft amended NRHP Bulletin 38 (NPS 2023).

It is estimated that 80–90 percent of cultural resources at SNL/NM have been surveyed. As of 2010, there were about 976 identified cultural resources: 206 archaeological sites and 770 facilities (Ullrich et al. 2010). Since 1936, SNL/NM has performed more than 170 small-scale archaeological inventories, recording about 206 archaeological (173 prehistoric and 33 historic) sites. Of the 206 known archaeological sites, 70 have been evaluated as eligible for NRHP listing under Criterion D (information value). Archeological sites at SNL/NM are found in less developed areas that have not been accessible to the public since the 1940s, and restricted access has likely contributed to their preservation. Human impacts such as vandalism, looting, and artifact removal may have occurred prior to DOE withdrawal of lands from the public and currently may still exist. Adverse effects from livestock grazing and mining, the two traditional

public uses most evident in the archaeological record, would have occurred prior to the withdrawals (SNL 2023d). This SWEIS does not include the exact location of prehistoric and historic archaeological resources because this is confidential information to which the public does not have access under provisions of the Archaeological Resources Protection Act of 1979.

Around 770 SNL/NM-owned or managed facilities constitute the historic built environment at SNL/NM (Ullrich et al. 2010). Refer to Appendix A, Section A.4.9, for additional information. Many properties considered in this SWEIS are of recent construction and not currently eligible for listing in the NRHP.

4.9.2 Prehistoric Resources

Prehistoric resources in New Mexico are typically defined as the physical remains of human activities prior to Spanish contact in AD 1540 (Precontact).⁶ Within SNL/NM-managed lands, these include lithic and ground stone scatters associated with hunting and gathering; lithic procurement areas; lithic, ground stone, and ceramic scatters associated with farming and foraging; field houses and check dams associated with farming; and small hamlets with roomblocks that are characteristic of prehistoric farming communities throughout the Rio Grande Valley. The New Mexico Archaeological Records Management Section identified 146 documented prehistoric sites within SNL/NM-managed lands, including 27 sites with evidence of occupations during multiple prehistoric time periods. Table 4-12 shows documented prehistoric sites by time period and NRHP eligibility as of 2024. Appendix A, Section A.4.9, offers general discussions of prehistoric resources by individual time periods.

Table 4-12. Prehistoric Sites by Time Period and NRHP Eligibility

Period	Eligible	Unevaluated	Not Eligible	Total (unit)
Paleo-Indian	5	1	1	7
Archaic	13	8	4	25
Late Archaic–Early Agricultural	7	4	2	13
Ancestral Puebloan	50	27	18	95
Unknown Prehistoric	6	15	12	33
TOTALS	81	55	37	173

Note: Some sites are multi-component and reflect multiple periods of occupation. In these instances, the site is included in each period represented. Table does not include 33 historic archaeological sites.

Source: Spangler 2024.

4.9.3 Historic Indigenous

Historic resources attributed to specific indigenous groups in New Mexico are rare on SNL/NM-managed lands. Three sites have potential historical affiliation to modern Puebloan groups. Kapo Black potsherds, a Northern Rio Grande Historic Plain Ware type dated from AD 1650–1950 (Pottery Typology Project 2024), were observed at site LA 38136 (NRHP eligible). Sankawi Black-on-cream potsherds, a Northern Rio Grande Historic Biochrome Ware that dates from AD 1500–1690 (Pottery Typology Project 2024), were observed at LA 81719 (not NRHP eligible),

⁶ The beginning of the prehistoric period is placed at AD 1600 within the constructs of the Rio Grande Classification System used in this analysis.

which includes a scatter of lithics and ceramics that also had an Archaic point. The third site, LA89368, is more ambiguous, with an artifact scatter of Puebloan affiliation assigned to the “Post Pueblo Revolt” that occurred between AD 1680 and AD 1696 (Sanchez et al. 2013). Attempts to find this site again after its initial discovery have been unsuccessful due to erosion and/or lack of specific locational information.

4.9.4 Historic Non-Indigenous

Historic resources attributed to non-indigenous groups are by far the most common historic properties found on SNL/NM-managed lands. These have been identified through two processes: archaeological inventories conducted as part of NHPA Sections 106 and 110 compliance activities and historic properties inventories conducted by SNL/NM. Historic sites identified during archaeological inventories are mostly associated with farming and ranching, mining, domestic activities (trash dumps), and military activities associated with nearby KAFB.

4.9.4.1 Historic Sites (Archaeological)

All historic contexts defined by NMHPD (2021) have been identified within SNL/NM-managed lands, although the Spanish Colonization and Mexican Period contexts are represented by a single mining site (LA 47869) that had artifacts and features attributed to all five historic contexts. The New Mexico Archaeological Records Management Section identified a total of 76 sites (including 33 archaeological sites) that are historic in nature or are sites where historic artifacts and/or features occur alongside prehistoric artifacts and/or features (refer to Appendix A, Section A.4.9). Most historic artifacts date from about AD 1912–1945, or the beginning of the Statehood era to the end of World War II.

Mining (Industry) is the most common SNL/NM historic theme associated with archaeological sites; resources include mine shafts, adits (horizontal or nearly horizontal passages to underground mines), tailing piles, prospecting pits, and mining camp detritus. Domestic sites and sites related to agriculture are common. Five sites are associated with more than one historic theme. Other historic resources include roads, a government survey benchmark, a flood control development, and three sites associated with nearby KAFB. More information on sites related to SNL/NM historical themes is in Appendix A, Section A.4.9.5.

4.9.4.2 Historic Properties

SNL operations began in 1945 as Z Division, the ordnance design, testing, and assembly arm of Los Alamos Scientific Laboratory, becoming a separate branch and renamed Sandia Laboratory in 1948. Sandia Laboratory operations existed within the Sandia Base (Albuquerque Army Air Base), which later became KAFB. Access to the military installation (and Sandia Laboratory) was restricted after KAFB construction. Post-1945 historic properties are thus related to KAFB and SNL/NM activities.

SNL/NM is responsible for about 770 facilities that are historically significant or have the potential to be historically significant in the future (refer to Appendix A.4.9). Over half fall into seven SNL/NM-proposed historic operational districts with weapons and non-weapons research themes (Ullrich et al. 2010). Table 4-13 shows the distribution of historic properties among these

proposed districts. NNSA has not consulted with the New Mexico SHPO or obtained NRHP listing for any of these districts.

NNSA has determined that 83 of these 770 facilities are eligible for listing on the NRHP; the New Mexico SHPO concurred with 75 of those determinations. The remaining facilities have not been evaluated; however, unevaluated facilities should be treated as potentially eligible until a determination is made. NNSA has also determined that 76 SNL/NM facilities are not eligible for listing, and the New Mexico SHPO has concurred with 74 of those determinations.

SNL/NM cultural resources staff periodically update these numbers as additional structures reach 50 years old or are determined to be exceptionally significant to the nation’s history at less than 50 years old (NPS 1997). Potential impacts from new construction, renovations to facilities, and maintenance activities are reviewed with the New Mexico SHPO.

Table 4-13. SNL/NM Historic Properties ^a by Proposed Historic District

Historic District	NNSA Determined Eligible	NNSA Unevaluated	NNSA Determined Not Eligible	New Mexico SHPO Concurred Eligible ^b	New Mexico SHPO Concurred Not Eligible ^b
Aerial Cable	3	4	0	3	0
Early Sandia	29	94	8	26	7
Explosive Testing	8	50	2	3	2
Solar Thermal Test Facility	4	18	0	4	0
Pulsed Power	4	99	3	4	3
Reactor Complex	9	15	1	9	1
TA-III	24	99	22	24	22
Non-District Buildings	2	232	40	2	39
TOTALS	83	611	76	75	74

a. Historic properties as defined in NHPA 54 U.S.C. §300308.

b. New Mexico SHPO concurrence refers to the New Mexico SHPO’s formal concurrence with NNSA site eligibility determinations; unevaluated sites are considered eligible until determined otherwise.

Source: SNL 2023g.

4.9.5 Paleontological Resources

Paleontological resources are protected by various statutes, including the Paleontological Resources Preservation Act (16 U.S.C. §§ 470aaa – 470aaa-11) and the Archaeological Resources Protection Act (16 U.S.C. §§ 470aa – 470mm). Paleontological resources are defined as the “fossilized remains, traces, or imprints of organisms, preserved in or on the earth’s crust, that are of paleontological interest and that provide information about the history of life on earth” (16 U.S.C. § 470) (Oxford 2024).

The fossil record of New Mexico is exceptionally complete and spans almost the entire stratigraphic column (Murray 1974). However, no paleontological resources have been identified on SNL/NM-managed lands. If paleontological resources are identified, they would be managed in accordance with all applicable requirements.

4.10 TRAFFIC AND TRANSPORTATION

This section describes the primary methods and routes used to transport SNL/NM-affiliated employees, commercial shipments, and hazardous and radioactive material shipments; transportation packaging; transportation accidents; and onsite/offsite traffic volumes. In addition, SNL/NM's transportation infrastructure, including its onsite parking and roadway configurations, is taken into consideration. Additional detailed information is provided in Appendix A, Section A.4.10.

4.10.1 Transportation Infrastructure

The primary means of transportation to SNL/NM is via motor vehicle. The nearest major commercial bus terminal is in downtown Albuquerque, about 8 miles driving distance from SNL/NM-managed lands. The nearest commercial rail connection is likewise located in downtown Albuquerque, about 8 miles from the site's main entrance. No rail-based facilities of any kind are available on KAFB or SNL/NM proper. The Burlington-Northern & Santa Fe railroad discontinued use of its spur into KAFB in 1994. SNL/NM does not currently utilize railways for any commercial shipping needs. SNL/NM is served by the City of Albuquerque bus transit system, *ABQ Ride*, from points around Albuquerque to KAFB and SNL/NM.

Additionally, Albuquerque is served by the New Mexico *Rail Runner Express*, which is a regional rail transit service. It serves primarily as a commuter rail line between downtown Albuquerque and outlying cities such as Santa Fe, Los Lunas, and Bernalillo. Commuters to SNL/NM have the option to ride the *Rail Runner* to the Alvarado Transportation Center in downtown Albuquerque, or to the station/park-and-ride location at Rio Bravo, and then take a city bus to SNL/NM-managed lands (NMDOT 2024).

Access to KAFB and SNL/NM consists of an urban road network maintained by the City of Albuquerque. The four major north-south arterials providing access to KAFB/SNL/NM are San Mateo Boulevard, Louisiana Boulevard, Wyoming Boulevard, and Eubank Boulevard. In 2021, there were 15,864 traffic accidents in Bernalillo County resulting in 143 fatalities and 7,326 injuries (NMDOT 2023). In 2021, 26 motor vehicle accidents occurred within KAFB proper, with nine injuries and no fatalities reported (NMDOT 2023). More than 21,600 motor vehicle accidents occurred in Bernalillo, Sandoval, Valencia, Santa Fe, and Tarrant Counties combined, resulting in 204 total fatalities. When accidents are considered per 100 million vehicle miles traveled, travel in Bernalillo County was the most dangerous within the transportation ROI during 2021; Bernalillo County likewise had the highest accident fatality rate among the assessed five-county area.

I-40 and I-25 provide primary access to Bernalillo County. Given the wide and diverse expanse of the greater Albuquerque area, as well as the considerable extent of pass-through traffic to/from points (in all directions) across the United States, only a very modest fraction of county local traffic volume on these freeways is primarily associated with SNL/NM activities. Commuter traffic originates from all across Bernalillo County, points north, south, east, and west, with the vast majority of commuters residing within a 30-mile radius of the site. A small number of SNL/NM personnel do, however, commute to SNL/NM from Santa Fe County to the northeast, from Sandoval County to the north, from Valencia County to the south, and from

Torrance County to the southeast. SNL/NM is accessible only by roadways. KAFB and SNL/NM are essentially bounded by University Boulevard to the west, Gibson Boulevard to the north, Tribal Road-201 to the south, and the Manzano Mountain Range to the east.

Eubank, Gibson, Wyoming, and San Mateo Boulevards are the principal Albuquerque city roads used to access the KAFB and SNL/NM entry gates. During CY 2018–2022, the estimated annual average daily traffic (ADT) for weekday trips anywhere along the length of Eubank Boulevard between Innovation Parkway and the Eubank Gate was 22,279; 17,062 was estimated along the length of Gibson Boulevard between Louisiana Boulevard and the Gibson Gate; 7,034 was estimated along the length of Wyoming Boulevard between Susan Avenue and the Wyoming Gate; and 53,310 was estimated at the very widely used intersection of Gibson Boulevard and San Mateo Boulevard located near the Truman Gate. These values were projected based on assumptions about transit and carpooling use and making a single roundtrip (two trips) using these routes each weekday.

4.10.2 Aviation

The primary commercial airport in proximity to SNL/NM-managed lands is the Sunport, which is adjacent to KAFB. KAFB uses runways and taxiways owned by the Sunport through a joint-use lease agreement. The Sunport is located in the northwest corner partly within and adjacent to KAFB, and several runways are shared between KAFB and the Sunport. Several military and SNL/NM test ranges are also located within KAFB boundary, but all are at least 0.6 mile (1 km) from any of SNL/NM's nuclear or radiological facilities. Landing and takeoff patterns for the various runways at the Sunport (or airborne-projectiles [and systems] originating from KAFB's test-ranges [e.g., UASs, tethered and/or free balloons]) do not affect operations at SNL/NM in any discernible capacity, with the possible exception of occasional acoustical/noise influences.

SNL/NM use of aviation-based shipping is discussed in Appendix A, Section A.4.11.2.

4.10.3 Onsite Circulation and Parking

SNL/NM and NNSA personnel enter KAFB through five main access points: the Carlisle, Truman, Gibson, Wyoming, and Eubank Gates. About 30,000 privately owned vehicles, on average, entered and exited through these gates daily over the recent years prior to the COVID-19 pandemic, with about two-thirds of those vehicles having direct affiliation with SNL/NM and/or NNSA activities (AAFES 2010), thus equating to about 20,000 net vehicles related to SNL and/or NNSA activities; such daily counts, however, have significantly decreased within the realm of around 20 percent to lower present-day numbers due to the wide-ranging remote work and telecommuting policies initially enacted site-wide in response to the pandemic. As such, it is assumed that on the order of about 15,000 net vehicles supporting SNL/NNSA activities enter and exit KAFB's gates on a daily basis at present.

The five entrance gates regularly experience traffic delays (typically between 5 to 10 minutes, and occasionally upwards to as much as 40 minutes) during morning peak hours due to security-check requirements. All gates are staffed by KAFB security forces who conduct a security check of each incoming vehicle. Outbound vehicles are not screened and, therefore, have a limited effect on KAFB outbound traffic.

4.10.3.1 Parking

At present, there are about 80 acres (0.125 mi²) of paved parking lots on SNL/NM-managed lands, designated to serve about 13,000 employees (i.e., Laboratory employees, contract employees, NNSA personnel, visitors with NNSA offices, and others, not including construction workers and consultants with sporadic presence). In addition to the vast expanse of paved lots across the site, several graded unpaved areas are available. Parking at some locations can be challenging on peak days and times but is generally adequate at most facilities.

4.10.4 Hazardous and Radiological Materials Shipments

Hazardous, radioactive, industrial, commercial, and recyclable materials, including wastes, are transported to, from, and on SNL/NM during routine operations. Hazardous materials include non-radioactive commercial chemical and construction products and wastes that are regulated and controlled based on applicable hazard classes established by the U.S. Department of Transportation (DOT). Radioactive materials include SNM (e.g., plutonium, enriched uranium), TRU material and waste, and other miscellaneous radioactive materials. Offsite shipments are primarily carried out by commercial carriers (including standard commercial truck and NNSA secure tractor-trailer). Numerous regulations and requirements govern the transportation of hazardous and radioactive materials, including those of the U.S. Nuclear Regulatory Commission (NRC), DOT, DOE, and SNL/NM.

4.10.4.1 Onsite Transfers

Onsite transfers of radioactive and hazardous materials and wastes regularly occur throughout SNL/NM-managed lands. Off-normal conditions during the loading, unloading, handling, and transit thereof may result in the inadvertent release of such materials to the environment. Although transfers of significant quantities of hazardous material seldom occur, SNL/NM's Hazardous Material Packaging and Transportation Program, Radiological Protection Program, Nuclear Criticality Safety Program, Industrial Safety Program, and Emergency Management Program ensure controls are commensurate with potential hazard levels. For example, a 3,000-gallon tanker-truck routinely delivers diesel fuel to generators and vehicles at TA-V; strict administrative controls/protocols for truck arrival and fuel off-loading are accordingly implemented to ensure the safe delivery/transfer of large fuel quantities. Similar compliance requirements with appropriate controls are regularly imposed at other SNL/NM-owned and -managed facilities for the handling of various other chemicals, compressed-gases, and hazardous wastes.

Onsite hazardous and radioactive material transfers are conducted in conformance with SNL's Transportation Safety Document and/or, if applicable, DOT regulations. A transfer is considered onsite if both the origin and destination are at SNL/NM. These transports are supported by a variety of SNL/NM-operated vehicles depending on the quantity and the hazard of the material being transferred. Vehicles range from SNL/NM-owned pickup trucks to NNSA-owned safe-secure trailers. Maintenance of these vehicles is closely monitored for physical performance as well as security.

The radioactive materials transported onsite between and among the SNL/NM-managed lands are of limited quantities, travel short distances, and are on roads closed to the general public. Any impacts from these transportation activities are assessed as part of normal site operations. For example, worker doses from handling and transporting radioactive materials are typically analyzed as part of normal SNL/NM site operational activities. Historical measurements across the NNSA complex have regularly shown that radiation doses to drivers are, on average, less than 1 mrem per onsite material transport/shipping endeavor, regardless of travel distance (NNSA 2008b).

4.10.4.2 Offsite Shipments

As designated by the State of New Mexico and governed by 49 CFR 177.825, I-40, I-25, and NM-285 are the primary routes for transporting hazardous and radioactive materials to and from SNL/NM within the state (49 CFR Part 177).

Offsite transport of hazardous and radioactive materials from SNL/NM almost exclusively occurs via commercial carriers. SNL/NM ships offsite all DOT 49 CFR hazard classifications. Radioactive materials (Class 7) transported offsite include, but are not limited to, plutonium, uranium, various small-scale sources, and small quantities of activation products. As discussed above, shipments must meet applicable DOT and DOE regulations and requirements.

Hazardous and radioactive wastes, including but not limited to low-level and TRU wastes, are also transported offsite from SNL/NM. During the period 2018–2021, two shipments of TRU waste were made to WIPP outside of Carlsbad, New Mexico; 30 total shipments of LLW/mixed low-level waste (MLLW) were made to various TSDFs. An estimated 182 total shipments of hazardous waste shipments were made to various TSDFs from 2018 through 2021. Appendix A, Section A.4.10.3 provides additional information on numbers of shipments to the various receiving facilities for each waste category. The two TRU waste shipments to WIPP comprised a total of 2,044 pounds gross weight. As of the end of FY 2022, about 2.30 yd³ of mixed TRU (MTRU) wastes subject to the Federal Facility Compliance Order (FFCO) remained onsite designated for eventual transport to WIPP (SNL 2023d).

DOE and NNSA regulations require that safe-secure trailers be used for offsite shipments of SNM, weapons components, and explosive-like assemblies in NNSA custody. Safe-secure trailers are similar in appearance to commercial tractor-trailers but are equipped with unique security and safeguard features that prevent unauthorized cargo removal and minimize the likelihood of an accidental radioactive materials release should a vehicle accident occur. Classified shipments are made in safe-secure trailers. Specific details regarding SNM shipping requirements and the different types of SNM categories to be shipped from and to SNL/NM are provided in Appendix E.

DOT and/or NRC packaging specifications comprise the primary regulatory approach to promoting safety from radiological exposure during offsite transportation of radioactive materials. Transportation packaging for radioactive materials is designed, constructed, and maintained to contain and shield its contents during transport conditions. For highly radioactive material such as SNM or remote-handled TRU waste, packaging must contain and shield its contents in the event of a severe accident condition. The type of packaging used is determined by

the total quantity and activity of the radioactive material. Four basic types of packaging are used: Excepted, Industrial, Type A, and Type B. Appendix E discusses additional details of packaging requirements for all shipment types and material categories.

4.11 INFRASTRUCTURE

Site infrastructure or general-purpose infrastructure includes physical resources and services required to support SNL/NM facility construction and operation.⁷ Utility infrastructure includes electrical power, fuel (natural gas, petroleum), water supply, sanitary wastewater systems, and telecommunications. SNL/NM procures electricity, natural gas, and water via an interagency support agreement with KAFB from external utility suppliers. The sanitary sewer connects to the City of Albuquerque’s network. SNL/NM purchases petroleum fuels independently from KAFB.

4.11.1 Electricity

NNSA sources electrical energy for SNL/NM via an interagency agreement with KAFB established with the Western Area Power Administration (WAPA). WAPA engages in power purchase agreements to obtain electrical energy from a wholesale provider that supplies this power to the Public Service Company of New Mexico (PNM), which further distributes it to SNL/NM and KAFB leveraging PNM’s transmission infrastructure. Onsite, electric lines above and below ground feed 20 substations across both KAFB and SNL/NM. SNL/NM maintains about 115 miles of electrical transmission/distribution lines. SNL/NM’s average yearly electrical consumption over the last decade is about 256,000 megawatt hours (MWh), as highlighted in Table 4-14 (SNL 2020c). In 2024, SNL/NM site-wide electrical consumption was approximately 286,000 MWh; this value serves as the baseline for analysis.

Table 4-14. SNL/NM Electrical Consumption (in MWh)

FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022
242,871	240,383	245,420	247,263	245,298	242,537	252,011	266,405	273,341	280,328

Source: SNL 2023h.

Overall site capacity is about 104 MW, based on combined capacity of five 115 kilovolts (kV) SNL/NM substations, along with total capacity of TA-III and TA-V substation transformers.⁸

4.11.1.1 Energy Management

SNL/NM continues to invest in many energy reduction initiatives, including buildings and development certified by Leadership in Energy and Environmental Design (LEED); building automation system upgrades; monitoring via energy analytics software; heating, ventilation, and

⁷ General-purpose infrastructure, per DOE Order 430.1C (DOE 2020a), includes “active, real property assets providing functions, services, or utilities essential to enable or support the Department’s mission at a Site. These assets are not exclusively dedicated to specific or explicit Program requirements or core capabilities; rather, these assets support multiple mission needs. [General purpose infrastructure] does not include Mission Unique Facilities; User Facilities; or Programmatic Real Property.”

⁸ Electrical consumption, measured in megawatt hours (MWh), reflects the total amount of electricity used over time, whereas peak load, measured in megawatts (MW), represents the maximum rate of electricity demand at a given moment that the site’s infrastructure must be capable of supporting.

air condition (HVAC) recommissioning; EV acquisitions and charging station installation; smart labs program; and light-emitting diode lighting upgrades.

Based on DOE and NNSA energy management goals, SNL/NM has worked toward an energy intensity-reduction goal of 30 percent by the end of FY 2025 from a 2003 baseline. It partly achieved that goal in 2015 by implementing many large energy conservation measures with short payback periods. However, it has failed to meet reduction goals due to low utility rates and uncertain project funding for future onsite energy production with longer payback periods.

To achieve energy management objectives, SNL/NM has incorporated energy-saving features into its design standards, such as using pre-cooling through evaporative cooling and using free cooling by leveraging outside air as a cost-free cooling resource as appropriate.⁹ This method of evaporative cooling acts as an initial treatment for chilled water-cooling systems, substantially decreasing energy requirements throughout the year, except during monsoon season, June 15 to September 30 (SNL 2020c). Total onsite electrical generation was 5,169 MWh for the period 2017-2022, which represented 0.3 percent of the total onsite electrical usage for the same period.

From 2013–2022, SNL/NM built 25 new facilities totaling about 670,000 square feet to LEED or Guiding Principles building certification standards. SNL/NM has 1.3 million square feet of LEED/Guiding Principles certified buildings, 19 percent of the total site footprint (SNL 2023i).

4.11.2 Fuel

Natural gas serves as the main energy source for heating facilities and supports SNL/NM R&D initiatives. Symmetry Energy Solutions, LLC, supplies natural gas delivered in pipelines that are maintained and operated by New Mexico Gas Company, which supplies KAFB and SNL/NM. New Mexico Gas Company distributes natural gas to three locations on KAFB to which SNL/NM is connected. KAFB and SNL/NM have about 496,000 primary linear feet of natural gas mains. SNL/NM maintains about 4.5 miles of gas lines. KAFB monitors use and allocates distribution based on projected use. Table 4-15 shows total annual natural gas usage.

Table 4-15 SNL/NM Natural Gas Usage (in thousand cubic feet)

FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022
269,108	278,197	267,587	262,737	253,426	261,842	292,383	284,974	299,610	302,471

Source: SNL 2023h.

The rural areas of the installation, which are not covered by the natural gas distribution network, depend on propane as their fuel source. Propane is transported to these areas and stored in dedicated local storage tanks. Table 4-16 shows propane usage.

⁹ Evaporative cooling should be considered as a supplemental source of cooling for office and lab applications and as a primary cooling option for warehouses, shops not requiring close (plus or minus 5°F) temperature controls, nonresidential-size kitchens, makeup air ventilation units, and mechanical equipment spaces (SNL 2024g).

Table 4-16. SNL/NM Propane Usage (in 1,000 gallons)

FY 2017	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022
168	144	156	183	145	175

Source: SNL 2023h.

SNL/NM's fuel needs that are not satisfied by natural gas and propane are met with petroleum fuels (gasoline and diesel). SNL/NM possesses 480 gallons of tank storage and 1,180 gallons of truck storage for gasoline, and 2,000 gallons of tank storage¹⁰ and 1,200 gallons of truck storage for diesel. Approximate consumption of gasoline and diesel is about 310,000 gallons annually.

4.11.3 Water

Groundwater beneath SNL/NM and adjacent regions is the primary drinking water source for SNL/NM, KAFB, adjacent sections of Albuquerque, and the Pueblo of Isleta. The KAFB area houses groundwater in saturated, unconsolidated geological material and fractured and porous bedrock. Local groundwater recharge mainly occurs via arroyo water infiltration during brief storm events, estimating a recharge range between 0.004 to 0.1 inch per year. Excessive pumping from city wells, KAFB, and water supply sources near KAFB's northern boundary and across the Albuquerque-Belen Basin surpasses the groundwater recharge rate, but, through conservation and proper environmental reuse management, the Regional Aquifer has been recovering. Withdrawals exceeding the recharge rate have caused continuous decline in groundwater levels beneath the site (SNL 2020c).

Water is supplied to KAFB by six groundwater wells and two distribution systems that have a collective water-pumping maximum capacity of 8.1 million gallons per day (mgd). The installation pumps an average of 5.5 mgd of treated, potable water through 160 miles of distribution mains. In 2020, KAFB pumped a total of 789 million gallons of water from these wells. The installation also purchased 83,500 gallons of water from the Albuquerque Bernalillo County Water Utility Authority (ABCWUA) during 2021 (DAF 2021).

4.11.3.1 Domestic (Potable) Water

Water uses at SNL/NM encompass several key functions such as fire protection, industrial and process use, cooling, irrigation, and sanitary use. SNL/NM relies on primary and secondary water suppliers. Primarily, SNL/NM procures potable water from KAFB, and ABCWUA serves as a secondary water source during high water demands or for alternate water supply needs.

KAFB is responsible for managing and operating onsite water supply and distribution system, which includes the main booster pump station, storage reservoirs, and wells. KAFB draws water from the Albuquerque Basin Regional Aquifer via six municipal wells. Water supplied by ABCWUA is either drawn from the Albuquerque Basin Regional Aquifer or diverted from the Rio Grande. In 2008, ABCWUA completed the San Juan-Chama Drinking Water Project. This \$400-million initiative consists of a diversion dam and intake structure, pump station, 8 miles of raw water pipeline, a water treatment plant with an 80-million-gallon daily capacity, and

¹⁰ More above-ground diesel storage is being considered at TA-II to support operations requirement continuity.

38 miles of distribution pipeline. This project diversified ABCWUA’s sole dependence on the groundwater aquifer, reducing extraction pressure and facilitating natural recharge.

KAFB’s current peak day use is about 3.3 mgd. The current upper limit is about 4.5 to 5.0 mgd to allow for water quality standards to be met.

SNL/NM water consumption (shown in Table 4-17) has remained relatively constant over the past decade, averaging 310 million gallons annually. SNL/NM’s onsite water storage is limited to two large tanks, a 200,000-gallon and a 700,000-gallon storage tank; both tanks contain potable water for fire protection (SNL 2020c).

Table 4-17. SNL/NM Water Usage (in millions of gallons)

FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022
305	317	291	264	291	348	364	314	293	321

Source: SNL 2023h.

4.11.3.2 Sanitary Wastewater

SNL/NM wastewater is categorized into two types: sanitary and industrial discharges. Sanitary waste streams, also referred to as “domestic,” comprise wastewater from restrooms, showers, food service areas, and other routine human activities. Industrial discharges are generated from general industrial or laboratory processes and operations. These discharges are generally more complex and may include various chemicals, heavy metals, or other contaminants.

SNL/NM personnel maintain six wastewater monitoring stations permitted by ABCWUA, which correspond to six permitted outfalls where the SNL/NM sewer system connects to ABCWUA’s sanitary sewer line. SNL/NM releases about 700,000 gallons of water daily into the public sewer system from manufacturing processes and routine sanitary activities. This water is directed to the ABCWUA wastewater treatment facility, where it is treated alongside other city sewage.

Post-treatment water discharges into the Rio Grande, roughly 0.7 miles north of Tijeras Arroyo. Table 4-18 shows data on 2022 annual SNL/NM wastewater flow and delineates the six outfalls.

Table 4-18. 2022 Permitted Wastewater Flows (in gallons)

Permit	Waste Stream Process	Total Flow
Permit 2069A (TA-I, TA-II, and TA-IV)	All waste streams. ^a Includes flow from MESA.	174,218,924
Permit 2069G (MESA)	Laboratory industrial process acid waste from Microelectronics Development Laboratory activities.	133,125,851
Permit 2069F (northwest TA-I)	All waste streams. Includes flow from CINT and KAFB buildings located west of TA-I.	37,794,684
Permit 2069K (TA-III, TA-V, remotes)	All waste streams and radiological screening of TA-V process water at Liquid Effluent Control System. Includes flow from the Lovelace Respiratory Research Institute South Campus, a private company located on KAFB.	29,069,710
Permit 2238A (CINT)	Laboratory industrial process acid waste from CINT.	8,164,760
Permit 2069I (Bldg. 905, east TA-IV)	All waste streams.	8,053,992
TOTAL ^b (excluding 2238A & 2069G)		249,137,310

a. “All waste streams” includes both sanitary and industrial discharges.

b. The total excludes (1) MESA (permit 2069G) because all MESA flow also feeds through the permit 2069A outfall and (2) CINT (permit 2238A) because all MESA flow ultimately feeds into sewer infrastructure connected to the 2069F

monitoring outfall. (These are tracked separately for regulatory reasons.) KARB's sewer infrastructure is interconnected, so it is not possible to fully separate SNL/NM flow from KAFB and Lovelace Respiratory Research Institute flow, and this total is consequently expected to be an overestimation.

Source: SNL 2023h.

Some facilities and operations in the installation's remote areas are not serviced by the sanitary sewer system; they use isolated, onsite septic systems to treat and dispose of wastewater.

4.11.3.3 Steam and Thermal Water

SNL/NM houses an abandoned steam piping system. Currently, only two buildings in TA-I use steam in small humidification systems, but not for heating. Thermal water (chilled water) is in a recycled loop and is consumed in minimal quantities within cooling towers (SNL 2023a, 2023i).

4.11.3.4 Water Management

FY 2022 potable water intensity (water usage to square footage ratio) was 50 gal/ft², a 33 percent decrease from the 2007 baseline, but a 9 percent increase from 2021 (46 gal/ft²) (SNL 2023i). MESA's deionized water system¹¹ independently accounted for 22 percent (71 million gallons) of the site's overall water consumption. MESA's water usage would be markedly higher if not for a reclamation system that recycles about 12 million gallons of spent water annually for use in the facility's air scrubbers. Other operations in MESA facilities and CUBs collectively accounted for 5 percent (16 million gallons) of SNL/NM's total water consumption.

4.12 MATERIALS MANAGEMENT AND WASTE MANAGEMENT

4.12.1 Materials Management

SNL/NM's materials management operations are conducted pursuant to DOE, NNSA, federal, state, and local laws, policies, and regulations. Regulatory oversight lies with federal, state, and local agencies. SNL/NM uses radioactive materials, chemicals, and explosive materials in scientific and weapons R&D, diagnostic research, and properties of materials research.

NRC categorizes quantities of SNM into three main levels according to risk and potential for use in a fissile explosive or in production of nuclear material for use in a fissile explosive. These safeguard categories are SNM Category I designating strategic quantities; SNM Category II designating quantities of moderate strategic significance; and SNM Category III designating quantities of low strategic significance (NRC 2020). NNSA uses a similar approach to categorize SNM managed at its locations. These groupings, again based on mass and form of SNM present, are designated Security Categories I–IV and are used to establish types and levels of security, control, and accounting measures required in management of these materials. SNL/NM does not have or use radioactive materials that are Category I SNM.

¹¹ Deionized water systems remove ions and impurities, using specialized filters, resins, reverse osmosis, and/or ultraviolet disinfection to achieve a high degree of water purity for various mission requirements.

NNSA SNM Security Categories

NNSA provides SNM safeguards and security via a cost effective, graded approach. SNM quantities stored at NNSA sites are categorized into Security Categories I–IV, with the greatest quantities in Security Category I and lesser quantities in descending order in Security Categories II–IV.

SNL/NM operations use a range of hazardous chemicals in small and large quantities. Hazardous chemicals are managed via SNL/NM's chemical safety program which ensures that hazard information and controls are available to workers, and chemicals are used in a manner to prevent worker exposure and ensure safety. SNL/NM uses a comprehensive chemical information tool to track workplace chemical and biological containers by location, which improves the ability to share chemicals and reduce waste and helps minimize chemical purchases and waste disposal expenses. Appendix A, Section A.4.12.1.1, contains more information on the tool. The nature of SNL/NM activities is such that chemical inventories can change significantly over time and from facility to facility as programs change or research findings dictate changes in direction.

The following general chemical types, many using DOE designations, are used and stored at SNL/NM: corrosives (liquids, solids, gases); toxic substances (including gases); flammables and combustibles (solids, liquids, gases); nonflammable gases; water reactives, pyrophorics, and spontaneously combustibles; oxidizing substances; organic peroxides; and explosives.

SNL/NM uses explosives in various R&D and test applications, which involve activities including synthesis and formulation, characterizations, machining, and detonations. SNL/NM uses a comprehensive explosives safety program to manage explosives, with DOE-STD-1212-2019, Change Notice No. 1 (DOE 2021a), as the controlling document.

4.12.2 Waste Management***4.12.2.1 Overview of Waste Management at SNL/NM***

Waste management activities at SNL/NM consist of treating, storing, and preparing for offsite disposal all wastes in accordance with applicable federal and state regulations, permits obtained under regulations, and DOE or NNSA orders and directives. Waste categories generated onsite during normal operations include radioactive waste (including LLW, MLLW, TRU waste, and MTRU waste), RCRA hazardous waste, Toxic Substances Control Act (TSCA) waste (primarily polychlorinated biphenyls [PCBs]) and other regulated wastes (chemical waste, infectious waste, asbestos-containing waste), and non-hazardous solid waste. Waste generated from SNL/NM operations is not disposed of onsite. Wastes are shipped offsite to commercial or federal TSDFs for treatment and/or disposal in accordance with applicable regulations. In addition, recycling hazardous and non-hazardous solid waste is an important component of waste management. Onsite waste management units enable SNL/NM to handle and store the waste in compliance with applicable federal, state, and local environmental regulations and DOE directives.

Other waste considered includes small amounts generated from DOE-funded operations at other DOE, NNSA, or federal facilities in the Albuquerque area that may also be managed at SNL/NM (SNL 2023h). Non-routine operations are limited-duration projects, such as corrective actions (site remediation) or decontamination and decommissioning activities, which are considered

separately from facility production. Non-routine projects can make a large contribution to overall waste generation activities at SNL/NM. Most of the non-routine projects are associated with site environmental remediation, the bulk of which was completed between 2000 and 2010. At present, non-routine waste makes up a small percentage of the waste generated at SNL/NM.

4.12.2.2 Compliance Status Overview

RCRA sets forth the framework for managing hazardous waste, including the hazardous waste component of mixed waste. NMED administers the hazardous waste program in New Mexico under the authority of the New Mexico Hazardous Waste Act. SNL/NM hazardous waste management is conducted pursuant to 20.4 NMAC (20.4.1 NMAC). Hazardous wastes generated from activities and operations are collected and managed at several locations (refer to Section 4.12.4.2). The Waste Program fulfills state requirements, state permits, and compliance orders and includes (SNL 2022a):

- operating hazardous and mixed waste management units under the RCRA Facility Operating Permit (RCRA Permit) issued by NMED;
- collecting and screening material and waste in preparation for treatment and shipment to offsite facilities for recycling, storage, treatment, or disposal;
- conducting investigations and remediation for past releases of hazardous waste and hazardous constituents in accordance with the Compliance Order on Consent (2004) with NMED, which requires corrective action for releases of hazardous waste or hazardous constituents and for releases of nitrate and perchlorate from activities and operations;
- adhering to long-term monitoring and maintenance requirements for past releases of hazardous waste and hazardous constituents in accordance with the RCRA Permit; and
- adhering to closure and post-closure requirements for closed waste management units in accordance with the RCRA Permit and the CWL Post-Closure Care Permit.

NMED Hazardous Waste Bureau representatives performed two no-notice hazardous waste compliance evaluation inspections of the entire SNL/NM site in 2021. The FY 2021 inspection was May 17–19, 2021, and a notice of violation was issued. The FY 2022 inspection was December 7–9, 2021, and a notice of violation was issued in early 2022. The notices of violations were limited to three findings relating to container labels and one finding relating to a container closure. All findings were corrected during the inspections, and no further action was required (SNL 2022a). NMED Hazardous Waste Bureau representatives did not perform any no-notice hazardous waste compliance evaluation inspection of SNL/NM in CY 2022 (SNL 2023d).

4.12.3 Radioactive Waste

The Atomic Energy Act (42 U.S.C. § 2011 et seq.) gives DOE regulatory authority to manage its own radioactive waste. Subsequent rulings have limited or clarified that this authority is specific to the radioactive component of its waste. A common example of this clarification is that DOE-generated LLW that also qualifies as hazardous waste under RCRA (defined as mixed waste) is subject to both DOE waste management rules and those established pursuant to RCRA and applicable state laws, such as the New Mexico Hazardous Waste Act.

Two categories of radioactive waste are generated at SNL/NM: LLW and TRU waste. SNL/NM is not involved in reprocessing spent nuclear fuel and, accordingly, does not generate high-level radioactive waste. With respect to LLW and TRU, Sections 4.12.3.2 and 4.12.3.3 address the management of waste that has only radionuclides as its regulated component. LLW and TRU also containing a RCRA hazardous component are characterized as mixed waste (MLLW and MTRU) and are addressed in Sections 4.12.3.5 and 4.12.3.6. DOE Order 435.1 (DOE 2021b) establishes the overriding requirements SNL/NM must meet in its management of LLW and TRU waste. Waste transported offsite must be packaged and shipped in accordance with DOT regulations and must meet the waste acceptance criteria of the receiving waste management facility, whether commercial or government. Radioactive wastes are not disposed of at SNL/NM.

4.12.3.1 Overview of SNL/NM Management of Radioactive Waste

LLW and MLLW at SNL/NM are generated primarily during laboratory experiments and component tests. R&D activities that use radioactive materials may also generate LLW. TRU waste (including MTRU waste) was primarily generated in reactors and from reactor test cleanup (i.e., legacy waste). TRU and MTRU waste are generated in small quantities from various activities, managed similarly, and disposed of at the same location. No high-level radioactive waste is generated at SNL/NM. Although SNL/NM personnel operate several nuclear reactors, no spent fuel has ever been generated, as the original fuel rods are still viable and are expected to remain so for the foreseeable future (SNL 2023h). Appendix A, Section A.4.12, Tables A-28 through A-33, show major generators of radioactive waste at SNL/NM from 2017 through 2022.

The SNL/NM Radioactive Waste Program controls generation of radioactive waste and requires identification of a pathway for waste treatment and disposal before waste is generated. All SNL/NM LLW, TRU, and mixed waste generators must contact the Radioactive Waste Program for approval before generating radioactive waste to ensure that an approved pathway for waste treatment and disposal exists before waste is generated (SNL 2010). Radioactive wastes typically are shipped to offsite facilities within 1 year but may remain onsite longer, if necessary, to complete the process for acceptance at an offsite facility or to make full use of transport vehicles.

Initial generators at SNL/NM receive training in radioactive and hazardous waste requirements, label each container when waste is first placed in it, and provide information about the waste on a Waste Description and Disposition Request form. After the waste is received at the waste management facility, personnel continue to obtain additional information as required for onsite treatment and/or shipment to an offsite TSDF. The certification process for radioactive and mixed waste disposal is based on rigorous procedures designed to assure the accepting facility that the waste is as described in the certification documents and does not contain prohibited or uncharacterized constituents. This process establishes that the waste, when shipped to the TSDF, has been adequately characterized, is consistent with the waste stream description preapproved by the offsite facility, and no prohibited materials have been added during accumulation or storage. The waste acceptance and approval process varies for different TSDFs but typically involves the following documentation (SNL 2010): potential shipments' physical characteristics (e.g., liquids, solids, gases); nature and characteristics of radionuclides present in the waste; hazardous constituents (e.g., hazardous waste codes), as appropriate; packaging (e.g., drums, boxes, laboratory-packed small vials); transportation methods (e.g., truck versus rail); and analytical data for confirmation of initial characterization.

Radioactive waste management occurs at the RMWMU, the seven Manzano Storage Bunkers (MSBs), and the AHCU (SNL 2022a). At each location, wastes are tracked, inspected, and managed to protect human health and the environment. For example, each radioactive, mixed, hazardous, or other waste item received at the RMWMU is labeled with a unique bar code linking the item to the original disposal request. Radioactive wastes are not disposed of at SNL/NM (SNL 2022a). Radioactive waste management activities at individual waste management units are summarized as follows, with more details in Appendix A, Section A.4.12.

- **RMWMU:** Hazardous, mixed, and radioactive wastes are screened, sorted, repackaged, and stored, and some are treated. Wastes may be treated by one or more of the following methods: solidification and stabilization, chemical deactivation and neutralization, macroencapsulation, physical treatment (volume reduction), or thermal deactivation.
- **MSBs:** Hazardous, mixed, radioactive, and solid wastes are stored and repackaged. Five of the seven bunkers are included in the RCRA Permit; hazardous and mixed waste management activities are limited to these five bunkers.
- **AHCU:** TRU and MTRU wastes are stored. Waste treatment is not currently performed at the AHCU.

4.12.3.2 Low-Level Radioactive Waste

4.12.3.2.1 Overview of SNL/NM Low-Level Radioactive Waste Management

LLW generally consists of laboratory waste, debris from maintenance activities, debris from decontamination and demolition activities, and personal protective equipment. LLW is contaminated primarily with one or more isotopes of americium, cesium, cobalt, plutonium, strontium, thorium, tritium, and/or uranium. Plutonium and americium in LLW are below the activity level designated for TRU waste (SNL 2022a).

Between 2017–2021, the RMWMU shipped most LLW to NNSS in Mercury, Nevada, with some LLW shipped to Perma-Fix in Gainesville, Florida, a DOE CAP-accredited commercial facility. SNL/NM does not dispose of LLW onsite. Table 4-19 summarizes LLW volumes shipped from SNL/NM over the last 6 years of record, 2017–2022.

Table 4-19. SNL/NM LLW Shipped, 2017–2022

	2017	2018	2019	2020	2021	2022	Average
Total LLW (pounds)	65,635	59,187	61,244	46,488	60,764	90,797	64,019
Total LLW (cubic meters)	63.3	57.1	59.1	44.8	58.6	87.6	61.8

Density of 1,036.82 pounds/cubic meter used to convert LLW in pounds to cubic meters (NNSS 2016) (e.g., in 2017, 65,635 pounds of LLW divided by 1,036.82 pounds/cubic meter equals 63.3 cubic meters of shipped LLW).

Source: SNL 2018a; SNL 2019a; SNL 2020b; SNL 2021a; SNL 2022a; and SNL 2023d.

4.12.3.2.2 Low-Level Waste Generation Rates

SNL/NM tracks its waste generation as routine or non-routine. Routine wastes are generated during normal operations. Non-routine wastes are generated during DD&D activities; during construction; and from ER actions. The non-routine category represents waste quantities that can be large and vary greatly from year to year.

Table 4-20 summarizes LLW volumes generated at SNL/NM over the last 6 years of record. Most radioactive waste generated in recent years was from routine operations. Historically, non-routine waste was generated by ER Operations, DD&D projects, other cleanup activities, and ongoing efforts to reduce SNL/NM’s legacy LLW. However, most ER projects were completed by 2010. On average, from 2000–2010, non-routine waste generation was much higher than routine waste generation due to non-routine ER and DD&D projects (SNL 2010).

Table 4-20. SNL/NM LLW Generation, 2017–2022

	2017	2018	2019	2020	2021	2022	Average
Routine (pounds)	38,813	31,859	24,503	36,256	21,760	65,714	36,484
Routine (cubic meters)	37.4	30.7	23.6	35.0	21.0	63.4	35.2
Non-routine (pounds)	20,186	1,440	0.0	17,492	0.0	372	6,582
Non-routine (cubic meters)	19.5	1.4	0.0	16.9	0.0	0.0	6.3
Total LLW (pounds)	58,999	33,299	24,503	53,748	21,760	66,087	43,066
Total LLW (cubic meters)	56.9	32.1	23.6	51.9	21.0	63.4	41.5

Density of 1,036.82 pounds/cubic meter used to convert LLW in pounds to cubic meters (NNSS 2016).

Source: SNL 2023h

4.12.3.3 Transuranic Waste

4.12.3.3.1 Overview of SNL/NM Management of Transuranic Waste

Total TRU waste generated at SNL/NM is notably smaller than LLW generated. SNL/NM TRU waste was generated in reactors and from reactor test cleanup in TA-V Research Reactor Facilities. Ongoing activities also generate small quantities. TRU waste is managed similarly to LLW, but TRU waste requirements for identifying waste constituents and waste-generating processes are more stringent. RMWMU personnel work with generators to ensure waste is managed appropriately and applicable waste characterization data are collected. Once it accepts waste, the RMWMU is responsible for storage and eventual shipment offsite. TRU wastes are not disposed of onsite; they are transported to DOE’s WIPP in Carlsbad, New Mexico, for disposal. WIPP is the Nation’s only deep geologic repository established and authorized for permanent disposal of TRU waste. WIPP requires generators to perform specific, rigorous waste characterization and certification actions before it will accept waste. SNL/NM does not have a TRU certification program for shipping TRU waste to WIPP. DOE established the WIPP CCP to standardize and provide efficiencies in characterization and certification at DOE waste generator sites. The CCP allows SNL/NM to ship TRU waste to WIPP. Table 4-21 summarizes SNL/NM TRU waste volumes shipped over the last 6 years of record. Only one shipment was made during this time; in 2020, legacy TRU waste generated prior to 2010 was shipped.

Table 4-21. SNL/NM TRU Waste Shipped, 2017–2022

	2017	2018	2019	2020	2021	2022	Average
Total TRU (pounds)	0	0	0	834	0	0	139.0
Total TRU (cubic meters)	0	0	0	1.2	0	0	0.2

Density of 683.43 pounds/cubic meter used to convert TRU waste in pounds to cubic meters (DOE 1999).

Source: SNL 2018a; SNL 2019a; SNL 2020b; SNL 2021a; SNL 2022a; and SNL 2023d.

4.12.3.3.2 Transuranic Waste Generation Rates

TRU waste inventory estimates from DOE sites that would send TRU waste to WIPP change frequently due to retrieval, treatment, characterization, and shipping activities. Consequently, TRU waste inventory estimates are collected annually from generator/storage sites. DOE prepares an Annual Transuranic Waste Inventory Report (ATWIR), which provides updated TRU waste inventory estimates; is used for strategic planning; and supports DOE Carlsbad Field Office input into documents (e.g., WIPP DSA, NEPA evaluations), performance assessments, planned changes, and other design changes as needed for WIPP. The most recent ATWIR (“ATWIR 2023”) has a data cutoff date of December 31, 2022 (DOE 2024a). ATWIR 2023 provides the best estimate of TRU waste inventories at generator sites and is used to support analyses in this SWEIS. Chapter 6 of this SWEIS includes a reasonably foreseeable effects analysis of TRU waste disposal at WIPP.

Table 4-22 summarizes routine SNL/NM TRU waste volumes generated over the last 6 years of record. Very small quantities of TRU waste were generated during 2021 and 2022. Note that no TRU waste is generated during non-routine operations.

Table 4-22. SNL/NM TRU Waste Generation, 2017–2022

	2017	2018	2019	2020	2021	2022	Average
Routine TRU (pounds)	0	0	0	0	0.1	0.1	0.018
Routine TRU (cubic meters)	0	0	0	0	0.000015	0.00001	0.00003

TRU wastes are not generated during non-routine operations.

Density of 683.43 pounds/cubic meter used to convert TRU waste in pounds to cubic meters (DOE 1999).

Source: SNL 2023h

4.12.3.4 Overview of SNL/NM Management of Mixed Waste

SNL/NM Mixed waste includes mixed low-level radioactive waste and MTRU waste. Low-level radioactive mixed waste and MTRU waste generally consist of inorganic debris and radioactive metallic objects with hazardous waste constituents (SNL 2022a). Radioactive components of low-level radioactive mixed waste and MTRU waste are similar to those in LLW or TRU waste. Mixed waste is subject to regulatory requirements for hazardous waste and radioactive waste and is managed at SNL/NM in the same manner as described for hazardous waste (Section 4.12.4), except for modified storage time limits for certain wastes with no or limited offsite treatment options. The Federal Facility Compliance Act (42 U.S.C. §§ 6961, 6965) requires federal facilities that generate or store mixed waste to submit a site treatment plan (STP) that includes a schedule for developing capacities and technologies to treat all mixed waste. In October 1995, the State of New Mexico issued an FFCO to SNL/NM requiring an STP for mixed waste (SNL 2022a). Under the FFCO, NNSA and SNL/NM are required to maintain an STP; it contains a mixed waste inventory subject to the FFCO at SNL/NM, with a plan and schedule for treating the waste and complying with applicable hazardous waste regulatory requirements. NNSA and SNL/NM update the STP annually to reflect changes in inventory (SNL 2010 and SNL 2023d).

4.12.3.5 Mixed Low-Level Waste

4.12.3.5.1 Overview of SNL/NM Mixed Low-Level Waste Management

SNL/NM MLLW is generated primarily during laboratory experiments and component tests. All radioactive waste and mixed waste generators are required to obtain approval from Radioactive Waste Program personnel before generating waste. This promotes waste minimization and allows a waste treatment and disposal pathway to be developed before waste is generated. MLLW is tracked at SNL/NM through documentation at each waste handling step. For example, each waste item received at RMWMU is labeled with a unique bar code linking the item to the original disposal request. An individually coded waste item typically is a bottle, plastic bag, or other small item that contains chemicals or other waste (SNL 2010 and SNL 2023d).

SNL/NM does not dispose of MLLW onsite. In recent years (2017–2022), RMWMU shipped (for disposal) most of its MLLW to NNSS (about 93 percent) and the remainder to Perma-Fix in Gainesville, Florida, and M&EC in Kingston, Tennessee (both DOE CAP-accredited commercial facilities), for treatment (SNL 2023h). Table 4-23 summarizes MLLW volumes shipped from SNL/NM over the last 6 years of record.

Table 4-23 SNL/NM MLLW Shipped 2017–2022

	2017	2018	2019	2020	2021	2022	Average
Total MLLW (pounds)	97,113	93,369	28,568	54,504	30,675	26,782	55,169
Total MLLW (cubic meters)	93.7	90.1	27.6	52.6	29.6	25.8	53.2

Density of 1,036.82 pounds/cubic meter used to convert MLLW in pounds to cubic meters (NNSS 2016).

Source: SNL 2018a; SNL 2019a; SNL 2020b; SNL 2021a; SNL 2022a; and SNL 2023d.

4.12.3.5.2 Mixed Low-Level Waste Generation Rates

Table 4-24 summarizes SNL/NM MLLW volumes generated over the last 6 years of record. As shown, most radioactive waste generated in recent years is from routine operations. Historically, non-routine waste was generated by the ER Project, DD&D projects, other cleanup activities, and ongoing efforts to reduce legacy SNL/NM MLLW inventory. On average, from 2000–2010, non-routine waste generation of MLLW was higher than routine waste generation due to non-routine ER and DD&D projects (SNL 2010).

Table 4-24. SNL/NM MLLW Generated, 2017–2022

	2017	2018	2019	2020	2021	2022	Average
Routine (pounds)	11,190	23,942	17,079	17,605	15,955	22,381	18,025
Routine (cubic meters)	10.8	23.1	16.5	17.0	15.4	21.6	17.4
Non-routine (pounds)	114	0.0	105	420	199	0.0	140
Non-routine (cubic meters)	0.1	0.0	0.1	0.4	0.2	0.0	0.1
Total MLLW (pounds)	11,304	23,942	17,184	18,026	16,154	22,381	18,165
Total MLLW (cubic meters)	10.9	23.1	16.6	17.4	15.6	21.6	17.5

Density of 1,036.82 pounds/cubic meter used to convert MLLW in pounds to cubic meters (NNSS 2016).

Source: SNL 2023h

4.12.3.6 Mixed Transuranic Waste

4.12.3.6.1 Overview of SNL/NM Management of Mixed Transuranic Waste

MTRU is primarily generated in reactors and from reactor test cleanup in TA-V Research Reactor Facilities. MTRU wastes are transported to DOE's WIPP in Carlsbad, New Mexico, for disposal. MTRU wastes are not disposed of onsite. SNL/NM does not currently have a TRU certification program for shipping TRU waste to WIPP. DOE established the WIPP CCP to standardize and provide efficiencies in characterization and certification at DOE waste generator sites. The CCP allows SNL/NM to ship TRU waste to WIPP. Table 4-25 summarizes SNL/NM MTRU volumes shipped over the last 6 years of record. Only one shipment was made during this timeframe; in 2020, all shipped MTRU was legacy waste.

Table 4-25. SNL/NM MTRU Waste Shipped, 2017–2022

	2017	2018	2019	2020	2021	2022	Average
Total MTRU (pounds)	0	0	0	1,210	0	0	202
Total MTRU (cubic meters)	0	0	0	7.2	0	0	1.2

Density of 167.55 pounds/cubic meter used to convert MTRU waste in pounds to cubic meters (DOE 1999).

Source: SNL 2018a; SNL 2019a; SNL 2020b; SNL 2021a; SNL 2022a; and SNL 2023d

4.12.3.6.2 Mixed Transuranic Waste Generation Rates

Table 4-26 summarizes routine SNL/NM MTRU waste volumes generated over the last 6 years of record. Three containers of MTRU were generated in 2020, and a very small volume was generated in 2018. Note that no MTRU waste is generated during non-routine operations.

Table 4-26. SNL/NM MTRU Waste Generation, 2017–2022

	2017	2018	2019	2020	2021	2022	Average
Routine MTRU (pounds)	0	1.0	0	235	0	0	39.3
Routine MTRU (cubic meters)	0	0.0007	0	1.40	0	0	0.23

Density of 167.55 pounds/cubic meter used to convert MTRU waste in pounds to cubic meters (DOE 1999).

MTRU wastes are not generated during non-routine operations.

Source: SNL 2023h

4.12.4 Hazardous Waste

SNL/NM performs a broad range of research activities that generate a variety of waste, including hazardous waste. Commonly generated hazardous waste includes many types of research chemicals, solvents, acids, bases, compressed gases, metals, and other solid waste contaminated with hazardous constituents. Hazardous waste may also include equipment, containers, structures, and other items intended for disposal that are considered hazardous (e.g., compressed gas cylinders, contaminated cleanup materials or protective gear). The nature of the SNL/NM mission is such that research activities often change over time, either in small ways or in their entirety, and wastes generated can likewise change. As a result, SNL/NM's approach to managing hazardous waste is to accommodate a wide variety of waste generators and waste types. This is also reflected in SNL/NM's hazardous waste permits issued by NMED.

SNL/NM personnel package, segregate, store, treat, and ship hazardous wastes to permitted offsite treatment and disposal or recycling facilities (SNL 2023h). Hazardous wastes are not disposed of at SNL/NM.

4.12.4.1 Overview of SNL/NM Hazardous Waste Management

Initial generators of hazardous waste at SNL/NM label containers when waste is first placed in them and then characterize, label, and collect the waste in appropriate storage areas. Many hazardous wastes are accumulated for up to 90 days at consolidated locations. Initial generators provide information about the waste on a Waste Description and Disposition Request form. After waste is received at the SNL/NM waste management unit, personnel continue to obtain more information as required for onsite treatment and/or shipment to an offsite TSDF. Hazardous wastes are collected and transported to one or more units listed in Section 4.12.4.2.1 for storage, repackaging, and treatment (for some wastes) prior to transportation to offsite facilities. Waste is ultimately shipped to offsite RCRA-permitted hazardous waste TSDFs for final treatment or disposal. Some hazardous wastes can be recycled. These include various batteries, silver compounds, mercury compounds, lamps, capacitors, and toxic metals such as lead (SNL 2022a).

SNL/NM collects and maintains data on each waste it generates in a waste management database. This information is used to track wastes from cradle to grave and includes the following elements: waste generation process and location, physical characteristics (e.g., waste volume and weight, container type and volume), characterization information (e.g., chemical constituents for hazardous wastes), and other information required for safe storage of the waste.

RCRA regulates wastes from generation to disposal. Hazardous wastes include all solid wastes that are (1) listed as hazardous by EPA (listed wastes); (2) ignitable, corrosive, reactive, or toxic (characteristic wastes); or (3) certain batteries, pesticides, lamp bulbs, or containing mercury (universal wastes). In 2017–2022, most RCRA hazardous waste was shipped to various TSDFs. Table 4-27 summarizes SNL/NM RCRA hazardous waste shipped over the last 6 years of record.

Table 4-27. SNL/NM RCRA Hazardous Waste Shipped, 2017–2022

	2017	2018	2019	2020	2021	2022	Average
Total RCRA Waste (kg)	83,031	62,461	99,772	88,462	48,506	57,883	73,353

Source: SNL 2018a; SNL 2019a; SNL 2020b; SNL 2021a; SNL 2022a; and SNL 2023d

4.12.4.2 Permitted Hazardous and Mixed Waste Management Units

The State of New Mexico is authorized by EPA to administer its hazardous waste management program and issue and enforce hazardous waste facility permits. Under RCRA, facilities that treat, store, or dispose of hazardous wastes, including mixed radioactive wastes, must obtain a permit from their regulatory authority. NMED has issued two permits for hazardous and mixed waste management activities, post-closure care, and long-term monitoring and maintenance at SNL/NM: RCRA Facility Operating Permit and CWL Post-Closure Care Permit (SNL 2022a).

4.12.4.2.1 RCRA Facility Operating Permit

The following waste management units and activities are subject to the RCRA Facility Operating Permit. These units enable SNL/NM to handle and store waste in compliance with applicable federal and state regulations. Appendix A, Section A.4.12, provides additional details.

- **Auxiliary Hot Cell Unit (AHCU):** The AHCU, in TA-V, is an HC-3 nuclear facility used for characterization, treatment (if necessary), repackaging, and storage of LLW, TRU waste, mixed waste, MTRU, and nuclear materials that cannot be managed at the RMWMU. Wastes are managed until offsite TSDFs are identified that can accept the waste (SNL 2010). In recent years, the AHCU is being used only for storage of TRU and MTRU waste (SNL 2023h).
- **Corrective Action Management Unit (CAMU) (post-closure care):** The CAMU was a 19-acre site used between 1999 and 2003 for management of remediation wastes generated as part of the voluntary corrective action activities undertaken during closure of the nearby CWL. The current CAMU is a closed containment cell containing soil excavated from the CWL.
- **Hazardous Waste Handling Unit (HWHU):** The HWHU is in TA-II. RCRA hazardous waste and non-hazardous waste generated at SNL/NM and associated satellite facilities in Albuquerque (e.g., the Advanced Materials Laboratory at the University of New Mexico, Albuquerque) are collected and transported to the HWHU for storage and repackaging before transportation to offsite facilities for recycling, treatment, or disposal. The HWHU is a low-hazard facility that consists of several buildings in a fenced compound on 1.35 acres. There are two permanent buildings, the Waste Packaging Building (Building 959) and Waste Storage Building (Building 958) (SNL 2010). In addition, the facility allows SNL/NM to prepare the waste for shipment for treatment and disposal in accordance with specific requirements regarding waste certification, packaging, and transport.
- **Manzano Storage Bunkers (MSBs) (five):** The MSBs, in the MSB Area, are used for storage and repackaging of wastes and materials. Five of the seven bunkers are RCRA-permitted units.
- **Radioactive and Mixed Waste Management Unit (RMWMU):** The RMWMU, in TA-III, serves as a centralized facility for characterization, treatment, repackaging, and storage of low-level waste, TRU waste, mixed waste, MTRU waste, and some hazardous waste. In addition, the facility allows SNL/NM to prepare the waste for shipment for subsequent treatment and disposal in accordance with specific requirements regarding waste certification, packaging, and transport (SNL 2010 and SNL 2023d).
- **Thermal Treatment Unit (TTU):** The TTU, in TA-III, was built in 1969, reconstructed in 1986, and refurbished in 2003 to support the Light-Initiated High Explosives Facility by providing onsite treatment for explosive waste and explosive-contaminated waste for which DOT requirements forbid transportation (SNL 2010 and SNL 2023h).

4.12.4.2.2 Chemical Waste Landfill Post-Closure Care Permit

The CWL post-closure care activities are subject to the CWL Post-Closure Care Permit. Appendix A, Section A.4.12, provides additional details.

4.12.4.3 Hazardous Waste Generation Rates

Table 4-28 summarizes the hazardous waste quantities, routine and non-routine, generated within SNL/NM over the last 5 years of record (2017–2021). On average, generation rates for RCRA hazardous waste have remained below those projected in the 1999 SWEIS.

Table 4-28. SNL/NM RCRA Hazardous Waste Generation, 2017–2021

	2017	2018	2019	2020	2021	Average
Routine RCRA Waste (kg)	53,039	40,859	81,580	38,945	61,832	55,251
Non-Routine RCRA Waste (kg)	3,475	3,110	907	1,162	89	1,749
Total RCRA Waste (kg)	56,514	43,969	82,487	40,107	61,921	57,000

Source: SNL 2023h

Certain types of explosives waste generated at SNL/NM are treated at the TTU or RMWMU. Treated explosive waste, along with all other SNL/NM explosive hazardous waste, is collected, containerized, stored, and shipped in compliance with DOT requirements for RCRA treatment and/or disposal at an offsite TSDF. Explosive wastes are not disposed of onsite at SNL/NM. Table 4-29 shows the weight of explosives wastes treated at SNL/NM between 2017 and 2021. Appendix A, Section A.4.12, provides additional details.

Table 4-29. Weight (kg) of Explosive Wastes Treated at SNL/NM (2017–2021)

Facility	2017	2018	2019	2020	2021
TTU ^a	628	596	450	555	840
RMWMU ^b	0	0	0	10	0

a. Treated by open burning.

b. Thermally or chemically deactivated by making inert through heat or enclosed burning or detonation in a boom box.

Source: SNL 2023h.

4.12.4.4 Toxic Substances Control Act Waste

TSCA addresses production, import, use, and disposal of specific chemicals, including PCBs and asbestos. Electrical equipment (e.g., capacitors, light ballasts) are evaluated for PCBs when taken out of service (SNL 2022a). In recent years (2017–2021), PCB waste was shipped to Veolia ES Technical Solutions LLC in Phoenix, Arizona. Appendix A, Section A.4.12.2.3, has more details.

SNL/NM periodically generates TSCA PCB waste from DD&D type activities or from taking equipment such as transformers, capacitors, and light ballasts out of service. Table 4-30 shows PCB quantities shipped for disposal from 2017–2022. TSCA wastes are not disposed of onsite.

Table 4-30. TSCA-Regulated PCBs Waste Shipped from SNL/NM, 2017–2022

Shipped	2017 (kg)	2018 (kg)	2019 (kg)	2020 (kg)	2021 (kg)	2022 (kg)
PCBs	1,260	200	473	437	88	390

Source: SNL 2018a; SNL 2019a; SNL 2020b; SNL 2021a; SNL 2022a; and SNL 2023d.

4.12.4.5 New Mexico Special Waste (infectious, asbestos)

New Mexico Special Waste (NMSW) is non-hazardous solid waste that has unique handling, transportation, and/or disposal requirements to ensure protection of the environment and public health, welfare, and safety. NMSW includes treated formerly characteristic hazardous waste, asbestos waste, ash, infectious waste, sludge, industrial solid waste, spill of a commercial chemical product, and petroleum-contaminated soil (SNL 2010). NMSW generated at SNL/NM includes asbestos waste and infectious waste. Table 4-31 shows NMSW quantities shipped for disposal from 2017–2022. NMSW is not disposed of at SNL/NM. Appendix A, Section A.4.12.2.2, contains additional information.

Table 4-31. NMSW Shipped from SNL/NM, 2017–2022

Shipped	2017 (kg)	2018 (kg)	2019 (kg)	2020 (kg)	2021 (kg)	2022 (kg)
Infectious waste	2,756	1,465	1,220	2,792	2,260	1,942
Asbestos	58,245	40,193	154,667	16,800	17,647	19,962

Source: SNL 2018a; SNL 2019a; SNL 2020b; SNL 2021a; SNL 2022a; and SNL 2023d.

4.12.4.6 Other Regulated Waste

Other regulated waste at SNL/NM includes chemical waste and used oil. Other regulated waste is subject to increased management standards due to its potential to adversely impact human health and the environment. Other regulated waste may be subject to waste management requirements under various policies and regulations including DOE and DOT orders, the CWA, Municipal Solid Waste, and CAA. Other regulated waste is not disposed of at SNL/NM.

4.12.4.6.1 Chemical Waste

Chemical waste (includes special waste and industrial solid waste) is managed as other regulated waste. Chemical waste includes various wastes generated from research and testing, production, maintenance and support, decontamination and demolition, and waste management activities. Wastes that cannot be recycled or treated onsite are sent to offsite facilities for treatment as needed before disposal at permitted offsite facilities. Chemical wastes are not disposed of onsite. Table 4-32 shows quantities of chemical waste shipped for disposal from 2017–2022.

Table 4-32. Other Regulated Wastes Shipped from SNL/NM, 2017–2022

Shipped	2017 (kg)	2018 (kg)	2019 (kg)	2020 (kg)	2021 (kg)	2022 (kg)
Chemical waste (includes special waste and industrial solid waste)	148,790	269,093	273,021	296,453	274,617	170,520
Used oil (not recycled)	0	0	0	0	0	0

Source: SNL 2018a; SNL 2019a; SNL 2020b; SNL 2021a; SNL 2022a; and SNL 2023d.

4.12.4.6.2 Used Oil

Used oil is managed as other regulated waste. From 2017–2022, no used oil was shipped to TSDFs for disposal but instead was recycled. Used oil was not disposed of onsite at SNL/NM.

4.12.4.7 Solid Waste

The SWCRC, in TA-II, collects, processes, and ships for offsite disposal SNL/NM solid waste. Solid waste processed at the SWCRC does not include hazardous, radioactive, residential, or food service wastes. Solid waste managed at SNL/NM is grouped as follows: SWCRC dry waste; offsite office waste (SSTP); and other solid waste. Table 4-33 shows quantities of solid waste for these groupings from 2017–2022. The total landfilled solid waste (sum of these groupings) ranged from 524.5 to 763.5 MT from 2017–2022, as shown in Table 4-33. Also shown in Table 4-33, about 41 percent of the total solid waste was diverted from disposal through recycling from 2017–2022; recycled solid waste ranged from 367.4 to 572.2 MT (SNL 2018a; SNL 2019a; SNL 2020b; SNL 2021a; SNL 2022a; and SNL 2023d).

Table 4-33. SNL/NM Solid Waste Shipped to Landfill and Recycled, 2017–2022

Shipped	2017	2018	2019	2020	2021	2022	Average
SWCRC dry waste (MT)	623.2	609.3	666.3	460.1	743.8	522.0	604.1
SSTP offsite office waste (MT)	56.3	50.3	56.1	19.2	1.8	2.0	31.0
Other solid waste (MT)	18.8	23.0	26.5	45.2	17.9	19.4	25.1
Total Landfilled (MT)	698.3	682.6	748.9	524.5	763.5	543.4	660.2
Total Recycled (MT)	572.2	548.2	495.2	367.4	403.0	495.4	480.2

Landfilled is the sum of SWCRC dry waste, SSTP offsite office waste, and other solid waste. Recycled waste was diverted from landfilled and is not included in the total landfilled waste.

Source: SNL 2018a; SNL 2019a; SNL 2020b; SNL 2021a; SNL 2022a; and SNL 2023d.

4.12.4.8 Solid Waste Collection and Recycling Center Dry Waste

SWCRC dry waste is managed at the SNL/NM SWCRC. The primary function of the SWCRC is to collect, process, and ship for disposal solid waste from SNL/NM. Solid waste processed at the SWCRC consists predominantly of office and non-hazardous laboratory trash. It does not include hazardous, radioactive, residential, or food service wastes. After non-hazardous solid waste is transferred to the SWCRC, it is screened for recyclable materials and potentially hazardous items, which are removed from the solid waste and managed through processes appropriate to each material or waste. The SWCRC also accepts and screens, but does not collect, solid waste from other NNSA entities that operate on KAFB (SNL 2022a).

Currently all solid waste from the SWCRC is shipped to the City of Albuquerque-owned Cerro Colorado landfill. The shipments consist strictly of general trash and do not include recyclables, hazardous material, or anything requiring special disposal, transportation, or regulatory tracking. Rio Rancho Sanitary Landfill in Rio Rancho, New Mexico, is an alternate location that has been used in the past (SNL 2023i). Solid waste is not disposed of at SNL/NM. Table 4-33 shows that SWCRC dry waste quantities shipped for disposal ranged from 460 to 744 MT from 2017–2022.

4.12.4.9 Offsite Office Waste

Offsite office waste (SSTP) is disposed of at the Cerro Colorado landfill. It is not disposed of at SNL/NM. Quantities of offsite office waste ranged from 1.8 to 56.3 MT from 2017–2022.

4.12.4.10 Other Solid Waste

Other solid waste is disposed of at the Cerro Colorado landfill. It is not disposed of at SNL/NM. Quantities of other solid waste ranged from 4.2 to 39.4 MT from 2017–2022.

4.12.4.11 Construction and Demolition Waste

Construction and demolition (C&D) debris is regulated as a separate category of solid waste under New Mexico Solid Waste Regulations. C&D debris is not hazardous and may be disposed of in a municipal landfill or a C&D debris landfill. C&D waste typically consists of soils, broken-up concrete, scrap metals, and various building material waste or rubble. SNL/NM has reused or recycled these materials when feasible rather than sending them for landfill disposal. From 2017–2022, about 73 percent of C&D waste was diverted from landfills by being recycled.

C&D waste is sent to the KAFB C&D landfill. Table 4-34 shows C&D waste quantities sent to the landfill versus recycled from 2017–2022. C&D waste is not disposed of onsite at SNL/NM.

Table 4-34 SNL/NM C&D Waste Shipped to Landfill or Recycled, 2017–2022

	2017	2018	2019	2020	2021	2022	Average
Landfilled (MT)	3,549.5	1,741.8	2,273.5	2,474.0	2,417.3	1,856.8	2,385.5
Recycled (MT)	1,066.6	13,394.2	1,042.4	7,858.7	12,422.7	3,470.8	6,542.6

Source: SNL 2018a; SNL 2019a; SNL 2020b; SNL 2021a; SNL 2022a; and SNL 2023d.

4.12.4.12 Classified Waste

Classified waste generated at SNL/NM is managed at the RMWMU and is shipped to NNSS for disposal. Classified waste is not disposed of at SNL/NM. The annual average for classified waste generated at SNL/NM from 2017–2022 was 4,210 kilograms (kg) (8.9 cubic meters) of classified hazardous waste and 7,480 kg (15.9 cubic meters) of classified solid waste (SNL 2023h).

4.12.5 Legacy Waste and Materials

Legacy wastes and materials are defined as wastes and materials generated prior to 2010.

4.12.5.1 Legacy Waste

The legacy waste inventory has decreased substantially since the 1999 SNL/NM SWEIS was released. Legacy wastes are not disposed of at SNL/NM.

Table 4-35 shows the waste inventory in storage as of June 2023. As shown, nearly all wastes in storage are non-legacy, and only small amounts of legacy TRU waste and LLW remain.

Table 4-35. Waste Inventory at SNL/NM RMWMU, AHCU, and MSB (as of June 2023)

	TRU	LLW	MLLW	Solid Waste	RCRA Waste
Non-Legacy (kg)	6,268.6	20,864.7	13,265.1	18,435.4	6,495.4
Legacy (kg)	0.6	24.9	0.0	0.0	0.0
Totals (kg)	6,269.1	20,889.6	13,265.1	18,435.4	6,495.4

Total waste stored at the RHWMU, MSBs, and AHCU.

Solid and hazardous waste are non-radioactive.

Source: SNL 2023h.

4.12.5.2 Legacy Materials

Legacy SNL/NM materials are evaluated to determine whether they can be used, reapplied, reprocessed, or recycled in the NNSA complex. Issues associated with legacy materials include designating usefulness and potential value and funding costs for additional characterization that may be required to evaluate potential application suitability. About 490 kg of legacy radioactive materials are being evaluated for future use as of September 2023 (SNL 2023h).

4.13 HUMAN HEALTH AND SAFETY

Operations at SNL/NM are conducted in accordance with applicable laws and regulations to protect the health and safety of workers and the public, preserve the quality of the environment, and prevent property damage. Routine operations at SNL/NM have the potential to affect public and worker health. This section characterizes potential human health impacts from current operations at SNL/NM. Against this baseline, the potential incremental and reasonably foreseeable effects associated with the alternatives are compared and evaluated. Appendix D, Section D.2, gives additional background on human health impacts from normal operations.

4.13.1 Public Health

4.13.1.1 Radiological

Background radiation is attributed to naturally occurring radiation, such as cosmic radiation from space and terrestrial gamma radiation, and from radionuclides naturally in the environment, including radon. All members of the population receive a radiation dose from background radiation, medical and dental uses of radiation, and from manmade products. Table 4-36 shows the major sources and levels of background radiation doses to a person in the Albuquerque area, as well as the collective dose to the population within 50 miles of SNL/NM. These sources and background radiation doses are unrelated to SNL/NM operations.

Table 4-36. Background Radiation Dose Unrelated to SNL/NM Operations

Source	Individual Dose ^a (mrem per year)	Population	Collective Dose ^b (person-rem per year)
Natural Background Radiation at SNL/NM			
Cosmic and terrestrial radiation	89 (0.089)	1,073,460	95,538
Internal (food and water consumption)	29 (0.029)	1,073,460	31,130
Radon and thoron in homes (inhaled)	228 (0.228)	1,073,460	244,749
Common Manmade Sources			
Diagnostic x-rays and nuclear medicine	300 (0.3)	1,073,460	322,038
Consumer products	13 (0.013)	1,073,460	13,955
Industrial plus occupational	1 (0.001)	1,073,460	1,073
Total	660 (0.66)	1,073,460	708,483

- a. The average background radiation dose to a person living in the vicinity of Albuquerque is about 660 mrem per year. In comparison, the average background radiation dose to the average U.S. resident is about 620 mrem per year. The higher background dose to a person living in the vicinity of Albuquerque is largely due to higher natural background radiation.
- b. Collective dose is the estimated dose to the entire population within a 50-mile radius of SNL/NM (about 1,073,460 people).

$$\text{Collective Dose} = (\text{Individual dose}) \times (\text{population}) \times \left(\frac{1 \text{ rem}}{1,000 \text{ mrem}} \right)$$
The average dose to an individual in a year from naturally occurring background radiation (no manmade source) is $(89 + 29 + 228) \text{ mrem} = 346 \text{ mrem}$, which is just under 1 mrem per day on average.

Source: SNL 2022a and NRC 2023.

Any radiation dose has the potential to cause impacts to human health (refer to Appendix D, Section D.2.1, for more information). Health impacts (expressed as “latent cancer fatalities” [LCFs]) are calculated from the risk factor of 0.0006 LCF to the general population expected per rem (or person-rem) of radiation dose (DOE 2003e). Table 4-37 provides the various dose limits set for exposure pathways by DOE and EPA for radiation workers and members of the public.

Table 4-37. Dose Limits for Members of the Public and Radiation Workers

Guidance Criteria (organization)	Member of the Public Dose Limits	Radiation Worker Dose Limit
10 CFR Part 835 (DOE)	100 mrem per year when entering a controlled area	5,000 mrem per year
DOE Order 458.1 (DOE)	10 mrem per year (all air pathways) ^a 4 mrem per year (drinking water pathways) ^b 100 mrem per year (all pathways)	--
40 CFR Part 61 (EPA)	10 mrem per year (all air pathways)	--
40 CFR Part 141 (EPA)	4 mrem per year (drinking water pathways)	--

a. Derived from 40 CFR Part 61

b. Derived from 40 CFR Part 141.

In addition to the background sources and other radiation sources mentioned in this section, releases of radionuclides to the environment from SNL/NM operations are another potential source of radiation dose to individuals in the vicinity of SNL/NM. Table 4-38 presents the annual doses to the public from SNL/NM emissions of radioactive materials to the air from 2018–2022.¹² Doses are presented for an MEI¹³ and the population within a 50-mile radius of SNL/NM. These doses fall within radiological dose limits presented in Table 4-37 and are much lower than the background radiation dose presented in Table 4-36.

¹² As discussed in Appendix D, Section D.2.1.5, radiological analyses performed on soil, sediment, and water samples have revealed no statistically significant increasing trends in the onsite locations sample results. Because more than 99% of the dose to the public from SNL/NM operations would be from air emissions, the analysis in this SWEIS focuses on radiological air emissions. Because radiological concentrations in soils, sediment, and water sources are insignificant, there would be no measurable radiological doses from agricultural or terrestrial food sources. Because agricultural or terrestrial food sources are not affected, populations that are more likely to engage in a subsistence lifestyle would not be affected.

¹³ The MEI is “a hypothetical member of the public who – because of realistically assumed proximity, activities, and living habits – would receive the highest radiation dose, taking into account all pathways, from a given event, process, or facility.” In 2021, the hypothetical maximally exposed offsite individual and onsite individuals were located on KAFB at the Eubank Gate area and the Honeywell Systems Support Site, respectfully (SNL 2022a).

Table 4-38. Annual Radiation Doses to Public from SNL/NM Operations (2018–2022)

Year	Annual Dose to Offsite MEI(mrem)	Annual Dose to an Individual within 50 miles (mrem)	Population	Collective Dose (person-rem)^a
2018	0.017	0.000017	1,073,460	0.018
2019	0.00065	0.000023	1,073,460	0.024
2020	0.00027	0.00001	1,073,460	0.011
2021	0.0085	0.000031	1,073,460	0.033
2022	0.0065	0.000025	1,073,460	0.027
2018 to 2022 average	0.0066	0.000021	1,073,460	0.023

a. Collective dose is the estimated dose to the entire population within a 50-mile radius of SNL/NM (about 1,073,460 people).

$$\text{Collective Dose} = (\text{Individual dose}) \times (\text{population}) \times \left(\frac{1 \text{ rem}}{1,000 \text{ mrem}} \right).$$

Source: SNL 2019a; SNL 2020b; SNL 2021a; SNL 2022a; and SNL 2023d.

The offsite MEI average dose of 0.0066 mrem in 2018 – 2022 primarily resulted from tritium releases at the Ion Beam Laboratory and the Neutron Generator Facility (SNL 2023d). Based on the information in Table 4-38, the offsite MEI would have a risk of about 0.000004 (or about 1 chance in 250,000) of developing an LCF from exposure to SNL/NM radiological air emissions. To put the MEI dose of 0.0066 mrem into perspective, the average natural background dose at SNL/NM to a person is 346 mrem, or less than 1 mrem/day, meaning it would take about 151 years of MEI dose to equal the average daily natural background radiation dose. As another comparison, the average dose from a dental x-ray 1.5 mrem. It would take about 227 years of MEI dose to equal the dose from one dental x-ray.

The current projected number of LCFs to the population within a 50-mile radius of SNL/NM is about 0.000014 (or about 1 chance in about 72,500). For perspective, this number may be compared with the number of fatal cancers expected in the same population from all causes. The latest mortality rate associated with cancer for the entire U.S. population in 2019 (for which final data are available) was 146 per 100,000 people (USCSWG 2022).¹⁴ Based on this national cancer mortality rate, nearly 1,567 fatal cancers would be expected to occur annually in the population of about 1,073,460 people living within 50 miles of SNL/NM.

As shown in Table 4-38, the annual radiological dose from SNL/NM is well below the applicable limits for radiation protection of the public. The dose to the offsite MEI resulting from SNL/NM operations is much less than 1% of the NESHAP standard of 10 mrem per year for the air pathway.

4.13.1.2 Non-Radiological

The background chemical environment important to human health consists of the atmosphere, which may contain hazardous chemicals¹⁵ that can be inhaled; drinking water, which may contain hazardous chemicals that can be ingested; and other environmental media through which

¹⁴ In 2019, the latest year for which incidence data are available, for every 100,000 people, 146 died of cancer (USCSWG 2022).

¹⁵ Hazardous chemicals can cause cancer and noncancerous health effects.

people may come in contact with hazardous chemicals (e.g., surface water during swimming and food through ingestion).

Effective administrative and design controls that decrease hazardous chemical releases to the environment and help achieve compliance with permit requirements (e.g., via National Pollutant Discharge Elimination System [NPDES]¹⁶ and NESHAP permits) contribute to minimizing public health impacts. The effectiveness of these controls is verified with environmental monitoring information and inspection of mitigation measures. In 2022, there were no releases to the environment that required reporting to NMED (SNL 2023d), and no primary drinking water contaminants exceeded state or federal standards (KAFB 2022b). Regarding soil, plants, and animals, 2022 sampling results for contaminants were similar to those of previous years, and no NMED soil screening levels for metals were met or exceeded (SNL 2023d).

Section 4.6.1 of this SWEIS addresses the baseline¹⁷ air emission concentrations and applicable standards for hazardous chemicals. The Laboratory's emissions of regulated pollutants are below the amounts allowed in SNL/NM's Title V operating permit. There are no measurable health effects to the public from the Laboratory's current air emissions (SNL 2023d).

4.13.1.3 Cancer Incidences

The National Cancer Institute (NCI) publishes national, state, and county incidence rates of various types of cancer. However, published information does not associate these rates with their causes (e.g., specific facility operations and human lifestyles). Table 4-39 presents incidence rates for the United States, New Mexico, Bernalillo County (where SNL/NM is located), and five other surrounding counties. As shown in that table, most cancer incidence rates in New Mexico and Bernalillo County are lower than national rates. Of the 5 surrounding counties, Tarrant County generally has higher cancer incidence rates for most cancer types than the other counties.

Table 4-39. Cancer Incidence Rates ^a for the United States, New Mexico, Bernalillo County, and Counties Adjacent to SNL/NM (2014–2018)

Location	All Cancers	Thyroid	Breast	Lung & Bronchus	Leukemia	Prostate	Colon & Rectum
United States	442.3	13.3	127	54	13.9	110.5	36.5
New Mexico	369.0	14.8	113.8	33.7	12.7	85.6	33.0
Bernalillo County	382.4	16.4	125.2	33.7	14.5	87.4	30.3
Valencia County	384.8	22.9	120.8	42.2	11.0	70.5	33.3
Tarrant County	445.2	*	147.6	52.8	27.2	88.3	36.2
Santa Fe County	349.2	14.2	129.4	26.4	9.4	87.6	30.3
Sandoval County	403.7	17.5	127.3	31.7	13.4	92.5	34.0
Cibola County	370.1	11.1	93.3	28.4	*	52.6	46.5

a. Age-adjusted incidence rates; cases per 100,000 persons per year.

* Data have been suppressed to ensure confidentiality and stability of rate estimates. Counts are suppressed if fewer than 16 records were reported in a specific area-sex-race category.

Source: NCI 2023.

¹⁶ Currently, SNL/NM does not discharge to waters of the United States, or tributaries thereto, and thus the permitting requirements of the NPDES do not apply to operations.

¹⁷ Baseline concentrations are estimates of the highest existing offsite concentrations and represent the highest concentrations to which members of the public could be exposed.

4.13.2 Worker Health

Each employee at SNL/NM, from director to laboratory worker, is required to know and understand the environment, safety, and health (ES&H) requirements of his or her assignment, the potential hazards in the work area, and the necessary controls for working safely. Employees must participate in all required ES&H training and health monitoring programs. All work assignments must be performed in full compliance with applicable ES&H requirements as published in SNL/NM manuals and guidelines and established in safety procedures. All employees are responsible for working in a manner that produces high-quality results, preserves environmental quality, and protects the health and safety of workers and members of the public.

The SNL/NM Integrated Safety Management System addresses the identification of workplace hazards, control measures, safe work practices, and feedback and continuous improvement functions necessary to perform work safely at SNL/NM. This program articulates the institutional requirements for all operations at SNL/NM or at any other sites where SNL/NM personnel and contractors are working.

When the SNL/NM mission is fulfilled through collaborations, both onsite and offsite, potential impacts could include worker exposure to electrical, low-level radiological, and transportation hazards. However, work activities would be performed in accordance with federal and state regulations, and the personnel safety exposures to radiological sources would be maintained as low as reasonably achievable (ALARA). Offsite transport of radiological materials and wastes also complies with DOT regulations, as well as DOE, NNSA, and/or SNL/NM procedures.

The regulations in 10 CFR Part 835 establish radiation protection standards, limits, and program requirements for protecting workers from ionizing radiation resulting from the conduct of NNSA activities and requires NNSA contractors to develop and maintain an approved Radiation Protection Program Plan (RPPP). SNL/NM has an RPPP, which governs radiological activities at SNL/NM and offsite locations where mission work is performed. As noted in the RPPP, SNL/NM's radiological support operations may include, when requested by NNSA, offsite activities or events involving radiation-generating devices and radioactive material.

DOE Order 458.1 (DOE 2020b) establishes requirements to protect the public and the environment against undue risk from radiation associated with NNSA-directed activities. Public radiological doses at SNL/NM, as well as for offsite NNSA-directed activities, are reported in the SNL/NM ASER. Radiological doses generated by these operations are consistently found to be well below the applicable limits for radiation protection.

4.13.2.1 Radiological

SNL/NM workers receive the same dose as the public from background radiation but also may receive occupational dose from performing radiological work. Table 4-40 presents the annual average individual and collective worker doses from SNL/NM operations from 2017 to 2021. These doses fall within the regulatory limits presented in Table 4-37.

Table 4-40. Internal and External Total Effective Radiation Doses to SNL/NM Workers from Operations (2017–2021)

Occupational Personnel	2017	2018	2019	2020	2021	Average
Number of workers receiving a measurable dose	73	175	154	89	105	119
Collective total effective worker dose (person-rem)	2.15	5.82	5.32	3.29	3.09	3.93
Average total effective worker dose (mrem) ^a	29.5	33.3	34.6	36.9	29.4	32.7

a. No standard is specified for an “average radiation worker”; however, the radiological limit for an individual worker is 5,000 mrem per year (10 CFR Part 835). The NNSA goal is to maintain radiological exposure ALARA. SNL/NM has established an administrative control level of 100 mrem per year for non-radiological workers and 250 mrem per year for radiological workers, with options to increase with managerial approval.

Source: DOE 2019a and DOE 2023b.

Based on the dose-to-risk conversion factor of 0.0006 LCF per 1 person-rem, the annual LCF risk to an average SNL/NM worker due to radiation exposure from SNL/NM operations is estimated to be 0.000019. That is, the estimated probability of a worker developing a fatal cancer at some point in the future from radiation exposure associated with 1 year of SNL/NM operations is about 1 in 51,000. No excess fatal cancers are projected in the total worker population from 1 year of normal operations.¹⁸ During 2017 – 2021, no worker exceeded the 250 mrem per year administrative control level established for radiological workers, nor DOE’s 5-rem-per-year dose limit (DOE 2021c and DOE 2023b).

As Low as Reasonably Achievable Program. SNL/NM occupational exposure continues to be deliberately managed under an ALARA Program within the SNL/NM RPPP, with emphasis on dose minimization during design, work control, training, ALARA goals, performance measurement, line management engagement, and oversight by SNL/NM senior management. Improvements in maintaining radiation exposures ALARA—such as improved dose tracking during work activities, additional shielding, better radiological safety designs, worker involvement, and innovative solutions—should result in continually lower SNL/NM radiological worker doses relative to the work conducted (SNL 2023d).

4.13.2.2 Non-Radiological

SNL/NM is a research site where a large variety of hazardous materials are used. If not appropriately managed SNL/NM operations present a potential for exposure of some workers to hazardous materials (such as solvents, metals, and carcinogens). Typically, operations are controlled through specific work control documents so that those workers may be exposed to low levels of a wide variety of chemicals that are below a threshold of concern throughout the duration of their research.

Workers are provided with information and training on identified hazards and follow requirements in specific work control documents to protect them and minimize hazards and exposures. SNL/NM has several programs and procedures in place to direct monitoring, handling, storing, and using hazardous materials. Work activities are periodically monitored with measurements performed at personal breathing zones and general work areas. ES&H monitoring

¹⁸ Statistically, based on a total worker dose of 3.93 person-rem per year, one LCF to the SNL/NM workforce would be expected to occur every 425 years of operation.

records indicate that personnel exposure to hazardous materials is kept well below established regulatory requirements and exposure guidelines.

Carcinogens. Carcinogens are used in SNL/NM operations only when it is not possible to use a noncarcinogenic material. Any use of carcinogens requires stringent controls to be in place to prevent exposures to workers, the public, and the environment. At SNL/NM, employees use carcinogens only when required by a specific research project. Worker exposures to certain hazardous materials are monitored by industrial hygiene staff and tracked using an occupational exposure database. Likewise, personnel may be monitored for certain chemical agents by routine medical examinations performed by the SNL/NM Health Services Department. All employees who work with carcinogens must receive sufficient information and training so that they may work safely and understand the relative significance of the potential hazard.

4.13.2.3 Occupational Injuries

SNL/NM's occupational health and safety performance is measured by injury and illness rates (Total Recordable Case [TRC] and Days Away, Restricted, or Transferred [DART]) pursuant to DOE orders that use Occupational Safety and Health Administration (OSHA) criteria. As shown in Table 4-41, the TRC rate at SNL/NM has varied between 0.72 and 1.46 over the past 5 years, with an average TRC rate of 1.1; this means that for every 100 workers at SNL/NM, there is about 1.1 work-related injury or illness annually that results in either death, days away from work, restricted work or transfer to another job, medical treatment beyond first aid, or loss of consciousness. DART represents severe injuries annually. As shown in Table 4-41, the DART rate at SNL/NM varied between 0.31 and 0.9 over the past 5 years, with an average DART rate of 0.5; this means that for every 100 workers at SNL/NM, there is an average of about 0.5 work-related severe injuries or illnesses annually that result in days away from work or days of job restriction or transfer.

Table 4-41. Occupational Injury Statistics for SNL/NM (2018 – 2022)

Metric	2018	2019	2020	2021	2022	Average
TRC Rate ^a	1.09	1.09	0.72	1.21	1.46	1.1
DART Rate ^b	0.50	0.34	0.31	0.55	0.90	0.5

a. TRC Rate: Work-related injuries or illnesses that resulted in either death, days away from work, restricted work or transfer to another job, medical treatment beyond first aid, or loss of consciousness per 100 workers.

b. DART Rate: Injuries or illnesses in which the most serious outcome of the case resulted in days away from work or days of job restriction or transfer per 100 workers.

Source: DOE 2023c.

During normal operations, SNL/NM workers may be exposed to hazardous conditions that can cause injury or death. In 2021 work-related injuries included slips, trips, and falls resulting in fractures sprains, and strains; struck against/by injuries resulting in lacerations and abrasions; and lift/push/pull injuries resulting primarily in strains. There were 242 TRC cases and 147 DART cases at SNL/NM in 2022 (DOE 2023c). No work-related fatalities occurred at SNL/NM between 2018 – 2022.

Workers are protected from workplace hazards through appropriate training, protective equipment, monitoring, materials substitution, and engineering and management controls. Under 10 CFR Part 851, DOE lists the requirements for a worker safety and health program to ensure that DOE contractors and their workers operate a safe workplace. NNSA establishes procedures

for investigating whether a violation of a requirement of this part has occurred, for determining the nature and extent of any such violation, and for imposing an appropriate remedy. In addition, 10 CFR Part 851 incorporates many OSHA requirements and other protections. Appropriate monitoring that reflects the frequency and quantity of chemicals used in the operational processes ensures that these standards are not exceeded. NNSA also requires that conditions in the workplace minimize hazards that cause, or are likely to cause, illness or physical harm.

4.14 ENVIRONMENTAL RESTORATION SITES

4.14.1 Introduction

ER encompasses efforts to protect human health and the environment from sites where releases of hazardous waste or hazardous constituents have occurred by implementing corrective actions under RCRA. The ER Operations Program at SNL/NM was created under the DOE Office of Environmental Management (EM) to identify, characterize, and remediate sites potentially contaminated by past spill, release, or disposal activities in accordance with RCRA, as amended by the Hazardous and Solid Waste Amendments of 1984. NMED is the delegated regulatory authority for implementing RCRA under the authority of the New Mexico Hazardous Waste Act. DOE EM is responsible for addressing the legacy of environmental contamination and cleanup at ER sites associated with the Nation's nuclear weapons production and nuclear energy research.

DOE regulates radioactive waste cleanup pursuant to the Atomic Energy Act of 1954, as amended. EPA regulates air and stormwater. The New Mexico Office of the State Engineer regulates water rights, well drilling, and well plugging and abandonment (DOE 2022). Corrective action standards at SNL/NM may also exist in the Compliance Order on Consent signed in 2004 by DOE, SNL, and NMED (NMED 2004). The RCRA Permit includes a list of sites requiring corrective action under the Compliance Order on Consent. NNSA and SNL/NM work closely with NMED to complete RCRA corrective actions at the six remaining ER sites using cost-effective approaches that meet regulatory requirements (DOE 2023d).

DOE EM funds and provides oversight support for remediation of ER sites during the corrective action process, focusing on activities such as:

1. **Investigation and Remediation:** Identifying, characterizing, and remediating environmental contamination caused by past nuclear-related activities. This includes soil and groundwater remediation, decontamination and decommissioning of facilities, and waste management.
2. **Waste Management:** Managing and disposing of radioactive and hazardous wastes generated from cleanup activities. This involves safely treating, packaging, transporting, and storing these wastes to prevent environmental and public health risks.
3. **Risk Reduction:** Implementing measures to reduce risks to human health and the environment posed by contaminated media. This may involve monitoring and institutional control implementation and/or land use restrictions during corrective action.
4. **Technology Development:** Researching and developing innovative technologies to improve the efficiency and effectiveness of ER processes.

5. **Community Engagement:** Engaging with local communities, stakeholders, and regulatory agencies to ensure transparency, gather input, and address concerns related to cleanup activities.

In recent years, completion of corrective action at 311 ER sites, together with environmental controls on ongoing testing, has reduced the concentrations and/or extent of soil contamination (SNL 2022a).

4.14.2 SNL/NM Environmental Restoration Site Types

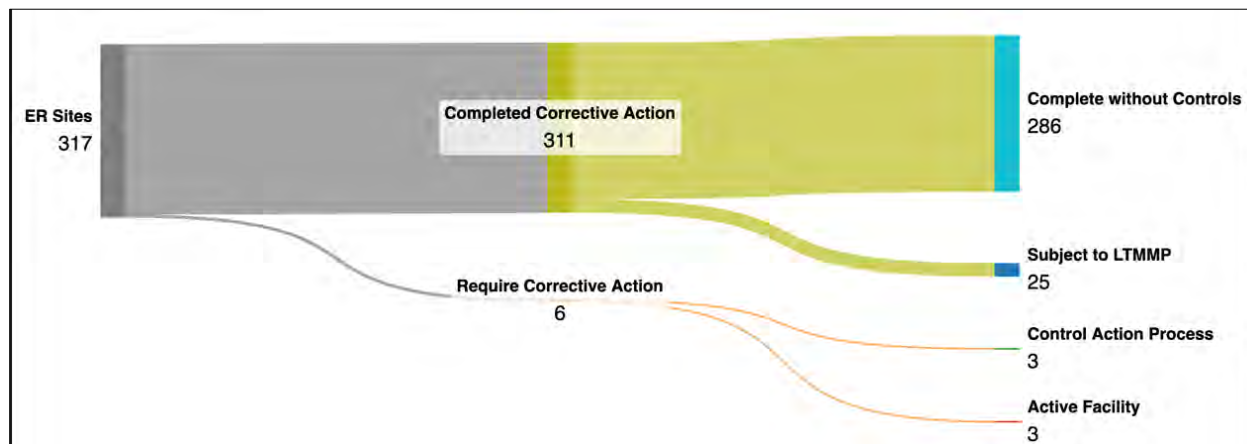
ER sites at SNL/NM denote specific areas targeted for cleanup, mitigation, or long-term management to address contamination or environmental hazards stemming from facility operations or releases. “ER site” is employed for SNL/NM as a catch-all term to cover sites where corrective action has been completed and RCRA closure was completed; sites where corrective action is in process (i.e., the groundwater AOCs), and sites requiring corrective action. ER sites include AOCs, CAMU, CWL, MWL, and SWMUs:

- Area of Concern (AOC): Any area that may have had a hazardous waste or constituent release and is not an SWMU (SNL 2017d). AOCs both requiring corrective action and that have completed corrective action are listed in RCRA Permit Attachment K.
- Post Closure Care Units: CAMU and CWL underwent closure through a different regulatory process than other ER sites (i.e., RCRA closure rather than remediation under the Consent Order). Both units have been closed and require post-closure care.
 - Corrective Action Management Unit (CAMU): A CAMU is an area in a facility used only for managing CAMU-eligible wastes to implement corrective action or cleanup at the facility. SNL/NM’s CAMU is a 3.75-acre site undergoing post-closure care. The site was active from 1997–2003 during remediation/closure of the CWL. The CAMU consisted of two treatment systems, four associated waste staging and storage areas, support areas, and a containment cell to store treated soils excavated from the CWL. Staging, treatment, and support areas were all clean-closed, but treated soil remains in the lined containment cell which is covered with an evapotranspirative cover system.
 - Chemical Waste Landfill (CWL): The CWL is a 1.9-acre former disposal site in the southeastern corner of TA-III that is undergoing post-closure care. The site was used for disposal of chemical and solid wastes generated by SNL/NM research activities from 1962–1985. Additionally, a small amount of radioactive waste was disposed of during operational years. The CWL is a closed, remediated hazardous waste landfill covered with an at-grade evapotranspirative cover to minimize infiltration of surface water into the former landfill. The CWL is a regulated unit under RCRA.
- Mixed Waste Landfill (MWL): The MWL is a 2.6-acre SWMU located centrally in TA-III. LLW and mixed wastes were disposed of in the MWL from March 1959 through December 1988. The MWL consists of two disposal areas: the classified area (occupying 0.6 acre) and unclassified area (occupying 2.0 acres) (SNL 2004). The MWL has completed corrective action. Final remedy selected included an evapotranspirative cover.
- Solid Waste Management Unit (SWMU): An SWMU is any discernible unit at which solid waste has been placed at any time, and from which the regulatory agency

determines there may be a risk of hazardous waste or constituent release, irrespective of whether the unit was intended for solid or hazardous waste management. Such units include any area at the facility at which solid wastes have been routinely and systematically released; they do not include one-time spills (SNL 2017d). SWMUs both requiring corrective action and that have completed corrective action are listed in RCRA Permit Attachment K.

4.14.3 SNL/NM Environmental Restoration Site Corrective Action Status

Figure 4-6 shows the path of 317 identified SNL/NM ER sites on the RCRA Permit from initial identification to current status. Of the sites, 311 have completed corrective action, and of those, 286 are closed without controls (i.e., closed to residential risk-based standards) and 25 are closed with controls and other measures to protect human health and the environment (i.e., requiring long-term monitoring and maintenance), as detailed in RCRA Permit Attachment M.¹⁹ The MWL is one of 25 corrective action complete with controls ER sites. It has its own LTMMMP detailing monitoring, inspection, maintenance/repair, and specific reporting requirements. The MWL LTMMMP is included by reference in the RCRA Permit. Long-term monitoring and maintenance of ER sites that are corrective action complete are managed under the Long-Term Stewardship Program with oversight by the DOE Office of Environment, Safety, and Health.



Source: SNL 2023d.

Figure 4-6. Number and Status of SNL/NM ER Sites

The remaining six active ER sites include three groundwater AOCs currently in various stages of corrective action and three SWMUs where corrective action has been deferred until active facility operations cease.

The CWL and CAMU, managed by the Long-Term Stewardship Program, are not listed in RCRA Permit Attachment K, so these ER sites are not included in the 317 ER site count. They

¹⁹ Measures to protect human health and the environment under the LTMMMP include surveillance of site conditions and maintenance of institutional controls. These sites were closed to industrial risk standards.

are identified as post-closure care units and have undergone RCRA closure. During post-closure care, both will be monitored and maintained to protect human health and the environment.

4.14.4 SNL/NM Environmental Restoration Sites Requiring Corrective Action

The remaining ER sites in RCRA Permit Attachment K Permit requiring corrective action include three AOCs with contaminated groundwater in various stages of corrective action (Burn Site Groundwater Investigation AOC, TA-V Groundwater AOC, and Tijeras Arroyo Groundwater Investigation AOC) and three SWMUs (SWMU 83, SWMU 84, and SWMU 240) where corrective action has been deferred because they are active testing facilities. Appendix A, Section A.4.5, analyzes the three groundwater AOCs and summarizes the groundwater quality, conceptual site models, and related activities at each. The three SWMUs will undergo corrective action at the end of their test operations.

4.14.5 Chemical Waste Landfill and Corrective Action Management Unit

The CWL and CAMU are closed units that require post-closure care. The CWL is a regulated unit where post-closure care activities are conducted in accordance with the CWL Post-Closure Care Permit, effective in 2011. The CAMU underwent closure in 2003 in accordance with the Closure Plan in the Class III Permit Modification Request (SNL 1997). Post-closure care activities at the CAMU are conducted in accordance with RCRA Permit Part 7 and the CAMU Post-Closure Care Plan, included in RCRA Permit Attachment H.

4.15 SOCIOECONOMICS

Socioeconomics refers to attributes of the human environment, particularly demographic and economic characteristics of an area. Demographics of the socioeconomic ROI refers to the characteristics of the population within that specific area. This typically includes variables such as population, age, earnings, education, employment, health, housing, income and poverty, and services. This analysis considers the attributes of human social and economic interactions of a Proposed Action and alternative and the impacts such actions may have on the ROI.

The socioeconomic ROI is defined as the area in which the principal direct and secondary socioeconomic effects of Proposed Action and alternatives are likely to occur and includes most of the residential distribution of SNL/NM personnel. In 2022, about 83 percent of SNL/NM personnel resided in Bernalillo County and another 17 percent resided in surrounding counties. Since most of the SNL/NM workforce resided in Bernalillo County, the ROI for this analysis is Bernalillo County. The socioeconomic assessment considers the impacts of the Proposed Actions and alternatives on broad indicators: population and demographics, employment and economic characteristics, housing, community services, and surrounding population as compared to state population. This assessment also considers impacts to tribes and tribal trust assets within the ROI and whether they experience impacts to their unique socioeconomic systems, lifestyles, and resources.

Data from the U.S. Census Bureau, particularly the 2018–2022 American Community Survey, and from state and local government agencies, are often used to describe baseline socioeconomic characteristics. Other data sources include the U.S. Bureau of Labor Statistics (BLS), U.S. Bureau of Economic Analysis (BEA), state economic development agencies, local government

agencies, chamber of commerce records, and private organizations that operate as data brokers. Appendix C of this SWEIS provides additional information on the methodology for considering population impacts in the environmental analyses.

4.15.1 Population and Demographics

In 2022, the population in the ROI was estimated to be 674,692 (USCB 2022a), an increase from 662,564 in 2010 (USCB 2010a). Over the last decade, New Mexico's population growth stagnated compared with that of neighboring states and the United States as a whole. Population estimates show a decline between 2020 and 2022 attributed to lower birth rates and more people leaving New Mexico than moving to the state since 2012 (NMLEGIS 2021). However, population projections for 2022–2040 show a gradual increase in population through 2035 with a slight decrease in population between 2035 and 2040 for the socioeconomic ROI and the state. Table 4-42 summarizes historic and projected population in the ROI and New Mexico.

Table 4-42. Historic and Projected Population in the ROI and New Mexico

Area	2010	2015	2020	2022	2025	2030	2035	2040
Bernalillo	662,564	673,943	676,438	674,692	680,584	683,372	684,673	684,461
New Mexico	2,059,179	2,084,117	2,117,527	2,112,463	2,143,658	2,161,645	2,164,780	2,153,964

Source: USCB 2015; USCB 2022a; and UNM 2024.

New Mexico is a majority-minority population state. In 2022, New Mexico's minority²⁰ population percentage was 64.4 percent, with the two largest populations being Hispanic at 49.8 percent and white, non-Hispanic at 35.6 percent (USCB 2022a). During the same period, the socioeconomic ROI's minority population percentage was 63.3 percent, with the two largest populations being Hispanic at 50.7 percent, followed by white, non-Hispanic at 36.7 percent (USCB 2022a).

4.15.2 Employment and Economic Characteristics

As of 2022, 13,078 full-time personnel were at SNL/NM, of whom about 10,826 (83 percent) resided in the socioeconomic ROI. In addition to SNL/NM employees, the NNSA SFO has about 90 employees, 83 of whom reside in the ROI (NNSA 2023a). SNL/NM operations represent the third largest employer in New Mexico (New Mexico Partnership 2023). For CY 2022, the SNL/NM payroll (including benefits) was approximately \$1.5 billion for the 10,826 personnel estimated to live in the ROI. Table 4-43 provides residence information for SNL/NM employees as of 2022 who reside in the ROI and surrounding counties in New Mexico.

Table 4-43. Geographic Distribution of SNL/NM Employee Residences, 2022

County of Residence	SNL/NM Number of Employees	Percent of Total Site Employment ^a
Total ROI (Bernalillo County)	10,826	82.8%
Other (surrounding counties)	2,252	17.2%
Total SNL/NM	13,078	100.0%

a. Derived from SNL 2022c and SNL 2023a.

²⁰ The U.S. Census Bureau defines a minority as any group other than non-Hispanic white, including American Indian or Alaskan Native; Asian or Pacific Islander; black, not of Hispanic origin; or Hispanic or Latino.

Between 2010–2022, the general labor force in the socioeconomic ROI increased about 4 percent to 336,801 persons. During the same period, general employment in the ROI increased by 8.2 percent to 324,606 persons, and the number of unemployed persons decreased by 49.3 percent, reflecting an economic recovery. During the same period, the unemployment rate declined from 7.4 percent to 3.6 percent (BLS 2022 and BLS 2023b). New Mexico experienced similar trends in employment characteristics (BLS 2023a). The 10,826 employees who reside in the ROI account for approximately 3.3 percent of total employment in the ROI. Table 4-44 presents the employment profile in the ROI and New Mexico for the years 2010 and 2022.

Table 4-44. Employment Profile in the ROI and New Mexico for the Years 2010 and 2022

County/Area	Labor Force		Employed		Unemployed		Unemployment Rate	
	2010	2022	2010	2022	2010	2022	2010	2022
Bernalillo	324,142	336,801	300,114	324,606	24,028	12,195	7.4%	3.6%
New Mexico	928,862	947,025	856,602	908,870	72,260	38,155	7.8%	4.0%

Source: BLS 2022; BLS 2023b; and SNL 2023j.

From 2010–2022, median household income in the socioeconomic ROI increased by 31 percent, from \$47,481 to \$62,220 dollars. In 2022, median household income in the ROI was greater than that for New Mexico as a whole. From 2010–2022 per capita income of the ROI increased by 41.5 percent from \$26,143 to \$36,996. State-wide, New Mexico experienced a similar increase of approximately 42.2 percent, to \$32,667 (USCB 2010b and USCB 2022b).

Low-income populations are defined as households that have incomes below the federal poverty level (in 2022, federal poverty level for a family of four was \$29,960). In 2022, the percentage of low-income populations in New Mexico was 17.7 percent, and the low-income population of the socioeconomic ROI was 16.4 percent (USCB 2022c). Refer to Section 4.15.5 for more on low-income populations. Table 4-45 shows income information for the ROI and New Mexico.

Table 4-45. Income Information for the ROI and New Mexico, 2022

County/Area	Median Household Income		Per Capita Personal Income		Percent Below Poverty	
	2010	2022	2010	2022	2010	2022
Bernalillo	\$47,481	\$62,220	\$26,143	\$36,996	14.4%	16.4%
New Mexico	\$43,820	\$58,722	\$22,966	\$32,667	16.9%	17.7%

Source: USCB 2010a; USCB 2010b; USCB 2022a; USCB 2022b.

In 2022, the largest industry in the socioeconomic ROI was the BEA category of Total Government (federal, state, and local), accounting for about 15.9 percent of employment. Health Care and Social Assistance was the next leading industry, at about 12.7 percent, followed by Professional, Scientific, and Technical Services at 10.1 percent; Retail Trade at 9.3 percent; Accommodation and Food Services at 7.7 percent; and Construction at 6.1 percent (BEA 2023 and BEA 2025). Leading employment industries in New Mexico are similar to those in the ROI.

4.15.3 Housing

From 2010–2022, the number of housing units in the socioeconomic ROI increased by about 6.9 percent, from 280,435 to 299,693. Over the same period, the number of housing units in New Mexico increased by about 6.2 percent, from 887,890 to 943,149. The number of housing units in the ROI accounts for about 31.8 percent of housing units in New Mexico. The average annual

growth rate for housing units in the ROI from 2010–2022 was approximately 0.6 percent, comparable to that of New Mexico, which experienced an average annual growth rate for housing units of 0.5 percent (USCB 2010c and USCB 2022d).

The 2022 homeowner vacancy rate was 0.9 percent for the socioeconomic ROI and 1.3 percent for New Mexico. The 2022 renter vacancy rate for the ROI was 5.9 percent, slightly lower than the renter vacancy rate of 6.7 percent for New Mexico. The median value of owner-occupied homes in the ROI was \$247,300. Comparatively, the statewide median home value during the same period was \$216,000 (USCB 2022d). Table 4-46 shows housing characteristics in the ROI.

Table 4-46. Housing Characteristics in the ROI and New Mexico, 2022

Parameter	Bernalillo	New Mexico
Total units	299,693	943,149
Occupied housing units	281,095	812,852
Median value (\$)	247,300	216,000
Vacant units	18,598	130,297
Homeowner vacancy rate	0.9%	1.3%
Renter vacancy rate	5.9%	6.7%

Source: USCB 2022d.

4.15.4 Community Services

This section describes the existing fire protection services, police protection services, public education, and health care services in the socioeconomic ROI.

Fire Protection. Fire departments and incorporated city fire departments provide fire protection in the socioeconomic ROI. Fire protection services in Bernalillo County, where SNL/NM is located, are provided by the Bernalillo County Fire Department, Albuquerque Fire Rescue, and KAFB Fire Department Branch (377th Mission Support Group/Civil Engineer). The Bernalillo County Fire Department has 12 fire districts, consisting of a total of 38 fire stations (BERNCO 2023). Albuquerque Fire Rescue is a paid municipal department of 22 fire stations and over 760 uniformed personnel (CABQ 2023b). Fire stations in Albuquerque also respond as part of the KAFB and Bernalillo County Fire Department mutual aid agreement on request (CABQ 2023b).

Police Protection Services. County sheriff’s departments, local police departments, and the New Mexico State Police provide police protection in the socioeconomic ROI. Native American tribes also operate their own tribal police departments and are responsible for law enforcement within their jurisdiction. Law enforcement services in Bernalillo County, where SNL/NM is located, include the Bernalillo County Sheriff’s Office and the Albuquerque Police Department. The Albuquerque Police Department is the largest police force in New Mexico with approximately 1,000 sworn officers (FBI 2023). In addition to serving as the primary police force in Albuquerque, the Albuquerque Police Department officers are sworn in as special deputy sheriffs by the Bernalillo Sheriff’s Office, which grants jurisdiction in Bernalillo County. The 377th Security Forces Group provides police services on KAFB, and SNL/NM’s Safeguards and Security Protective Force provide additional, but limited security services for SNL/NM.

Medical Services. Across New Mexico, including the socioeconomic ROI, physician supply lags significantly behind patient need and demand. The state currently ranks in the bottom one-third

of all states for primary care and physician availability. Currently, 32 of New Mexico's 33 counties have health professional shortages (Cicero Institute 2024). Medical services in the ROI include seven full-service hospitals and clinics (AHD 2023). 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.

Educational Services. There are 28 school districts within the socioeconomic ROI, with a total of 206 schools serving 90,678 students during the 2022–2023 school year (Table 4-47). KAFB has two elementary schools within the base, Wherry Elementary and Sandia Base Elementary. The total student population of 90,678 within the ROI comprises approximately 25.2 percent of the state student population of 359,870. The ROI has a student-to-teacher ratio of 14 to 1 (NCES 2021). While schools within the ROI tend to have higher rankings, New Mexico overall currently ranks last in national education rankings (U.S. News 2024).

Table 4-47. School Year 2022–2023 Enrollment in the Socioeconomic ROI

Parameter	ROI
Total school districts	28
Total schools	206
Total school enrollment	90,678
Total teachers	6,708
Average student-teacher ratio	14:1

Source: NCES 2021.

4.15.5 Surrounding Population Considerations

This SWEIS identifies and assesses environmental health risks and safety risks that may disproportionately affect surrounding populations in the ROI. The assessment considers socioeconomic indicators of income, age, language, and educational attainment to identify populations that could be more vulnerable to environmental impacts and includes impacts to tribes because of their unique socioeconomic systems, lifestyles, and tribal trust resources.

This section presents poverty-level and demographic data for the socioeconomic ROI potentially affected by the Proposed Action and alternatives to assess whether a population group is disproportionately impacted. For example, it considers whether young or old populations in the ROI would be disproportionately impacted as compared to New Mexico's general population.

Population distributions of the socioeconomic ROI are calculated using data at the block-group level of spatial resolution from U.S. Census Bureau population estimates. There are 468 census block groups in the ROI. The analysis uses information from the U.S. Census Bureau's 2018–2022 American Community Survey 5-year estimates on income, age, language, and educational attainment statistics, which were assessed to identify populations that could be more vulnerable to environmental impacts. Census block groups that exceed New Mexico percentages for socioeconomic indicators were identified as at-risk populations.

In 2022, population in the socioeconomic ROI was 674,692, about 31.9 percent of the total population of New Mexico. At-risk populations are generally equally distributed throughout the

ROI, and average percentage of at-risk populations in the ROI is lower than New Mexico averages. Average ROI percentage for the socioeconomic indicators examined did not exceed average percentages for New Mexico. Table 4-48 summarizes percentages for low-income, age, linguistically isolated,²¹ and educational attainment in the ROI. Additional maps of census blocks within the ROI with these populations are provided in Appendix A, Section A.4.15.

Table 4-48. Surrounding Populations in the ROI

Parameter	ROI ^a : Population	ROI: % of Population Considered	New Mexico ^a : Population	New Mexico: % of Population Considered
Linguistic Isolation	11,243	4.0%	43,081	5.3%
Population Under 5 Years Old	34,866	5.2%	115,927	5.5%
Population over 64 Years Old	115,541	17.1%	382,672	18.1%
Population with Less than High School Education	46,035	9.8%	184,974	12.9%
Income in the past 12 months below poverty level ^b	N/A	16.4%	N/A	17.7%
Pueblos/Nation	3	N/A	23	N/A

a. Population estimates are based on Census Bureau 2022 American Community Survey 5-year estimates (2018–2022). Percentage presented is representative of a specific group within the total population that is relevant for the specific parameter being analyzed.

b. Low-income populations include households whose income during the last 12 months fell below the federal poverty level. Source: USCB 2022a; USCB 2022e; USCB 2022f; USCB 2022g; USCB 2022h; USCB 2022i; and NMSS 2025.

The socioeconomic ROI also encompasses all or part of three pueblos/nations, including the Pueblo of Isleta, Pueblo of Laguna, and Navajo Nation. Because of the federal government’s trust responsibilities to tribes, this SWEIS considers the Proposed Action and alternative impacts on tribal trust resources (including agricultural activities), traditional tribal practices, and treaty rights in the ROI. The Pueblo of Isleta is the closest to SNL/NM-managed lands and is adjacent to the southern boundary of KAFB.

Income. In 2022, the percentage of low-income populations within New Mexico was 17.7 percent. The average percentage of low-income populations in the socioeconomic ROI was lower than that for the state at 16.4 percent. Of the 468 census block groups in the ROI, 170 block groups had a percentage of low-income populations greater than that of the state (USCB 2022c). Low-income populations include households whose income during the last 12 months fell below the federal poverty level. Studies show that low-income populations tend to live in areas with a higher concentration of pollution sources, such as factories, industrial sites, and busy roads (American Lung Association 2023).

Age. In 2022, the percentage of the population under age 5 in New Mexico was 5.5 percent, and the average percentage of under age 5 populations in the ROI was 5.2 percent. The percentage of adults over age 64 in New Mexico was 18.1 percent. The average percentage of adults over age 64 within the ROI was 17.1 percent (USCB 2022e). Of the 468 census block groups in the ROI, 47 block groups had a percentage of under age 5 populations greater than that of the state and

²¹ The U.S. Census Bureau defines “linguistically isolated” households as those households in which all adults (age 14 and older) speak a language other than English and none speaks English “very well.”

212 block groups had a percentage of populations of adults over age 64 greater than that of the state (USCB 2022h). Younger and older populations may be more susceptible to pollution sources due to lowered immune function or accumulated oxidative stress associated with a lifetime of exposures (American Lung Association 2024).

Language. In 2022, the percentage of linguistically isolated populations in New Mexico was 5.3 percent. The percentage of linguistically isolated populations in the ROI was lower than that of the state at 4.0 percent (USCB 2022g). The U.S. Census Bureau defines “linguistically isolated” households as those households in which all adults (age 14 and older) speak a language other than English and none speaks English “very well” (USCB 2022f). Of the 468 census block groups in the ROI, 121 block groups had a percentage of linguistically isolated households greater than that of the state. Households with linguistic isolation may be more susceptible to health impacts associated with emissions or release alerts.

Educational Attainment. In 2022, the percentage of populations with less than high school education in New Mexico was 12.9 percent. The percentage of populations with less than high school education in the ROI was lower than that of the state at 9.8 percent (USCB 2022g). Of the 468 census block groups in the ROI, 74 block groups had a percentage of populations with less than high school education greater than that of the state (USCB 2022i). Educational attainment may influence a population’s ability to navigate information about pollution and local-scale resources. Education also influences a population’s susceptibility to the health impacts of negative pollution sources or emissions.

Federally Recognized Tribes. Twenty-three federally recognized tribes are in New Mexico, including 19 pueblos, 3 Apache tribes, and a portion of the Navajo Nation. The ROI contains portions of three pueblos/nations (NMSS 2025). Tribes that engage in agriculture, grazing, and traditional land uses may be more susceptible to impacts due to negative pollution sources or emissions and may experience greater impacts to economic security and socioeconomic factors should environmental contamination of tribal trust resources occur.

5.0 ENVIRONMENTAL CONSEQUENCES

5.1 INTRODUCTION

This chapter discusses the potential direct and indirect environmental impacts of the three alternatives described in Chapter 3: the No-Action Alternative, the Modernized Operations Alternative, and the Expanded Operations Alternative. For purposes of this assessment, for the No-Action Alternative, construction activities are assumed to occur in the period 2025–2030, with steady-state operations expected from 2030 onward. For the Modernized Operations Alternative and the Expanded Operations Alternative, construction activities are expected to occur in the period 2025–2040, with steady-state operations from 2030 onward, dependent on project completions expected in 2040.

The potential impacts (Sections 5.2 through 5.15) are based on the resources and ROIs identified in Section 4.1 and are presented in the same order as the resource descriptions in Sections 4.2 through 4.15. This chapter also presents the potential impacts of unlikely or unanticipated events, such as accidents and intentional destructive acts (IDAs) by third parties (Section 5.14.6).

NNSA estimated the potential impacts from the three alternatives using the methodologies described in Appendix C. The analysis for each includes the potential impacts from construction and infrastructure projects, DD&D, and operations. For many resources, the potential impacts from construction and operation are estimated and presented separately because these activities have different types of impacts.

5.2 LAND USE AND AIRSPACE

This section presents potential land use impacts to SNL/NM-managed lands under the three alternatives evaluated in this SWEIS. Key metrics in the analysis of land use include the (1) number and footprint of existing and new facilities and infrastructure, (2) amount of land disturbance and the conversion of currently undeveloped land, and (3) a qualitative analysis of consistency with current land use plans, classifications, and policies. To assess the effects on land use, the analysis is based on the highest estimated land disturbance identified in Chapter 3. This approach ensures that this SWEIS presents a bounding estimate of impacts with the maximum foreseeable land disturbance. Potential impacts from “large” projects and facilities (projects greater than 50,000 square feet [1.15 acres] in size or land disturbance) are examined in greater detail than smaller projects. For each alternative, individual projects/facilities less than the 50,000-square-foot threshold are aggregated to assess SNL/NM-managed land use impacts. Any potential offsite land use will utilize leased facilities that do not require land development. The airspace analysis focuses on any changes, disruptions, or other impacts to the current use, management, or operational procedures of existing airspace.

5.2.1 No-Action Alternative

Under the No-Action Alternative, SNL/NM will experience changes from the construction of replacement facilities, infrastructure changes or improvements, and DD&D activities. Developed land area will increase by less than 1 percent. Facility footprints and development density in the

five TAs will increase by 3 percent (less than 1 percent annually). Development and DD&D actions will be consistent with historical land uses.

Under the No-Action Alternative, about 13.1 acres of land will be permanently disturbed for replacement facilities and infrastructure, and 2.8 acres will undergo DD&D. More information about permanent land disturbances under this alternative is in Appendix A, Section A.3.1. Under this alternative, SNL/NM's net developed land area will increase by an estimated 10.4 acres, to a total of 3,260 permanently disturbed acres, or 0.3 percent greater than existing conditions. An additional 6 acres of land will be disturbed to establish a 5-acre dedicated construction staging area in TA-I and a 1-acre power substation in TA-II (refer to Section 3.2.1, Table 3-1).

Land Use Terminology Used in this SWEIS

Developed Land Area refers to the portion of land that has undergone alteration from its natural state through human activities for various purposes. It encompasses land covered by structures, infrastructure, and other artificial features.

Development Density is the facility square footage per acre.

Development Footprint represents the estimated square footage of a project/facility plus any construction laydown areas and temporary parking and access areas that may be required. To be conservative, this SWEIS assumes that the development footprint represents the maximum amount of land that could be disturbed.

Facility Footprint is the total square footage of all permanent facilities. The term “facility square footage” is used interchangeably.

Net Developed Land Area is the “proposed development” land area minus any land area that could be available for future development after completion of DD&D.

Proposed Development includes all permanent facilities, utilities/infrastructure, and any construction laydown areas that may be required. After construction, laydown areas may be converted to parking areas or landscaped areas or restored to a pre-construction state. To be conservative, this SWEIS assumes that the proposed development represents the maximum amount of land that could be disturbed.

If all projects under the No-Action Alternative are implemented, the net developed onsite land area will total 3,260 acres or 24 percent of the overall SNL/NM-managed land area (13,829 acres). Land use actions, whether development or DD&D, will be consistent with previous uses. Additional information regarding changes to facility footprint and development density in the five TAs under the No-Action Alternative is provided in Appendix A, Section A.5.2.

No new offsite facilities or infrastructure projects are proposed under the No-Action Alternative. Ongoing maintenance and operations will continue at existing levels or be increased to maintain existing and aging facilities and infrastructure.

5.2.1.1 Airspace under No-Action Alternative

Under the No-Action Alternative, no specific projects or actions are proposed that will result in any changes, disruptions, or other impacts to the current use, management, or operational procedures of existing airspace. The current airspace functionality will be preserved without interference or modification to established aeronautical practices or regulations.

5.2.2 Modernized Operations Alternative

Under the Modernized Operations Alternative, SNL/NM would have increased land disturbances from the construction of proposed facilities, infrastructure, and DD&D activities. If all onsite projects under the Modernized Operations Alternative are implemented, net developed land area would total 3,290 acres or 24 percent of the overall SNL/NM-managed land area (13,829 acres). SNL/NM's net developed land area would increase by less than 1 percent. Facility square footage in the five TAs would increase by an estimated 15 percent (about 1 percent annually). Development and DD&D actions would be consistent with historical land uses.

About 42 acres of land would be disturbed during construction of facilities and infrastructure, and 12.4 acres would undergo DD&D. Under this alternative, SNL/NM's net developed land area would increase by about 29.6 acres over existing conditions to 3,290 acres, which would be 0.9 percent greater than the end-state of the No-Action Alternative.

Eight major facilities are slated for construction in TAs under the Modernized Operations Alternative. Three of these facilities would be sited in TA-I, two in TA-II, two in TA-III, and one in TA-IV. TA-II and TA-III would experience the largest percentage increases to their facility footprints of 85 and 62 percent, respectively. The TA-II increase is largely due to the 321,000-square-foot NGE+ facility. The TA-III increase is largely due to the 100,000-square-foot Consolidated Environmental Test Facility (CETF).

As available land in TA-I becomes scarce, future facility construction would be sited on parcels slated for redevelopment or would spill over into TA-II. If all projects under the Modernized Operations Alternative are implemented, TA-II would be considered 35 percent developed (89.3 acres net developed land area divided by 256 acres total size). Under this alternative, TA-I would continue to house the greatest overall amount and concentration of development, TA-III would house the least concentration due to its large size, and TA-V would remain virtually unchanged with about 207,000 square feet of facilities. Additional information regarding changes to facility footprint and development density in the five TAs under the Modernized Operations Alternative is provided in Appendix A, Section A.5.2.

The 20th Street Utility Corridor infrastructure project is proposed under the Modernized Operations Alternative. This project would disturb about 3 acres of land within TA-I for infrastructure and utility improvements. Improvements to this 3-acre site could support future development of a currently vacant 34-acre parcel within the heavily developed TA-I. Implementing this project would allow for future growth and development in SNL/NM's most crowded TA.

Offsite, this alternative includes planned construction of the Center for Advanced Manufacturing and Innovation (CAMINO) facility in the SSTP. It would serve as a replacement for multiple offsite leased facilities and to relocate advanced manufacturing capabilities.

5.2.2.1 Airspace under Modernized Operations Alternative

Under the Modernized Operations Alternative, no specific projects or actions are proposed that would result in any changes, disruptions, or other impacts to the current use, management, or operational procedures of existing airspace. The current airspace functionality would be

preserved without interference or modification to established aeronautical practices or regulations.

5.2.3 Expanded Operations Alternative

If all projects under the Expanded Operations Alternative are implemented, about 342.1 acres of new SNL-managed land would be disturbed for new facilities and infrastructure. Net developed land area would potentially increase to 3,577.2 acres or 26 percent of the overall SNL/NM-managed land area, a 9.7 percent increase over the No-Action Alternative. In the five TAs, facility square footage and development density would increase by about 27 percent (about 2 percent annually). Excluding expanded energy projects, the land disturbances from facility construction, other infrastructure projects, and DD&D would be consistent with historical land development and uses.

The Expanded Operations Alternative¹ includes nine major projects in addition to the eight major projects analyzed under the Modernized Operations Alternative. Both TA-I and TA-II would experience more than 40 acres of new development. KAFB-West and -East would add about 222 acres of proposed new facilities and infrastructure.²

Ninety-four percent of total land disturbances under the Expanded Operations Alternative would stem primarily from the construction of 1,441 acres of expanded energy projects. This includes a 210-acre expansion of capabilities at the existing NSTTF located KAFB-permitted land in KAFB-West. The Utility Scale CSP Tower would be an SNL/NM-run PV + CSP expanded energy project that is part of the ASGARD initiative and would disturb up to 1,200 acres at Site B or Site C on KAFB managed lands as shown in Figure 3-2. Should the project go through planning and a land use agreement is reached, SNL/NM-managed lands would increase by up to 1,200 acres.

Onsite facilities proposed for development under the Expanded Operations Alternative include the 150,000-square-foot CREST Complex. This is the only project proposed for development in TA-V. Because TA-V is small in both land area and existing facility square footages, this single facility would cause an 11 percent increase in the developed area and a 39 percent increase in facility square footage in the TA.

TA-II would experience the largest percentage change (64 percent) to its developed land area, including construction of two large facilities: (1) the NGPP Facility at 480,000 square feet, which would be sited between TA-II and TA-IV, and (2) the Weapons Component Engineering Capability Sustainment Facility at 210,000 square feet. These two facilities account for 89 percent of all the new facility footprints in TA-II.

¹ Figures and tables for the Expanded Operations Alternative include the facilities and infrastructure for the Expanded Operations Alternative plus the Modernized Operations Alternative. Refer to Figure 3-1.

² Not including up to 1,200 acres for expanded energy projects proposed to be sited on non-SNL/NM-managed lands.

This alternative includes an additional offsite project, a 30,000-square-foot addition to the CINT on land owned by NNSA, within the Eubank Corridor and outside of KAFB.

Another project affecting land use is the proposed transfer of Forest Service withdrawn lands to DOE (4,595 acres) or partial land transfer to DOE with the Forest Service retaining up to 315 acres. Refer to Section 3.4.2 for a description of the proposed land transfer project. Due to its withdrawn status, this land is already SNL/NM-managed and is included in the KAFB-West and -East existing 10,922 acres. Transfer of the land would be an administrative action and would not affect SNL/NM's usage, though it has the potential to disturb 3.3 acres within KAFB-East for new fencing to restrict access via the CNF. Additional information regarding changes to facility footprint and development density in the five TAs under the Expanded Operations Alternative is provided in Appendix A, Section A.5.2.

Expanding UAS operations would not change land use onsite at SNL/NM. Refer to Section 5.2.3.1 for UAS impacts to airspace under the Expanded Operations Alternative.

5.2.3.1 Airspace under Expanded Operations Alternative

SNL/NM operations currently include use of UxS, including UAS, tethered balloons, and free balloons, for various R&D operations. Under the Expanded Operations Alternative, SNL/NM would expand UxS operations to include air systems, UAS flight “swarms,” and counterterrorism activities using UAS. SNL/NM airspace would continue to be governed by FAA COAs. Apart from expanded UAS operations, another project that has the potential to affect airspace at SNL/NM are the proposed expanded energy projects under the Expanded Operations Alternative. The CSP associated “tower” is proposed as either one 400-foot tower or up to three 200-foot towers and would need to comply with FAA and other federal regulations governing tower siting, construction, marking, and lighting, such as FAA Advisory Circular (AC) 70/7460-1L, *Obstruction Marking and Lighting*, and 14 CFR Part 77.

5.2.4 Summary of Land Use and Airspace Impacts

All three alternatives would continue existing land uses at SNL/NM. In the five TAs, SSTP, and Eubank Corridor, actions would occur within the context of existing development. In the lower density KAFB-West (including the CTF) and KAFB-East, operations would be dispersed throughout the site. The high-density TAs (i.e., TA-I, TA-II, and TA-V) and the open space character of the low-density areas (i.e., TA-III, TA-IV, KAFB-West [including CTF], and KAFB-East) would be retained. The potential sites for the PV + CSP project with up to a 1,200-acre disturbance are on KAFB lands that would remain outside of SNL/NM's current land management. Table 5-1 and Table 5-2 summarize the impacts on land development and TA facility development for each alternative.

Table 5-1. Summary of Land Development Impacts for Each Alternative on SNL/NM-Managed Lands (rounded to the nearest acre) ^a

Name of Area	Total Size (acres)	No-Action Alternative		Modernized Operations Alternative ^b		Expanded Operations Alternative ^c	
		Net Developed Land Area	Percent Developed	Net Developed Land Area	Percent Developed	Net Developed Land Area	Percent Developed
TA-I	356	321	90%	329	92%	349	98%
TA-II	256	79	31%	89	35%	129	50%
TA-III	1,865	336	18%	341	18%	342	18%
TA-IV	316	81	26%	82	26%	89	28%
TA-V	28	17	61%	17	61%	19	68%
KAFB-West & -East	10,922	2,362	22%	2,367	22%	2,584	24%
Eubank	86	65	76%	65	76%	66	77%
Totals	13,829	3,260	24%	3,290	24%	3,577	26%

a. Does not include potential offsite leased facilities that do not require land development.

b. Includes No-Action Alternative figures.

c. Includes No-Action Alternative and Modernized Operations Alternative figures.

Table 5-2. Summary of Facility Development Impacts for Each Alternative by TA (in ft²)

TA	Existing Environment	No-Action Alternative		Modernized Operations Alternative		Expanded Operations Alternative	
	Facility Footprint	Facility Footprint	Percent Change ^a	Facility Footprint ^b	Percent Change ^c	Facility Footprint ^d	Percent Change ^c
TA-I	4,361,000	4,297,328	-2%	4,504,908	5%	4,580,608	7%
TA-II	336,000	494,500	47%	915,000	85%	1,420,000	187%
TA-III	279,000	297,500	7%	482,000	62%	532,500	79%
TA-IV	740,000	805,400	9%	880,400	9%	987,400	23%
TA-V	208,000	208,000	no change	207,000	-1%	289,000	39%
Totals	5,924,000	6,102,728	3%	6,989,308	15%	7,809,508	28%

a. “Percent Change” is calculated against the Existing Environment.

b. “Facility Footprint” for the Modernized Operations Alternative includes No-Action Alternative figures.

c. “Percent Change” is calculated against the No-Action Alternative.

d. “Facility Footprint” for the Expanded Operations Alternative includes No-Action Alternative and Modernized Operations Alternative figures.

For each alternative, the developed land area and TA facility footprint would change. After implementation of these alternatives, the current percent of land area developed at SNL/NM (23 percent) would increase to approximately 24 percent for the Modernized Operations Alternative or 26 percent for the Expanded Operations Alternative. For the No-Action and Modernized Operations Alternatives, the change to net developed land area would be about 1 percent (refer to Table 5-1). For the Expanded Operations Alternative, the percentage change to the net developed land area of SNL/NM’s onsite lands would be about 10 percent (refer to Table 5-1), chiefly due to large, utility-scale PV installations. Not all new projects would result in additional land disturbance, as several projects would involve modifications to existing facilities or construction of new or replacement facilities on previously developed areas of SNL/NM-managed lands. On an annualized basis over the 15-year period of analysis, the increases in TA facility square footages under the Modernized and Expanded Operations Alternatives would be consistent with historical growth at SNL/NM. Activities under each alternative would be consistent with existing land use and identified mission needs at SNL/NM.

For airspace, no specific projects or actions are proposed that would result in any changes, disruptions, or other impacts to the current use, management, or operational procedures of existing airspace under the No-Action Alternative and Modernized Operations Alternative. Under the Expanded Operations Alternative, SNL/NM would expand UAS operations to include new air devices across all KAFB property, UAS flight “swarms,” and counterterrorism activities. Airspace would continue to be governed by FAA COAs.

5.3 VISUAL RESOURCES

This section presents the potential impacts to aesthetics and visual resources for the three alternatives evaluated in this SWEIS. The key metric in this analysis is visual compatibility. Visual compatibility means whether the proposed actions would be consistent with existing landscapes or would obscure views, cause glare, increase the visibility of structures, or otherwise detract from the scenic perspectives of existing and planned offsite residential developments and the Pueblo of Isleta community south of SNL/NM-managed lands.

Developments and modifications under each alternative would largely occur within the context of existing developed areas; would be similar in character to existing infrastructure and, for the most part, would be screened from public view by surrounding fences, vegetation/topography, and physical distance from offsite land. Proposed actions with the potential to introduce visual changes are identified and analyzed herein.

5.3.1 No-Action Alternative

Under the No-Action Alternative, the ongoing NNSA activities described in Chapter 2 and Chapter 3 will continue. Replacement facility construction, upgrade utility projects, DD&D, and operational changes described in Section 3.2 will occur. Based on current planning and approvals, 22 projects will be completed, consisting of facilities, infrastructure, and utility projects with a permanent land disturbance of 13.1 acres including 5 acres of permanent land disturbance for a dedicated construction staging area in TA-I, and 1 acre for a new electrical substation in TA-II. DD&D actions will remove about 2.7 acres of facilities. Overall, the permanent developed land area under this alternative will grow by 10.4 acres.

The following actions have been identified for individual analysis due to their potential to result in adverse visual impacts. These impacts may stem from one or more of the following factors: actions conducted in or visible from offsite locations, scale of facilities or operations, unique operations, and/or deviation from established development patterns.

- Power Sources Capability Facility – This building is the only large facility proposed in the No-Action Alternative. It is an approximately 135,000-square-foot facility with a maximum height of 36 feet and will be constructed within TA-II. There will be short-term visual impacts from construction.
- Dedicated Construction Staging Area – This project will create the largest single amount of land disturbance, 5 acres, under the No-Action Alternative. Development of a construction staging area within TA-I will allow for management of SNL/NM-owned materials to support small scale, SNL/NM-executed construction projects throughout the

site. The staging area will be close to the Eubank Gate and visible from public locations outside KAFB; visual effects are unlikely as the project will include fencing/screening.

- **Unmanned Systems (UxS)** – UxS operations within KAFB’s secure boundary will continue to occur and will have little visual impacts to adjacent residential developments or the Pueblo of Isleta community due to the remote operation locations and size of the UxS used on SNL/NM-managed lands. Appendix A, Section A.3.4.7, outlines the areas where UxS are engaged unless specific authority is provided to host activity in other locations.

The primary potential impacts to visual resources from the No-Action Alternative stem from the active facility construction, infrastructure projects, laydown areas, and DD&D. Figure 3-2 shows the locations of the proposed major projects for all alternatives. Construction of these facilities and infrastructure could result in short-term visual impacts due to the presence of heavy construction equipment, buildings in various stages of construction, and possibly increased dust, which, however, is minimized due to air permitting requirements. Cranes used during construction and the temporary construction laydown areas could also create short-term visual impacts but will not be out of character for SNL/NM. Many of the projects will be in the interior of SNL/NM-managed lands, and construction-related activities will not be noticeable at or beyond KAFB’s boundary. Site visitors and employees observing construction will find these activities similar to past construction activities of other developed areas at SNL/NM.

After construction and DD&D actions conclude, permanent impacts on visual resources are not anticipated. Development will be driven by function and purpose and will be similar in visual appearance to the existing built environment. TA-I, TA-II, and TA-IV are all in Class IV, the top VRM class that features dense development (refer to Table 4-6). As outlined in Table 5-2, TA-II will experience the highest percentage change to its development density, but this will not result in changes to the existing VRM class. Replacement facilities and infrastructure will be in character for these areas. Under this alternative, TA-III and TA-V will retain their existing VRM Class III. There will be no changes to the existing visual classification of KAFB-West or KAFB-East.

5.3.2 Modernized Operations Alternative

Under the Modernized Operations Alternative, ongoing NNSA activities described in Chapter 2 and Chapter 3 would continue at SNL/NM. In addition, replacement facility construction, modernization of utility projects, DD&D, and operational changes described in Section 3.3 would occur. SNL/NM would build a total of 38 either new or replacement facilities, and 20 upgrade/utility/infrastructure projects with a permanent land disturbance of 42.0 acres. DD&D actions would remove 12.4 acres of facilities. The permanent developed land area would increase by a net 29.6 acres.

The following activities are highlighted due to their potential to result in adverse visual impacts. These impacts may stem from one or more of the following factors: actions conducted in or visible from offsite locations, scale of facilities or operations, unique operations, and/or deviation from established development patterns.

- Facilities – The following three facilities, proposed under the Modernized Operations Alternative, have substantial footprints: (1) NGE+, a 321,000-square-foot facility, is proposed for TA-II; (2) CAMINO is a 100,000-square-foot facility planned for an offsite location, likely within or near the SSTP, an industrial and commercial development adjacent to KAFB; and (3) the Weapons Systems Engineering Capability Facility, a 210,000-square-foot facility, is proposed for TA-I. These replacement facilities would have heights consistent with surrounding structures, typically up to about 60 feet, with specialized features (e.g., antennas, parapets, high bays) potentially extending to about 100 feet. Beyond their large footprints, these facilities would have no notable visual characteristics and would integrate into the existing, heavily developed environment without causing significant visual resource impacts.
- 20th Street Utility Corridor – This project would disturb 3 acres of vacant lands within TA-I for infrastructure construction. Heavy construction equipment would create short-term adverse impacts to visual resources, and long-term adverse impacts to visual resources would result from above-ground utilities. The project is in the heavily developed TA-I, so its long-term visual effects would tie into the surrounding environment.

Projects identified for completion in the Modernized Operations Alternative represent a continuation of past and present industrial and commercial uses and would not introduce visual change in the built environment. Figure 3-2 shows the locations of the major projects for the Modernized Operations Alternative. Short-term impacts would be similar to those described for the No-Action Alternative. While there would be land disturbance associated with construction as well as increase in built acreage/square footage, there would be no change in VRM class based on assessment of the VRM criteria.

5.3.3 Expanded Operations Alternative

The Expanded Operations Alternative includes the actions identified in the No-Action and Modernized Operations Alternatives. Under the Expanded Operations Alternative, the ongoing NNSA activities described in Chapter 2 and Chapter 3 would continue. In addition, the new facility construction, utility/infrastructure projects, DD&D, and operational changes described in Section 3.4 would occur. SNL/NM would build a total of 30 facility and infrastructure projects with a permanent land disturbance of 1,542.1 acres. Of this total acreage, the PV + CSP project would disturb up to 1,200 acres of land within the KAFB boundary but outside of current SNL/NM-managed lands purview. DD&D actions would remove 25.3 acres of existing facilities. The permanent developed land area would increase by a net 1,516.8 acres.

Construction and modifications would primarily occur within developed areas and would be similar in character to the existing environment. Projects would be largely screened from public view by the surrounding fences, vegetation/topography, and physical distance from offsite land.

The following actions have been identified for individual highlight due to their potential to have visual impacts. These impacts may stem from one or more of the following factors: actions conducted in or visible from offsite locations, scale of facilities or operations, unique operations, and/or deviation from established development patterns.

- PV + CSP Project – As detailed in Appendix A, Section A.3.4.13, this project would introduce a new visual element on KAFB lands. The project components would be sited on up to 1,200 acres within KAFB-West. Figure 3-2 and Appendix A, Figure A-14, show the two possible locations (labeled Site B and C) analyzed for the project. Site B is in the northern portion of KAFB-West, and Site C is in the southern portion. Visually, at either site, the project would consist of a combination of PV panels, energy storage, heliostat (mirror) array, and solar tower(s) of either one taller (up to 400 feet) tower or up to three shorter (up to 200 feet) towers. For reference, SNL/NM's existing solar tower at the NSTTF in the southern portion of KAFB-West is 200 feet tall. Of the two locations under consideration for the KAFB/SNL/NM project, Site B, located in the northern part of KAFB-West, would be more visible from locations in the city of Albuquerque north of the KAFB boundary and from areas of higher elevation with sightlines to the northern regions of KAFB. Site C, closer to KAFB's southern border and TA-V, would produce more obvious and extensive sightlines from Pueblo of Isleta lands. The existing 200-foot CSP tower at the NSTTF is located approximately 1 mile from Pueblo of Isleta lands. Site C would be a more interior location within KAFB-West, approximately 2 miles from KAFB's border with the Pueblo of Isleta. Regarding the number and heights of towers (i.e., a single taller tower up to 400 feet or one or more shorter towers up to 200 feet), a taller tower in the same location would be visible from more locations and over greater distances. KAFB-West's VRM rating would increase from a II-III rating to a III-IV. More details regarding the project are available in Appendix A, Section A.3.4.13. More details regarding the project visual impacts are available in Appendix A, Section A.5.3.
- NSTTF PV Field – This project would entail installing a 210-acre PV array at the NSTTF in KAFB-West. Utility-scale solar facilities in the southwestern United States create unique and obvious visual impacts because of their large size, strong regular geometry, highly reflective surfaces, and contrast with the natural brown tones of the landscape. Impacts from this project are somewhat mitigated by its location within the interior of the site. Its location in the southern part of KAFB-West would screen it from the dense residential and commercial development north of KAFB but would place an additional utility-scale PV array within sightlines of Pueblo of Isleta lands. Sullivan et al. (2012) found that with very low vertical profiles, PV arrays tend to blend in with the horizon line when viewed from low elevations. The arrays may also be viewed as partially screened by vegetation or variations in the site topography. The study further suggested that, even in plain view, a relatively small surface area is visible from relatively short distances, meaning that the PV facility can appear as a thin line just above or below the horizon. While the strong horizontal line of the collector array may be evident to the viewer, the large size and strong gridded geometry of the array can oftentimes be concealed. With less of the facility being visible, glare and other reflections may be diminished, and contrasts between lit and shadowed surfaces can also be minimized.
- PV Installation Assemblage – Six additional PV arrays totaling 31 acres are proposed under the Expanded Operations Alternative. The largest of the six arrays would occupy 8 acres. As these installations would be dispersed throughout SNL/NM in TA-I, TA-II, and TA-IV, the visual impacts are expected to be less than those of the two utility-scale solar projects outlined previously. All six arrays would be co-located at existing or new parking lots or garages. The short- and long-term visual impacts are similar to those

described for the NSTTF PV Field, but on a reduced scale due to the PV arrays' dispersed footprint.

- UxS Expanded – Expanding UxS operations under this alternative would produce visual impacts from UxS greater than those described for UxS operations under the No-Action Alternative or Modernized Operations Alternative. Expanded UxS operations include increasing the craft size, number of UAS (i.e., swarms), dropping of explosive and non-explosive payloads, and frequency of operations across the UxS mission. Larger systems, more frequent operations, swarms of aircraft, and explosive payloads could produce some visual impacts. These effects may be noticeable at times from SNL/NM-managed lands as outlined in Appendix A, Section A.3.4.7; however, this would be minimized due to the remote operation locations and reduced sightlines to adjacent residential developments and Pueblo of Isleta.
- Facilities – Two facilities, proposed under the Expanded Operations Alternative, would have substantial footprints. (1) The NGPP, if implemented, would be a 480,000-square-foot facility serving as a replacement for the Z-machine complex. Due to its size and proposed location, its footprint would extend across a site spanning a portion of TA-II and TA-IV. The facility would have heights consistent with surrounding structures, generally up to about 60 feet, with specialized features (e.g., antennas, parapets, high bays) potentially extending to about 100 feet. (2) The CREST Complex would have a total footprint of 150,000 square feet and a maximum height of 96 feet, within TA-V. The anticipated short- and long-term visual impacts of these facilities would align with existing site characteristics as described for general facility construction in the visual resources analysis for the No-Action and Modernized Operations Alternatives.

Wildland Fire Risk Reduction – This action includes expanded management of existing flora, vegetation removal, and stepped-up defensible zones around facilities and infrastructure. The expanded management and vegetation removal at testing areas and within withdrawn lands may create open areas or a mosaic of openings, groups, and clumps to reduce fire fuels. The removal of vegetation may produce short-term adverse visual impacts from the presence of people and heavy equipment but would ultimately net long-term beneficial visual impacts by improving the health and resiliency of the forest and reducing wildland fire impacts. The wildland fire reduction would not introduce new uses or create any permanent land disturbances; there would be no long-term visual impacts or changes to VRM class for KAFB-East (i.e., withdrawn lands). KAFB analysis of forest resource management actions to reduce wildfire risks, which are coordinated with federal, state, and local agencies, institutions, and tribes, shows that such management actions would not result in significant environmental impacts on visual and other resource areas (KAFB 2023a). SNL/NM wildfire risk reduction actions would be similar.

Land under the Expanded Operations Alternative would be altered as described in this section, but ultimately, developed areas would remain developed and less developed areas would remain in their “natural,” albeit human-managed, state. The visual impacts that would introduce glare and viewer obstructions with sightlines beyond those described for the Modernized Operations Alternative are the proposed utility-scale solar projects and potential expansion of UxS operations. Short-term impacts associated with general facility and infrastructure DD&D and development would be similar to those described for the No-Action and Modernized Operations Alternatives. KAFB-West would see a long-term change to its existing VRM class, from a II-III

to a III-IV due to the visual impacts from the CSP tower element of the proposed PV + CSP project. No other area on SNL/NM-managed lands would experience a long-term change to its existing VRM class as a result of the projects proposed for the Expanded Operations Alternative.

5.3.4 Summary of Visual Resources Impacts

Table 5-3 summarizes the VRM ratings assigned to the different SNL/NM areas. Ratings were assigned for existing conditions. Short-term effects and long-term effects are shown for each alternative. TA-I, TA-II, and TA-IV are all developed industrial areas, consistent with VRM Class IV. They were assigned this rating because their development represents a major modification to the natural landscape, dominates the landscape, demands attention, and is highly visible from public and/or visually sensitive viewpoints. TA-III, TA-V, and KAFB-West were assigned a Class III rating because of their interior location, with distance mitigating some of the visual effects from existing and proposed development. While some areas within these TAs remain in a natural state, large-scale facilities and infrastructure may attract attention of the casual observer (refer to Table 4-6). KAFB-West would experience an increase in its VRM class if the two proposed utility-scale solar installations occur. If built, these projects would amplify existing visual impacts from SNL/NM operations on sites adjacent to residential developments and Pueblo of Isleta lands. Although KAFB-East consists of largely less developed areas and limited management activities, it was assigned a long-term Class II rating due to the few pockets of low-intensity development scattered about the area. One project proposed in KAFB-East under Expanded Operations Alternative is 3.3 acres of new fencing that would be associated with the proposed land transfer from the Forest Service to NNSA. This would represent a minimal change to the viewshed, likely only visible to members of the public hiking in this area.

Table 5-3. Summary of VRM Ratings

Area	Existing Class	No-Action		Modernized Operations		Expanded Operations		Long-term Change
		Short-term Class	Long-term Class	Short-term Class	Long-term Class	Short-term Class	Long-term Class	
TA-I, TA-II, TA-IV	IV	IV	IV	IV	IV	IV	IV	no
TA-III, TA-V	III	III	III	III	III	III	III	no
KAFB-West	II-III	III	II-III	III	II-III	IV	III-IV	yes
KAFB-East	II	II	II	II	II	II	II	no
La Semilla Buffer Zone ^a	I	N/A	I	N/A	I	N/A	I	no
Offsite	IV	IV	IV	IV	IV	IV	IV	no

a. No projects under any alternative are proposed within the La Semilla Buffer Zone.

Short-term visual effects would be associated with an increase in construction and DD&D activity in some areas. TA-III, TA-V, and KAFB-East would not experience short-term rises in their VRM classes due to the restrained number and size of proposed facilities and actions under each alternative. Aside from KAFB-West, all areas would retain their existing classes in the long term under each alternative. KAFB-West could see both short- and long-term reclassifications to its VRM rating under the Expanded Operations Alternative if the proposed utility-scale infrastructure and associated CSP towers project is completed.

5.4 GEOLOGY AND SOILS

This section presents the potential impacts to geology and soils under the three alternatives evaluated in this SWEIS. Key metrics in this analysis include (1) the amount of soil disturbance; (2) the potential for causing erosion, soil loss, or soil destabilization; and (3) analysis of whether soils and geologic features support new facilities (e.g., potential for landslides). In addition, the analysis identifies and discusses seismic requirements for new facilities.

The geology and soils impact analyses address potential impacts across SNL/NM-managed lands and KAFB rather than within specific planning or TAs of the site, although most of the activities would take place within the five SNL/NM TAs. In general, present SNL/NM operations have limited impact on geology and soils, except in specific circumstances. Although SNL/NM activities do not significantly impact geology and soils, some geological hazards apply to SNL/NM facilities, such as the potential for seismic events. Geology and soils information feeds into other sections in this SWEIS, including human health and accidents. The following sections address each subject area described for the Existing Environment in Section 4.4.

5.4.1 No-Action Alternative

Impacts under the No-Action Alternative were estimated for new projects, DD&D activities, and upgrades that could disturb about 15.8 acres (2.7 acres for DD&D), 7.1 acres for facilities, 5.0 acres for a permanent construction staging area, and 1.0 acre for an electrical substation) of land. The projects that disturb the largest amounts of land will be the proposed construction staging area (5 acres) and the Power Sources Capability Facility in TA-II (about 3.1 acres). Refer to Table 3-1 for a complete list of projects associated with the No-Action Alternative.

5.4.1.1 *Slope Stability, Subsidence, and Liquefaction*

The No-Action Alternative does not include any new construction, DD&D activities, or ongoing operations that will result in additional slope instability or other soil movement impacts. Ground and slope stability evaluations are important considerations in siting facilities. Most SNL/NM facilities are sited on level ground or gentle slopes. Most existing and ongoing facilities and activities associated with the No-Action Alternative have occurred on previously disturbed land engineered for necessary foundation stability to ensure facility and infrastructure integrity. Activities involving explosives use (surface and subsurface) are not expected to cause impacts to level surfaces or slope stability, or cause subsidence or liquefaction given relatively low yield of detonations (up to 2,000 pounds) and lack of soil characteristics conducive to these phenomena.

Project planning and BMPs ensure that future facilities and activities will not be sited in areas with stability concerns or where engineering practices, such as soil berms at explosive ranges, would not reduce or eliminate potential foundation stability issues. Therefore, no potential impacts involving slope stability, subsidence, or liquefaction are anticipated.

5.4.1.2 *Faulting and Seismic Activity*

SNL/NM construction and operation activities, including utilities/infrastructure, environmental remediation, and DD&D activities, do not include activities that could activate or modify fault movement or increase seismic event probability at SNL/NM-managed lands or in the region. No

earthquakes have occurred within the KAFB boundary in about the last 50 years, consistent with a relatively stable seismic profile (refer to Section 4.4.2.2). Several deep, inactive, regional faults bisect SNL/NM explosives testing ranges, further contributing to a relatively stable seismic profile of the area. Explosives testing capabilities vary by region. Each region is assessed against maximum operational capability across multiple test ranges/sites (refer to Table 5-18 and Appendix A, Table A-8). TA-III has approved Explosives Safety Site Plans for intentional detonation events up to 2,600 pounds and rocket motor firing up to 10,000 pounds. For CTF, ongoing use of potential explosives with yields up to 2,000 pounds at relatively shallow depths could cause surface vibrations that may be felt within radial distances ranging from 112 feet (34 meters) to 2,238 feet (682 meters), which occurs entirely on SNL/NM-managed lands (DOE 2008a). These surface vibrations are highly unlikely to change seismic characteristics of the area's deep, regional faults. The vibrations at the closest border from the test range (approximately 4,265 feet or 1,300 meters south) from the largest explosive tested, would be akin to the ground vibration of a car door slamming. These vibrations would be no different than currently experienced. Additionally, there are no known instances at SNL/NM where explosives use has changed the area's seismic and faulting capabilities.

5.4.1.3 Soils and Soil Monitoring

TA-III and SNL/NM operational lands outside TAs are less developed/industrialized, and most of the soil column is not disturbed as a result of facility construction; limited interaction occurs with geological materials because few SNL/NM processes involve subsurface work. The remaining TAs are more extensively developed with resultant soil disturbances associated with past and ongoing facility construction and operations. Vegetation removal and new facility construction will cause soil disturbances, including soil loosening and compaction from heavy equipment use; however, lasting impacts will be minimal given soil management, erosion control, and revegetation BMPs. Surface and subsurface (buried at relatively shallow depths) explosives use at designated ranges during operations will also cause short-term soil disturbance. Refer to Appendix A, Section A.2.5.34 for more details on one range used. Soil stabilization, runoff, and erosion BMPs, including protecting slopes and channels, controlling site perimeters (e.g., silt fences, sediment track out pads, mulch socks), stabilizing stockpiles, and good housekeeping, will be implemented to ensure minimal impacts from explosives use.

Although construction activities could affect about 13.1 acres of soils, the No-Action Alternative does not include activities that will significantly increase the potential for soil erosion or contamination from legacy activities. The highest erosion rates generally occur in drainage channels and on steep slopes from natural events such as flooding and wildfires. Existing and future SNL/NM facilities are generally not sited on or planned for these location types.

Active monitoring and remediation activities for environmental compliance of legacy contamination are ongoing at SNL/NM (SNL 2022a). While construction activities with surface and subsurface applications of fluids can cause soil runoff, erosion, or movement of potential contamination within soils and deeper geologic formations, SNL/NM employees implement BMPs for controlling runoff and erosion to minimize impacts during construction and DD&D.

DD&D of legacy facilities will also contribute to ongoing environmental remediation of soils and will be considered a positive impact or outcome. Removal of outmoded, outdated, and

excess facilities along with cleanup of contamination contribute to environmental stewardship principles and goals. As identified in Section 4.4.3.1, no prime farmlands have been identified on SNL/NM-managed lands and therefore are not discussed further.

Ongoing onsite soil monitoring for ER efforts, long-term stewardship, environmental compliance, and miscellaneous non-routine projects will continue to help ensure that existing and potential contaminants are reduced and any identified are quickly remediated (SNL 2022a). Overall, minimal impacts to soils from No-Action Alternative activities are anticipated.

5.4.1.4 Mineral Resources

Economic production of mineral resources is not allowed on SNL/NM-managed lands. Potential mineral resources at SNL/NM-managed lands include sand, gravel, and rubble, which are used for fill storage, backfill and grading, cover material during remediation efforts, concrete preparation, and landscaping. The No-Action Alternative will not affect the mineral resources (fill material) in use at SNL/NM. The activities associated with the No-Action Alternative are also not expected to impact the availability of borrow material.

5.4.2 Modernized Operations Alternative

Potential Modernized Operations Alternative impacts were estimated for construction/DD&D activities that could disturb about 54.4 acres of land (12.4 acres for DD&D, 38.0 acres for facilities, 3.0 acres for utility corridor, and 1 acre for electrical substation). Except for increased soil disturbance acreage, potential Modernized Operations Alternative construction and operations impacts related to slope stability and subsidence, faulting and seismicity, soils and soil monitoring, and mineral resources are expected to be the same as the No-Action Alternative.

The development footprint of the largest three Modernized Operations Alternative projects would be about 15.4 acres. New facilities would consist of the NGE+ facility and Energetics Components Capability proposed for TA-II and the Weapons Systems Engineering Capability proposed for TA-I. Refer to Table 3-3 for a complete list of Modernized Operations Alternative projects. Extensive soil grading for site preparation and new facility installation could result in wind and water erosion of native soils if graded areas remain uncovered for long periods of time. Minimal impacts from potential disturbance of about 42 acres of land are anticipated given disturbances from past construction activities, planned DD&D, and standard BMP use.

5.4.3 Expanded Operations Alternative

The Expanded Operations Alternative includes the Modernized Operations Alternative actions. About 1,555.1 acres of land could be disturbed (13.0 acres for DD&D, 73.8 acres for facilities; 3.0 acres for utility corridor; 1.0 acre for substation; 1,441.0 acres for expanded energy projects; 20.0 acres for roads; and 3.3 acres for fence). Refer to Table 3-5 for a complete list of Expanded Operations Alternative projects. Potential geothermal facilities could include geothermal and wastewater exchange systems with up to 8,050 bores up to 600 feet deep and up to 1,000 feet long. Except for increased acreage of soil disturbance, potential Expanded Operations Alternative impacts related to slope stability and subsidence, faulting and seismicity, soils and soil monitoring, and mineral resources are expected to be the same as the No-Action and Modernized Operations Alternatives. Extensive soil grading for site preparation and expanded

energy project installation could result in wind and water erosion of native soils if graded areas remain uncovered for long periods of time. BMPs and environmental compliance requirements (e.g., soil management and revegetation practices) would help prevent long-term impacts.

The proposed CREST Complex in TA-V is identified as a high-risk facility with assigned HC-2 and SDC-2 (SNL 2023e). A 2022 preconceptual seismic analysis of the CREST Complex indicated that seismic demands on the current proposed configuration are relatively low (SNL 2023e). Nevertheless, categories HC-2 and SDC-2 require a PSHA to address site-specific seismic design criteria for existing and proposed nuclear facilities. Existing and ongoing CREST geotechnical studies, such as seismic soil profiles, active and potentially active fault characterization, and a screening level PSHA, would be used to perform a fully compliant PSHA for input to facility seismic design and potential accident analyses (refer to Appendix A, Section A.3.4.8).

An Expanded Operations Alternative change that could impact SNL/NM soils involves wildland fire risk reduction treatments of certain high-risk areas. These treatments are designed to reduce potential operational impacts from wildland fires by forest thinning (i.e., removal of trees and other vegetation) and other measures (KAFB 2022). Refer to Section 3.4.3 and Appendix A (Section A.3.4.11) for more details on this risk-reduction program. Forest thinning could create short-term impacts to soils from heavy equipment use, but it provides long-term protection to remaining and emerging vegetation, soils, and water runoff characteristics through resiliency and managed vegetation density should a wildfire occur. Following soil management BMPs (refer to Section 5.16.1) would minimize erosion and runoff during operations in treated areas.

5.4.4 Summary of Geology and Soils Impacts for the Alternatives

Table 5-4 summarizes potential geology and soils impacts for the three alternatives.

Table 5-4. Potential Impacts to Geology and Soils for the Alternatives

Resource Parameter	Common to All Alternatives Except as Noted
Slope stability, subsidence, and liquefaction	Activities to be located on previously disturbed lands or other stable lands that have been, or would be, engineered for necessary foundation integrity. No significant impacts anticipated from construction, operations, or explosives use.
Faulting and seismic activity	Facilities and infrastructure would be designed and constructed to meet seismic design criteria commensurate with risk category requirements and site-specific PSHA. No activities would increase seismic event probability. Surface and subsurface use of explosives would not change faulting or seismic characteristics of the area.
Development footprint (surface disturbance) on previously developed and undeveloped land	No Action: 15.8 acres total (2.7 acres DD&D); 7.1 acres for facilities, 5 acres for a permanent construction staging area, and 1 acre for an electrical substation. Modernized Operations: 54.4 acres total (12.4 acres DD&D); 38 acres for facilities, 3 acres for a utility corridor, and 1 acre for an electrical substation. Expanded Operations: 1,555.1 acres total (13.0 acres DD&D); 73.8 acres for facilities; 3 acres for utility corridor; 1 acre for substation; 1,441 acres for expanded energy projects; 20 acres for roads; and 3.3 acres for fence.
Soil erosion	No activities would significantly impact soil erosion potential, no facilities in drainage channels or steep slopes, BMPs implemented, and minimal impacts expected.
Soil contamination	No legacy contamination level or ongoing operations increase expected. Overall decrease in soil contamination due to soil monitoring, remediation, and DD&D activities. Recovered contaminated soil would be managed/disposed of based on requirements and procedures.

Resource Parameter	Common to All Alternatives Except as Noted
Mineral resources	No known mineral resources would be adversely affected by construction and operations. Sufficient mineral resources necessary for construction activities are available on the SNL/NM site and at nearby commercial locations. No impacts would be expected.

5.5 WATER RESOURCES AND HYDROLOGY

This section presents the potential impacts on water resources (e.g., surface water, groundwater, floodplains) for the three alternatives evaluated in this SWEIS. Key metrics presented in this analysis include establishing whether measures are in place to (1) control stormwater runoff and sediment transport due to C&D activities, as well as for permanent increases in impervious areas; (2) promptly clean up small environmental releases (e.g., petroleum spills, other potentially hazardous material); and (3) confirm successful mitigation through robust monitoring programs.

Section 5.8 discusses wetlands. Potential impacts associated with water use and wastewater are discussed in Section 5.11.

5.5.1 No-Action Alternative

Activities under the No-Action Alternative could lead to additional surface-water runoff due to soil disturbance, loss of vegetative cover, and increases to impervious areas. In addition, water-quality could be affected by increased sediment load from erosion of exposed soils, potential contaminant sources including construction materials; hydraulic fluid, oil, and diesel fuel; and releases from transportation or materials handling accidents. However, as discussed in the following sections, SNL/NM follows stringent management practices included in SNL/NM specific SOPs and must comply with federal regulations to ensure that no adverse impacts to water resources occur.

5.5.1.1 Projects

Under the No-Action Alternative, there are no projects that are likely to cause measurable adverse impacts to water resources based on the surface water, groundwater, and floodplain protection requirements presented in Sections 5.5.1.2 through 5.5.1.4. No-Action Alternative projects are listed and described further in Table 3-1.

5.5.1.2 Surface Water

The SNL/NM Stormwater Program operates in compliance with federal stormwater regulations per NPDES³ requirements for discharges to the waters of the United States (40 CFR Part 120). The requirements include the Construction General Permit (CGP), the Middle Rio Grande Municipal Separate Storm Sewer System (MS4) Permit, and the Multi-Sector General Permit (MSGP) issued to SNL. The CGP regulates stormwater discharges associated with construction activities. NOIs are submitted to EPA for coverage under the CGP when it is anticipated that a construction or demolition project will disturb 1 or more acres of land.

³ Currently, operations at SNL/NM does not have direct discharge to waters of the United States, or tributaries thereto, that would be applicable to NPDES permitting requirements of NPDES.

A key requirement of the CGP is to develop and follow a site-specific stormwater pollution prevention plan (SWPPP), which includes a detailed site plan and schematics developed for each construction site, including details about applying BMPs, implementing pollution prevention measures, conducting site inspections routinely and after storm events, and stabilizing disturbed areas of a site upon completion of a project (SNL 2024h). The MS4 Permit issued to SNL/NM covers storm drainage within TA-I, TA-II, and TA-IV and encompasses about 1.16 square miles. The permit establishes requirements to reduce non-point source municipal stormwater pollutants discharged to the Rio Grande. SNL/NM complies with the MS4 Permit by maintaining a stormwater management plan, implementing control measures, conducting inspections, sampling stormwater, submitting discharge monitoring reports, and submitting annual reports. The MSGP regulates stormwater discharges associated with industrial activities that meet the criteria for one or more specific industrial sectors as defined in the permit. In 2022, 18 activity areas at SNL/NM operated under the MSGP. The MSGP requirements include routine inspections, sampling of effluent, documentation of any corrective actions, and submittal of an annual report to EPA.

In addition, Section 438 of the Energy Independence and Security Act of 2007 (EISA) specifically calls for federal development with a footprint that exceeds 5,000 square feet to maintain or restore pre-development hydrology. As such, facility design incorporates “low impact” development controls to maintain the water temperatures, flow rates, flow volumes, and durations that were present before development. Examples of appropriate controls include vegetated swales, infiltration basins, permeable pavement, vegetated strips, rain barrels, and cisterns. The implementation of the CGP, SWPPP, and low-impact development controls is designed to mitigate potential erosion, impacts to stormwater quality from sediment, and alteration of existing drainage patterns during construction and operations.

During operations, impacts to surface water from above-ground storage tanks for petroleum is not expected as EPA requires SNL/NM to develop, maintain, and implement a Spill Prevention, Control, and Countermeasure (SPCC) plan that enforces the use of tank and piping primary and secondary containment, detection, and monitoring systems designed to prevent oil spills and to effectively remediate any spill.

SNL/NM has also developed a Field Operations Procedure Manual for rapidly cleaning up and sampling small environmental releases that result from the unapproved release of a substance of unknown composition to the environment (SNL 2022i). These activities are conducted under the Environmental Release Response & Reporting Team (ERRRT) Program and the Stormwater Program.

Surface-water monitoring is in accordance with the NPDES stormwater permit and will continue in accordance with the ongoing environmental monitoring and surveillance program. Because stormwater monitoring will continue in accordance with the NPDES permit, impacts to downstream surface waters would not be expected. Under the No-Action Alternative, SNL/NM’s continued compliance with federal regulations and BMPs, in conjunction with proactive initiatives conducted by ERRRT, will protect surface water from potential degradation (e.g., increased sediment load and/or contamination).

5.5.1.3 Groundwater

Groundwater resources will be protected from potential contaminant releases during construction and operations of facilities under the No-Action Alternative. The potential for spills of hazardous materials to impact groundwater largely depends on the depth to groundwater where the spill occurs and spill response procedures. As described in Section 4.5.2, the depth to groundwater within the regional aquifer ranges from near surface to 200 feet ft-bgs in the eastern portion of the installation, and to depths of 350 to 500 ft-bgs west of the fault zone (refer to Appendix A, Figures A-21 and A-22). A perched groundwater system can occur at shallower depths in canyon bottoms, and intermediate perched water can be found at depths ranging from 270 to 320 ft-bgs under TA-I, TA-II, and TA-IV. However, the perched groundwater system is separated from the regional aquifer by about 200 feet of unsaturated alluvial sediments.

The relatively limited groundwater contamination under SNL/NM-managed lands is a result of past operations (refer to Appendix A, Section A.4.5.1). Groundwater monitoring will continue under the No-Action Alternative to ensure that management of contamination already present continues to be effective and that contaminant fate is fully understood (refer to Appendix A, Section A.4.5.1). Groundwater quality would be expected to continually improve because the remedy selected is protective of human health and the environment for the groundwater Areas of Concern.

Because SNL/NM will continue to comply with the federal regulations and implement management practices described in Section 5.5.1.2, any spills would be quickly managed and no adverse impacts to groundwater are likely. Potential impacts associated with sanitary wastewater are presented in Section 5.11.

5.5.1.4 Floodplains

The 100-year floodplain, as defined by the Federal Emergency Management Agency (FEMA), at SNL/NM is associated with the Tijeras and Arroyo del Coyote watersheds (Figure A-19). In TA-I and TA-II, where most of the construction activities will occur, the 100-year floodplain is either non-existent (TA-I) or very limited in extent (TA-II). No construction is proposed within the 100-year floodplain or arroyos. Construction and operations within or near floodplains will require compliance with EO 11988 and 10 CFR 1022, which requires floodplain assessment and protection measures. Construction and operations will also be subject to requirements in CWA Sections 401 and 404 (33 U.S.C. §§ 1251–1387). Under the No-Action Alternative, SNL/NM's continued compliance with federal regulations and other mitigation measures described in Section 5.5.1.2 will provide continued protection of floodplains.

5.5.2 Modernized Operations Alternative

The same regulatory requirements for the No-Action Alternative would be in place for the Modernized Operations Alternative. The mitigation measures required by federal regulations and adopted by SNL/NM are designed to be scalable resulting in potential impacts that are independent of the actual project size or complexity. Therefore, potential impacts under the Modernized Operations Alternative would not differ from the impacts for the No-Action Alternative.

5.5.2.1 Projects

Under the Modernized Operations Alternative, proposed projects are likely to have minimal adverse impacts on surface water, floodplains, and groundwater. Modernized Operations Alternative projects are listed in Table 3-3.

5.5.2.2 Surface Water

As under the No-Action Alternative, stormwater runoff from SNL/NM would continue to discharge to waters of the United States. Therefore, proposed activities at all SNL/NM facilities would be evaluated for possible revisions to the existing NPDES permits, detailed in Section 5.5.1 for the No Action Alternative.

SNL/NM would continue to comply with NPDES permitting requirements, including NOI submission and SWPPP implementation, as described in Section 5.5.1.2.

5.5.2.3 Groundwater

Protection of groundwater resources would be the same as discussed under the No-Action Alternative. Compliance with NPDES requirements would minimize impacts to groundwater from NPDES outfalls.

5.5.2.4 Floodplains

The 100-year floodplains, as defined by FEMA, are presented in Section 4.5.1 and are associated with the arroyos. Floodplain assessment would be required by 10 CFR Part 1022 and EO 11988 prior to construction. The projects would also be subject to CGP, SWPPP, and CWA Section 401/404 requirements. SNL/NM's continued compliance with federal regulations and other mitigation measures (refer to Section 5.5.1.2) would provide continued protection of floodplains.

5.5.3 Expanded Operations Alternative

Impacts on water resources from implementation of the Expanded Operations Alternative would not differ from the impacts described in Sections 5.5.1 and 5.5.2 for the No-Action and Modernized Operations Alternatives, respectively. As presented in Section 5.5.1.2, under the No-Action Alternative, the requirements of the federal regulations are adjusted based on the potential for the project to adversely affect the environment. For example, NNSA prepared a detailed flood study for the CREST Complex Site, proposed under the Expanded Operations Alternative (Appendix A, Section A.3.4.8). The flood study analyzed the potential for flooding and provided recommendations for drainage improvements to minimize impacts.

5.5.3.1 Projects

Under the Expanded Operations Alternative, all proposed projects are likely to have minimal adverse impacts on surface water, floodplains, and groundwater.

5.5.3.2 Surface Water

Protection measures for surface water would be the same as those discussed under the No-Action Alternative. As under the Modernized Operations Alternative, all the proposed SNL/NM projects would be evaluated for possible revisions to the required permits. SNL/NM would also comply with applicable rules and regulations, monitoring and reporting requirements, and timely implementation of corrective actions. Under the Expanded Operations Alternative, SNL/NM's continued compliance with federal regulations and other mitigation measures described in Section 5.5.3 and in Section 5.5.1.2 would ensure protection of surface water resources.

Figure 5-1 shows the easternmost proposed federal actions within the Hubbell Springs watershed. All stormwater flow from these actions would flow to the west, as described in Sections 4.5.1.1 and 4.5.1.2. Since stormwater runoff flows to the west, the Hubbell Springs watershed to the east would be unaffected by proposed actions described in this SWEIS. PV array development in sites C and I (Figure 3-2) is not expected to cause increases to stormwater flows within this watershed due to plans to minimize removal of vegetation and BMPs to limit stormwater impacts (Appendix A, Figure A-14 shows PV Arrays C and I; Figure 5-1 shows stormwater flows).

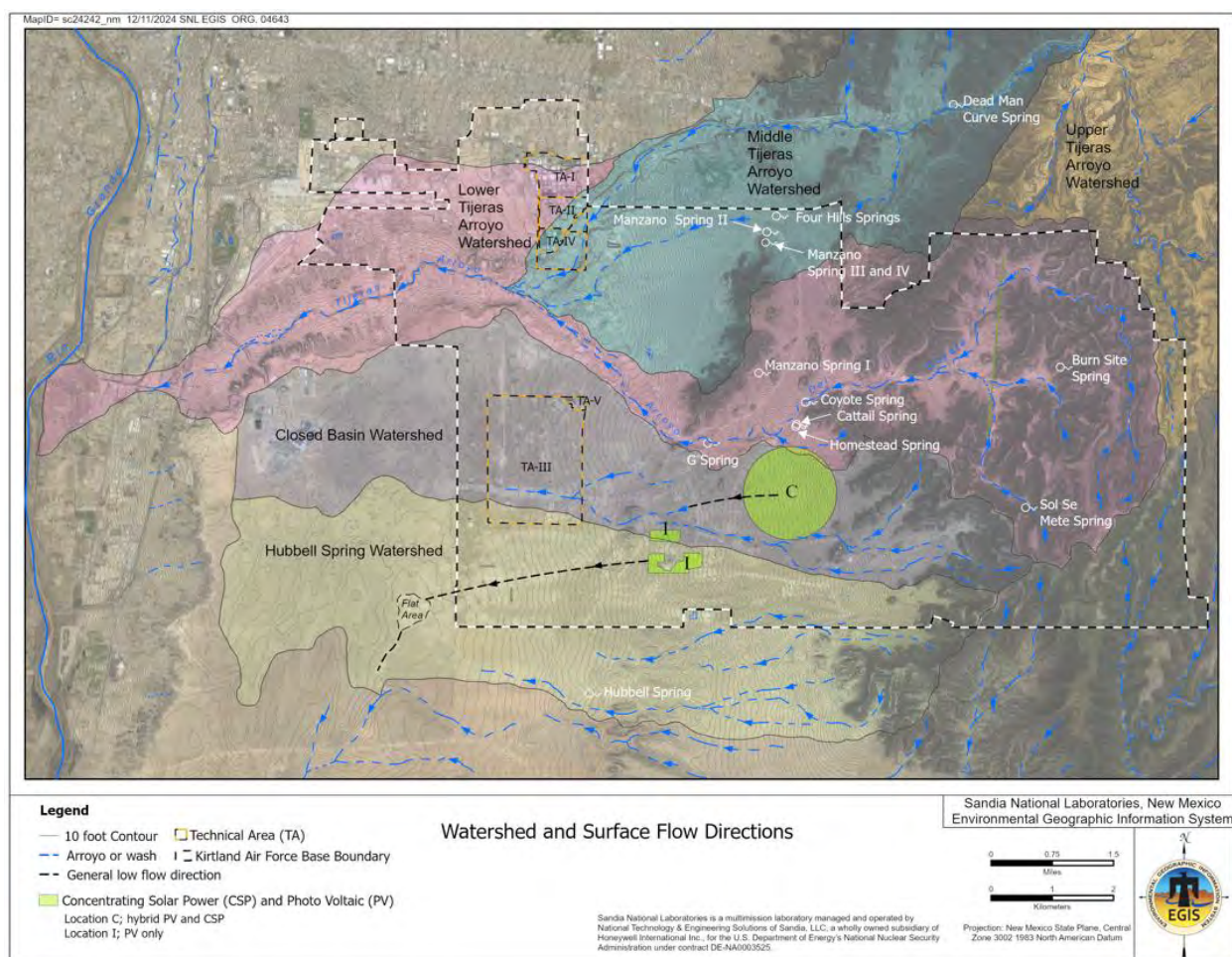


Figure 5-1. Watershed and Surface Flow Directions

5.5.3.3 Groundwater

If any geothermal facilities, including wastewater and geothermal exchange systems, are self-contained, no groundwater resources would be impacted. Protection of groundwater resources would be the same as discussed under the No-Action Alternative.

5.5.3.4 Floodplains

The 100-year floodplains, as defined by FEMA, are presented in Section 4.5.1 and are associated with the arroyos. Floodplain assessment would be required by 10 CFR Part 1022 and EO 11988 prior to any construction. The projects would also be subject to CGP, SWPPP, and CWA Section 401/404 requirements. SNL/NM's continued compliance with federal regulations and other mitigation measures described in Section 5.5.1.2 would provide continued protection of floodplains.

5.5.4 Summary of Water Resources Impacts for the Alternatives

Table 5-5 summarizes the potential impacts to water resources under the No-Action Alternative, Modernized Operations Alternative, and Expanded Operations Alternative.

Table 5-5. Potential Adverse Impacts to Water Resources for the Alternatives

Resource Parameter	No-Action	Modernized Operations	Expanded Operations
Increased sediment load to surface water due to land disturbance.	Minimal. SNL/NM would comply with NPDES stormwater requirements consisting of CGP, MS4, and MSGP permits.	Minimal. SNL/NM would comply with EISA Section 438 in addition to No-Action Alternative Requirements.	Same as Modernized Operations Alternative.
Increased surface water flow volumes due to impervious surfaces.	Minimal. SNL/NM would comply with NPDES stormwater requirements consisting of CGP, MS4, and MSGP permits.	Minimal. SNL/NM would comply with EISA Section 438 in addition to No-Action Alternative Requirements.	Same as Modernized Operations Alternative.
Contamination released to surface water and floodplains due to spills.	Minimal due to implementation of the ERRRT and stormwater programs, implementation of the SPCC, and small environmental release cleanup plans.	Same as No-Action Alternative.	Same as No-Action Alternative.
Potential for contaminant releases reaching groundwater.	None due to the ERRRT and stormwater programs, implementation of the SPCC, and small environmental release cleanup plans.	Same as No-Action Alternative.	Same as No-Action Alternative.
Potential impacts to floodplains	None due to ongoing watercourse protection activity, as well as compliance with CWA Section 401/404 requirements and floodplain assessment requirements.	Same as No-Action Alternative.	Same as No-Action Alternative.

5.6 AIR QUALITY

This section presents the potential impacts to air quality from each alternative evaluated in this SWEIS for both non-radiological and radiological sources. The scope of this analysis includes emissions generated from construction activities at SNL/NM-managed lands associated with each of the alternatives and anticipated changes to operations for each alternative. Key metrics presented in the air quality analysis for air emissions include: (1) quantities of projected air emissions, (2) quantities of projected GHG emissions, and (3) quantities of projected radiological emissions (Section 5.13 presents potential human health impacts from radiological emissions).

All alternatives are expected to include an increase in emissions to the ambient air, due to construction activities, increased fuel usage, and increased commuter travel. Air emission levels vary for each alternative; however, there is an expected increase to reported air emissions from permitted operations within the No-Action Alternative and the Proposed Alternatives due to increased fuel usage by the site over the period of analysis. The Expanded Operations Alternative also includes increase emissions from a 50% increase above baseline in the number of explosive events. There will also be increases in emissions from C&D activities, increased commuting from contractors supporting C&D, and UxS use in the Proposed Alternatives.

The environment is not reasonably expected to be affected by changes to air emissions from SNL/NM. Generally, impacts from air emissions vary depending on how long a compound lasts in the atmosphere and its ability to absorb infrared radiation. The impacts from air and GHG emissions will be minimal for the No-Action and Proposed Alternatives (Table 5-15).

5.6.1 No-Action Alternative

Section 3.2 presents projects and activities included in the No-Action Alternative.

5.6.1.1 Non-Radiological Air Emissions

Non-radiological air emissions associated with ongoing operations will remain consistent with the air emissions detailed in Section 4.6, with a slight increase due to a projected increase in natural gas usage. Construction of replacement facilities; DD&D activities; and upgrading of existing facilities will temporarily increase air emissions. Table 5-6 presents estimated air emissions for the activities identified. Assumptions and data stores used to develop these emissions estimates are provided in Appendix C, Section C.6.

**Table 5-6. Estimated Emissions from the No-Action Alternative
(tons per year [tpy])**

Emissions	CO	NO _x	PM ₁₀	PM _{2.5}	SO ₂	VOC	Total HAP
Highest Single-Year Construction Emissions ^a	5.1	0.3	0.05	0.03	0.01	0.5	0.5
Operations ^b	15.3	18.8	12.1	12.1	11.9	15.1	11.5
Employee Commuting	198.4	4.0	0.5	0.4	0.3	15.6	18.8
Explosive Events	0.84	2.94	96.0	96.0	0.09	0.05	0.1
Total Annual Emissions ^c	214.5	25.7	108.6	108.6	12.3	30.7	30.5
Change from Baseline ^d	3.8	9.4	10.4	10.4	11.6	11.2	2.25

CO: carbon monoxide, NO_x: oxides of nitrogen, PM: particulate matter, SO₂: sulfur dioxide, VOC: volatile organic compound, HAP: hazardous air emissions

- a. Temporary emissions from C&D.
- b. 2018–2022 average annual emissions plus increased fuel usage through period of analysis.
- c. Does not include temporary construction emissions.
- d. Change from baseline due to increased natural gas usage under No-Action Alternative.

Source: SNL/NM ASERs 2018–2022 (SNL 2023d; SNL 2022a; SNL 2021a; SNL 2020b; SNL 2019a; and Air Emissions Estimates [Appendix C]).

Vehicular traffic and construction will generate most of the air emission change. Fugitive dust (PM₁₀) is formed from land disturbance and the deposition of particulate onto paved surfaces, which is then disturbed by vehicular traffic. To manage fugitive dust generation in the City of Albuquerque and Bernalillo County, the Albuquerque EHD issues fugitive dust control permits that specify reasonably available control measures to reduce generation of fugitive dust from construction activities and maintenance of unpaved parking areas (20.11.20 NMAC). Any construction activity that disturbs three-quarters of an acre (32,670 square feet) or more of soil must obtain a fugitive dust permit from EHD. SNL/NM employs dust abatement measures consistent with the requirements of fugitive dust permits, including limiting vehicle speeds, covering materials during transport and storage, and applying dust suppressants (e.g., water) to unpaved access roads and parking areas.

Additionally, the demolition or renovation of any structure containing over 75,000 cubic feet of space requires a fugitive dust control demolition permit from EHD and written notification certifying to the presence (or absence) of RACM. The asbestos notification will specify the analysis, removal, and disposal methods for RACM (CABQ 2023a).

The No-Action Alternative also includes the limited OB/OD of explosive hazardous wastes that are unsafe to transport. Certain OB/OD events within the City of Albuquerque and Bernalillo County require a fugitive dust control permit and/or an open burning permit from EHD (20.11.20 NMAC and 20.11.21 NMAC). Appendix A, Section A.3.4.12, provides additional information on OB/OD, identifying alternative technologies for treatment of the explosive hazardous materials that are not currently available to SNL/NM due to the nature of materials at issue.

5.6.1.2 Radiological Air Quality

No radiological air emissions are expected as part of construction and DD&D activities under the No-Action Alternative. Table 5-7 shows the annual releases of radiological emissions estimated for the No-Action Alternative. These estimates are based on the average annual radiological emissions that occurred in 2018 – 2022. Section 5.13 of this SWEIS addresses the potential health effects of the releases shown in Table 5-7.

Table 5-7. Average Annual Radioactive Element Releases from the No-Action Alternative (curies per year [Ci/yr])

Tritium	Noble Gases	Fission/Activation Products	Strontium	Uranium	Other Actinides
45	1.572	7.76×10^{-4} ^a	5.02×10^{-6}	2.6×10^{-11}	2.39×10^{-6}

a. Scientific notation is used to simplify the presentation; as a clarifying example, 7.76×10^{-4} Ci/yr is the same as 0.000776 Ci/yr.

Source: SNL 2019a.

5.6.1.3 Greenhouse Gases

GHG emissions associated with ongoing operations will remain consistent with the GHG emissions detailed in Table 4-8. Construction of new facilities and upgrading of existing facilities will temporarily increase GHG emissions from the combustion of fossil fuels from construction equipment and the increase in persons commuting. During operations, however, GHG emissions will be reduced from several projects, including expansion of the EV fleet, purchase of electrical power from the Foxtail Flats solar project, and infrastructure projects that will reduce SF₆ emissions (refer to Table 3-1). Table 5-8 presents the GHG emissions estimated to change for the activities identified in the No-Action Alternative.

Table 5-8. Estimated Change in Emissions from the No-Action Alternative (MTCO₂e)

Category	Maximum Annual Increase from Construction Equipment	Annual Decrease from Operations	Maximum Total Annual Change
Total GHG Emissions	771	-2,991	-2,220

MTCO₂e: metric tons of carbon dioxide equivalent

Source: SNL/NM ASER (SNL 2022a) and GHG Emissions Estimates (Appendix C).

Maximum estimated Scope 1 through 3 GHG emissions for SNL/NM-managed lands from the No-Action Alternative are expected to be 213,033 MTCO₂e, which represents a reduction of 1% from the baseline.

5.6.2 Modernized Operations Alternative

Section 3.3 presents the projects and activities included in the Modernized Operations Alternative.

5.6.2.1 Non-Radiological Air Emissions

Emissions of non-radiological air emissions associated with ongoing operations would increase slightly compared to the air emissions detailed in the No-Action Alternative. Construction of replacement facilities and upgrading of existing facilities may temporarily increase air emissions. Additionally, a 14 percent increase in the number of employees commuting would increase recurring annual emissions. Emissions from annual operations are expected to increase more than the No-Action Alternative due to increased fuel usage. Increases to total annual emissions are due to increased fuel usage, construction activities, and an increase in the number of commuting employees. Table 5-9 presents the air emissions estimated to change under the Modernized Operations Alternative because of activities related to construction and commuting. Assumptions and data stores used to develop these emissions estimates are provided in Appendix C, Section C.6.

Total non-construction-related air emissions are expected to increase by 29 percent compared to the No-Action Alternative, primarily from the increase in employee commuting and additional fuel usage for the new facilities. The majority of temporary construction emissions would be generated from construction of facilities 100,000 square feet or more, including the NGE+ facility, Weapons Systems Engineering Capability, New Parking Structures, CAMINO, Energetics Components Facility, and Ceramic Tile Education Foundation.

Table 5-9. Estimated Change in Emissions from the Modernized Operations Alternative Compared to Baseline (tpy)

Emissions	CO	NO _x	PM ₁₀	PM _{2.5}	SO ₂	VOC	Total HAP
Highest Single-Year Construction Emissions ^a	10.4	0.8	0.2	0.1	0.01	1.1	0.9
Operations	22.1	28.3	13.0	13.0	12.4	219.2	11.7
Employee Commuting	28.5	0.6	0.1	0.1	0.04	2.2	2.7
Explosive Events	0	0	0	0	0	0	0
Total Annual Emissions^b	50.7	28.9	13.1	13.1	12.4	21.5	14.4

a. 2018 – 2022 Average Annual Emissions.

b. Does not include temporary construction emissions.

Source: SNL/NM ASERs 2018 – 2022 (SNL 2023d; SNL 2022a; SNL 2021a; SNL 2020b; and SNL 2019a) and the air emissions estimates in Appendix C, Section C.6.

5.6.2.2 Radiological Air Quality

No radiological emissions would be expected as part of construction activities under the Modernized Operations Alternative. Table 5-10 shows the maximum expected annual releases of radiological emissions for the Modernized Operations Alternative, which are conservatively based on the highest radiological emissions that would be expected to occur from operations. The increase in tritium emissions is due to NGE+ operation. Section 5.13 of this SWEIS addresses the potential health effects of the releases shown in Table 5-10.

Table 5-10. Maximum Radioactive Element Releases from the Modernized Operations Alternative (Ci/yr)

Tritium	Noble Gases	Fission/Activation Products	Strontium	Uranium	Other Actinides
50	1.572	7.76×10^{-4} ^a	5.02×10^{-6}	2.6×10^{-11}	2.39×10^{-6}

a. Scientific notation is used to simplify the presentation; as a clarifying example, 7.76×10^{-4} Ci/yr is the same as 0.000776 Ci/yr.

Source: SNL 2019a.

5.6.2.3 Greenhouse Gases

Sources of GHG emissions associated with the Modernized Operations Alternative would remain consistent with the GHG emissions detailed in the No-Action Alternative. Construction of new facilities and upgrading of existing facilities would temporarily increase GHG emissions during construction activities. Annual GHG emissions will increase due to a slight increase in the number of employees commuting and increased energy demand to support new operations. Table 5-11 presents GHG emissions estimated to change for the activities in the Modernized Operations Alternative.

Table 5-11. Estimated Change in Emissions from the Modernized Operations Alternative (MTCO_{2e})

Category	Maximum Annual Increase from Construction Equipment	Annual Increase from Operations	Maximum Total Annual Change
Total GHG Emissions	1,647	16,169	17,816

Source: SNL 2023d and the GHG emissions estimates in Appendix C, Section C.6.

Maximum estimated Scope 1 through 3 GHG emissions for SNL/NM-managed lands from the Modernized Operations Alternative are expected to be 231,661 MTCO₂e, which represents a 8% increase from the baseline.

5.6.3 Expanded Operations Alternative

Section 3.4 presents the projects and activities included in the Expanded Operations Alternative.

5.6.3.1 Non-Radiological Air Emissions

Construction of new facilities and upgrading of existing facilities would temporarily increase some types of air emissions. Additionally, an increase in the number of employees commuting would increase recurring annual emissions. Some emissions from annual operations are expected to increase more than under the No-Action Alternative and Modernized Operations Alternative due to increased fuel usage for stationary sources. Table 5-12 presents the air emissions estimated to change under the Expanded Operations Alternative as a result of increased fuel usage, construction, commuting, and explosive events. Assumptions and data stores used to develop these emissions estimates are provided in Appendix C, Section C.6.

Table 5-12. Estimated Change in Emissions from the Expanded Operations Alternative Compared to Baseline (tpy)

Emissions	CO	NO_x	PM₁₀	PM_{2.5}	SO₂	VOC	Total HAP
Highest Single-Year Construction Emissions	58.0	20.8	4.5	2.3	0.08	9.2	3.4
Operations ^a	27.8	33.7	13.8	13.8	129	23.9	11.7
Employee Commuting	73.9	1.5	0.17	0.17	0.10	5.8	7.0
Explosive Events ^b	0.4	1.5	48.0	48.0	0.04	0.02	0.1
Total Annual Emissions	102.1	40.7	62.0	62.0	13.0	29.5	18.8

a. Change compared to 2018 – 2022 average annual emissions.

b. Does not include temporary construction emissions.

Source: SNL/NM ASERs 2018 – 2022 (SNL 2023d; SNL 2022a; SNL 2021a; SNL 2020b; and SNL 2019a) and the air emissions estimates in Appendix C, Section C.6.

Total non-construction-related air emissions in the Expanded Operations Alternative are expected to increase by about 62 percent compared to the No-Action Alternative, primarily from the increase in employee commuting and additional fuel usage for the new facilities. The Expanded Operations Alternative also includes an increase in explosive events compared to the No-Action and Modernized Operations Alternatives. The majority of temporary construction emissions would be generated from construction of facilities related to expanded energy projects, the NGPP Facility, and TA-II infrastructure lines and road installation. The increase in air emissions would have a minimal negative impact on local air quality. Generally, an increase in HAP is from fossil fuel combustion related to the increase in commuting; these emissions are subject to the EPA Mobile Source Air Toxics rule, which regulates HAP content in fuels and includes cleaner engine emission standards while also limiting excessive engine operation. The increase in HAP emissions from commuting would be concentrated in existing commuter corridors to and within SNL/NM and are expected to have a minimal negative health impact in these areas.

5.6.3.2 Radiological Air Quality

No radiological emissions would be expected as part of construction activities under the Expanded Operations Alternative. The projects included in the Expanded Operations Alternative once operational would have the potential to generate additional radiological emissions, specifically the CREST Complex and the NGPP Facility. Table 5-13 shows the expected maximum annual releases of radiological emissions for the Expanded Operations Alternative. Compared to the No-Action Alternative, radiological emissions (refer to Table 5-7), radioactive air emissions for the Expanded Operations Alternative are expected to increase by about 35 Ci per year, with tritium and noble gases accounting for most of the increase. Section 5.13 of this SWEIS addresses the potential health effects of these emissions.

Table 5-13. Maximum Radioactive Element Releases from the Expanded Operations Alternative (Ci/yr)

Tritium	Noble Gases	Fission/Activation Products	Strontium	Uranium	Other Actinides
75	11.8	1.16×10^{-3} ^a	7.53×10^{-6}	3.9×10^{-11}	3.58×10^{-6}

a. Scientific notation is used to simplify the presentation; as a clarifying example, 1.16×10^{-3} Ci/yr is the same as 0.00116 Ci/yr. Source: Appendix A, Table A-3.

5.6.3.3 Greenhouse Gases

GHG emissions associated with ongoing operations would remain consistent with the GHG emissions detailed in the No-Action Alternative. Construction of new facilities and upgrading of existing facilities would temporarily increase GHG emissions; however, these GHG emissions would be partially offset by additional GHG-reduction projects including EDAF, ECIL, and other expanded energy projects. Table 5-14 presents GHG emissions estimated to change for the activities in the Expanded Operations Alternative. Appendix A, Section A.3.4.13, presents additional information on expanded energy projects.

Table 5-14. Estimated Change in Emissions from the Expanded Operations Alternative (MTCO₂e)

Category	Maximum Annual Increase from Construction Equipment	Annual Increase from Operations	Maximum Total Annual Change
Maximum GHG Emissions	14,208	21,642	35,850

Source: SNL 2023d and the GHG emissions estimates in Appendix C, Section C.6.

Maximum estimated Scope 1 through 3 GHG emissions from SNL/NM-managed lands from the Expanded Operations Alternative are expected to be 250,490 MTCO₂e, which represents a 16% increase from the baseline.

5.6.4 Summary of Air Quality Emissions and Impacts for All Alternatives

Table 5-15 summarizes the potential air quality impacts for the No-Action Alternative, the Modernized Operations Alternative, and the Expanded Operations Alternative.

Table 5-15. Potential Air Quality Impacts for the Alternatives

Resource Parameter	No-Action Alternative	Modernized Operations Alternative	Expanded Operations Alternative
General Conformity	N/A ^a	N/A	N/A
Maximum Expected Annual Increase in Emissions from Construction Activities	Minimal impact to air quality CO: 5.1 tpy NO _x : 0.3 tpy PM ₁₀ : <0.1 tpy PM _{2.5} : <0.1 tpy SO ₂ : <0.1 tpy VOC: 0.5 tpy Lead: <0.1 tpy HAP: 0.5 tpy CO ₂ e: 771 MT	Minimal impact to air quality CO: 10.4 tpy NO _x : 0.8 tpy PM ₁₀ : 0.2 tpy PM _{2.5} : 0.1 tpy SO ₂ : <0.1 tpy VOC: 1.1 tpy Lead: <0.1 tpy HAP: 0.9 tpy CO ₂ e: 1,647 MT	Minimal impact to air quality CO: 58.0 tpy NO _x : 20.8 tpy PM ₁₀ : 4.5 tpy PM _{2.5} : 2.3 tpy SO ₂ : 0.08 tpy VOC: 9.2 tpy Lead: <0.1 tpy HAP: 3.4 tpy CO ₂ e: 14,208 MT
Maximum Expected Annual Increase in Emissions from Operations	Minimal impact to air quality CO: 3.8 tpy NO _x : 9.4 tpy PM ₁₀ : 10.4 tpy PM _{2.5} : 10.4 tpy SO ₂ : 11.6 tpy VOC: 11.2 tpy Lead: <0.1 tpy HAP: 2.25 tpy CO ₂ e: -2,220 MT 1% reduction in GHG emissions compared to baseline and upon full implementation	Minimal impact to air quality CO: 50.7 tpy NO _x : 28.9 tpy PM ₁₀ : 13.1 tpy PM _{2.5} : 13.1 tpy SO ₂ : 12.4 tpy VOC: 21.5 tpy Lead: <0.1 tpy HAP: 14.4 tpy 32% increase in air emissions compared to No-Action Alternative CO ₂ e: 17,816 MT 8% increase in GHG emissions compared to baseline and upon full implementation	Minimal impact to air quality CO: 102.1 tpy NO _x : 40.7 tpy PM ₁₀ : 62.0 tpy PM _{2.5} : 62.0 tpy SO ₂ : 13.0 tpy VOC: 29.5 tpy Lead: <0.1 tpy HAP: 18.8 tpy 65% increase in air emissions compared to No-Action Alternative CO ₂ e: 35,850 MT 16% increase in GHG emissions compared to baseline and upon full implementation
Maximum Expected Increase in Radiological Emissions	Tritium: 45 Ci/yr Noble Gases: 1.572 Ci/yr Fission/Activation Products: 7.76×10^{-4} Ci/yr Strontium: 5.02×10^{-6} Ci/yr Uranium: 2.6×10^{-11} Ci/yr Other Actinides: 2.39×10^{-6} Ci/yr (refer to Section 5.13 for potential health impacts)	Tritium: 50 Ci/yr Noble Gases: 1.572 Ci/yr Fission/Activation Products: 7.76×10^{-4} Ci/yr Strontium: 5.02×10^{-6} Ci/yr Uranium: 2.6×10^{-11} Ci/yr Other Actinides: 2.39×10^{-6} Ci/yr (refer to Section 5.13 for potential health impacts)	Tritium: 75 Ci/yr Noble Gases: 11.8 Ci/yr Fission/Activation Products: 1.16×10^{-3} Ci/yr Strontium: 7.53×10^{-6} Ci/yr Uranium: 3.9×10^{-11} Ci/yr Other Actinides: 3.58×10^{-6} Ci/yr (refer to Section 5.13 for potential health impacts)

a. General Conformity no longer applies to federal actions at SNL/NM; it expired 20 years after the 1995 redesignation of Bernalillo County, NM to attainment (2015).

b. Scientific notation is used to simplify presentation; as a clarifying example, 7.76×10^{-4} Ci/yr is the same as 0.000776 Ci/yr.

5.7 NOISE

This section presents the potential noise impacts from each of the three alternatives evaluated in this SWEIS. The scope of this analysis includes noises generated from operations on SNL/NM-managed lands and impacts to nearby residential and commercial areas.

5.7.1 No-Action Alternative

Section 3.2 presents No-Action Alternative projects and activities. Noise impacts are short term in association with construction, DD&D, and related support activities (i.e., increased traffic for construction personnel). Temporary noise impacts are expected onsite from these activities and are expected to range from 74 to 101 A-weighted decibels (dBA) within 50 feet of equipment. No additional noise impacts associated with the No-Action Alternative are expected.

Noise decreases logarithmically over distance, so construction activity noise impacts were estimated for nearby residential and industrial areas. The closest residential area is on base housing north and west of TA-I; the nearest offsite residential area is about 620 feet north of the Robotic Vehicle Range (RVR). Since RVR construction is limited to expanding fenceline and staging area, none of these activities are expected to utilize equipment that would exceed 92 dBA and the maximum short-term expected noise to offsite receptors in this area would be less than 70 dBA, the level noted by EPA as causing hearing loss from prolonged exposure. The next nearest offsite residential area that could be exposed to noise from construction or DD&D activities is about 1,695 feet east of the eastern TA-II SNL/NM property boundary. A maximum short-term expected noise level to offsite receptors within this residential area is 70.4 dBA, which is above the level noted by EPA as causing hearing loss from prolonged exposure. For comparison, maximum airport noise is expected to be 59 dBA for this area. SNL/NM does not expect to use equipment generating noise greater than 100 dBA, which would yield noise impacts on the closest residential area below the EPA recommendation of 70 dB for hearing loss from prolonged exposure (EPA 1974). Construction noise impacts in the southeasternmost part of TA-III to the Pueblo of Isleta northern border will be an extreme maximum of 56.4 dBA. Potential noise impacts from DD&D and construction equipment are provided in Table C-21 of Appendix C. Construction, renovation, and DD&D activities could also generate ground-borne vibrations, which are expected to be confined to the area immediately around equipment and to not extend beyond SNL/NM-managed lands. None of these construction activities require blasting or generation of other airborne vibrations.

Temporary workforce traffic is expected to increase to support construction activities, mainly along Eubank Boulevard NE, south of I-40 and Central Avenue. Since these are major traffic thoroughfares for the City of Albuquerque and the expected increase in construction traffic noise is less than 1 dBA, no increased construction traffic noise impacts are anticipated. This traffic increase reflects current short-term activities that cease upon completion, providing an offset.

The No-Action Alternative includes use of UxS, such as UGS, UAS, tethered balloons, and free balloons, for R&D activities, such as dropping liquid and solid objects. UGS generally make less noise than a traditional lawn mower (UAS Legislative Task Force 2015). UAS generate noises at a high frequency of a magnitude between 45–81 dBA and are generally described as a buzzing noise, like a lawnmower. Noise observed from directly below UAS will be reduced during flight operations to 50–65 dBA for normal UAS operations at 400 feet above ground and a swarm of up to 10 UAS. UAS operated above this level will have further reduction in observed noise. UAS will be operated away from SNL/NM boundaries with offsite receptors, further attenuating noise impacts. When UAS are flown within 100 meters (328 feet) of KAFB's southern boundary, UAS noises will be modeled to establish a flight configuration to reduce flight noise, with a goal of 50 dBA on the ground at the southern boundary. Noise impacts will be greatest for areas where

UAS activities occur on a repetitive basis; flights will occur intermittently and at an altitude as high as practical to reduce noise disturbance. In most cases, UxS events are not perceptible outside KAFB, as a person would have to be within 200 to 2,900 feet of UxS to register noise above a conversational level. More information on UxS noise is in Appendix A, Section A.3.2.2.

Explosives Test ranges have been evaluated based on each region's largest operating capability. Overpressure from the maximum detonation event at the Clear Zone (CZ)⁴ border is about equal to 147 dB. Overpressure (SPL) is converted to dB based on explosives safety siting criteria. This approximation does not account for variables such as explosive type, atmospheric conditions, terrain, and other environmental factors, which can increase or decrease the noise expressed in dBA. Most explosive test operations are well below maximum potential explosive size in Table 5-16 and are expected to attenuate to less than 120 dB outside KAFB. Given the remote location of explosives test sites, noise attenuates further before reaching residential areas. Atypical test operations which may result in impulse noise levels exceeding 140 dB offsite are far less frequent. These include test operations with a large net explosive weight and where atmospheric conditions may not allow for typical attenuation. Potential annual frequency of events which would exceed 140 dB offsite is estimated in Table 5-16, although some years may have fewer events. More details on explosive event noise is in Appendix A, Section A.3.2.3. The CZ used in Table 5-16 is a delineated safety area to restrict personnel from potentially hazardous operations, reducing potential exposure to noise, air emissions, metal fragments, and other potentially hazardous conditions. The CZ only occurs within KAFB boundaries and does not extend offsite of SNL/NM-managed lands, including the La Semilla Buffer Zone.

Table 5-16. Estimated Test Range Hazardous Noise (by region)

Region	Maximum Potential Explosive Size (pounds)	Clear Zone (feet)	CZ Exceeds KAFB boundary	Expected to exceed 140dB offsite?	Estimated Annual Frequency Exceeding 140 dB Offsite
Technical Area III	2,600	4,511	Yes ¹	Yes ¹	≤20
KAFB-West	2,000	4,133	No	Yes ²	≤20
KAFB-East	10,000	7,067	No	Yes ²	≤10

1. Does not exceed La Semilla Buffer Zone.

2. Attenuates to less than 140 dB prior to reaching residential areas.

In most cases, explosive events heard outside KAFB resemble a dull thud or short burst (less than 3 seconds). To minimize noise impacts and sound propagation, larger explosive test events expected to produce noise levels exceeding 140 dB offsite may be coordinated with the SNL/NM meteorologist (SNL 2021a). DAF's Range Officer is responsible for scheduling range explosive events conducted by SNL/NM and DAF. The Range Officer applies DAF regulations and BMPs to minimize flights and explosive activities during sensitive events. Other testing, such as rocket motors, gun firing, and sled track and aerial cable collisions, generate less noise than explosive detonations (SNL 1994). Noise hazards from rocket motors are predicted based on motor specifications and can be modeled to predict noise levels (refer to Table 5-17) (SNL 1994). These noises constitute the current actual ambient noise exposure.

⁴ The CZ is the required minimum distance for protection of personnel and facilities from a potential explosion site.

Table 5-17. Example Rocket Motor Firing Hazardous Noise (by region)

Region	Noise Level	Distance (feet)	Attenuated Noise Level	Attenuated Distance (feet)	Modeled Boundary
Technical Area III	148 dBA	50	111 dBA	3,715	Western KAFB
Technical Area III	148 dBA	50	103 dBA	8,840	Western La Semilla Buffer Zone
Technical Area III	148 dBA	50	100 dBA	13,380	Southern KAFB
Aerial Cable Facility	148 dBA	50	105 dBA	4,265	Eastern KAFB

Ground vibrations are caused by surface or subsurface explosions. The likely radius of hazardous vibrations from explosive events or collisions varies depending on explosion size and geology of the area in which a test occurs. Surface and subsurface explosions can be modeled for ground shock using analytical methods to demonstrate ground shock effects from a test event in a given region. For example, an explosive test event at the Aerial Cable Facility involving 4 pounds of explosives would have a likely hazard radius for ground shock of 98 feet; for 1,000 pounds of explosives, the likely hazard radius would expand to 1,580 feet (SNL 1994). Surface and subsurface explosives testing may be conducted at greater depths and with greater explosives weights, provided the hazardous vibrations do not exceed the explosives CZ as defined by the applicable approved Explosives Safety Site Plan. Except for explosives 5,000 pounds or more detonated at the Lurance Canyon site, the ground shock radius for explosions is well within SNL/NM testing areas, so ground vibration impact to offsite receptors would not be expected. Ground vibration impacts of explosives 5,000 pounds or more detonated at the Lurance Canyon site could be detected offsite. Vibrations with a ground particle velocity of 2 inches per second (ips) or less will not cause damage to facilities or structures (SNL 1994). Distances for ground vibrations of 2 ips or more are in Table 5-18; all ground vibrations of 2 ips or more are within KAFB, so no damage to facilities or structures is expected beyond the KAFB boundary.

Table 5-18. Example Detonation Ground Shock

Region	Maximum Potential Explosive Size (pounds)	Detectable Ground Shock Radius (feet)	Detectable Ground Shock Radius Exceeds KAFB Boundary?	2 ips Ground Shock Radius (feet) ¹	2 ips Ground Shock Radius Exceeds KAFB Boundary?
Technical Area III	2,600	448	No (including La Semilla Buffer Zone)	<448	No
Thunder Range	2,000	410	No	<410	No
Lurance Canyon	10,000	12,580	up to 2,800 feet (on Forest Service managed lands)	2,659	No
Lurance Canyon	5,000	9,984	up to 200 feet (on Forest Service managed lands)	2,111	No
Lurance Canyon	3,000	8,842	No	<8,842	No
Aerial Cable Facility	1,000	1,580	No	<1,580	No
Coyote Test Field	830 (20' subsurface) ²	300	No	300	No

1. Additional ground shock vibration analysis for structure damage was only conducted for Lurance Canyon explosive detonations of 5,000 lbs or greater, as only these had potential detectable offsite ground vibrations.
2. Surface and subsurface explosives testing may be conducted at greater depths and with greater explosives weights, provided the hazardous vibrations do not exceed the explosives CZ as defined by the applicable approved Explosives Safety Site Plan.

5.7.2 Modernized Operations Alternative

Section 3.3 presents Modernized Operations Alternative projects and activities. Frequency of temporary noise impacts from additional construction, demolition, and related support activities within the Modernized Operations Alternative would increase compared to the No-Action Alternative. Maximum construction noise is expected to be the same as the No-Action Alternative (Appendix C, Section C.7, Table C-21) and is not expected to exceed 100 dBA at generation, resulting in an estimated noise of less than 70 dBA at the closest offsite residence.

Ground-borne vibrations and generation of other airborne vibrations are the same as the No-Action Alternative. Traffic noise from temporary construction and additional permanent workforce is also expected to be the same as the No-Action Alternative.

There is no change in expected explosive frequency or magnitude and ambient noise impacts of explosives used or in UxS frequency or use in the Modified Operations Alternative compared to the No-Action Alternative.

5.7.3 Expanded Operations Alternative

Section 3.4 presents Expanded Operations Alternative projects and activities. Frequency of temporary noise impacts from construction, demolition, and support activities in the Expanded Operations Alternative would increase compared to the No-Action Alternative. Maximum construction noise is expected to be the same as the No-Action Alternative (Table 5-19).

Ground-borne vibrations and generation of other airborne vibrations are the same as the No-Action Alternative. Traffic noise from temporary construction and additional permanent workforce is also expected to be the same as the No-Action Alternative.

An increase of up to 50 percent in explosive frequency, with all explosive types and sizes, is expected in the Expanded Operations Alternative. While this would increase the number of noise and vibration events associated with explosive detonation, the magnitude of any explosive event and ambient noise impacts would not change. Each explosive event would still require Range Officer approval and be subject to requirements in the No-Action Alternative to minimize impacts to nearby areas.

The Expanded Operations Alternative also includes additional UAS operations, such as increasing number of flights and size of swarms. Swarm size would increase from 10 UAS to up to 100 UAS; this represents a ten-fold increase to the maximum swarm in the No-Action Alternative. Although magnitude of sound produced by any individual UAS would not change, the total sound produced by a swarm of 100 vehicles is expected to increase observed noise by 10 dBA during operations observed from directly below UAS. Noise from UAS operated away from SNL/NM boundaries with offsite receptors would further attenuate.

The number of UAS flights in the Expanded Operations Alternative would increase by almost 60 percent compared to the No-Action Alternative. More frequent flights would not increase magnitude of UAS noise impact. As detailed in the No-Action Alternative, noise impacts from UAS flights would be perceptible above a conversational level only within 2,900 feet of the

UAS. Other UxS events are not perceptible outside the KAFB boundary. The number of UGS days is expected to remain the same as the No-Action Alternative.

UxS used in New Mexico lakes (USV and UUV) will have noise profiles similar to or less than similar sized commercial watercraft (85 dBA) (USFS 1992).

5.7.4 Summary of Noise Impacts for All Alternatives

Table 5-19 summarizes potential noise impacts for the No-Action Alternative, the Modernized Operations Alternative, and the Expanded Operations Alternative.

Table 5-19. Potential Noise Impacts for the Alternatives

Resource Parameter	No-Action Alternative	Modernized Operations Alternative	Expanded Operations Alternative
Construction	Peak Noise: <100 dBA Frequency: Minimal	Peak Noise: <100 dBA Frequency: Moderate	Peak Noise: <100 dBA Frequency: Moderate
Explosive Events	Peak Noise: 140–157 dB (onsite); <120 dB (offsite) ¹ Frequency: ~4,200 events annually	Peak Noise: No change Frequency: No change	Peak Noise: No change Frequency: 50% increase
UxS	Peak Noise: 57.9 dBA Frequency: ~2,600 flights annually	Peak Noise: No change Frequency: No change	Peak Noise: 67.9 dBA (swarm) Frequency: ~4,100 flights annually

1. Noise from explosive events was provided in decibels (dB) to provide a conservative estimate of the total noise generated, rather than noise detected by the human ear (dBA).

5.8 BIOLOGICAL RESOURCES

This section presents the potential impacts to biological resources from each alternative evaluated in this SWEIS. Differences in impacts relate to the amount and type of land area under development, project location relative to sensitive habitats, and project type planned.

5.8.1 No-Action Alternative

Under the No-Action Alternative, ongoing SNL/NM activities (refer to Section 3.2) will continue. Project activities will disturb 13.1 acres above current SNL/NM development area. Most construction will occur in TA-I, with 5.9 acres of development (including 5 acres of permanent construction staging area), and in TA-II, which will support facility construction of 158,500 square feet (3.6 acres of building) plus a 1-acre electrical substation. TA-I and TA-II, classified as mostly disturbed, urban habitat, will remain under the No-Action Alternative.

5.8.1.1 Vegetation

The primary vegetation type disturbed under the No-Action Alternative will be native grassland. Appendix A, Section A.4.8, details general habitat types and vegetation in TA-I, TA-II, TA-III, TA-IV, TA-V, KAFB-East, and KAFB-West. Revegetation of disturbed areas will be consistent with vegetation in surrounding areas, using native species.

Technical Areas I, II, IV, and V

TA-I, TA-IV, and TA-V are mainly developed, urban work and industrial areas primarily consisting of paved surfaces. Landscaping near buildings and walkways consists of ornamental

trees, shrubs, perennials, bunch grasses, and some turf or xeric grass areas. Most of TA-II and areas south and east of TA-IV grow native vegetation (SNL 2017). An area of 65,400 square feet (1.5 acres) will be used for installation of above-ground fuel storage tanks; impacts to vegetation will be primarily confined to that area of construction. Refer to Appendix A, Section A.4.8 for more details on vegetation types.

Additional construction and DD&D will be consistent with previous disturbances in these areas. Impacts will be minimal, given the relatively small footprint and location in a mainly developed landscape. Some impacts to vegetation will be temporary, during construction and DD&D, with reseeded drought tolerant vegetation after construction disturbance. Permanent impervious surfaces including buildings and pavement will have long-term impacts on grasslands, shrubs, and landscaped vegetation on about 10.4 acres of land in these TAs.

Technical Area III

The primary vegetation types that occur in TA-III include Dwarf-Shrub Grassland, Large Shrub Grassland, and Grasslands with Sparse Dwarf-Shrubs (SNL 2017). A maximum of 0.68 acre of vegetation could be impacted from construction in this area.

KAFB-East and KAFB-West

The primary vegetation types that occur within KAFB-East are Closed Canopy Woodland; Open Canopy Woodland; and Shrub, Woodland, Grassland habitats (SNL 2017). The primary types of vegetation that occur in KAFB-West include Dwarf Shrub Grassland, Large Shrub Grassland, and Grasslands with Sparse Dwarf-Shrubs. These vegetation types constitute a variety of vegetation heights and amount of cover. A maximum of 0.31 acre of vegetation could be impacted from construction in this area.

Invasive Vegetation

Consistent with EO 13112, construction will be monitored to control detrimental vegetation and invasive species transport. Any new landscaping will be native and drought tolerant.

5.8.1.2 Wildlife

Impacts to native wildlife will be minimal: increased disturbance from explosives, noise, and localized human and construction activities. Construction and DD&D on SNL/NM-managed lands will constitute most notable disturbances to vegetation and wildlife and will largely occur in already altered habitats. Habitats adjacent to construction areas will be undisturbed, allowing displaced animals to occupy adjacent habitats. Explosives will be detonated at CTF, Lurance Canyon Burn Site, and TA-III and TA-IV, causing temporary disturbance to wildlife.

Before construction, wildlife surveys (particularly of breeding birds) will be conducted to avoid disruption of breeding and other activities. Avoidance of seasonal construction activities could also minimize risk to birds. All native, migratory birds are protected by the MBTA (16 U.S.C. § 703 et seq.) and by EO 13186. In 2013, DOE signed a memorandum of understanding with the USFWS (DOE and USFWS 2013) that promotes monitoring, habitat enhancement, and migratory bird protection, including design considerations for sustainable buildings and facilities.

Bird-friendly glass or glazing will be considered on large expanses of glass to minimize bird mortality at new construction, given that window strikes are common in already developed areas, with about 43–47 percent of reported bird deaths attributed to window strikes (SNL 2018c; SNL 2020e; and KAFB 2023a). For existing facilities, NNSA is considering potential modifications to reduce bird collisions, such as glass retrofits. All new construction projects will consider underground distribution lines when feasible to minimize electrocution hazards to migratory birds, especially raptors.

The health impacts analysis in Section 5.13 shows that potential radiological doses to workers and the public under all alternatives would be so low that populations of plants and animals would not be impacted by the effects of ionizing radiation (DOE 2002b).

UAS and UGS activities under the No-Action Alternative could disturb wildlife, particularly birds and possibly ungulates and other mammals (e.g., Afridi et al. 2024). UAS flight disturbance will be intermittent but will occur over a project's life. UAS activity can negatively impact birds by eliciting avoidance or aggressive response. UASs can mimic predators, causing birds to attack and expend energy or to abandon their nests for extended periods of time, leaving eggs and chicks exposed to extreme heat or predation (Mulero-Pazmany et al. 2017). Areas of activity will be checked for wildlife prior to deployment to minimize impacts. As detailed in Appendix A, Table A-5, UAS flight activity would obtain biological review from the SNL/NM Ecology Program for protected species and follow applicable location requirements to minimize impacts to wildlife. UAS flight activity would maintain flight distance from animals and would be conducted at an altitude as high as practical and/or allowable to limit disturbance to animals at ground level when logistically possible (refer to BMPs and to Appendix A, Table A-6).

Generally, less than 10 percent of expected UAS flight days at KAFB will occur in wooded areas where elk (*Cervus canadensis*) and other large mammals may be present. Most of these days will be spent at heights such that UAS noise is less than 60 dBA at ground level. Should UAS activities call for concentrated flights over wooded areas, BMPs to limit adverse impacts to wildlife, including ungulates, will be that the UAS team will involve the SNL/NM ecology team on flight plan specifics to identify location and timing strategies to limit visual and auditory disturbances to ungulates and other wildlife. Migratory periods and concentrations of ungulates, which may be particularly vulnerable in large herds, will be avoided (Schroeder et al. 2020).

Explosives testing dropped from UAS or occurring on sites (such as Lurance Canyon Burn Site, Thunder Range, and CTF) can affect wildlife via ground shock and noise. Displacement from habitat (which can be temporary depending on disturbance frequency) can affect mobile wildlife (Shannon et al. 2016), and noise impacts can affect birds' reproductive success (Senzaki et al. 2020). Avoiding birds' breeding season (March through August) can minimize impacts.

5.8.1.3 Special Status Species and Habitats

No current federally listed species or critical habitats are present on the site. Projects will be evaluated before construction to determine the presence of migratory birds, mammals, reptiles, amphibians, and sensitive species and to avoid seasonal impacts. Use of bird-friendly glass will be considered for new construction. As of August 17, 2023, USFWS announced a status review for the pinyon jay (88 FR 55991). Should USFWS determine a special status for this species

under the ESA (16 U.S.C. §§ 1531–1544) is warranted, formal consultation with USFWS may be necessary. The pinyon jay could be minimally impacted by construction and disturbances in KAFB-East and KAFB-West.

Gunnison’s prairie dogs and western burrowing owls that rely on prairie dog burrows (Forest Service Sensitive Species, USFWS Bird of Conservation Concern, BLM State Sensitive Species) could be impacted via colony displacement, poisoning, and intentional burrow filling (Chaon et al. 2020 and Conway and Locatelli 2021). Implementation of BMPs to avoid mowing, construction, and burrow filling during breeding season in inhabited areas will minimize impacts to these grassland species that utilize TA-I, TA-II, and TA-III; the Eubank Corridor; and CTF (McMurry et al. 2022 and McMurry and Smith 2023).

No-Action Alternative impacts would not be expected except for explosive events which could occur in or near areas of bat and bird activity. Lurance Canyon, CTF, and Thunder Range will have explosive testing that may impact breeding birds via displacement or reduced reproductive success in proximity to explosives (Senzaki et al. 2020). For explosives and UAS/UGS activities, habitat and special status species will be avoided; for example, UAS activities will comply with Bald Eagle Management Guidelines (refer to Appendix A, Section A.3.2.2).

Prior to construction and other disturbance, barn owl and great horned owl nest boxes near construction areas (e.g., in TA-II and TA-III, depending on proximity) could be relocated to avoid impacts. UAS activities will obtain biological review from the SNL/NM ecology team for protected species at UAS locations and will follow any applicable BMPs specific to location to minimize impact and to avoid proximity to nest boxes and known raptor nesting areas.

UxS activities in or on New Mexico lakes are not anticipated to affect species protected under the ESA, and lake impacts will be similar to commercial use impacts. Under all alternatives, no UxS operations are proposed at Escondida Lake, which is within designated Critical Habitat of the southwestern willow flycatcher. Future proposals to conduct UxS operations at Escondida Lake will require interagency cooperation with USFWS (SNL 2024i). UxS requirements are in Appendix A, Table A-5, and BMPs for UxS are in Table A-6.

5.8.1.4 Wetlands

No wetlands are known to exist on SNL/NM-managed lands, so construction and DD&D activities will not occur in wetlands (Figure A-27). Very few wetlands are on KAFB, but ephemeral arroyos or drainages may run through and near TA-I, TA-II, TA-III, and CTF. A wetlands delineation prior to construction will ensure that wetlands are not impacted, as recommended in the last wetlands survey (Marcus et al. 2006). Any new construction or DD&D will avoid wetlands and buffers in accordance with EO 11990.

5.8.2 Modernized Operations Alternative

The projects proposed under the Modernized Operations Alternative would disturb about 42 additional acres. Most facility construction would occur in TA-I and TA-II.

5.8.2.1 Vegetation

Modernized Operations Alternative impacts to urban and ornamental vegetation would be similar No-Action Alternative impacts, with an additional approximately 42 acres disturbed. Under the Modernized Operations Alternative, additional remote areas and other SNL/NM-managed lands would be developed. Depending on location and extent of development in remote areas, woodlands (likely primarily pinyon-juniper) would be impacted. Revegetation of disturbed areas would be consistent with vegetation in surrounding areas, using native species as described in Section 5.8.1 for the No-Action Alternative to maintain natural communities to the greatest extent possible, including managing invasive species (refer to EO 13112).

5.8.2.2 Wildlife

Similar to wildlife assessments under the No-Action Alternative, conservation measures would continue to minimize potential impacts from construction, explosives, and operational activities. Impacts from new facilities would be minimized through pre-construction biological surveys, consideration of BMPs, natural resources awareness training, and siting new construction in and adjacent to already disturbed areas when possible. For construction projects and explosive testing in remote areas, impacts to wildlife could be reduced if pre-construction or pre-activity biological surveys and historical data on high wildlife activity areas are consulted prior to disturbance. The amount of construction in this alternative represents a small portion of the overall habitat available for wildlife, and use of BMPs would minimize impacts (for BMPs, refer to pp. 2-3 and 2-4 of DAF 2014). Explosives testing and UAS/UGS activity would be unchanged from the No-Action Alternative, so disturbance from this activity would be similar or identical.

5.8.2.3 Special Status Species and Habitats

In consideration of the potential listing of the pinyon jay, special attention to associated habitat would be given prior to construction activities that could impact the species. If local species statuses change, consultation with USFWS under Section 7 of the ESA may be necessary once projects are further defined. As described for the No-Action Alternative, avian species protected under the MBTA nest in developed and undeveloped portions of SNL/NM-managed lands, particularly in some remote areas potentially affected by the Modernized Operations Alternative.

In addition, golden eagles occasionally forage throughout SNL/NM grasslands (KAFB 2014). Conservation measures would be continued to minimize potential impacts, with particular attention to power lines. As with the No-Action Alternative, bird-safe glass would be considered and used in new construction when possible.

To minimize impacts from construction, especially to special status species and their habitats, pre-activity biological surveys would be performed, and historical information would be consulted to avoid and minimize disturbance. For example, given that wildlife is attracted to water features both human-caused and natural (e.g., wildlife guzzlers, natural springs), avoidance of areas adjacent to those features during construction and operations would minimize impacts to all wildlife, including some special status species.

5.8.2.4 Wetlands

No wetlands exist on SNL/NM-managed lands, so construction and DD&D activities would not occur in wetlands (Figure A-26). As with the No-Action Alternative, any new construction or DD&D would avoid wetlands and buffers in accordance with EO 11990.

5.8.3 Expanded Operations Alternative

The Expanded Operations Alternative includes the actions discussed for the Modernized Operations Alternative (refer to Section 3.3). In total, up to 1,542.1 acres could be disturbed (73.8 acres for facilities and 1,468.3 acres for expanded energy projects and infrastructure). Of this acreage, as described further in Appendix A, Section A.3.4.13, the PV + CSP project at Sites B and C would disturb up to 1,200 acres of KAFB lands. Expanded Operations Alternative activities would likely impact grasslands and associated species including prairie dogs, bats, and birds due to the large footprint and operations of the proposed project. Due to the increase in UxS and forest management activities proposed under the Expanded Operations Alternative, disturbance of wildlife, particularly birds, may occur. BMPs, discussed previously, would be considered in project management to minimize disturbance of breeding and roosting.

5.8.3.1 Vegetation

Under the Expanded Operations Alternative, up to 1,410 acres of native grassland could be disturbed due to expanded energy project construction (i.e., proposed PV + CSP project [up to 1,200 acres] at Site B or Site C [Figure 3-2 and Appendix A, Figure A-14] and the NSTTF PV project [210 acres]). Because SNL/NM's terrestrial vegetation exists within KAFB without differentiation, this SWEIS evaluates native grassland disturbance of up to 1,410 acres against KAFB's vegetated area. As described in Section 4.8.1, about 33 percent of KAFB's vegetated area is grassland, meaning about 17,000 acres of grasslands are on KAFB. Expanded Operations Alternative activities could disturb up to about 8.3 percent (1,410 acres) of KAFB grasslands. In addition, mainly expanded energy projects, prescribed burns, explosives, and infrastructure would disturb shrubland and open canopy pinyon-juniper woodland vegetation. As with the No-Action and Modernized Alternatives, efforts would be made to control detrimental vegetation and invasive species transport during construction to the extent possible (EO 13112).

Wildland fire risk reduction treatments proposed under the Expanded Operations Alternative would focus on KAFB-West and KAFB-East lands in the Withdrawn Areas. Thinning, prescribed burns, and herbicide use for invasive vegetation species would impact primarily pinyon-juniper woodlands (KAFB 2022). Vegetation removal via these treatments would remove diseased vegetation, and fuel load reduction would benefit most species long-term if fewer high-intensity fires resulted from these measures (Huffman et al. 2009). These treatments would have temporary, minimal impacts on vegetation due to long-term benefits.

5.8.3.2 Wildlife, Including Special Status Species and Habitats

Similar to the wildlife assessment under the Modernized Action Alternative, conservation measures would continue to be implemented to minimize potential operational activity impacts, especially in the TAs and CTF. As discussed in Section 5.8.3.1, construction could disturb up to 1,410 acres of native grassland, which would adversely impact wildlife habitats.

SNL/NM proposes to develop an INCRMP that may mimic portions of the KAFB INRMP and ICRMP (KAFB 2023a) and to collaborate with KAFB to minimize impacts to natural resources, such as vegetation (refer to Appendix A, Section A.3.4.14).

Wildland fire risk reduction treatments in pinyon-juniper woodlands could positively impact species reliant on pinyon-juniper habitat (e.g., Bombaci and Pejchar 2016 and Novak et al. 2021). Reduction treatments would be performed outside sensitive times of year to limit negative impacts on wildlife. Requirements of pinyon-juniper reliant species would be considered in BMP development in SNL/NM's INCRMP (e.g., avoid March through August for breeding birds).

Explosives testing would increase in frequency by 50 percent in the Expanded Operations Alternative, leading to an increase in disturbance of wildlife through noise and ground shock, at sited explosive ranges. Ungulate herds and large mammals would likely be affected via displacement and nesting birds may experience reduced reproductive success if in proximity to frequent high dBA noise events (Shannon et al. 2016 and Senzaki et al. 2020).

The Expanded Operations Alternative has additional UAS operations, including increasing flight number and swarm size (refer to Appendix A, Section A.3.4.7, Table A-11). Magnitude of sound produced by individual UAS would not change, but total sound produced by a 100-vehicle swarm is expected to increase noise level observed from directly below UAS. Impacts of large numbers of UAS on wildlife are not well-studied, with most studies on single UAS flights used for wildlife monitoring (e.g., Scobie and Hugenholtz 2016). Noise levels would likely reach 65–75 dBA (refer to Section 5.7), and meta-analysis of noise effects on wildlife shows that impacts are common at levels above 40 dBA (Shannon et al. 2016). Breeding birds may attack or avoid a single UAS (Mulero-Pazmany et al. 2017 and Cantu de Leija et al. 2023), and avian responses to UAS are often based on visual cues rather than auditory disturbance (Mesquita et al. 2021). Mitigations such as Ecology Program staff review of nest locations would minimize these concerns (refer to requirements and BMPs in Appendix A, Tables A-5 and A-6). Impacts could be minimized by avoiding areas of eagle activity, bat roosts, and high ungulate activity and by coordinating with Ecology Program staff to avoid known areas of high wildlife activity.

Proposed UAS operations include dropping explosives in disturbed and explosives sited locations (Appendix A, Section A.3.4.7), which may negatively impact wildlife, due to loud noise, displacement, or death. Impacts to wildlife could be minimized through UAS flight limitations and BMPs in Tables A-5 and A-64 (Appendix A, Section A.3.2.2). Tethered and free balloons would also be used, increasing only the number of flight days above the No-Action Alternative, with no impacts to wildlife anticipated, given the BMPs.

As described in Appendix A, Section A.3.4.7, USV and UUV activities, proposed for seven lakes in New Mexico, are not likely to disturb wildlife. Consultation with USFWS would occur when necessary if southwestern willow flycatcher critical habitat is in the project area (Fahey 2024).

Expanded energy projects have potential direct impacts on birds and bats, including fatality of individuals from collisions with project structures, burning/singeing, habitat destruction, fragmentation, modification, and/or glare. Other potential indirect impacts on birds, bats, and their communities are behavioral changes and avoidance due to temporary construction noise and long-term light pollution, altered fire regimes and surface water habitat conditions (e.g.,

turbidity, heat), and affected navigation abilities due to electromagnetic fields (ANL 2015). Insects are attracted to solar energy systems and may contribute to bird and bat mortality risk.

Solar energy developments near the RVR on the landfill grasslands and adjacent areas (Site B) and near the NSTTF (Site C) have could impact grassland nesting birds via displacement from nesting grounds and risk of mortality. At least 60 grassland bird species use SNL/NM grasslands in various seasons (Cruz-Carretero and Cruz-McDonnell 2015).

Uncertainty surrounding impacts at Sites B and C points to the importance of implementing a Bird and Bat Conservation Strategy at SNL/NM, especially as impacts of deterrents and heliostat aiming strategies have not been well-studied and mortality estimates have a wide range depending on various circumstances (Walston et al. 2016). More information regarding studies on avian mortality is in Appendix A, Section A.5.8.

Dozens of raptor nests of at least eight species have been documented in the northwest region of KAFB, with sightings of four additional raptor species, including peregrine falcons and golden eagles (KAFB 2014; Cruz-Carretero and Cruz-McDonnell 2015; SNL 2019a). Some sightings have been near grasslands slated for development of expanded energy projects (Site B); this project would result in loss of foraging habitat and would pose a mortality risk to raptors not deterred from the area. Solar development near the NSTTF (Site C, Figure 3-2) would result in loss of additional, though smaller, areas of grassland and shrubland habitat, including disturbing multiple barn owl and great horned owl nest boxes. Moving the boxes and encouraging nesting in areas away from the solar facilities could mitigate these impacts.

High bat diversity and activity has been observed on KAFB TAGC and Coyote Springs areas (Hauer et al. 2018), which are close to proposed location sites for expanded energy projects (Site B or C). Displacing and/or killing birds and bats may occur at these projects. If necessary, a Bird and Bat Conservation Strategy (BBCS) would be developed for each expanded energy project as part of the Expanded Operations Alternative to minimize impacts to migratory birds and bats (e.g., ANL 2015). A BBCS documents methods to systematically monitor for avian and bat abundance, activity, and fatality at the project location, including a Before-After Control-Impact methodology (ANL 2015). A site-specific BBCS could mitigate and minimize impacts to birds and bats through BMPs (ANL 2015). Bat mortality has not been well-studied at CSP facilities, but increased insect activity (e.g., Ho 2016) and thus bat activity could cause mortality, though reported bat mortality has been fairly low at other CSP facilities (WEST 2023). Bat activity may decrease around PV installations, thus reducing mortality potential but increasing habitat loss and fragmentation (e.g., Tinsley et al. 2023).

Proposed PV arrays would have overall lower impacts to birds than the CSP tower. Utility-scale PV facilities may attract migrating waterfowl and shorebirds through what has been called the “lake effect” (Kagan et al. 2014), whereby birds perceive reflective surfaces of PV panels as bodies of water and collide with project structures as they attempt to land on the panels. For this reason, impacts to waterbirds are likely greater at installed PV array locations than at the CSP tower. To date, however, little empirical research has been conducted to evaluate the attraction of PV facilities to migrating birds, which would be an important component of a BBCS.

Insects may be attracted to both PV (Horvath et al. 2010) and CSP facilities, and solar flux is known to kill insects (Ho 2016). These impacts could be of particular concern for monarch butterflies as a proposed threatened species (89 FR 100662), but BMPs, particularly at PV installations, could reduce mortality levels (Horvath et al. 2010).

For other taxonomic groups, expanded energy project impacts in the Expanded Operations Alternative would come mainly from direct grassland habitat loss. Reptiles, small mammals that inhabit grasslands (refer to Section 4.8.2), and their predators would be displaced from habitat by construction. Habitat loss and fragmentation and collisions with vehicles due to increased road traffic also create risks and are a primary cause of impacts to non-flying mammals and reptiles. Expanded Operations Alternative impacts to species reliant on woodlands would be minimal.

As with the other alternatives, consultation with USFWS would occur when necessary to determine presence of federally listed species (for pinyon jay, for example, 88 FR 55991). Under the Expanded Operations Alternative, if the expanded energy project is at Site B, loss of landfill grassland area (historically productive area for prairie dogs and western burrowing owls) would result in loss of habitat for Gunnison’s prairie dog and impacts on western burrowing owls (e.g., Conway and Locatelli 2021). As previously noted, for the No-Action and the Modernized Operations Alternatives, prairie dog management strategies would minimize impacts, particularly in and adjacent to the TAs and Eubank Corridor. Grassland habitat loss and potential impacts to prairie dogs and burrowing owls could be reduced with relocation and BMPs.

Impacts of development to pinyon jays can be minimized in remote areas if pre-operation surveys are completed and nesting habitat in pinyon-juniper woodlands is avoided. Avoidance of breeding season impacts can further minimize harm as well as implementing seasonal and spatial restrictions (e.g., McMurry et al. 2022 and McMurry and Smith 2023).

5.8.3.3 Wetlands

No wetlands are present on SNL/NM-managed lands, so construction and DD&D activities from the Expanded Operations Alternative would have no impact on this resource (Section 4.8.4). Wetlands cumulatively occupy about 9 acres at KAFB (KAFB 2023b), and as with the No-Action and Modernized Operations Alternatives, new construction or DD&D would avoid wetlands and buffers in accordance with EO 11990. However, as discussed in Section 4.8.4, multiple arroyos and temporal streams run east to west across the TAGC and into the proposed PV + CSP installation in Site B; these would need to be delineated and avoided under the Expanded Operations Alternative. Existing and potential wetland areas, including springs, should be surveyed every 5 years, or less depending on need, to meet regulatory requirements (Marcus et al. 2006 and KAFB 2023a).

5.8.4 Summary of Biological Resources Impacts for All Alternatives

Table 5-20 summarizes biological resource impacts of the alternatives. Notable vegetation impacts would occur on grasslands and notable wildlife impacts are associated with birds, bats, and prairie dogs due to the expanded energy projects. These impacts would be moderate for vegetation (direct removal and habitat fragmentation) and significant for wildlife, particularly birds, bats, and insects. These mobile species can be impacted by expanded energy project

facilities due to habitat loss and direct mortality even if cited in degraded habitat, potentially impacting aerial species for the reasons discussed in Section 5.8.3.2. Consultations would be conducted as appropriate.

Table 5-20. Potential Impacts to Biological Resources for the Alternatives

Resource/ Metric	No-Action Alternative	Modernized Operations Alternative	Expanded Operations Alternative
Land disturbance (total acres)	13.1 total acres (includes 5 acres of permanent staging area)	42.0 total acres	1,542.1 total acres (73.8 acres for facilities; 3 acres for utility corridor; 1 acre for substation; 1,441 acres for expanded energy projects; 20 acres for roads; 3.3 acres for fence)
Vegetation (potential impact)	Minimal	Minimal	Moderate impacts primarily on grasslands, due to 1,441 acres for expanded energy projects
Wildlife (potential impact)	Minimal impacts with BMPs and conservation measures	Minimal impacts with BMPs and conservation measures	Significant impacts to grassland-reliant wildlife, bats, and migratory birds and raptors. Some impacts could be reduced by implementing a BBCS and BMPs.
Special status species and habitats (potential impact)	Minimal impacts with BMPs for birds, including relocations of nest boxes for raptors and non-lethal prairie dog BMPs	Minimal impacts with BMPs for birds, including relocations of nest boxes for raptors and non-lethal prairie dog BMPs	Significant impacts to grassland-reliant and migratory special status species: bats, prairie dogs, and dozens of bird species. Some impacts could be reduced by implementing a BBCS and BMPs.

5.9 CULTURAL AND PALEONTOLOGICAL RESOURCES

This section presents the potential impacts on cultural (historic and archaeological sites) and paleontological resources for each of the three alternatives evaluated in this SWEIS. The scope of analysis on SNL/NM-managed lands includes the historic built environment and archaeological resources, both prehistoric and historic, identified through archaeological inventories. Most of these resources are in less developed areas (i.e., withdrawn from public use and/or are on KAFB permitted lands) but also include some SNL/NM mission-related historic sites and structures in developed areas such as TAs I–V. Key metrics include (1) a quantitative analysis of the extent of ground disturbances with the assumption that there is greater potential for adverse effects to both prehistoric and historic archaeological resources when previously undisturbed lands are developed and (2) a qualitative analysis of the potential to directly and indirectly impact cultural resources.

Both types of cultural resources are managed by SNL/NM pursuant to NEPA and Section 106 of NHPA requirements, and in consultation with the NMHPD. In addition, the SNL/NM Cultural Resource Program, through an internal program assessment, ensures that no federal actions occur prior to cultural review.

Archaeological resources at SNL/NM are managed primarily for long-term preservation and protection following established New Mexico Archaeological Council procedures (4.10.8 NMAC and 4.10.15 NMAC), although they do not legally apply to federal lands. Historic built resources are managed in accordance with the 2010 historic building survey and assessment for SNL/NM (Ullrich et al. 2010). SNL/NM protocols in accordance with NHPA Sections 106 and

110 for avoiding, minimizing, and mitigating adverse effects to historic properties and for inadvertent discoveries are summarized in the SNL/NM ASERs (SNL 2019a; SNL 2020b; SNL 2021a; SNL 2022a; and SNL 2023d).

The SNL/NM Cultural Resource Management Program protocols include (1) surveys for additional archaeological inventory prior to any ground-disturbing activities, (2) evaluations of newly identified sites for their eligibility for listing in the NRHP, (3) redocumentations and reevaluations of previously documented archaeological sites prior to ground-disturbing activities, and (4) surveys and NRHP eligibility evaluations of historic built environment resources prior to any proposed activities. Protocols (2) and (3) are completed in consultation with the New Mexico SHPO+ and the tribes/pueblos. SNL/NM protocols also address inadvertent discoveries, such as subsurface ground disturbances that identify human remains, cultural items, suspected cultural items, or historic properties. Inadvertent discoveries of indigenous cultural materials during construction would require additional consultation with the New Mexico SHPO and, as necessary, tribes according to NHPA Sections 106 and 110 (36 CFR Part 800), Native American Graves Protection and Repatriation Act (25 U.S.C. §§ 3001–3013), American Indian Religious Freedom Act (42 U.S.C. § 1996), DOE Policy 141.1 (DOE 2001b), and DOE Order 144.1A (DOE 2024b). If cultural resources are found during construction or other activities, work would stop, SNL/NM archaeological personnel would be consulted, and appropriate notifications would be made. These actions are applicable to all alternatives discussed hereafter.

Before historic properties scheduled for demolition are eliminated, SNL/NM considers ways to avoid or minimize potential adverse effects resulting from DD&D. Any demolition would occur only after consultation with the New Mexico SHPO and determination of eligibility for listing in the NRHP. When the property is determined to be not eligible, demolition can proceed with no additional requirements. When the property is determined eligible for listing, NNSA is required to consult further with the New Mexico SHPO and ACHP and may also need to consult with tribal governments and the public to “avoid, minimize, or mitigate” adverse effects (36 CFR 800.8(c)(1)(v)). This requirement applies to all alternatives discussed in the sections that follow.

Interior and exterior renovations may adversely affect NRHP-eligible historic properties by diminishing the integrity of the property’s aspects of integrity (36 CFR 800.5). New construction may also adversely affect historic properties and historic districts eligible for NRHP listing by altering physical features within the property’s setting that contribute to its historic significance. New construction can introduce visual, atmospheric, or audible elements that diminish the integrity of the property’s significant historic features. Such potential indirect effects are relevant to all alternatives considered in Sections 5.9.1, 5.9.2, and 5.9.3.

All alternatives discussed in the following sections have the potential to adversely affect TCPs through indirect impacts such as noise, vibrations, and visual changes. If direct impacts are anticipated, appropriate consultations will be conducted.

No paleontological resources have been identified and none are expected based on local geology within the SNL/NM-managed lands, and no impacts are anticipated under any of the alternatives.

5.9.1 No-Action Alternative

Impacts under the No-Action Alternative were estimated for projects and upgrades totaling a development footprint of 309,660 square feet (7.1 acres), plus an additional 5 acres for a dedicated construction staging area, and 1 acre for a new electrical substation in TA-II. DD&D of facilities will total 117,172 square feet (2.7 acres).

5.9.1.1 No-Action Alternative: Historic Properties – Archaeological Resources

SNL/NM manages 206 archaeological sites within SNL/NM-managed lands. These sites represent all periods of human occupation from terminal Pleistocene hunting to Ancestral Puebloan farming to historic mining and ranching activities. Of the 206 known sites, 70 have been evaluated as eligible for NRHP listing under Criterion D (information value), and the remaining sites are either unevaluated or of unknown status; unevaluated sites are managed as eligible sites pending a determination otherwise (SNL 2023d).

Current and future adverse effects evident at archaeological sites will be minimal under the No-Action Alternative. Restricted access will continue under the No-Action Alternative, and human impacts to archaeological sites will be incidental to occasional use of less developed areas by SNL/NM and KAFB employees.

Other adverse effects include natural erosion of archaeological sites, a process that can be exacerbated by human activities such as road and utility maintenance. Additionally, the introduction of new construction could potentially affect culturally significant landscapes. Furthermore, vibratory impacts could diminish the integrity of archaeological sites. The construction of new facilities under the No-Action Alternative will occur in developed areas (TAs I–V). This construction will not directly affect the integrity of eligible or potentially eligible archaeological sites in less developed areas. Some sites might be indirectly impacted by the introduction of construction dust and noise, and the new construction might visually intrude on landscapes of significance to the tribes/pueblos. There is also a potential for inadvertent discoveries of cultural resources during construction. Should cultural resources be found during construction or other activities, work will stop, an SNL/NM archaeologist will be consulted, and appropriate notifications will be made.

There is a potential that SNL/NM operations, such as UxS activities and explosives testing, could directly and indirectly affect archaeological sites. For UxS activities, in the unlikely event that a device would accidentally crash and damage archaeological sites, SNL/NM archaeological personnel will assess the damage. However, the potential for errant devices to cause inadvertent damage to archaeological sites is minimal. SNL/NM has BMPs in place (e.g., pedestrian retrieval) to ensure the recovery of UxS does not further impact archaeological sites. Proposed UxS activities on various New Mexico lakes have a minimal potential to impact archaeological resources (SNL 2024j). BMPs for UxS are listed in Appendix A, Tables A-5 and A-6.

Vibrations from explosives testing have the potential to indirectly affect archaeological sites. Therefore, an archaeological survey is completed during the conceptual location analysis prior to explosives activity to identify visible cultural resources and determine whether archaeological resources need to be avoided. It is unlikely archaeological resources would be observed after

explosive testing. If they are identified, immediate recording and assessment will determine the resource integrity and eligibility to the NRHP.

5.9.1.2 No-Action Alternative: Historic Properties – Built Environment

Ten historic properties and other support facilities with a total footprint of 117,172 square feet (2.7 acres) are scheduled for DD&D under the No-Action Alternative (refer to Section 3.2.1). Historic properties scheduled for demolition would be eliminated, following consultation and agreement with the New Mexico SHPO regarding the appropriate mitigation for their demolition.

5.9.2 Modernized Operations Alternative

Potential impacts under the Modernized Operations Alternative were estimated for replacement projects and upgrades (42 acres) and DD&D of more than 40 properties and infrastructure features.

5.9.2.1 Modernized Operations Alternative: Historic Properties – Archaeological Resources

Adverse effects to archaeological sites under this alternative would be the same as described for the No-Action Alternative. The construction footprint is estimated to be 42 acres (38 acres for facilities, 3 acres for a utility corridor, and 1 acre for an electrical substation). Facility construction, although greater in scope, would not directly affect known archaeological sites. There is a potential for inadvertent discoveries of cultural resources during construction on acreage not previously developed. Should cultural resources be found during construction or other activities, work would stop, an SNL/NM archaeologist would be consulted, and appropriate notifications would be made.

5.9.2.2 Modernized Operations Alternative: Historic Properties – Built Environment

More than 40 facilities, some of which could be historically significant, are proposed for DD&D under the Modernized Operations Alternative compared to 10 under the No-Action Alternative. DD&D would total 538,000 feet (12.4 acres). Historic properties scheduled for demolition would be eliminated, following consultation and agreement with the New Mexico SHPO regarding the appropriate mitigation for their demolition. Potential impacts from new construction, renovations to facilities, and maintenance activities would be reviewed with the New Mexico SHPO.

5.9.3 Expanded Operations Alternative

The Expanded Operations Alternative includes the actions discussed for the Modernized Operations Alternative (refer to Section 5.9.2), plus construction activities associated with 30 projects, totaling about 1,557,200 square feet (35.7 acres) of facility development and an additional 1,464 acres of other infrastructure development. Of these 30 projects, 7 utility/infrastructure projects are proposed under the Expanded Operations Alternative, including expanded energy projects as described further in Appendix A, Section A.3.4.13, that would require about 1,441 acres of land; infrastructure, utility lines, and roads that would disturb another 20 acres of land; and fences that would disturb an additional 3.3 acres. In addition, about

52 facilities and other support structures with a total footprint of 566,000 square feet (13 acres) are proposed to undergo DD&D.

5.9.3.1 Expanded Operations Alternative: Historic Properties – Archaeological Resources

The major difference between the Expanded Operations Alternative and the No-Action and Modernized Operation Alternatives would be the development of 1,441 acres for expanded energy projects and 23.3 acres for related infrastructure and fencing. The potential for direct and indirect adverse effects to archaeological resources would be greater under the Expanded Operations Alternative, given that archaeological resources are primarily located in less developed areas where the potential projects would be located. For example, CSP will disturb 1,200 acres at Site B, and the 210-acre NSTTF PV project is in a less developed and intact area where there is a moderate potential for direct and indirect adverse effects to archaeological sites. The expanded energy project located in Site C is in an area previously disturbed where the potential for direct and indirect adverse effects to archaeological resources is minimal. Even if direct effects are avoided, minimized, or mitigated, there is a high potential for indirect effects, including the introduction of construction dust and noise, and the new infrastructure (e.g., banks of solar panels) might visually intrude on prehistoric and/or culturally significant landscapes important to the tribes/pueblos. Noise impacts would be temporary, whereas visual and biological impacts to culturally significant resources would be cumulative and ongoing.

As discussed for the No-Action Alternative, SNL/NM operations such as explosive testing and UxS testing could potentially affect archaeological resources. Although the amount and intensity of testing would be greater under the Expanded Operations Alternative, NNSA will follow the same survey and mitigation processes for explosive testing and UxS testing described in Section 5.9.1.1, and the potential for adverse impacts would remain minimal.

5.9.3.2 Expanded Operations Alternative: Historic Properties – Built Environment

When combined with the Modernized Operations Alternative, under the Expanded Operations Alternative, approximately 100 potentially historic properties would undergo DD&D. These properties have a combined footprint of about 1.1 million square feet (25.3 acres), most of which would be replaced by new construction. Historic properties scheduled for demolition would be eliminated, following consultation and agreement with the New Mexico SHPO regarding the appropriate mitigation for their demolition. Potential impacts from new construction, renovations to facilities, and maintenance activities would be reviewed with the New Mexico SHPO.

5.9.4 Summary of Cultural and Paleontological Resource Impacts for All Alternatives

Table 5-21 summarizes the potential impacts to cultural and paleontological resources for the No-Action Alternative, the Modernized Operations Alternative, and the Expanded Operations Alternative. The Modernized Operations Alternative includes the scope of the No-Action Alternative, plus additional modernization activities. The Expanded Operations Alternative includes the scopes of the No-Action Alternative and the Modernized Operations Alternative, plus actions that would expand or add operations.

Table 5-21. Potential Cultural Resources and Paleontological Impacts for all Alternatives

Resource Parameter	No-Action Alternative	Modernized Operations Alternative	Expanded Operations Alternative
Development Footprint (total acres)	13.1 total acres	42 total acres	1,542.1 total acres (73.8 acres for facilities, 3 acres for utility corridor, 1 acre for substation, 1,441 acres for expanded energy projects, 20 acres for roads, 3.3 acres for fence)
Archaeological Sites (Prehistoric and Historic) ^a	Direct Impacts: None anticipated, but there is a potential for inadvertent discoveries. Indirect Impacts: Impacts to site integrity through the introduction of auditory, atmospheric, and visual impacts are anticipated. Any construction in less developed areas would require archaeological survey and monitoring.	Same as No-Action Alternative.	Direct Impacts: Potential for impacts to NRHP-eligible sites from development activities, of which up to 1,200 acres would be on less developed lands. Any construction in undeveloped areas would require archaeological survey and monitoring. Indirect Impacts: Potential for impacts to site integrity. If NRHP-eligible sites are encountered, further consultation may be required.
Historic Buildings ^b	Direct Impacts: Planned DD&D would eliminate 10 historic buildings with a footprint of 2.7 acres from the historic landscape (refer to Table 3-2); consultations with New Mexico SHPO ongoing. Indirect Impacts: Potential impacts from new facilities, upgrades to facilities, and maintenance on remaining historic buildings or unassessed facilities; consultations with the New Mexico SHPO ongoing.	Direct Impacts: DD&D would remove more than 40 facilities, some of which could be historically significant, with a footprint of 12.4 acres (refer to Table 3-4); consultation with New Mexico SHPO required. Indirect Impacts: Potential impacts from new facilities, upgrades to facilities, and maintenance on remaining historic buildings or unassessed facilities; consultations with the New Mexico SHPO ongoing.	Direct Impacts: DD&D would remove approximately 100 potentially historic buildings with a combined footprint of 25.3 acres (refer to Table 3-7); consultation with New Mexico SHPO required. Indirect Impacts: Potential impacts from new facilities, upgrades to facilities, and maintenance on remaining historic buildings or unassessed facilities; consultations with the New Mexico SHPO ongoing.
Paleontological Resources / TCP	No impacts are anticipated.	No impacts are anticipated.	No impacts are anticipated.

a. The exact location of prehistoric and historic archaeological resources is confidential information to which the public does not have access under provisions of the Archaeological Resources Protection Act of 1979. As such, this SWEIS does not disclose these site locations.

b. The historic buildings listed are considered historic properties as defined in NHPA 54 U.S.C. §300308.

5.10 TRAFFIC AND TRANSPORTATION

This section describes the potential impacts to local and onsite traffic and parking conditions, as well as impacts related to the shipping of materials to and from SNL/NM to various locations (such as waste disposal sites and other DOE or commercial sites) under both incident-free and accident conditions for each of the three alternatives evaluated in this SWEIS. Appendix E presents the analysis to support this section.

Of note, construction and DD&D activities under the alternatives would use the existing transportation infrastructure in the region and could potentially cause periodic adverse impacts to local traffic flows from construction-worker commuting and the intermittent presence of additional construction vehicles.

5.10.1 No-Action Alternative

5.10.1.1 Traffic and Onsite Transportation and Parking

Construction activities under the No-Action Alternative will occur between 2025 – 2030. No contractor workforce growth is expected (i.e., workforce is not anticipated to increase beyond the current baseline level of 1,300). During operations, no additional workforce growth is expected; the operational workforce is anticipated to remain at the current baseline level of 13,078 employees (refer to Section 5.15.1 for additional information). As a result, no discernible changes to local traffic, onsite traffic, or onsite parking are anticipated under this alternative as compared to the present baseline characteristics discussed in Section 4.10.

5.10.1.2 Transportation of Radiological and Hazardous Materials to/from SNL/NM

Under the No-Action Alternative, roughly 11 SNM shipments per year are expected to collectively occur between SNL/NM and LANL/LLNL. Such shipments to and from LANL/LLNL would be expected to mostly involve SNM materials (e.g., targets or other test articles) for irradiation and evaluation at SNL/NM's nuclear facilities. In addition to the shipment of such materials, 32 total LLW/MLLW (routine and non-routine) offsite shipments (all assumed to go to NNSS for analytical purposes) and 1 TRU waste shipment to the WIPP would be expected annually. These numbers reflect increases of 68% and 0%, respectively, over the baseline shipping averages for these wastes and are primarily driven by projected increases in radioactive waste from direct mission activities, including those from DD&D. The associated total projected (one-way) distances traveled annually on public roads transporting these wastes to NNSS and WIPP under the No-Action Alternative would be about 21,600 miles and 300 miles, respectively. No high-level radioactive waste shipments to or from SNL/NM are expected under the No-Action Alternative.

For annual hazardous waste offsite shipments, the analysis conservatively estimates that the baseline annual shipment numbers (about 31 per year, on average) would increase to approximately 250 shipments per year. The shipment increase is directly proportional to the expected eight times increase in associated waste volumes between the baseline and what is anticipated under the No-Action Alternative (i.e., 76 metric tons per year [MT/yr] versus 606 MT/yr; refer to Appendix A, Table A-3, for additional information). The projected increases in waste volumes and shipments would be driven by the site's planned implementation of extensive DD&D related activities under this alternative.

Impacts of Incident-Free Transportation

Health impacts related to radiation exposure are presented in terms of LCFs, which are described in Appendix D, Section D.2.1. The annual collective dose to transportation crews from all offsite transportation activities under the No-Action Alternative would range from about 0.012 person-rem for SNM transport to 0.38 person-rem for LLW/MLLW transport and would total about 0.41

person-rem annually from all potentially shipped materials under all possible material categories. The associated annual doses to the general population along these routes would range from 0.014 to 0.15 person-rem, respectively, and would total about 0.167 person-rem annually from all potentially shipped materials under all possible material categories. Accordingly, incident-free transportation of all material sources would result in an annualized total of 0.00025 additional LCF among all transportation workers (0.0037 LCF from shipments over the entire 15-year period) and 0.00010 annualized additional LCF in all affected public populations (0.0015 LCF from shipments over the entire 15-year period). Table 5-23 summarizes the associated potential risks to both the public and transportation crews.

DOE regulations limit the maximum annual dose to a transportation worker to 100 mrem per year unless the individual is a trained radiation worker, which have an administrative control dose level of 2 rem per year (DOE 2017 and SNL 2000). The potential for a trained radiation worker to develop a fatal latent cancer from an annual dose at the maximum annual exposure level is 0.0012.⁵ Furthermore, a maximally exposed truck inspector would be expected to receive no greater than 19 mrem per hour of inspection duty performed, which would likewise equate to a minimal (essentially 0) increase in LCF risk on an annual basis. These facets, as they relate to the identified occupational receptor groups identified above, uniformly apply under all three alternatives evaluated in this SWEIS.

Impacts of Accidents During Transportation

Under all three alternatives evaluated, the maximum reasonably foreseeable offsite truck transportation accident with the greatest potential consequence would involve a truck carrying a maximum allowable capacity of plutonium-based powder (or equivalent thereof) to or from SNL/NM. Resulting unmitigated public impacts (neglecting the probability of the accident occurring) are estimated to be <4.3 rem (<0.003 LCF) to an MEI and <6,300 person-rem (<4 LCFs) to nearby populations along any given route segment assumed to be used for transport.

Under the No-Action Alternative, the total estimated annualized transportation accident risk (calculated via the summation of individual annual accident probabilities of occurrence times their associated unmitigated consequences) for all projected accidents involving radioactive shipments, regardless of type, was determined to be 0.00000054 LCF to the general population, as compared to the maximum assessed cumulative non-radiological accident risk (traffic accident fatalities) of 0.00075 fatality per year from shipments of all material categories to and from SNL/NM.

Impacts of Construction, Operations, and Hazardous Material Transportation

Impacts of transporting various non-radiological hazardous materials are presented in terms of annual distance traveled and annual numbers of expected traffic fatalities. The annual transportation impacts under the No-Action Alternative would total 0.002 (i.e., essentially 0) traffic fatalities. This total considers about 250 shipments per year, or about 220 shipments per

⁵ The maximum annual exposure level is assumed to be 2 rem, which is the administrative control level. A dose of 2 rem per year would result in the following LCF risk: $2 \text{ rem} \times 0.0006 \text{ LCF/rem} = 0.0012 \text{ LCF}$.

year more than the average number of annual shipments during the baseline period (2017 – 2022). For all three alternatives evaluated in this SWEIS, based on shipments made over the last several years to Veolia Environmental Services – Colorado, or Veolia Environmental Services – Arizona, hazardous waste shipments are assumed to travel an average of 460 miles. No radiological or hazardous waste materials/shipments are expected as part of the construction activities under any of the three alternatives. Moreover, any radiological and hazardous wastes associated with planned DD&D have been included in assessed impacts from site operations under all three alternatives.

5.10.2 Modernized Operations Alternative

5.10.2.1 Traffic and Onsite Transportation and Parking

Under the Modernized Operations Alternative, 200 additional construction contractors are expected above the No-Action Alternative (a 15% increase). Because the ramp-up of construction projects under the Modernized Operations Alternative is expected to fully utilize existing contractor personnel to the greatest extent possible, only a modest increase in construction personnel demand (i.e., 15%) over the 15-year construction period is anticipated as compared to the No-Action Alternative (roughly 1% per year incremental increase). An annual increase of 1% in construction workers at SNL/NM would not impact the level of service (LOS) on area roads.

Level of Service

The LOS is a qualitative measure that describes operational conditions as they relate to the traffic stream and perceptions by motorists and passengers. The LOS generally describes these conditions in terms of such factors as speed and travel time, delays, freedom to maneuver, traffic interruptions, comfort, convenience, and safety. The operational LOS are given letter designations from A to F, with A representing the best operating conditions (free-flow) and F the worst (severely congested flow with high delays). Intersections generally are the capacity-controlling locations with respect to traffic operations on arterial and collector streets.

Once steady-state operating conditions are reached in 2040, an additional 1,882 workers are expected to be added to the site workforce beyond the No-Action Alternative projected level of 13,078 (about a 14% increase). An increase of 1,882 operational workers would be expected to proportionally increase the annual ADT for weekday trips at and nearby any of KAFB's presently utilized five gate locations. As a representative example, daily traffic increases along the length of Eubank Boulevard could be as much as 17% over the present-day baseline ADT value in the area if all additional workers were to enter and exit the site through the Eubank Gate, and would not be expected to change the LOS designation on/along Eubank Boulevard.^{6,7} Much of the current primary and secondary road network onsite (particularly within TA-I) is often at relative capacity and would benefit from additional improvements to traffic efficiency

⁶ 1,882 workers × 2 trips/day divided by 22,279 (which is the existing daily traffic).

⁷ In general, traffic would need to increase by at least 20% to cause an LOS change (Rodrigue 2024). However, the distinctions between LOS ratings are subjective, and many factors can affect how a given traffic change would affect the LOS on a given road, including road design, number of lanes, number of intersections, speed limit, and signalization. Consequently, the ability to make definitive conclusions about an LOS change on a given road is limited.

and flow, particularly during the morning and afternoon rush hours. For the Modernized Operations Alternative, associated projects such as SNL/NM's proposed new 100,000-square-foot parking structure in TA-I, a new dedicated parking garage installed in TA-IV, and potential road/lane widenings in certain areas across the site would help accommodate any increases in onsite traffic and parking.

5.10.2.2 Transportation of Radiological and Hazardous Materials and Waste to/from SNL/NM

Under the Modernized Operations Alternative, transportation of SNM such as small quantities of plutonium metals and oxides, Pu-ICE, and HEU (as well as other specialized or exotic nuclear materials) from SNL/NM across the NNSA/DOE complex (as well as to a private commercial entity) is possible. Up to 3 regular SNM shipments per year to LLNL are conservatively assumed for transport (with up to 8 shipments per year of Pu-ICE theoretically possible). See Appendix E for additional information.

Under this alternative, the potential exists for additional SNM shipments to support SNL/NM reactor fuel recladding efforts that may take place in the future at INL and/or PNNL (refer to Table 5-22 and Table 5-23, as well as Appendix E, for additional information).

In addition to the shipment of such materials, 32 total LLW/MLLW (routine and non-routine) offsite shipments (all assumed to go to NNS) and 1.33 TRU waste shipments to WIPP would be expected on average annually. These values reflect no increase in the estimated number of shipments for LLW/MLLW and only a marginal statistical increase in the number of TRU waste shipments as compared to the No-Action Alternative. They are primarily driven by projected quantities of radioactive waste generated from direct mission activities, including the DD&D activities presumed to take place under the Modernized Operations Alternative. The associated total projected (one-way) distances traveled annually on public roads transporting these wastes to NNS and WIPP under this alternative would be about 21,600 miles and 400 miles, respectively. No high-level radioactive waste shipments to or from SNL/NM are expected under the Modernized Operations Alternative.

For annual hazardous waste offsite shipments, the analysis conservatively estimates that baseline annual shipment numbers (about 31 per year, on average) would increase to approximately 430 shipments per year, which is directly proportional to the expected 14 times increase in associated waste volumes between the baseline and the Modernized Operations Alternative (i.e., 73.4 MT/yr [average] versus 1,048 MT/yr; refer to Appendix A, Table A-3, for additional information). The site's planned extensive replacement and upgrading of various existing facilities, as well as the numerous DD&D-related endeavors associated with this alternative, account for the projected increases in waste volumes and shipments.

Impacts of Incident-Free Transportation

The annual collective dose to transportation crews from all offsite transportation activities under the Modernized Operations Alternative would range from about 0.027 person-rem for TRU waste transport to 0.53 person-rem for SNM transport and would total about 0.93 person-rem annually from all potentially shipped materials under all possible material categories. The

associated annual doses to the general populations along these routes would range from 0.0087 to 0.92 person-rem, respectively, and would total about 1.08 person-rem annually from all potentially shipped materials in all possible material categories. Accordingly, incident-free transportation of all material sources would result in an annualized total of 0.00056 additional LCF among all transportation workers (0.0038 LCF from shipments over the entire 15-year period) and 0.00066 annualized additional LCF in all affected public populations (0.0097 LCF from shipments over the entire 15-year period). Table 5-23 summarizes the associated potential risks to both the public and transportation crews.

Impacts of Accidents During Transportation

Under the Modernized Operations Alternative, the total estimated annualized transportation accident risk (calculated via the summation of individual annual accident probabilities of occurrence times their associated unmitigated consequences) for all projected accidents involving radioactive shipments, regardless of type, was determined to be 0.00000055 LCF to the general population, as compared to the maximum assessed cumulative non-radiological accident risk (traffic accident fatalities) of 0.0011 fatality per year from shipments of all material categories to and from SNL/NM.

Impacts of Construction, Operations, and Hazardous Material Transportation

The proposed modernization/consolidation of the NGE+ facility would be one of the largest capital projects proposed under the Modernized Operations Alternative. There would, however, be no expected additional discernible transportation impacts (onsite or offsite) associated with this activity. A replacement consolidated facility (refer to Appendix A, Section A.3.3.7) would be designed to improve workflows and efficiencies to a considerable degree, and in doing so would accordingly *reduce* the extent/frequency of intra-site material movements.

Under the Modernized Operations Alternative, annual transportation impacts associated with the shipment of non-radiological hazardous materials would total 0.0034 (i.e., essentially 0) traffic fatalities. This total considers about 430 shipments per year, which is about 400 shipments per year more than the average number of annual shipments during the baseline period (2017 – 2022).

5.10.3 Expanded Operations Alternative

5.10.3.1 Traffic and Onsite Transportation

Local Traffic, Onsite Traffic, and Onsite Parking

Under the Expanded Operations Alternative, 500 additional construction contractors are expected to join the workforce above the No-Action Alternative (a 38% increase). Because the ramp-up of construction projects under the Expanded Operations Alternative is expected to fully utilize existing contractor personnel to the greatest extent possible, only a moderate net increase in construction personnel demand (i.e., 38%) over the 15-year period is anticipated. If this were assumed to happen gradually over the 15-year period, which would depend on the availability of annual funding, the annual increase would be about 2.5% year-over-year. In some years, annual

increases could be higher. An annual increase of 2.5% in construction workers at SNL/NM would not impact the LOS on area roads.

Once steady-state operating conditions are reached in 2040, an additional 4,872 workers (SNL/NM personnel) are expected to be added to the site workforce beyond the No-Action Alternative projected level of 13,078 (about a 37% increase). The timing of the increases in construction and operations personnel would be staggered such that when construction was completed for particular facilities (and the number of construction personnel decreased), the numbers of operations personnel would increase. An increase of 4,872 operational workers would be expected to proportionally increase the annual ADT for weekday trips at and nearby any of KAFB's presently utilized five gate locations. As a representative example, a correlated daily traffic increase along the length of Eubank Boulevard could be as much as 44% over the present-day baseline ADT value in the area if all additional workers were to enter and exit the site through the Eubank Gate, which could hypothetically be enough to exacerbate traffic and ultimately change the LOS designation on/along Eubank Boulevard.^{8,9}

The projected increases in the workforce would also increase onsite traffic and parking needs. To accommodate increases, the Expanded Operations Alternative includes proposals to construct four covered-parking structures in TA-I, newly dedicated parking garages within both TA-II and TA-IV, and potential road/lane widenings in certain areas across the site. The schedule for implementation of these projects would depend on available funding and priorities dictated by the construction schedule of other facilities proposed under the Modernized and Expanded Operations Alternatives.

5.10.3.2 Transportation of Radiological and Hazardous Materials and Waste to/from SNL/NM

Under the Expanded Operations Alternative, there would be no differences with the shipping of SNM to various NNSA sites from those addressed in Section 5.10.2.2 under the Modernized Operations Alternative (refer to Table 5-22 and Table 5-23 for additional information).

In addition to the shipment of such materials, 48 total LLW/MLLW (routine and non-routine) offsite shipments (all assumed to go to NNSS) and 5.33 TRU waste shipments to WIPP would be expected on average annually. These values represent increases of 16 shipments and 4.33 shipments, respectively, over the estimated numbers of annual shipments for these wastes as compared to those under the No-Action Alternative. The increases would be primarily driven by projected quantities of radioactive waste generated from new mission activities, including the DD&D activities presumed to take place over the entire Expanded Operations Alternative period. The associated total projected (one-way) distances traveled annually on public roads transporting

⁸ 4,872 workers × 2 trips/day divided by 22,279 (which is the existing daily traffic).

⁹ Many factors can affect how a given traffic change would affect the LOS on a given road, including road design, number of lanes, number of intersections, speed limit, and signalization. Consequently, the ability to make definitive conclusions about an LOS change on a given road is limited.

these wastes to NNSS and WIPP under this alternative would be about 32,400 miles and 1,600 miles, respectively.

For annual hazardous waste offsite shipments, the analysis conservatively estimates that the baseline annual shipment numbers (about 31 per year, on average) would increase to approximately 800 shipments per year, which is directly proportional to the expected 26 times increase in associated waste volumes between the baseline and the volume anticipated under the Expanded Operations Alternative (i.e., 76 MT/yr versus 1,991 MT/yr; refer to Appendix A, Table A-3, for additional information). SNL/NM's planned implementation of new facility/building projects and extensive replacement and upgrading of various existing facilities, as well as the numerous DD&D-related activities associated with this alternative, drive the projected increases in waste volumes and shipments.

Impacts of Incident-Free Transportation

The annual collective dose to transportation crews from all offsite transportation activities under the Expanded Operations Alternative would range from about 0.11 person-rem for TRU waste transport to 0.57 person-rem for LLW/MLLW waste transport and would total about 1.21 person-rem annually from all potentially shipped materials in all possible material categories. The annual doses to the general population along these routes would range from 0.034 person-rem for TRU waste transport to 0.92 person-rem for SNM transport and would total about 1.18 person-rem annually from all potentially shipped materials in all possible material categories. Accordingly, incident-free transportation of all material sources would result in an annualized total of 0.00073 additional LCF among all transportation workers (0.011 LCF from shipments over the entire 15-year period) and 0.00071 annualized additional LCFs in all affected public populations (0.011 LCFs from shipments over the entire 15-year period). While these impacts are higher than those of the No-Action and Modernized Operations alternatives, they are still essentially statistically zero. Table 5-23 summarizes the associated potential risks to both the public and transportation crews.

Impacts of Accidents During Transportation

Under the Expanded Operations Alternative, the total estimated annualized transportation accident risk (calculated by the summation of individual annual accident probabilities of occurrence times their associated unmitigated consequences) for all projected accidents involving radioactive shipments, regardless of type, was determined to be 0.00000082 LCF to the general population, as compared to the maximum assessed cumulative non-radiological accident risk (traffic accident fatalities) of 0.0015 fatality per year from shipments of all material categories to and from SNL/NM. While these accident risks are higher than those of the No-Action and Modernized Operations alternatives, they are still essentially statistically zero and driven primarily by traffic accident fatalities as opposed to radiological impacts.

Impacts of Construction, Operations, and Hazardous Material Transportation

Under the Expanded Operations Alternative, annual transportation impacts associated with the shipment of non-radiological hazardous materials would total 0.0063 traffic fatalities (i.e., essentially none). This total considers about 800 shipments per year, which is about 770

shipments per year more than the average annual number of shipments during the baseline period (2017–2022).

5.10.4 Summary of Traffic and Transportation Impacts for All Alternatives

At SNL/NM, radioactive materials (e.g., SNM) and waste (e.g., LLW/MLLW and TRU) are transported both onsite (between SNL/NM-managed lands) and offsite to multiple locations. Onsite transportation constitutes the majority of activities that are part of routine operations in support of various programs. Radioactive materials and waste transported onsite between SNL/NM-managed lands (as well as within the TAs themselves) are primarily limited quantities moved over short distances and mostly on controlled roadways, driveways, and pathways. The impacts of these activities are part of the impacts of normal operations at these areas and are reflected in the historical and average worker doses presented in Sections 4.13 and 5.13 of this SWEIS, respectively.

For evaluation purposes, assessed offsite transportation locations were limited to those that would be involved in the expected majority of shipments of radiological materials and wastes to and from SNL/NM. Table 5-22 provides the overall estimated numbers of material and waste shipments, as well as total projected shipping miles, under the three alternatives during the 15-year analysis period.

Table 5-22. Estimated Numbers of Total Cumulative Shipments and Miles Driven for Radiological Materials and Wastes over Each Alternative’s Proposed Full 15-Year Duration (2025 – 2040) (Inbound + Outbound)

Alternative	No-Action Total Shipments / (total miles driven)	Modernized Operations Total Shipments / (total miles driven)	Expanded Operations Total Shipments / (total miles driven)
Radioactive LLW & MLLW (to NNSS)	480 / (324,000)	480 / (324,000)	720 / (486,000)
Radioactive TRU (to WIPP)	15 / (4,500)	20 / (6,000)	80 / (24,000)
Radioactive SNM (to/from LANL/LLNL)	173 / (60,000)	173 / (60,000)	173 / (60,000)
Radioactive SNM (Pu-ICE) to INL and/or WIPP	-	120 / (67,800)	120 / (67,800)
“Other” SNM/Nuclear Materials ^a (to other listed locations)	-	6 / (8,220)	6 / (8,220)
ACRR SNM (to/from INL and/or PNNL)	-	80 / (82,800)	80 / (82,800)
Non-Radioactive Hazardous (to offsite TSD location)	3,750 / (1,725,000)	6,450 / (2,967,000)	12,000 / (5,520,000)

a. Other SNM/nuclear materials are not included in the area-specific generation and destination shipments provided in this table.

Assumptions and background information related to the values in this table are provided in Appendix E, Tables E-2 and E-3.

Table 5-23 estimates the total impacts from transporting radioactive materials and wastes over each alternative’s proposed 15-year duration. Data shown here suggests that the highest potential total dose to the public under any of the alternatives would be about 17.7 person-rem from all incident-free shipments over the 15-year Expanded Operations Alternative. The expected additional risk among the associated exposed populations would be about 0.011 LCF (or statistically one fatality every 91 years). The highest potential total dose to transportation crews (truck drivers) would be 18.1 person-rem from all incident-free shipments over the 15-year Expanded Operations Alternative period, with an associated 0.011 excess LCF among the

exposed crews. However, because the potential for a trained radiation worker truck-crew member developing a fatal latent cancer from a maximum allowable annual exposure is 0.0012, an individual worker thus would not be expected to develop a lifetime latent fatal cancer even from a continual 15-year maximum allowable annual exposure associated with these activities (0.018 LCF total).

Table 5-23 summarizes total annual risk of traffic accident fatalities for each of the alternatives. Under all alternatives, annualized risk of a traffic accident fatality is greater than annualized risk of an additional LCF due to potential radiological exposure from an accident. For example, the annualized LCF risk among exposed populations from an accident occurring during all material shipments over the Expanded Operations Alternative period would be 0.00000082, while the estimated annualized number of traffic accident fatalities associated with these shipments over the period would be 0.0015 (a factor of about 1,800 higher). Additional information regarding each transport segment analyzed is provided in Appendix A, Section A.5.10.

Table 5-23. Estimated Impacts of Transporting Radioactive Materials and Wastes over Each Alternative’s Proposed 15-Year Duration

Alternative/ Transport Segments	Incident-Free ^a Crew Total Dose (person-rem)	Incident-Free ^a Crew Total Risk (LCFs)	Incident-Free ^a Population Total Dose (person-rem)	Incident-Free ^a Population Total Risk (LCFs)	Accident ^a Annualized Radiological Risk (LCFs/yr)	Accident ^a Non-Radiological Risk (# of traffic-accident fatalities/yr)
No-Action 15-year Total Impact	6.18	3.7×10^{-3}	2.50	1.5×10^{-3}	5.4×10^{-7}	7.5×10^{-4}
Modernized Operations 15-year Total Impact	14.0	8.4×10^{-3}	16.2	9.7×10^{-3}	5.54×10^{-7}	1.1×10^{-3}
Expanded Operations 15-year Total Impact	18.1	0.011	17.7	0.011	8.2×10^{-7}	1.5×10^{-3}

a. Cumulative risks from shipments over the entire action period (15 years for all alternatives) are shown for incident-free transportation; annualized risks over the action periods are presented for accidents.

NOTES: Scientific notation is used to simplify the presentation; as a clarifying example, 6.2×10^{-3} is the same as 0.0062, or one chance of an LCF in 161 years. Presented impact values throughout the table may be subject to slight deviations from calculated values due to rounding.

5.11 INFRASTRUCTURE

This section presents potential impacts to general-purpose and utility infrastructure, as defined in Section 4.12, for the three alternatives evaluated in this SWEIS. Projects defined as “infrastructure” in Tables 3-1, 3-3, and 3-5 are included in the analysis.¹⁰ Key metrics include (1) quantities of water, sanitary wastewater, electricity, and fuel (petroleum, natural gas) associated with the alternatives; and (2) the ability of the current infrastructure to meet demands.

¹⁰ For the purposes of this analysis, infrastructure does not include individual facilities or the transportation network. Roadways and parking facilities are analyzed in Section 5.10.

5.11.1 No-Action Alternative

Construction, DD&D, and operational activities under the No-Action Alternative will result in additional demands on the region's infrastructure. Table 5-24 summarizes existing infrastructure capacities, current demands, and projected demands under the No-Action Alternative compared to baseline. Table 3-1 contains details for the seven infrastructure projects proposed under the No-Action Alternative.

Electricity Usage. NNSA sources electrical energy for SNL/NM via an interagency agreement with KAFB established with WAPA (refer to Section 4.12.1). In 2024, site-wide electrical consumption at SNL/NM was approximately 286,000 MWh; this figure serves as the baseline demand for analysis. Under the No-Action Alternative, no notable changes in electricity consumption will stem from construction and DD&D activities. On an annualized basis, new facility construction under this alternative represents less than 1 percent of SNL/NM total built environment, which is consistent with historical activity and factored into existing site-wide capacity. During facility operations, electricity consumption at SNL/NM is expected to peak at about 340,000 MWh of electricity in 2037. Peak electrical demand would be 87 MW. Projected electrical demands reflect continued operations of existing facilities plus those in Table 3-1. Electrical capacity is estimated at 732,000 MWh, which is sufficient to handle demands from the No-Action Alternative (KAFB 2016).

Fuel Usage. Petroleum fuel consumption during construction and DD&D will not deviate from established site-wide consumption levels as these activities are factored into existing estimates. Currently, petroleum usage is about 310,000 gallons per year. During operations NNSA assumes that fuel usage will minimally increase under the No-Action Alternative.

Natural Gas Usage. Natural gas consumption associated with construction and DD&D activities is anticipated to be minimal due to the limited or nonexistent utilization of this fuel source in such operations. Natural gas usage for SNL/NM averaged 282 million cubic feet per year during 2017–2021. By 2030, natural gas usage at SNL/NM would increase to about 325 million cubic feet per year under the No-Action Alternative. This 15-percent increase is primarily due to demands from new facilities coming online.

Table 5-24. Infrastructure Requirements (No-Action Alternative versus Existing Baseline)

Resource/Metric	Existing Capacity	Existing Environment Baseline Demand ^a	Change to Baseline from No-Action Alternative Construction/DD&D	Change to Baseline from No-Action Alternative Operation	No-Action Alternative Demand ^{b, c}	Percentage Change
Annual electrical consumption (MWh/yr)	732,000	286,000	No notable change	+54,000	340,000	+19%
Electrical – peak demand (MW)	104	52	No notable change	+35	87	+67%

Resource/Metric	Existing Capacity	Existing Environment Baseline Demand ^a	Change to Baseline from No-Action Alternative Construction/DD&D	Change to Baseline from No-Action Alternative Operation	No-Action Alternative Demand ^{b, c}	Percentage Change
Fuel (oil, gasoline, diesel) usage (gal/yr)	N/A ^d	310,000	Construction and DD&D is included in SNL/NM-managed lands fuel use during operations	+31,000	341,000	+10%
Natural gas (million ft ³ /yr)	2,235	282	No notable change	+43	325	+15%
Potable water (million gal/yr)	2,900	325	+5	+7	342	+5.2%
Sanitary wastewater (million gal/yr)	850 ^e	250	0	0	250	0%

a. Average value from 2017–2021 (KAFB 2016).

b. No-Action Alternative construction assumed to be completed by 2030, with increase to be partially offset by purchase of solar power and energy storage in Foxtail Flats.

c. DD&D projects included in the No-Action Alternative are scheduled through 2040.

d. Fuel (oil, gasoline, and diesel) is not limited by site capacity.

e. Permissible KAFB sewer discharge rate fixed at 850 million gallons per year (gal/yr), including SNL/NM sewer water (KAFB 2016).

Water Usage. SNL/NM uses about 325 million gallons of water per year (annual average 2017–2021). Construction and DD&D under the No-Action Alternative will require an additional 0.6 million gallons per year above baseline consumption, which will be allocated to fugitive dust mitigation measures. Building square footage increases at SNL/NM would require an additional 12 million gallons of water per year during operations. Under the No-Action Alternative, by 2030, average annual water demand would be 342 million gallons, 5.2 percent greater than baseline demand. SNL/NM’s water distribution system is interconnected with, and supplied by, KAFB’s water supply system. KAFB owns, operates, and maintains the deep well supply, transmission, and storage systems for the entire base. Current pumping capacity for KAFB wells is 8.0 million gallons per day, or about 2.9 billion gallons per year. KAFB’s water supply system capacity is adequate to meet SNL/NM water demand under the No-Action Alternative.

Sanitary Wastewater. From 2017–2021, SNL/NM generated an average of 250 million gallons of sanitary wastewater annually. The construction and DD&D workforce will use temporary facilities and will not add to wastewater discharges. During steady-state operations, SNL/NM’s workforce will not change; thus, wastewater discharges will not increase. The permissible KAFB sewer discharge rate is fixed at 850 million gallons per year, including SNL/NM sewer water. Under the No-Action Alternative, wastewater discharge will remain at about 250 million gallons per year and will not make additional demands on the sanitary wastewater system.

5.11.2 Modernized Operations Alternative

Construction, DD&D, and operational activities under the Modernized Operations Alternative would result in additional demands on the infrastructure in the region. Table 5-25 summarizes the existing infrastructure capacities and compares the Modernized Operations Alternative projected demands with the No-Action Alternative demands. Table 3-3 details 20 infrastructure projects proposed under the Modernized Operations Alternative.

Electricity Usage. Under the Modernized Operations Alternative, no notable changes in electricity consumption would stem from construction and DD&D activities. On an annualized basis, new facility construction under this alternative represents about 1 percent of SNL/NM total built environment. This is consistent with historical activity and is factored into existing site-wide capacity. During facility operations, SNL/NM electricity consumption is expected to peak at about 388,000 MWh of electricity in 2039. Peak electrical demand would be 93 MW. Overall electrical demands reflect continued operations of existing facilities plus those in Table 3-3. Thirty-eight new facility projects, totaling about 1.6 million square feet, would be a primary reason for increased electrical demand. If all Modernized Operations Alternative projects are implemented, SNL/NM's steady-state operations of electricity in the peak year (2039) would utilize 53 percent of the existing system's capacity.

Fuel Usage. Petroleum fuel consumption during construction and DD&D would not deviate from established site-wide consumption levels as these activities are already factored into existing estimates. During operations, relative to the No-Action Alternative, NNSA assumes that fuel usage would minimally increase under the Modernized Operations Alternative.

Natural Gas Usage. Natural gas consumption associated with construction and DD&D activities is anticipated to be minimal due to limited or nonexistent use of this fuel source in such operations. The projected baseline natural gas usage for SNL/NM during steady-state operations under the No-Action Alternative is 325 million cubic feet annually. By 2040, natural gas usage at SNL/NM would increase to about 393 million cubic feet per year under the Modernized Operations Alternative. This 21-percent increase over the No-Action Alternative baseline is due to new facilities coming online and increased operational demands under the Modernized Operations Alternative. This increase is in line with increases in electrical consumption and can be accommodated by existing systems.

Water Usage. Construction and DD&D under the Modernized Operations Alternative would require an 1.1 million gallons per year above No-Action Alternative estimates, which would be allocated to fugitive dust mitigation measures. Increased operations associated with new facilities at SNL/NM would require an additional 14 million gallons of water per year. By 2040, average annual water demand would be 359 million gallons, 5 percent greater than the No-Action Alternative demand. Current pumping capacity for KAFB wells (about 2.9 billion gallons per year) would meet SNL/NM water demand under the Modernized Operations Alternative.

Sanitary Wastewater. Under the Modernized Operations Alternative, SNL/NM's workforce would increase. Wastewater discharges would increase from 250 million gallons per year under the No-Action Alternative to about 262 million gallons per year. Because the permissible KAFB sewer discharge rate is fixed at 850 million gallons per year (including sewer water from

SNL/NM), the sanitary wastewater system has sufficient capacity to handle wastewater discharges under the Modernized Operations Alternative.

Table 5-25. Infrastructure Requirements (Modernized Operations Alternative and No-Action Alternative)

Resource/Metric	Existing Capacity	No-Action Alternative Demand ^a	Change to No-Action Alternative from Modernized Operations Alternative Construction/ DD&D	Change to No-Action Alternative from Modernized Operations Alternative Operation	Modernized Operations Alternative Demand ^b	Percentage Change
Annual electrical consumption (MWh/yr)	732,000	340,000	No notable change	+48,000	388,000	+14%
Electricity – average annual peak demand (MW)	104	87	No notable change	+6	93	+7%
Fuel (oil, gasoline, diesel) usage (gal/yr)	N/A ^c	341,000	Construction and DD&D is included in SNL/NM-managed lands fuel use during operations	+34,100	375,100	+10%
Natural gas (million ft ³ /yr)	2,235	325	No notable change	+68	393	+21%
Potable water (million gal/yr)	2,900	342	+3	+14	359	+5%
Sanitary wastewater (million gal/yr)	850 ^d	250	+1.3	+11	262	+4.8%

a. No-Action Alternative reaches steady-state in 2030.

b. Modernized Operations Alternative reaches steady-state in 2040.

c. Fuel (oil, gasoline, and diesel) is not limited by site capacity.

d. The permissible KAFB sewer discharge rate is fixed at 850 million gal/yr, including SNL/NM sewer water.

5.11.3 Expanded Operations Alternative

Construction, DD&D, and operational activities under the Expanded Operations Alternative would result in additional infrastructure demands. Table 5-26 summarizes existing infrastructure capacities and compares Expanded Operations Alternative projected demands with No-Action Alternative demands. The Expanded Operations Alternative includes 30 projects, totaling about 1,513 acres (in addition to Modernized Operations Alternative projects).

Table 3-5 shows infrastructure projects proposed under the Expanded Operations Alternative. Expanded energy projects would have the greatest potential to affect infrastructure and would enable SNL/NM to increase energy production and independence. Energy technologies in R&D at SNL/NM for future implementation (next-generation nuclear, geothermal, and geo-exchange

systems) would require more study and reporting if deemed viable. They could be a key addition to the KAFB and SNL/NM energy portfolio and reduce demands on imported power.

Electricity Usage. Electricity consumption for construction and DD&D activities would not change. On an annualized basis, new facility construction under this alternative represents about 2 percent of SNL/NM total built environment, which is consistent with historical activity and is factored into existing site-wide capacity. During operations, electricity demand at SNL/NM would be expected to increase as new facilities come online and the site’s facility footprint increases. Under the Expanded Operations Alternative, steady-state electricity usage would increase from a peak of about 340,000 MWh annually (under the No-Action Alternative) to about 440,000 MWh, a 29 percent increase. The average annual peak demand would increase from 87 MW (under the No-Action Alternative) to about 102 MW, a 17 percent increase.

If all Expanded Operations Alternative projects are implemented, SNL/NM’s steady-state operations would require approximately 440,000 MWh of electricity in the peak year (2039), which is 60 percent of the existing system’s supply capacity.¹¹ Offsetting these increases, electrical power generation at SNL/NM could be augmented with about 215 MW of proposed PV projects. Total proposed site-generated power would help offset anticipated demand under this alternative and help SNL/NM decrease its dependence on grid-purchased electricity.

Table 5-26. Infrastructure Requirements (Expanded Operations Alternative and No-Action Alternative)

Resource/Metric	Existing Capacity	No-Action Alternative Demand ^a	Change to No-Action Alternative from Expanded Operations Alternative Construction/DD&D	Change to No-Action Alternative from Expanded Operations Alternative Operation	Expanded Operations Alternative Demand ^b	Percentage Change
Annual electrical consumption (MWh/yr)	732,000	340,000	No notable change	+100,000	440,000 ^c	+29%
Electricity – average annual peak demand (MW)	104	87	No notable change	+15	102	+17%
Fuel (oil, gasoline, diesel) usage (gal/yr)	N/A ^d	341,000	Construction and DD&D is included in SNL/NM-managed lands fuel use during operations	+71,610	412,610	+21%

¹¹ Overall site capacity to meet peak load is currently estimated at 104 MW, based on combined capacity of five 115-kV substations and total capacity of TA-III and TA-V substation transformers. Site capacity is expected to increase as new “site-generated” and substation project(s) are brought online but may become a limiting factor in the future. SNL/NM is currently studying site-wide electrical infrastructure to identify system limitations and recommend necessary upgrades to support future growth and ensure reliable power delivery.

Resource/Metric	Existing Capacity	No-Action Alternative Demand ^a	Change to No-Action Alternative from Expanded Operations Alternative Construction/DD&D	Change to No-Action Alternative from Expanded Operations Alternative Operation	Expanded Operations Alternative Demand ^b	Percentage Change
Natural gas (million ft ³ /yr)	2,235	325	No notable change	+145	470	+45%
Potable water (million gal/yr)	2,900	342	+6	+63	411	+20%
Sanitary wastewater (million gal/yr)	850 ^c	250	+3.2	+28	281	+12.4%

a. No-Action Alternative reaches steady-state in 2030.

b. Expanded Operations Alternative reaches steady-state in 2040.

c. Onsite alternative energy projects (i.e., PV arrays, CSP tower, and microreactor) proposed under the Expanded Operations Alternative would add capacity to offset demand increases.

d. Fuel (oil, gasoline, and diesel) is not limited by site capacity.

e. The permissible KAFB sewer discharge rate is fixed at 850 million gal/yr, including SNL/NM sewer water.

NNSA proposes wildfire risk reduction to protect electrical and telecommunications lines from wildfire and severe weather events (refer to Section 3.4.3), which would not affect electrical consumption but would benefit electrical and telecommunications availability and reliability.

Fuel Usage. Petroleum fuel consumption during construction and DD&D would not deviate from established site-wide consumption levels as these activities are already factored into existing estimates. During operations, relative to the Modernized Operations Alternative, NNSA assumes that fuel usage would minimally increase under the Expanded Operations Alternative.

Natural Gas Usage. Consumption of this fuel source associated with construction and DD&D is anticipated to be minimal due to limited or nonexistent use in such operations. The projected baseline natural gas usage for SNL/NM during steady-state operations under the No-Action Alternative is 325 million cubic feet annually. By 2040, natural gas usage at SNL/NM would increase to about 470 million cubic feet per year under the Expanded Operations Alternative. This 45 percent increase over the No-Action Alternative baseline is due to new facilities coming online and increased operational demands and is in line with increased electrical consumption and can be accommodated by existing systems.

Water Usage. Construction and DD&D under the Expanded Operations Alternative would require an additional 1.1 million gallons per year above No-Action Alternative estimates, which would be allocated to fugitive dust mitigation measures. Increased operations associated with new facilities at SNL/NM would require an additional 63 million gallons of water per year. Under the Expanded Operations Alternative, average annual water demand would be 411 million gallons, 20 percent greater than the No-Action Alternative demand. Current pumping capacity for KAFB wells (about 2.9 billion gallons per year) would meet SNL/NM water demand under the Expanded Operations Alternative. Impacts to increased water use are discussed in 5.19.1.

Sanitary Wastewater. Under the Expanded Operations Alternative, the SNL/NM workforce would increase. Wastewater discharges would increase from 250 million gallons per year under the No-Action Alternative to about 281 million gallons per year. Because the permissible KAFB sewer discharge rate is fixed at 850 million gallons per year (including sewer water from SNL/NM), the sanitary wastewater system has sufficient available capacity to handle wastewater discharges under the Expanded Operations Alternative.

5.11.4 Summary of Infrastructure Impacts for All Alternatives

Table 5-27 summarizes potential impacts to infrastructure under the No-Action Alternative, Modernized Operations Alternative, and Expanded Operations Alternative.

Table 5-27. Potential Infrastructure Demands for the Alternatives

Resource/Metric	Existing Capacity	No-Action Alternative Demand ^a	Modernized Operations Alternative Demand ^b	Expanded Operations Alternative Demand ^b
Electricity – average consumption (MWh/yr)	732,000	340,000	388,000	440,000 ^c
Electricity –peak demand (MW)	109	87	93	102
Fuel (oil, gasoline, diesel) usage (gal/yr)	N/A ^c	341,000	375,100	412,610
Natural gas (million ft ³ /yr)	2,235	325	393	470
Potable water (million gal/yr)	2,900	342	359	411
Sanitary wastewater (million gal/yr)	850 ^d	250	262	281

a. No-Action Alternative reaches steady-state in 2030.

b. Modernized Operations Alternative and Expanded Operations Alternative reach steady-state in 2040.

c. Expanded energy projects proposed under the Expanded Operations Alternative would add capacity to offset demand increases.

d. The permissible KAFB sewer discharge rate is fixed at 850 million gal/yr, including SNL/NM sewer water.

e. Fuel (oil, gasoline, and diesel) is not limited by site capacity.

5.12 MATERIALS MANAGEMENT AND WASTE MANAGEMENT

This section presents potential impacts related to materials management and waste management from each of the three alternatives evaluated in this SWEIS. The materials management analysis focuses on the impacts of managing radioactive and hazardous materials used at SNL/NM for new projects. Key metrics for the radioactive/hazardous materials use analysis include (1) identification of potential increased inventory from new projects, and (2) determination of whether the capacity and capability of the existing SNL/NM materials management system can safely accommodate any expected increases in radioactive/hazardous material quantities.

Waste management analysis focuses on potential impacts of managing radioactive and hazardous waste generated at SNL/NM from projects. Key metrics include (1) existing SNL/NM waste management system capacity to appropriately manage expected increases in waste quantities,

and (2) offsite facility capacity to receive more SNL/NM waste for subsequent treatment and/or disposal. As shown in Appendix A, Table A-13 and this section, NNSA does not expect waste or hazardous wastes associated with these activities to be unique or substantially different from waste types already managed at SNL/NM, although quantities could increase.

Potential waste management impacts are assessed in terms of projected waste amounts for shipment under each alternative. Projections for shipped waste are based on average shipped waste from 2017–2022 (refer to Section 4.12) and projected operational level under each alternative. Shipped waste projections include waste generated from operations and necessary packaging and containers required for transport to the disposal facility. As such, shipped waste projections are conservative, as containers and packaging for shipping increase weight and volume. Note, projected TRU amounts are based on average waste generation from 2017–2022, as the only shipment made during this timeframe was for legacy TRU in 2020.

5.12.1 No-Action Alternative

5.12.1.1 Materials Management

As described in Section 4.12 SNL/NM's materials management operations follow DOE orders and various applicable federal, state, and local laws and regulations. Regulatory oversight lies with various federal, state, and local agencies. SNL/NM uses radioactive materials, chemicals, and explosive materials in a wide variety of operations including scientific and weapons R&D, diagnostic research, and research on the properties of materials.

Many No-Action Alternative projects are replacements, additions, and support for existing, aging facilities, while others are office building and storage facilities. Based on Proposed Action and alternative development (refer to Chapter 3), these projects will not change existing SNL/NM operations. Use and presence of radioactive/hazardous materials at SNL/NM will be similar to current use. New radioactive/hazardous materials will not be allowed without appropriate equipment, facilities, procedures, and training necessary to safely manage the materials.

SNL/NM operates according to DOE orders and applicable federal and state regulations, so NNSA does not expect adverse radioactive/hazardous material management impacts. Section 5.13 describes potential operations impacts on human health. Section 5.10 presents potential impacts from transportation accidents involving radioactive/hazardous material.

5.12.1.2 Radioactive Waste

Waste projections in this section include wastes from existing SNL/NM operations and those associated with No-Action Alternative projects. The following sections address waste categories in the same order as in Section 4.12.2.

This discussion categorizes radioactive waste as LLW, MLLW, and TRU waste (including MTRU waste). Under the No-Action Alternative, most projects will be replacements and will not substantially increase routine wastes. DD&D of buildings under the No-Action Alternative is not expected to generate any non-routine radiological waste.

LLW. Table 5-28 summarizes estimates of LLW shipped annually under the No-Action Alternative. For comparison, the table also shows average LLW shipped from SNL/NM over the past 6 years. As discussed in Section 4.12.3.1, SNL/NM tracks its routine LLW generation from facility operations (i.e., research, production, and maintenance) and non-routine LLW generation from DD&D activities of excess facilities and ER cleanup operations under the Consent Order; DD&D is the largest source of non-routine LLW. Estimates in Table 5-28 are annual averages; temporary excursions or increases could occur in any given year, but these higher projections have been accounted for in the total waste projected for the 15-year analytical period covered by this SWEIS. For non-routine LLW and MLLW waste, 10 buildings and support facilities, with a footprint of 117,172 square feet, will undergo DD&D over 5 years. None of the facilities house radiological operations or have known radiological contamination, so radiological wastes are anticipated to be the same as the 6-year baseline average from this DD&D.

Table 5-28. SNL/NM LLW Shipped Under No-Action Alternative

LLW Category	Baseline/Existing Environment 6-year Average, 2017–2022 (m ³ /yr)	No-Action Alternative Projection (m ³ /yr)	Percent Increase ^c over Baseline/Existing Environment, 6-year Average
Routine LLW	55.5	87.6 ^a	57.8%
Non-routine DD&D LLW	6.3	6.3	0%
TOTALS	61.8 ^b	93.9	52.1%

m³/yr: cubic meters per year

a. From Table A-25 (highest shipped value from 2018–2021).

b. From Table A-25 (average shipped value from 2018–2021).

c. Percent increase equals No-Action Alternative Projection minus Baseline Average / Baseline Average x 100%.

Table 5-28 shows total LLW shipped will increase by 52.1 percent compared to the 6-year average (2017–2022) presented for the baseline/existing environment. Most No-Action Alternative projects will be replacements, additions, and support facilities, and will not increase routine wastes. To be conservative, this SWEIS uses the highest value for shipped LLW from the past 6 years for the No-Action Alternative routine waste projection.

NNSA expects that final disposition of LLW generated under the No-Action Alternative will be the same as described for current operations. As discussed in Section 4.12.2.2, SNL/NM sends most solid LLW offsite to NNSS, with lesser amounts sent to DOEAP-accredited commercial licensed TSDF. About 96.2 percent of SNL/NM's LLW is sent to NNSS, and the remaining 3.8 percent is sent to Perma-Fix, a DOEAP-accredited commercial TSDF, in Gainesville, Florida. From 2015–2022, SNL/NM disposed an average of 766,800 cubic feet (NNSS 2016; NNSS 2017; NNSS 2018; NNSS 2019; NNSS 2020; NNSS 2021; NNSS 2022; and NNSS 2023), or 21,700 cubic meters, of LLW per year in NNSS land-based disposal cells. Currently, SNL/NM LLW accounts for about 0.27 percent of the LLW disposed of at NNSS annually. Under the No-Action Alternative, about 94 cubic meters of LLW (96.2 percent of 93.9 cubic meters) generated at SNL/NM will be sent to NNSS or a DOEAP-accredited commercial facility. 94 cubic meters accounts for about 0.4 percent of the LLW disposed of at NNSS annually.

Perma-Fix in Gainesville, Florida, is a commercial, RCRA-licensed and DOEAP-accredited commercial facility. During 2021, Perma-Fix received about 2,029.3 tons (5,172 cubic meters) of hazardous waste (EPA 2022). The SNL/NM LLW estimated under the No-Action Alternative would be 3.6 cubic meters per year, which accounts for about 0.1 percent of the waste managed by Perma-Fix.

MLLW. SNL/NM tracks its routine MLLW generation from facility operations. Table 5-29 shows total MLLW shipped projections for the No-Action Alternative. MLLW estimates are presented as annual averages with acknowledgment that temporary excursions or increases could occur in any given year; higher projections are accounted for in total waste projected for the 15-year analytical period covered by this SWEIS.

Table 5-29. SNL/NM MLLW Shipped under No-Action Alternative

MLLW Category	Baseline/Existing Environment 6-year Average, 2017–2022 (m³/yr)	No-Action Alternative Projection (m³/yr)	Percent Change ^c over Baseline/Existing Environment 6-year Average
Routine MLLW	53.1	93.7 ^a	76.5%
Non-routine MLLW	0.1	0.1	0%
TOTALS	53.2 ^b	93.8	76.3%

a. From Table A-25 (highest shipped value from 2018–2021).

b. From Table A-25 (average shipped value from 2018–2021).

c. Percent increase equals No-Action Alternative Projection minus Baseline Average / Baseline Average x 100%.

Table 5-29 shows that routine MLLW quantities would increase by 76 percent compared to the 6-year average (2017–2022) presented for the baseline/existing environment. To be conservative, this SWEIS uses the highest value for shipped wastes from the past 6 years for the No-Action Alternative routine waste projection. However, most No-Action projects will be replacements and will not increase routine wastes.

SNL/NM ships about 93 percent of its MLLW to NNSS. The remaining 7 percent is sent to several other DOE/CAP-accredited commercial facilities for treatment and/or disposal. Use of DOE/CAP-accredited commercial facilities is limited to those able to show adequate capacity and compliance with applicable permitting and regulatory requirements, (i.e., audited and accredited by DOE/CAP). As Section 4.12.3.5 notes, commercial facilities most recently used by SNL/NM for MLLW include Perma-Fix in Gainesville, Florida, and Diversified Scientific Services, Inc. (DSSI), in Kingston, Tennessee. These facilities have permits with their respective states, are accredited by DOE/CAP, and receive MLLW for treatment and/or disposal.

NNSA expects that final disposition of MLLW generated under the No-Action Alternative will be the same as described for current operations. From 2015–2022, SNL/NM disposed an average of 91,054 cubic feet (NNSS 2016; NNSS 2017; NNSS 2018; NNSS 2019; NNSS 2020; NNSS 2021; NNSS 2022; and NNSS 2023), or 2,578 cubic meters, of MLLW per year in NNSS land-based disposal cells. Currently, SNL/NM MLLW accounts for about 1.9 percent of MLLW disposed of at NNSS annually. Under the No-Action Alternative, about 87.3 cubic meters of MLLW (93 percent of 93.8 cubic meters) generated at SNL/NM will be sent to NNSS and will account for about 3.4 percent of MLLW disposed of at NNSS annually. In the biennial reporting required under RCRA for hazardous waste facilities, Perma-Fix reported receiving 2,029 tons and DSSI reported 234 tons in 2021 (EPA 2022). Based on about 600 pounds per cubic yard (EPA 2016), MLLW received by commercial facilities in 2021 equates to about 182,600 and 21,100 cubic feet, respectively. Under the No-Action Alternative, about 6.6 cubic meters (7 percent of 93.7 cubic meters [232 cubic feet]) will be shipped to commercial facilities, which will represent about 0.11 percent of the total volume sent to these commercial facilities annually.

TRU and MTRU Waste. SNL/NM generates TRU waste and, in smaller quantities, MTRU waste. Whether TRU waste or MTRU waste, all TRU waste goes to DOE’s WIPP facility and is managed as MTRU waste. For purposes of analysis, combined TRU waste and MTRU waste are simply referred to as “TRU waste.” Under the No-Action Alternative, NNSA estimates that TRU waste could be generated within SNL/NM at the annual rate shown in Table 5-30, which also shows average TRU waste generated at SNL/NM over the past 6 years for comparison.

Table 5-30. SNL/NM Generation of TRU and Mixed TRU Waste under No-Action Alternative

TRU Waste Category	Baseline/Existing Environment 6-year Average, 2017–2022 ^a (m ³ /yr)	No-Action Alternative Projection ^b (m ³ /yr)	Percent Increase ^c over Baseline/Existing Environment, 5-year Average
Routine TRU and MTRU waste	0.2	1.4	483%
Non-routine TRU and MTRU waste	0	0	0%
TOTALS	0.2	1.4	483%

a. From Table 4-22 (0.00003 m³ TRU) and Table 4-26 (1.4007 m³ MTRU). Calculation: (0.00003 m³ TRU + 1.4007 m³ MTRU) / 6 years = 0.23 m³ TRU + MTRU/year, as a 6-year average.

b. The No-Action Alternative projection is based on highest generated MTRU + TRU wastes from the past 6 years.

c. Percent increase equals No-Action Alternative Projection minus Baseline Average / Baseline Average x 100%.

TRU waste estimates are presented as annual averages with acknowledgment that temporary excursions or increases could occur in any given year; these higher projections are accounted for in total waste projected for the 15-year analytical period covered by this SWEIS.

As shown in Table 5-30, the total volume of TRU waste projected for the No-Action Alternative would increase compared to the 6-year average (2017–2022) presented for the baseline/existing environment. However, most No-Action Alternative projects will be replacements and will not increase routine wastes. To be conservative, this SWEIS uses the highest value for routine wastes from the past 6 years for the No-Action Alternative projection. SNL/NM TRU waste (including MTRU waste) is primarily produced in reactors and from reactor test cleanup in TA-IV Research Accelerator Facilities. No non-routine TRU waste is expected.

WIPP is DOE’s only authorized repository for defense-related TRU waste and has an NMED-issued Hazardous Waste Facility Permit for the management of MTRU waste.

TRU waste generated under the No-Action Alternative (1.4 cubic meters per year) is consistent with SNL/NM’s recent projections of TRU waste generation, which is primarily associated with continued Z-machine operations in TA-IV.

5.12.1.3 Non-Radiological Waste

Under the No-Action Alternative, hazardous waste and NMSW (asbestos-containing material [ACM]) will be shipped from SNL/NM at the annual rate shown in Table 5-31. Large quantities of ACM are not generated during routine operations and will be produced primarily during DD&D. For direct comparison as a baseline, the table also shows average hazardous waste and ACM shipped from SNL/NM over the past 6 years. Prior to DD&D, RCRA hazardous waste and ACM will be removed from contaminated buildings to the extent possible and shipped to the appropriate TSDF, but RCRA hazardous waste and ACM could become co-mingled.

Table 5-31. SNL/NM RCRA Hazardous Waste, NMSW, and Other Regulated Waste Shipped under No-Action Alternative

Waste Category	Baseline/Existing Environment 6-year Average 2017–2022 (MT/yr)^a	No-Action Alternative Projection (MT/yr)	Percent Change over Baseline/Existing Environment 6-year Average
Routine RCRA hazardous waste	67.5	91.9	36%
Non-routine DD&D RCRA hazardous waste	1.7	253.0	14,782%
Classified RCRA hazardous waste (routine) ^b	4.2	8.1	93%
Total RCRA hazardous waste^c	73.4^d	353.0	381%
Non-routine DD&D ACM ^e	51.1	253.0	395%
Infectious waste ^e (routine)	2.1	2.8	33%
Chemical waste ^f (routine)	238.7	296.4	24%
Classified non-hazardous waste ^g (routine)	7.5	10.2	36%

a. One MT equals 1,000 kg. MT multiplied by 1.1023 equal tons.

b. Classified RCRA hazardous waste (routine) will be shipped to NNSS for disposal.

c. Total RCRA Hazardous Waste is the sum of Routine RCRA hazardous waste, Non-routine DD&D RCRA hazardous waste, and Classified RCRA hazardous waste (routine)

d. From Table 4-27.

e. ACM and infectious wastes are classified as NMSW.

f. Chemical waste is classified as Other Regulated Waste.

g. Classified non-hazardous waste (routine) will be shipped to NNSS for disposal.

Table 5-31 shows that total hazardous waste projected for the No-Action Alternative would increase by 381 percent compared to the 6-year average (2017–2022) presented for the baseline/existing environment. Most No-Action Alternative projects are replacements and will not change routine wastes. However, to be conservative, this SWEIS uses the highest amount shipped during the past 6 years (100 MT/yr). Some hazardous materials, such as asbestos, lead-based paint, and chemical contaminants, could be present. NNSA has conservatively estimated that about 30 percent of the total wastes from DD&D could be hazardous. Building specific characterization to determine the amount of hazardous material will be performed before DD&D activities (SNL 2023a). Waste quantities from DD&D were estimated based on an EPA report (EPA 2009) estimating that about 158 pounds of waste are generated per square foot of DD&D.

Using a rough approximation of 1 cubic yard of hazardous waste weighing 600 pounds (or about twice the density of typical uncompacted mixed municipal solid waste [EPA 2016]), 353 MT per year of total hazardous waste equates to 1,297 cubic yards (35,011 cubic feet) per year (if the waste is assumed heavier than 600 pounds per cubic yard, storage space required decreases).

When a hazardous waste is generated, it is characterized, labeled, and collected in appropriate accumulation and storage areas. SNL/NM sends hazardous waste to a variety of offsite commercial TSDF. About 46 shipments of routine hazardous waste and 108 shipments of non-routine hazardous waste would be made to a variety of commercial offsite facilities, based on the average yearly shipments from 2017–2022 (SNL 2023h).

Based on EPA's biennial reports for hazardous waste, there were 35.9 million tons (32.5 million MT) of hazardous waste generated nationally in 2021, with 3,814 tons (3,460 MT) generated in New Mexico in that year (EPA 2022). The 353 MT per year projected for SNL/NM represents a small portion (less than 0.01 percent) of the hazardous waste quantities nationally but would comprise about 10.2 percent of the hazardous waste generated in New Mexico.

As discussed in Section 4.12.4.5, NMSW generated at SNL/NM includes infectious waste and ACM. NMSW is a non-hazardous solid waste that has unique handling, transportation, and/or disposal requirements to ensure protection of the environment and of public health, welfare, and safety. During routine operations under the No-Action Alternative, NMSW, as infectious waste, will continue to be shipped in about the same quantities as the current baseline. This SWEIS uses highest amount shipped during the past 6 years (2.8 MT annually) to be conservative. As described in Table 5-31 and related text, ACM shipping will increase from non-routine DD&D. About 253 MT of ACM could be shipped during DD&D. Management of these wastes will continue as described in Section 4.12.4. Table 5-31 shows the total quantity of ACM projected for the No-Action Alternative would increase by 395 percent compared to the 6-year average (2017–2022).

Chemical waste (includes special waste and industrial solid waste) will continue to be shipped in about the same quantities as the current baseline. To be conservative, this SWEIS uses highest amount shipped during the past 6 years (296 MT annually).

Classified waste (including hazardous and non-hazardous) will continue to be shipped in similar quantities as the current baseline. To be conservative, this SWEIS uses the highest values from the past 6 years for classified wastes, 8.1 MT (hazardous) and 10.2 MT (non-hazardous). Classified wastes will continue to be shipped to NNSS for disposal.

Non-Hazardous Solid Waste. Under the No-Action Alternative, non-hazardous solid waste could be shipped from SNL/NM at the annual rate shown in Table 5-32, which also summarizes quantities of non-hazardous solid waste shipped from SNL/NM over the past 6 years for comparison. The increase in non-hazardous waste is attributed to the increase in workers at SNL/NM and increases in C&D debris from proposed DD&D activities.

Table 5-32. SNL/NM Non-Hazardous Solid Waste Shipped under No-Action Alternative

Non-Hazardous Solid Waste Category	Baseline/Existing Environment 6-year Average, 2017–2022, (MT/yr) ^a	No-Action Alternative (MT/yr) ^b	Percent Increase over Baseline/Existing Environment 6-year Average
Site-wide non-hazardous solid waste	3,046 – includes both routine CSW and non-routine C&D waste	5,450 – includes both routine (4,250 MT/yr) and non-routine (1,200 MT/yr)	78.9%

CSW: commercial solid waste

a. One MT equals 1,000 kg. MT multiplied by 1.1023 equal tons.

b. Projected increase in non-hazardous waste is attributed to the increase in workers at SNL/NM and increases in C&D debris from proposed DD&D activities

Under the No-Action Alternative, the total amount of non-hazardous solid waste could increase by up to 78.9 percent to 5,450 MT/yr, compared to baseline. Other than the accumulation bins and containers, there are no storage facilities for this waste, and it is expected that existing bins and containers will be adequate for waste generated under the No-Action Alternative.

5.12.2 Modernized Operations Alternative

New projects under the Modernized Operations Alternative with radioactive/hazardous material inventories and waste generation include:

- **Neutron Generator Enterprise+ (NGE+) Facility** – This facility is a replacement construction that would improve operations by consolidating work spread across nine buildings and mitigate risks associated with aging facilities. This project would benefit neutron generator R&D, design, and production, and enable NNSA’s neutron generator operations at SNL/NM to better meet national security needs. Neutron generator operations generate LLW and MLLW.
- **ACRR Fuel Recladding** – The activity would support ACRR operations until that facility is replaced. This project could increase radiological wastes compared to the No-Action Alternative.

Most modernization projects would be replacements or upgrades to existing facilities and would not substantively increase routine wastes compared to existing operations. However, wastes associated with DD&D activities would increase.

The following sections address material and waste categories described in Section 4.12.

5.12.2.1 Materials Management

The Modernized Operations Alternative would involve construction of replacement facilities (refer to Table 3-3) that would not expand capabilities. Use and presence of radioactive/hazardous materials at SNL/NM would increase to some extent, but they likely would be the same or similar to materials already used at SNL/NM. New radioactive/hazardous materials would not be allowed on SNL/NM-managed lands without appropriate equipment, facilities, procedures, and training necessary to safely manage those materials.

5.12.2.2 Radioactive Waste

Under the Modernized Operations Alternative, most projects would replace facilities, upgrade facilities and utility infrastructure along with DD&D, and not notably change wastes/capabilities. DD&D for over 40 buildings (total footprint of 538,000 square feet) would be scheduled over 15 years (about 36,000 square feet per year). The facilities do not house radiological operations or have radiological contamination, so no radiological wastes would result from DD&D.

Low-Level Radioactive Waste (LLW). Table 5-33 provides estimates of LLW that would be shipped annually under the Modernized Operations Alternative and shows LLW estimates for the No-Action Alternative for comparison. Estimates in Table 5-33 are annual averages; temporary excursions or increases could occur in any given year, but these higher projections have been accounted for in total waste projected for the 15-year analytical period covered by this SWEIS.

Table 5-33. SNL/NM LLW Shipped under Modernized Operations Alternative

LLW Category	No-Action Alternative (m ³ /yr) ^a	Modernized Operations Alternative Projection (m ³ /yr) ^b	Percent Change over No-Action Alternative
Routine LLW	87.6	87.6	0%
Non-routine DD&D LLW	6.3	6.3	0%
TOTALS	93.9	93.9	0%

a. From Table 5-28.

b. Most projects would replace facilities, upgrade facilities and utility infrastructure along with DD&D, and not notably change wastes/capabilities

Table 5-33 shows that routine LLW quantities under the Modernized Operations Alternative are expected to be the same as under the No-Action Alternative. Most modernization projects would update existing capabilities and not notably change wastes/operations. Non-routine LLW waste is expected to be the same as the baseline 6-year average.

NNSA expects that final disposition of routine LLW generated under the Modernized Operations Alternative would be the same as current operations. As discussed in Section 4.12.3, SNL/NM sends almost all solid LLW to NNSS and to DOEAP-accredited commercial TSDF. About 96 percent of LLW was sent to NNSS, and the remaining 4 percent was sent to Perma-Fix, a DOEAP-accredited commercial TSDF, in Gainesville, Florida, in 2017–2021. If 96 percent of SNL/NM's future LLW generated under the Modernized Operations Alternative (90 cubic meters) is sent to NNSS, it would account for about 0.4 percent of LLW disposed of at NNSS annually. About 4 cubic meters per year would be sent to Perma-Fix, which would account for about 0.1 percent of waste managed by this facility in 2021. Other offsite facilities would be used only if they had appropriate permits/licenses, accreditation by DOEAP, and capacity and capability to treat, store, and/or dispose of specific LLW.

Mixed Low-Level Waste (MLLW). Table 5-34 summarizes total MLLW shipped projections under the Modernized Operations Alternative. Estimates are presented as annual averages with acknowledgment that temporary excursions or increases could occur in any given year; higher projections are accounted for in total waste projected for the 15-year analytical period covered by this SWEIS.

Table 5-34. SNL/NM MLLW Shipped under Modernized Operations Alternative

MLLW Category	No-Action Alternative (m ³ /yr) ^a	Modernized Operations Alternative Projection (m ³ /yr) ^b	Percent Change over No- Action Alternative
Routine MLLW	93.7	93.7	0%
Non-routine DD&D MLLW	0.1	0.1	0%
TOTALS	93.8	93.8	0%

a. From Table 5-29.

b. Most modernization projects would update existing capabilities and not notably change wastes/operations

Table 5-34 shows that overall MLLW shipped under the Modernized Operations Alternative would be the same as under the No-Action Alternative. Most modernization projects would update existing capabilities and not notably change wastes/operations. To be conservative, this SWEIS uses the highest shipped wastes value from the past 6 years for projected routine MLLW. Non-routine MLLW from DD&D is expected to be the same as the baseline 6-year average.

Final MLLW disposition generated under the Modernized Operations Alternative is expected to be the same as current operations. MLLW generated and shipped to NNSS (about 87.3 cubic meters or 93 percent of 93.8 cubic meters) would represent about 3.4 percent of the volume sent to NNSS annually. About 6.6 cubic meters (or 7 percent of 93.8 cubic meters) of MLLW would be sent to commercial DOEAP-accredited TSDF (e.g., Perma-Fix in Gainesville, Florida; DSSI in Kingston, Tennessee), accounting for 0.11 percent of the annual volume managed by the facilities in 2021.

TRU and Mixed TRU Waste. Under the Modernized Operations Alternative, estimated TRU waste could be generated at SNL/NM at the annual rate shown in Table 5-35, which also shows estimated quantity of TRU waste that would be generated under the No-Action Alternative. TRU waste estimates are presented as annual averages with acknowledgment that temporary excursions or increases could occur in any given year; higher projections are accounted for in total waste projected for the 15-year analytical period covered by this SWEIS.

Table 5-35 shows the total volume of TRU waste projected under the Modernized Operations Alternative would increase by 0.6 percent compared to the No-Action Alternative, due to the ACRR recladding, which would generate about 0.009 cubic meters per year of TRU waste. No non-routine TRU waste is expected during DD&D.

Table 5-35. SNL/NM Generation of TRU Waste under Modernized Operations Alternative

TRU Waste Category	No-Action Alternative (m ³ /yr) ^a	Modernized Operations Alternative Projection (m ³ /yr)	Percent Increase over No-Action Alternative
Routine TRU and MTRU waste	1.40	1.41	0.6% ^b
Non-routine DD&D TRU and MTRU waste	0	0	0%
TOTALS	1.40	1.41	0.6%

a. From Table 5-30.

b. ACRR recladding would generate about 0.009 m³/yr of TRU waste.

Projected TRU waste for the Modernized Operations Alternative (1.41 cubic meters per year) is consistent with SNL/NM's recent projections of TRU waste generation and would remain a small contributor to total TRU waste sent to WIPP. Chapter 6 includes a reasonably foreseeable effects analysis of TRU waste disposal at WIPP.

5.12.2.3 Non-Radiological Waste

Under the Modernized Operations Alternative, hazardous waste and NMSW (ACM) would be shipped from SNL/NM at the annual rate shown in Table 5-36. No Modernized Operations Alternative projects would generate large amounts of hazardous waste. Most modernization projects would replace facilities, upgrade facilities and utility infrastructure along with DD&D, and not notably change wastes/capabilities. Hazardous waste generation under routine operations for the Modernized Operations Alternative would be the same as for the No-Action Alternative, because most proposed facilities would replace existing facilities and operations. Large ACM quantities would be generated only during DD&D and not during routine operations.

Non-routine hazardous waste estimates for DD&D are 474 MT/yr. Over 40 buildings and other support facilities (total footprint of 538,000 square feet) would be scheduled to undergo DD&D under the Modernized Operations Alternative, and about half are considered uncontaminated. Some hazardous materials (e.g., asbestos, lead-based paint, and chemical contaminants) could be present. NNSA has estimated about 30 percent of total wastes from DD&D could be hazardous. One building has extensive chemical contamination. Building-specific characterization to estimate hazardous waste that could be generated would be performed before DD&D activities (SNL 2023b). Hazardous waste estimates are presented as annual averages with acknowledgment that temporary excursions or increases could occur in any given year; higher projections are accounted for in total waste projected for the 15-year analytical period covered by this SWEIS.

Table 5-36. SNL/NM Hazardous Waste, NMSW, and Other Regulated Wastes Shipped under Modernized Operations Alternative

Waste Category	No-Action Alternative (MT/yr) ^a	Modernized Operations Alternative Projection (MT/yr)	Percent Change over No-Action Alternative
Routine RCRA hazardous waste	91.9 ^b	91.9	0%
Non-routine DD&D RCRA hazardous waste	253 ^b	474	87.4%
Classified RCRA hazardous waste (routine) ^c	8.1	8.1	0%
Total RCRA hazardous waste ^d	353	574	62.6%
Non-routine DD&D ACM ^e	253	474	87.4%
Infectious waste ^e (routine)	2.8	2.8	0%
Chemical waste ^f (routine)	296.4	296.4	0%
Classified non-hazardous waste (routine) ^g	10.2	10.2	0%

a. One MT equals 1,000 kg. MT multiplied by 1.1023 equal tons.

b. From Table 5-31.

c. Classified RCRA hazardous waste (routine) would be shipped to NNSS for disposal.

d. Total RCRA Hazardous Waste is the sum of Routine RCRA hazardous waste, Non-routine DD&D RCRA hazardous waste, and Classified RCRA hazardous waste (routine).

e. ACM and infectious wastes are classified as NMSW.

f. Chemical waste is classified as Other Regulated Waste.

g. Classified non-hazardous waste (routine) would be shipped to NNSS for disposal.

Table 5-36 shows total hazardous waste projected under the Modernized Operations Alternative would increase by 62.6 percent compared to the No-Action Alternative. The 574 MT per year of total hazardous waste equates to 2,108.5 cubic yards or about 56,929.3 cubic feet per year. (If waste is assumed heavier than 600 pounds per cubic yard, storage space required decreases). The 574 MT per year represents a small portion (less than 0.1 percent) of hazardous waste nationally but would constitute about 17 percent of hazardous waste generated in New Mexico (EPA 2022).

As discussed in Section 4.12.4, NMSW is a non-hazardous solid waste that has unique handling, transportation, and/or disposal requirements to ensure protection of the environment and of public health, welfare, and safety. Under the Modernized Operations Alternative, during routine operations, NMSW as infectious waste would be shipped in about the same quantities as under the No-Action Alternative (2.8 MT annually). About 474 MT of ACM could be shipped during non-routine DD&D. Management of these wastes would continue as described in Section 4.12. Table 5-36 shows total ACM projected for the Modernized Operations Alternative would increase by 87 percent compared to the No-Action Alternative due to additional DD&D.

Chemical waste would be shipped in about the same quantities as under the No-Action Alternative (about 296 MT annually). Similarly, classified waste (including hazardous and non-hazardous) would be shipped in about the same quantities as the No-Action Alternative, 8.1 MT (hazardous) and 10.2 MT (non-hazardous), to NNSS for disposal.

Non-Hazardous Solid Waste. Under the Modernized Operations Alternative, non-hazardous solid waste could be shipped from SNL/NM at the annual rate shown in Table 5-37, which also presents estimated quantities of non-hazardous solid waste that would be shipped from SNL/NM under the No-Action Alternative. The increase in non-hazardous waste is attributed to additional DD&D activities proposed under the Modernized Operations Alternative.

Table 5-37. SNL/NM Non-Hazardous Solid Waste Shipped under Modernized Operations Alternative

Non-Hazardous Solid Waste Category	No-Action Alternative (MT/yr) ^a	Modernized Operations Alternative (MT/yr)	Percent Increase over No-Action Alternative
Site-wide non-hazardous solid waste	5,450 – includes both routine (4,250 MT/yr) and non-routine (1,200 MT/yr)	6,450 – includes both routine (4,250 MT/yr) and non-routine (2,200 MT/yr)	18.3%

a. One MT equals 1,000 kilograms. MT multiplied by 1.1023 equal tons.

Under the Modernized Operations Alternative, the total amount of non-hazardous solid waste could increase by up to 18.3 percent to 6,450 MT/yr, compared to the No-Action Alternative. Waste not diverted for reuse or recycling would be handled similarly to its treatment under the No-Action Alternative, as would C&D debris.

5.12.3 Expanded Operations Alternative

New facilities or operations under the Expanded Operations Alternative with radioactive/hazardous materials inventories and waste generation include the following.

- CREST Complex** – This proposed project would include open-pool reactors and an accelerator that would provide an enhanced replacement facility for the ACRR. Reductions (on a unit basis) in waste streams and improvements in safety are expected but cannot be definitively quantified until detailed design occurs. Thus, this SWEIS assumes operational parameters would be like those of existing operations, but it accounts for increased operating parameters (e.g., wastes) associated with an increased testing capability level (SNL 2023c). This SWEIS therefore conservatively assumes a 50 percent increase in operations at facilities that emit radioactive material.
- Microreactor** – This project could integrate up to 10 MWe of advanced nuclear power technologies into the KAFB and SNL/NM energy portfolio using a microreactor, which is typically factory manufactured, fully assembled, and pre-fueled and generates between 5 and 10 MWe. The microreactor would be connected to the electric grid. Microreactors have several features that enable them to achieve high levels of safety and are generally considered to have highly reliable safety functions that can control reactor power, cool the reactor fuel/core, and contain radiological material with very high safety margins. The microreactors would be swapped out when fuel is depleted. Existing capabilities within the DOE Complex would manage depleted fuel from a microreactor.
- Z-machine Operations/Next Generation Pulsed Power (NGPP) Facility** – SNL/NM proposes to increase experiments at the Z-machine by about 50 percent, which would increase the workforce requirements and generation of TRU waste and LLW. The Z-machine is expected to reach the end of its useful life before 2030 without significant additional investment. The NGPP project is a proposed replacement/enhancement of the Z-machine complex, which is scheduled for DD&D if the NGPP facility is constructed.

5.12.3.1 Materials Management

The Expanded Operations Alternative would involve new facility construction (described in Section 3.4). Although radioactive/hazardous material use and presence at SNL/NM would increase to some extent, additional radioactive/hazardous materials likely would be the same or similar to materials already used within SNL/NM; new radioactive/hazardous materials would not be allowed on SNL/NM-managed lands without appropriate equipment, facilities, procedures, and training necessary to safely manage those materials. Projections assumes that operation levels in 2040 would be about 50 percent higher than current operations. Waste increases almost proportionately with operations, so projected waste may increase by 50 percent on a site-wide basis.

5.12.3.1.1 Radioactive Waste

Under the Expanded Operations Alternative, projects and operations could increase annual average amount of radioactive waste shipped from SNL/NM.

In addition, the DD&D of radiologically contaminated buildings is addressed as a non-routine waste, specifically, DD&D of the ACRR. There would be additional DD&D activities beyond those included in the Modernized Operations Alternative.

LLW. Table 5-38 provides estimates of LLW that would be shipped annually under the Expanded Operations Alternative and shows the LLW estimates for the No-Action Alternative for comparison. The estimates in Table 5-38 are annual averages; temporary excursions or increases could occur in any given year; higher projections are accounted for in the total waste projected for the 15-year analytical period covered by this SWEIS.

Table 5-38. SNL/NM LLW Shipped under Expanded Operations Alternative

LLW Category	No-Action Alternative (m ³ /yr) ^a	Expanded Operations Alternative Projection (m ³ /yr) ^b	Percent Increase over No- Action Alternative
Routine LLW	87.6	130	48.4%
Non-routine DD&D LLW	6.3	120	1,804.8%
TOTALS	93.9	250	166.2%

a. From Table 5-28.

b. Projection based on routine operation levels in 2040 about 50 percent higher than current operations and increased non-routine DD&D.

Table 5-38 shows total LLW quantities would increase by 166.2 percent compared to those under the No-Action Alternative. Under the Expanded Operations Alternative, about 130 cubic meters per year would be shipped from routine operations. The routine LLW estimate includes 8.6 m³/yr from CREST. About 120 cubic meters per year of LLW would be shipped during DD&D. About 295 cubic meters of LLW would be expected from DD&D in TA-V, after construction of the CREST Complex. The DD&D of HERMES III in TA-IV would generate about 15 cubic meters of LLW. The increase in DD&D LLW shipped should be seen in context of a decrease in long-term risks due to removal of excess facilities that are contaminated.

NNSA expects that final disposition of the LLW generated under the Expanded Operations Alternative would be the same as current operations. As discussed in Section 4.12.3, SNL/NM

sends its solid LLW to NNSS and to DOECAP-accredited commercial, licensed TSDF. About 96.2 percent of the LLW was sent to NNSS, and a combined 3.8 percent was sent to Perma-Fix, a DOECAP-accredited commercial TSDF, in Gainesville, Florida, in 2017–2021. If 96.2 percent of SNL/NM’s future LLW generated under the Expanded Operations Alternative (241 cubic meters) is sent to NNSS, it would account for about 1.1 percent of LLW disposed of at NNSS annually. The remaining approximately 9 cubic meters per year of SNL/NM LLW would be sent to Perma-Fix, which would account for about 0.18 percent of the waste managed by this facility in 2021.

MLLW. Table 5-39 summarizes projected total MLLW shipped under the Expanded Operations Alternative. MLLW estimates are presented as annual averages with acknowledgment that excursions or increases could occur in any given year; higher projections are accounted for in total waste projected for the 15-year analytical period covered by this SWEIS.

Table 5-39. SNL/NM MLLW Shipped under Expanded Operations Alternative

MLLW Category	No-Action Alternative (m ³ /yr) ^a	Expanded Operations Alternative Projection (m ³ /yr) ^b	Percent Change over No- Action Alternative
Routine MLLW	93.7	140	49.4%
Non-routine DD&D MLLW	0.1	0.1	0%
TOTALS	93.8	140.1	49.3%

a. From Table 5-29.

b. Projection based on routine operation levels in 2040 about 50 percent higher than current operations

Table 5-39 shows total MLLW shipped under the Expanded Operations Alternative would increase by 49.3 percent compared to the No-Action Alternative. Non-routine MLLW is expected to be the same as the baseline 6-year average during DD&D.

SNL/NM manages MLLW through a combination of onsite treatment and shipment to NNSS for disposal, or shipment to DOECAP-accredited commercial facilities for treatment and/or disposal. Final disposition of MLLW generated under the Expanded Operations Alternative would be expected to be the same as current operations. 140 cubic meters (or 4,944 cubic feet) of MLLW generated annually at SNL/NM under the Expanded Operations Alternative would be sent to NNSS or a DOECAP-accredited commercial TSDF, (e.g., Perma-Fix in Gainesville, Florida; DSSI in Kingston, Tennessee). This amount is about 5 percent of the total volume sent to NNSS annually; 10 cubic meters (7 percent of 140 cubic meters) of MLLW would account for 0.2 percent of the total annual volume managed by these commercial facilities in 2021.

TRU and Mixed TRU Waste. Under the Expanded Operations Alternative, NNSA estimates TRU waste could be generated at SNL/NM at the annual rate shown in Table 5-40, which also shows estimated TRU waste that would be generated under the No-Action Alternative. TRU waste estimates are presented as annual averages with acknowledgment that temporary excursions or increases could occur in any given year; higher projections are accounted for in the total waste projected for the 15-year analytical period covered by this SWEIS.

Table 5-40. SNL/NM Generation of TRU Waste under Expanded Operations Alternative

TRU Waste Category	No-Action Alternative (m ³ /yr) ^a	Expanded Operations Alternative Projection (m ³ /yr) ^b	Percent Increase over No-Action Alternative
Routine TRU and MTRU waste	1.4	2.1	50%
Non-routine DD&D TRU and MTRU waste	0	0	0%
TOTALS	1.4	2.1	50%

a. From Table 5-30.

b. Increased TRU wastes from expanded Z-machine operations/NGPP.

Table 5-40 shows total TRU waste projected under the Expanded Operations Alternative would increase by 50 percent compared to the No-Action Alternative. It is expected that this would accommodate increased TRU wastes from expanded Z-machine operations/NGPP.

TRU waste generated under the SNL/NM Expanded Operations Alternative (2.1 cubic meters per year) is consistent with SNL/NM's recent projections of TRU waste generation. Chapter 6 includes a reasonably foreseeable effects analysis of TRU waste disposal at WIPP.

5.12.3.1.2 Non-Radiological Waste

Under the Expanded Operations Alternative, hazardous waste and NMSW (ACM) would be shipped from SNL/NM at the annual rate shown in Table 5-41. Operational levels in 2040 are projected as 50 percent greater than current operations. Non-routine hazardous waste estimates for DD&D are 919 MT per year. About 52 facilities and other support facilities with a total footprint of 566,000 square feet (13 acres) would be scheduled to undergo DD&D. About 75 percent of the facilities are considered uncontaminated. Some hazardous materials, such as asbestos, lead-based paint, and chemical contaminants, could be present in other facilities. Five buildings contains asbestos contamination, and one building contains extensive chemical contamination. Building-specific characterization to estimate hazardous waste that could be generated would be performed prior to DD&D activities (SNL 2023c). The estimate also includes 188 MT from DD&D in TA-V after CREST Complex construction. Hazardous waste estimates are presented as annual averages with acknowledgment that temporary excursions or increases could occur in any given year; higher projections are accounted for in total waste projected for the 15-year analytical period covered by this SWEIS.

Table 5-41. SNL/NM Hazardous Waste, ACM, and Other Regulated Wastes Shipped under Expanded Operations Alternative

Waste Category	No-Action Alternative (MT/yr) ^a	Expanded Operations Alternative Projection (MT/yr)	Percent Change over No-Action Alternative
Routine RCRA hazardous waste	91.9 ^b	137.9	50%
Non-routine DD&D RCRA hazardous waste	253 ^b	919	263%
Classified RCRA hazardous waste (routine) ^c	8.1 ^b	12.1	50%
Total RCRA hazardous waste^d	353	1,069	203%
Non-routine DD&D ACM ^e	253	922	264%
Infectious waste ^e (routine)	2.8	4.2	50%
Chemical waste ^f (routine)	296.4	444.6	50%
Classified non-hazardous waste (routine) ^g	10.2	15.3	50%
Classified non-hazardous waste (non-routine) ^h	0	37.7	N/A

a. One MT equals 1,000 kg. MT multiplied by 1.1023 equal tons.

- b. From Table 5-31.
- c. Classified RCRA hazardous waste (routine) would be shipped NNSS for disposal.
- d. Total RCRA Hazardous Waste is the sum of Routine RCRA hazardous waste, Non-routine DD&D RCRA hazardous waste, and Classified RCRA hazardous waste (routine).
- e. ACM and infectious wastes are classified as NMSW.
- f. Chemical waste is classified as Other Regulated Waste.
- g. Classified non-hazardous waste (routine) would be shipped to NNSS for disposal.
- h. About 37.7 MT (equates to 80.3 cubic meters) of non-routine non-hazardous classified waste from corrective action of the TA-3 Classified Waste Landfill would be sent annually to NNSS for disposal from 2030–2040.

Table 5-41 shows total hazardous waste projected for the Expanded Operations Alternative would increase by 203 percent compared to the No-Action Alternative. The 1,069 MT per year of total hazardous waste equates to 3,927 cubic yards or about 106,023 cubic feet per year. (If waste is assumed heavier than 600 pounds per cubic yard, storage space required decreases.)

When a hazardous waste is generated, the waste is characterized, labeled, and collected in appropriate accumulation and storage areas. SNL/NM sends hazardous waste to a variety of offsite commercial TSDF. About 64 routine hazardous waste shipments and 390 non-routine hazardous waste shipments would be made to commercial offsite facilities (SNL 2023c).

The 1,069 MT per year projected for SNL/NM represents a small portion (less than 0.1 percent) of hazardous waste quantities nationally but would comprise about 31 percent of hazardous waste generated in New Mexico (EPA 2022).

Under the Expanded Operations Alternative, NMSW, as infectious waste, could increase by up to 50 percent to 4.2 MT/yr because of increased routine operations. Five buildings contain extensive asbestos contamination. About 922 MT/yr of ACM could be shipped during non-routine DD&D. Management of these wastes would continue as described in Section 4.12.4. Table 5-41 shows total ACM shipped for the Expanded Operations Alternative would increase by 264 percent compared to the No-Action Alternative because of increased DD&D.

Chemical waste could increase to 445 MT annually (50 percent increase compared to the No-Action Alternative). Similarly, classified waste including hazardous and non-hazardous would increase to 12.1 MT and 15.3 MT, respectively. In addition, non-routine, non-hazardous classified waste would increase by 37.7 MT (equates to 80.3 cubic meters) annually due to corrective action of the TA-3 Classified Waste landfill. Classified wastes would continue to be shipped to NNSS for disposal.

Non-Hazardous Solid Waste. Under the Expanded Operations Alternative, non-hazardous solid waste could be shipped from SNL/NM at the annual rate shown in Table 5-42, which also shows estimated quantities of non-hazardous solid waste that would be shipped from SNL/NM under the No-Action Alternative. The increase in non-hazardous waste is attributed to the increase in workers at SNL/NM and additional DD&D activities proposed under the Expanded Operations Alternative. The projection includes 4,200 MT of non-hazardous waste from DD&D in TA-V after the construction of the CREST Complex.

Table 5-42. SNL/NM Non-Hazardous Solid Waste Shipped under Expanded Operations Alternative

Non-Hazardous Solid Waste Category	No-Action Alternative (MT/yr) ^a	Expanded Operations Alternative (MT/yr) ^b	Percent Increase over No-Action Alternative
Site-wide non-hazardous solid waste	5,450 – includes both routine (4,250 MT/yr) and non-routine (1,200 MT/yr)	9,990 – includes both routine (6,375 MT/yr) and non-routine (3,615 MT/yr)	83%

a. One MT equals 1,000 kg. MT multiplied by 1.1023 equal tons.

b. Projection based on increased routine operations and additional DD&D activity.

Under the Expanded Operations Alternative, total non-hazardous solid waste could increase by up to 83 percent, compared to the No-Action Alternative, to 9,900 MT/yr, because of increased routine operations and additional DD&D activity. Waste not diverted for reuse or recycling would be handled similarly to its treatment in the No-Action Alternative, as would C&D debris.

5.12.4 Summary of Waste Management Impacts for All Alternatives

Table 5-43 summarizes potential waste management impacts for the No-Action Alternative, the Modernized Operations Alternative, and the Expanded Operations Alternative.

Table 5-43. Waste Management Impacts for the Alternatives

Waste Shipped	Baseline (existing environment)	No-Action	Modernized Operations	Expanded Operations
Total LLW (m ³ /yr)	61.8	93.9	93.9	250
Total MLLW (m ³ /yr)	53.2	93.8	93.8	140.1
Total TRU waste shipped (m ³ /yr)	0.24	1.40	1.41	2.1
Total hazardous waste (MT/yr) ^a	73.4	353	574	1,069
Total ACM (MT/yr) ^{b, c}	51.1	253	474	922
Infectious waste (MT/yr) ^c	2.1	2.8	2.8	4.2
Chemical waste (MT/yr) ^d	238.7	296.4	296.4	444.6
Classified hazardous waste (MT/yr) ^e	4.2	8.1	8.1	12.1
Classified non-hazardous waste (MT/yr) ^e	7.5	10.2	10.2	53.0 ^f
Total non-hazardous solid waste (MT/yr) ^g	3,046	5,450	6,450	9,990

a. Total RCRA Hazardous Waste is the sum of Routine RCRA hazardous waste, Non-routine DD&D RCRA hazardous waste, and Classified RCRA hazardous waste (routine).

b. Most ACM is generated during non-routine DD&D.

c. ACM and infectious wastes are classified as NMSW.

d. Chemical waste is classified as Other Regulated Waste.

e. Classified waste (hazardous and non-hazardous) would be shipped to NNSS for disposal.

f. About 37.7 MT (equates to 80.3 cubic meters) of non-routine non-hazardous classified waste from corrective action of the TA-III Classified Waste Landfill would be sent annually to NNSS for disposal during 2030–2040.

g. CSW and C&D.

5.13 HUMAN HEALTH AND SAFETY

This section presents the potential human health impacts from each of the 3 alternatives evaluated in this SWEIS. Key metrics presented are (1) radiological doses and potential LCFs¹² (refer to Section 5.13.1.1) to the public and workers from normal operations, (2) occupational injuries/deaths to workers, and (3) health impacts to workers and the public from normal operations involving chemicals and hazardous materials. For additional background related to the human health impacts from normal operations, refer to Appendix D, Section D.2.

5.13.1 No-Action Alternative

Under the No-Action Alternative, activities described in Chapters 2 and 3 will continue at SNL/NM, along with previously approved projects described in Section 3.2, which have NEPA documentation. Operations at SNL/NM will continue to be conducted in accordance with applicable requirements (refer to Section 4.13) in a manner that protects the health and safety of workers and the public, preserves the quality of the environment, and prevents property damage. The following sections discuss the potential impacts associated with the No-Action Alternative.

5.13.1.1 Radiological Impacts

It is anticipated that facility construction and utility/infrastructure projects will not occur in areas that would pose radiological risks to workers or the public, nor will construction activities result in any radiological health impacts. Radiological contamination, aside from naturally occurring radioactive material, is not anticipated in the soil of undeveloped land at SNL/NM. Before any construction begins, a site conceptual location analysis will be conducted. If radiation is identified as a potential concern during this analysis, soil sampling will be initiated to check for radiological contamination. If contamination is found, the area will be remediated prior to construction.

NNSA regulates the release of radioactive materials for its facilities and the potential level of radiation doses¹³ to the public. DOE Order 458.1, Change 4 (DOE 2020b), which sets annual radiation dose standards from routine DOE operations of 100 mrem per year through all exposure pathways to members of the public, currently governs environmental radiation protection. The order requires that no member of the public receive an effective radiation dose in a single year greater than 10 mrem from airborne emissions of radioactive elements and 4 mrem from ingestion of drinking water. In addition, the radiation dose requirements in 40 CFR Part 61, Subpart H, limit exposure to the MEI from all radiological air emissions to 10 mrem per year.

¹² LCFs are defined as death resulting from cancer that became active after a latent period following exposure to radiation.

¹³ Radiation doses are typically measured in units of “rem” or “person-rem”. Rem is used to measure the radiation dose for a single individual. Individual doses are converted to LCFs by multiplying the dose by 0.0006. Person-rem is used to measure the total collective radiation dose for a group of people. To determine the population dose, this SWEIS sums up the individual doses.

In this SWEIS, radiation doses from normal operations were calculated based on the CAP88 package of computer codes, version 4.1.1 (EPA 2024b).¹⁴ This package uses a steady-state Gaussian plume atmospheric dispersion model to calculate concentrations of radioactive elements in the air as they decrease because of distance from the release.

Under normal operations, public radiation doses occur from airborne releases from continued operations. Compared to the existing baseline, projects under the No-Action Alternative will not (1) change the radiological air emissions under normal operations, (2) change the number of workers who receive radiological doses, or (3) change the radiological dose to workers at SNL/NM.

NNSA has estimated that there would be about 47 Ci released annually to the air under the No-Action Alternative. Of the 47 Ci released, nearly 45 Ci are tritium releases associated with operations at the Ion Beam Laboratory and the Neutron Generator Facility. Nearly 2 Ci of argon-41 are released from the ACRR annually. The annual tritium releases associated with the Ion Beam Laboratory and the Neutron Generator Facility account for more than 99% of the dose to the MEI and to the 50-mile population surrounding SNL/NM (SNL 2023a).

Why Does NNSA Analyze the Impacts to the MEI and the 50-Mile Population?

NNSA analyzes the MEI to disclose the highest possible impact that a member of the public could experience from radiation exposure. NNSA analyzes the potential impacts to the **50-mile population** in order to aggregate/accumulate the total dose that could occur to all of the people who live within 50-miles of SNL/NM. Such an approach ensures that all doses are considered/disclosed and to ensure doses are not underestimated.

Table 5-44 lists incremental annual radiation doses estimated for the public (offsite MEI and collective population dose) and corresponding incremental LCFs from SNL/NM operations. As shown in Table 5-44, the annual radiation dose to the offsite MEI would be much less than the limit of 10 mrem per year set by both EPA (40 CFR Part 61) and DOE (DOE 2020b) for airborne releases of radioactivity. Under the No-Action Alternative, the MEI dose would be 0.0066 mrem per year (or an LCF risk of 0.0000000039 per year). For perspective examples see Section 4.13.1.1 Radiological.

The projected number of LCFs to the population within a 50-mile radius would be 0.00002 per year.

Table 5-44. Annual Radiological Impacts to the Public from Potential Operational Radiological Emissions under the No-Action Alternative at SNL/NM

Receptor and Dose/Risk	Baseline ^d (Existing Environment)	No-Action Alternative ^d
Offsite MEI ^a : Dose (mrem)	0.0066	0.0066
Offsite MEI ^a : LCF risk ^b	0.0000000039	0.0000000039
Population within 50 Miles: Collective dose (person-rem) ^c	0.023	0.023
Population within 50 Miles: LCF ^c	0.000014	0.000014

a. The offsite MEI at SNL/NM is assumed to be located at the KAFB Eubank Gate area.

¹⁴ Developed under EPA sponsorship to demonstrate compliance with 40 CFR Part 61, Subpart H, which governs the emissions of radioactive elements other than radon from DOE facilities.

- b. Based on the dose-to-risk conversion factor of 0.0006 LCF per rem or person-rem
 - c. Based on projection of about 1,075,207 people living within 50 miles of SNL/NM in 2020.
 - d. Baseline and No-Action Alternative values are based on the average annual radiological releases in 2018 – 2022.
- Source: SNL 2023a; SNL 2019a; SNL 2020b; SNL 2021a; SNL 2022a; and SNL 2023i.

Table 5-45 shows the estimates of annual radiological doses to workers for the No-Action Alternative. The annual doses to individual workers would be well below the DOE limit of 5,000 mrem (10 CFR Part 835) and the SNL/NM administrative control level of 100 mrem per year for non-radiological workers and 250 mrem per year for radiological workers, with options to increase with managerial approval. Under the No-Action Alternative, the total annual collective dose to all SNL/NM workers would be 2.38 person-rem, which would result in 0.0014 LCFs annually.

A total of 10 buildings and support facilities, with a footprint of 117,172 square feet (2.7 acres), would undergo DD&D under the No-Action Alternative. In terms of square footage, most (87%) of this DD&D would occur in TA-I, with the remainder in TA-III and CTF. None of the facilities houses radiological operations or have radiological contamination, so no radiological doses would result from this DD&D.

Table 5-45. Annual Radiological Impacts to Workers from Operations under the No-Action Alternative at SNL/NM

Receptor/Dose/Risk	Baseline ^b (Existing Environment)	No-Action Alternative ^b
Number of workers who receive a measurable dose	120	120
Average total effective dose to worker (mrem)	33	33
Average annual radiological risk to workers (LCFs) ^a	0.00002	0.00002
Collective total effective dose to workers (person-rem)	2.38	2.38
Total annual radiological risk to workers (LCFs) ^a	0.0014	0.0014

a. Based on the dose-to-risk conversion factor of 0.0006 LCF per rem or person-rem.

b. The baseline and No-Action Alternative values are based on the average number of workers and doses during 2017–2021.
Source: NTESS 2023.

5.13.1.2 Non-Radiological Hazards and Occupational Health Impacts

Potential human health impacts to workers were evaluated using BLS occupational injury/illness/fatality rates. These rates at NNSA sites are historically lower than BLS values due to the increased focus on safety fostered by ongoing health and safety processes. Table 5-46 lists the potential estimates of injuries/illnesses and fatalities in an average year for the No-Action Alternative. As shown in the table, in an average year, nearly 384.5 days of lost work from illness/injury and 1.0 fatality would be expected from SNL/NM operations. For illness/injury, this would represent an increase of 1.1% compared to the existing baseline. For fatalities, the increase would be 1.0% above the existing baseline. These are statistical estimates and are expected to be conservative based on BLS statistics. No work-related fatalities occurred at SNL/NM between 2018 and 2022.

Table 5-46. Occupational Injury/Illness and Fatality Estimates at SNL/NM for Construction, DD&D, and Operations under the No-Action Alternative

Injury, Illness, and Fatality Categories	Baseline (Existing Environment)			No-Action Alternative			Percent Change vs. Baseline ^f
	Construction and DD&D ^c	Operations ^c	Total	Construction and DD&D ^d	Operations ^e	Total	
Lost days due to injury/illness ^a	27.3	353	380.3	31.5	353	384.5	+1.1%
Number of fatalities ^b	0.09	0.9	0.99	0.10	0.9	1.0	+1.0%

- a. Based on 2.1 injuries in New Mexico per 100 workers for construction/DD&D and 3.0 injuries in New Mexico per 100 workers for manufacturing (operations) (BLS 2024).
- b. Based on 6.8 fatalities in New Mexico per 100,000 workers for all occupations (BLS 2024). (Note: Data for construction- and manufacturing-related fatalities are not available for New Mexico.)
- c. Existing workforce of 14,378 workers is estimated to have 13,078 operational workers and 1,300 additional contractor workers who perform construction and DD&D.
- d. Based on 1,500 contractor workers who perform construction and DD&D.
- e. Based on 13,078 operational workers.
- f. Percent change is presented for the “Total.”

SNL/NM uses explosives in various R&D and test applications that involve a wide range of activities, including detonations. SNL/NM uses a comprehensive explosives safety program to manage explosives, with DOE Explosives Safety Standard (DOE-STD-1212) as the controlling document. Explosives operations have the potential to injure or cause fatalities to workers, but no offsite public impacts would be expected.

Non-Ionizing Radiation Hazards. Technologies used at SNL/NM that generate non-ionizing radiation¹⁵ include lasers, microwave-generating and radiofrequency (RF) devices, technologies that generate ultraviolet radiation, video displays and instrumentation, welding, and security-related devices. Non-ionizing radiation devices are regulated by the U.S. Food and Drug Administration, while worker exposures are regulated by OSHA and the American National Standards Institute. Site policies and procedures required through SNL/NM’s Non-Ionizing Radiation Program are anticipated to be protective of workers and the public through appropriate controls. In addition, non-ionizing radiation generated by site operations does not have enough energy to cause impacts over significant distance. Worker exposures could occur because of equipment failure, improper use of equipment, or non-adherence to procedures.

The UxS technologies used by SNL/NM include active RF (active radar), passive RF detectors, Electro-Optical/Infrared, and acoustic (passive listening devices) methods. RF is the only technology used in UxS systems with the potential to emit energies that could impact living organisms. For all alternatives, UxS active radar systems would not exceed maximum exposure limits for the public as referenced in applicable regulatory requirements (i.e., 10 CFR Part 851 and American Conference of Governmental Industrial Hygienists Threshold Limit Values [TLVs]), and would comply with all regulatory requirements, including Federal Communications

¹⁵ Non-ionizing radiation refers to any type of electromagnetic radiation that does not carry enough energy to completely remove an electron from an atom in living material. Because non-ionizing radiation has lower energy than ionizing radiation, it has fewer health risks than ionizing radiation.

Commission regulations at 47 CFR 1.1307(b). The continued operations involving UxS by SNL/NM would not result in any impacts to human health from RF energy (Classic 2024).

Non-Radiological Air Emissions and Chemicals. Regarding health impacts associated with non-radiological air emissions, SNL/NM's release of regulated emissions are below the limits stated in SNL/NM's Title V Operating Permit. As shown in Table 5-47, emissions of hazardous air emissions and VOCs were significantly below the Title V Operating Permit limits (SNL 2023a).

Table 5-47. VOCs and HAPs from Chemical Use in Research and Development Activities at SNL/NM

Emission Type	Requested Title V Operating Permit Emission Limits (tons per year [tpy])	2021 Emissions (tpy)
Hazardous Air Emissions	<25	10.68
VOCs	32	2.48

Source: SNL 2023a.

Compliance with permit requirements provides assurance that operations are protective of human health and the environment. There are no measurable non-radiological health effects to the public from SNL/NM air emissions (SNL 2023a). With regard to health impacts associated with non-radiological effluents, based on annual analyses, NNSA has concluded that there is no measurable risk to the public from exposure to surface water and sediment resulting from either current or legacy SNL/NM releases (SNL 2023a).

Workers would be protected from overexposure to hazardous chemicals by adherence to regulatory occupational standards that limit concentrations of potentially hazardous chemicals. DD&D activities have the potential to cause exposure to chemical hazards. The facilities scheduled to undergo DD&D under the No-Action Alternative, incidental hazardous material (such as asbestos and lead-based paint contamination) could be present but is expected to be less than 5% of the total facility square footage. Prior to DD&D, facilities would be characterized to identify waste types (e.g., hazardous waste), construction material types (steel, roofing, concrete, etc.), presence of equipment, levels of contamination, expected waste volumes, and other information to support safe demolition. Pre-demolition surveys would identify any asbestos-containing materials and lead-based paint present, and both hazardous materials would be handled and disposed of according to applicable regulations. Any hazardous material would also be disposed of at a licensed offsite TSDF.

Overall site usage of chemicals would increase under the No-Action Alternative as activity levels increase at existing facilities and as new facilities are constructed and begin operation. As discussed in Section 5.2, the square footage associated with replacement, addition, and support facilities with similar laboratory or research capabilities could increase for the No-Action Alternative compared to existing operations at SNL/NM. However, no notable chemical-related health impacts are associated with normal operations at SNL/NM (SNL 2023a). Initial hazard screens did not identify any additional controls necessary to protect the public from direct chemical exposures during normal operations. Section 5.14 discusses potential impacts from chemical accidents.

5.13.2 Modernized Operations Alternative

Under the Modernized Operations Alternative, activities described in Chapters 2 and 3 would continue at SNL/NM. The Modernized Operations Alternative includes the use of facilities and projects described for the No-Action Alternative, as well as new facility construction, modernization/upgrade/utility projects, operational changes, and DD&D activities described in Section 3.3, and operational workforce increases.

5.13.2.1 Radiological Impacts

Similar to the No-Action Alternative, it is anticipated that facility, utility, or infrastructure construction activities would not occur in areas that would pose radiological risks to workers or the public. Radiological contamination, aside from naturally occurring radioactive material, is not anticipated in the soil of undeveloped land at SNL/NM. Before any construction begins, a site conceptual analysis would be conducted. If radiation is identified as a potential concern during this analysis, soil sampling would be initiated to check for radiological contamination. If any contamination is found, the area would be remediated before construction.

Under normal operations, public radiation doses occur from airborne releases from continued operations and implementation of the Modernized Operations Alternative. Most of the new facilities would replace existing facilities that have reached their end of life, as such there would be no changes to radioactive air emissions. NNSA has estimated that there would be a maximum of 52 Ci released to the air annually under the Modernized Operations Alternative, which is conservatively based on the highest amount of radioactivity released in 1 year over 2018 – 2022. Of the 52 Ci released annually, nearly 50 Ci are tritium releases primarily associated with operations at the Ion Beam Laboratory and the Neutron Generator Facility. Nearly 2 Ci of argon-41 are released from ACRR operations (SNL 2023b).

Table 5-48 lists incremental radiation doses estimated for the public (offsite MEI and collective population dose) and corresponding incremental LCFs at SNL/NM. As shown in Table 5-48, the annual radiation dose to the offsite MEI would be much less than the limit of 10 mrem per year set by both EPA (40 CFR Part 61) and DOE (DOE 2020b) for airborne releases of radioactivity. Under the Modernized Operations Alternative, the MEI dose would be 0.0166 mrem per year, which equates to an LCF risk of 0.0000000099 per year. The projected number of annual LCFs to the population within a 50-mile radius would be 0.00002. Although the doses and risks to the MEI and the public would be more than the No-Action Alternative, they remain well below regulatory limits.

Table 5-48. Annual Radiological Impacts to the Public from Operations under the Modernized Operations Alternative at SNL/NM

Receptor/Dose/Risk	No-Action Alternative	Modernized Operations Alternative
Offsite MEI ^a : Dose (mrem)	0.0066	0.0166
Offsite MEI ^a : LCF risk ^b	0.0000000039	0.0000000099
Population within 50 Miles: Collective dose (person-rem) ^c	0.023	0.033
Population within 50 Miles: LCF ^c	0.000014	0.00002

a. The offsite MEI at SNL/NM is assumed to be located at the KAFB Eubank Gate.

b. Based on the dose-to-risk conversion factor of 0.0006 LCF per rem or person-rem.

c. Based on projection of about 1,075,207 people living within 50 miles of SNL/NM in 2020.

Source: SNL 2023b.

NNSA has estimated that the number of workers who receive a measurable radiation dose would increase from 120 (No-Action Alternative) to 200 under the Modernized Operations Alternative. The average worker dose associated with the Modernized Operations Alternative is conservatively assumed to be the highest annual dose that occurred over 2018 – 2022, with the exception of ACRR radiation workers. The ACRR is expected to increase the number of operations from 250 experiments per year to 310, and ACRR fuel recladding could also increase worker dose. In total, the annual dose to ACRR radiation workers could increase to 100 mrem (SNL 2023b), still well within limits.

More than 40 buildings and other support facilities with a total footprint of 538,000 square feet (12.4 acres) would be scheduled to undergo DD&D under the Modernized Operations Alternative. None of the facilities houses radiological operations or have radiological contamination, so no radiological impacts to workers would result from this DD&D.

Table 5-49 presents the estimates of annual radiological doses to workers for the Modernized Operations Alternative. Under this alternative, the total annual collective dose to all SNL/NM radiological workers would be 9.5 person-rem, which would result in 0.0057 LCFs annually to the SNL/NM workforce.¹⁶

Table 5-49. Annual Radiological Impacts to Workers from Operations under the Modernized Operations Alternative at SNL/NM

Receptor/Dose/Risk	No-Action Alternative	Modernized Operations Alternative
Number of workers who receive a measurable dose	120	200
Average total effective dose to worker (mrem)	33	47.5
Average annual radiological risk to workers (LCFs) ^a	0.00002	0.000028
Collective total effective dose to workers (person-rem)	2.38	9.5
Total annual radiological risk to workers (LCFs) ^a	0.0014	0.0057

a. Based on the dose-to-risk conversion factor of 0.0006 LCF per rem or person-rem

Source: SNL 2023b.

5.13.2.2 Non-Radiological Hazards and Occupational Health Impacts

Table 5-50 lists the potential estimates of injuries, illnesses, and fatalities in an average year for the Modernized Operations Alternative. As shown in the table, in an average year, about 440 days of lost work from illness or injury and 1.1 fatalities would be expected from SNL/NM operations under the Modernized Operations Alternative. For illness or injury, this would represent an increase of 14.4% compared to the No-Action Alternative. For fatalities, the increase would be 10% above the No-Action Alternative. These are statistical estimates and are expected to be conservative based on BLS statistics. No work-related fatalities occurred at SNL/NM between 2018 – 2022.

¹⁶ Of the 200 workers, 175 would receive an average dose of 40 mrem/year, and 25 ACRR workers would receive an average dose of 100 mrem/year.

Table 5-50. Occupational Injury/Illness and Fatality Estimates at SNL/NM for Construction, DD&D, and Operations under the Modernized Operations Alternative

Injury, Illness, and Fatality Categories	No-Action Alternative			Modernized Operations Alternative			Percent Increase over No-Action Alternative ^f
	Construction and DD&D ^c	Operations ^c	Total	Construction and DD&D ^d	Operations ^e	Total	
Lost days due to injury/illness ^a	31.5	353	384.5	36	404	440	14.4%
Number of fatalities ^b	0.1	0.9	1.0	0.12	1.0	1.1	10%

- a. Based on 2.1 injuries in New Mexico per 100 workers for construction/DD&D and 3.0 injuries in New Mexico per 100 workers for manufacturing (operations) (BLS 2024).
- b. Based on 6.8 fatalities in New Mexico per 100,000 workers for all occupations (BLS 2024). (Note: Data for construction- and manufacturing-related fatalities are not available for New Mexico.)
- c. The No-Action Alternative workforce of 14,378 workers is estimated to have 13,078 operational workers and 1,300 additional contractor workers who perform construction and DD&D.
- d. Based on 1,700 contractor workers who perform construction and DD&D.
- e. Based on 14,960 operational workers.
- f. Percent change is presented for the “Total.”

Non-Ionizing Radiation Hazards. Potential human health impacts associated with working with non-ionizing radiation would be the same as those presented in Section 5.13.1.1.

Non-Radiological Air Emissions and Chemicals. None of the actions proposed under the Modernized Operations Alternative would result in release of regulated air emissions above amounts in SNL/NM’s Title V Operating Permit and/or non-radiological effluents. Compliance with permit requirements provides assurance that operations are protective of human health and the environment. Consequently, NNSA has concluded that there is no measurable risk to the public from exposure to non-radiological air emissions and/or non-radiological effluents. Overall site usage of chemicals would increase under the Modernized Operations Alternative as activity levels increase at existing facilities and as replacement facilities are constructed and begin operation. However, no notable chemical-related health impacts are associated with normal (accident-free) operations at SNL/NM. Section 5.14 presents potential impacts from chemical accidents.

5.13.3 Expanded Operations Alternative

Under the Expanded Operations Alternative, activities described in Chapters 2 and 3 would continue at SNL/NM. The Expanded Operations Alternative includes the use of facilities and projects described for the Modernized Operations Alternative and the No-Action Alternative, as well as new facility construction, utility/infrastructure projects, and operational changes described in Section 3.4. The operational workforce would also increase.

5.13.3.1 Radiological Impacts

As discussed for the Modernized Operations Alternative and the No-Action Alternative, facility construction and utility/infrastructure projects would not occur in areas that would pose radiological risks to workers or the public.

Under normal operations, public radiation doses would occur from airborne releases from continued operations. In addition, under the Expanded Operations Alternative, the CREST

Complex would replace the ACRR, and the NGPP facility would replace the Z-machine.¹⁷ The CREST Complex is expected to increase annual radioactive air emissions from nearly 2 Ci to 11.8 Ci. Argon-41 would account for more than 99% of the radioactive element activity released from the CREST Complex. Radioactive element releases from the NGPP are not expected to significantly increase compared to existing releases from the Z-machine. For the Expanded Operations Alternative, this SWEIS conservatively assumes a 50% increase in operations at facilities that emit radioactive material. Radioactive air emissions are estimated at 75 Ci per year for all facilities, plus the abovementioned 11.8 Ci from the CREST Complex (NTESS 2023).

Table 5-51 lists incremental radiation doses estimated for the public (offsite MEI and collective population dose) and corresponding incremental LCFs at SNL/NM. Under the Expanded Operations Alternative, the MEI dose would be 0.025 mrem per year (or LCF risk of 0.000000015 per year). The projected number of annual LCFs to the population within a 50-mile radius would be 0.00003. As shown in Table 5-51, although the doses and risks to the MEI and the public would be about twice as much as the No-Action Alternative, they would remain well below regulatory limits.

Table 5-51. Annual Radiological Impacts to the Public from Operations under the Expanded Operations Alternative at SNL/NM

Receptor/Dose/Risk	No-Action Alternative	Expanded Operations Alternative
Offsite MEI ^a : Dose (mrem)	0.0066	0.025
Offsite MEI ^a : LCF risk ^b	0.0000000039	0.000000015
Population within 50 Miles: Collective dose (person-rem) ^c	0.023	0.05
Population within 50 Miles: LCF ^c	0.000014	0.00003

a. The offsite MEI at SNL/NM is assumed to be located at the KAFB Eubank Gate.

b. Based on the dose-to-risk conversion factor of 0.0006 LCF per rem or person-rem.

c. Based on projection of about 1,075,207 people living within 50 miles of SNL/NM in 2020.

Source: SNL 2023c.

NNSA predicts that the number of workers who receive a measurable radiation dose would increase from 120 (No-Action Alternative) to 262 under the Expanded Operations Alternative. Of these 262 workers, 25 would be ACRR workers (until the facility is eventually phased out), and 37 would be CREST Complex workers. The dose to non-ACRR and non-CREST Complex workers is conservatively assumed to increase from 40 mrem to 60 mrem annually as a result of potential increased operations. ACRR workers are estimated to receive an average dose of 100 mrem per year, and CREST Complex workers are estimated to receive an average dose of 178 mrem per year. Operation of a microreactor would require about 10 workers involved in radiological operations, each of whom could receive radiation exposure of nearly 2 mrem per year (SNL 2023c).

About 52 facilities and other support facilities with a total footprint of 566,000 square feet would be scheduled to undergo DD&D under the Expanded Operations Alternative. Several facilities contain radiological exclusion areas and could have minimal radiological contamination.

¹⁷ The Z-machine accounts for less than 1% of radioactive air emissions at SNL/NM.

However, any increased dose to workers is expected to fall within the 60-m rem annual dose identified in the previous paragraph.

Table 5-52 shows the estimates of annual radiological doses to workers for the Expanded Operations Alternative. Under the Expanded Operations Alternative, the total annual collective dose to all SNL/NM workers would be 21.1 person-rem, which would result in 0.013 LCF annually to the SNL/NM workforce.

Table 5-52. Annual Radiological Impacts to Workers from Operations under the Expanded Operations Alternative at SNL/NM

Receptor/Dose/Risk	No-Action Alternative	Expanded Operations Alternative
Number of workers who receive a measurable dose	120	262
Average total effective dose to worker (mrem)	33	80.5
Average annual radiological risk to workers (LCFs) ^a	0.00002	0.000048
Collective total effective dose to workers (person-rem)	2.38	21.1
Total annual radiological risk to workers (LCFs) ^a	0.0014	0.013

a. Based on the dose-to-risk conversion factor of 0.0006 LCF per rem or person-rem.

Source: SNL 2023c.

5.13.3.2 Non-Radiological Hazards and Occupational Health Impacts

Table 5-53 lists the potential estimates of injuries/illnesses and fatalities estimated in an average year for the Expanded Operations Alternative. As shown in the table, in an average year, nearly 524 days of lost work from illness/injury and 1.3 fatalities would be expected from SNL/NM operations under the Expanded Operations Alternative. For illness/injury, this would represent an increase of 36% compared to the No-Action Alternative. For fatalities, there would be a 30% increase compared to the No-Action Alternative. These are statistical estimates and are expected to be conservative based on BLS statistics. NNSA notes that no work-related fatalities occurred at SNL/NM during 2018 – 2022.

Table 5-53. Occupational Injury/Illness and Fatality Estimates at SNL/NM for Construction and Operations under the Expanded Operations Alternative

Injury, Illness, and Fatality Categories	No-Action Alternative			Expanded Operations Alternative			Percent Change vs. No-Action Alternative ^f
	Construction and DD&D ^c	Operations ^c	Total	Construction ^d	Operations ^e	Total	
Lost days due to injury/illness ^a	31.5	353	384.5	40	484	524	36%
Number of fatalities ^b	0.1	0.9	1.0	0.13	1.2	1.3	30%

a. Based on 2.1 injuries in New Mexico per 100 workers for construction/DD&D and 3.0 injuries in New Mexico per 100 workers for manufacturing (operations) (BLS 2024).

b. Based on 6.8 fatalities in New Mexico per 100,000 workers for all occupations (BLS 2024). (Note: Data for construction- and manufacturing-related fatalities are not available for New Mexico.)

c. The No-Action Alternative workforce of 14,378 workers is estimated to have 13,078 operational workers and 1,300 additional contractor workers who perform construction and DD&D.

d. Based on 1,900 contractor workers who perform construction and DD&D.

e. Based on 17,950 operational workers.

f. Percent change is presented for the “Total.”

Non-Radiological Air Emissions and Chemicals. None of the actions proposed under the Expanded Operations Alternative would result in releases of regulated emissions above amounts

in SNL/NM's Title V Operating Permit and/or non-radiological effluents. Compliance with permit requirements provides assurance that operations are protective of human health and the environment. Consequently, NNSA has concluded that there is no measurable risk to the public (or workers) from exposure to non-radiological air emissions and/or effluents under the Expanded Operations Alternative (SNL 2023d). Overall site usage of chemicals would increase under the Expanded Operations Alternative as activity levels increase at existing facilities and as new facilities are constructed and begin operation. However, no notable chemical-related health impacts are associated with normal (accident-free) operations at SNL/NM. Section 5.14 presents the potential impacts from chemical accidents. Proposed changes in UxS operations (including the use of larger UxS, flights beyond the visual line of sight, and swarms) would not change the potential impacts to the public or workers from non-radiological air emissions and chemicals.

5.13.4 Summary of Human Health Impacts for All Alternatives

Table 5-54 summarizes the potential human health impacts for all 3 alternatives evaluated in this SWEIS.

Table 5-54. Potential Human Health Impacts for the Alternatives

Resource/Metric	No-Action Alternative	Modernized Operations Alternative	Expanded Operations Alternative
MEI risk (LCF)	0.0000000039	0.0000000099	0.000000015
Population risk (LCF)	0.000014	0.00002	0.00003
Collective total effective dose to workers (person-rem)	2.38	9.5	21.1
Total annual radiological risk to workers (LCFs)	0.0014	0.0057	0.013
Lost days due to injury/illness per year	384	440	524
Number of occupational fatalities per year	1.0	1.1	1.3

SNL/NM continuously monitors, evaluates, and reports all radioactive emissions from its site that have a potential to impact the public. The calculated radiation doses from air emissions to the offsite MEI under the No-Action Alternative (0.0066 mrem in a year) and the Expanded Operations Alternative (0.025 mrem in a year) are significantly less than all of the regulatory limits (10 mrem in a year for the air pathway). To compare these doses to the annual average naturally occurring background dose (no man-made sources) of 346 mrem in Albuquerque, New Mexico (about 1 mrem a day), it would take about 40 years of dose from SNL/NM operations to equal 1 day of naturally occurring background radiation dose.

The average annual dose to the general public (all people in a 50-mile radius of SNL/NM) under the No-Action Alternative is 0.023 person-rem, and could increase in the future under the Expanded Operations Alternative to 0.05 person-rem. Based on LCF risk analysis, these radiation doses present an insignificant risk to the general public compared to other daily risks (driving, accidents, etc.) and illnesses (non-radiation induced cancers, heart disease, etc.).

Special Pathways – Subsistence Consumption of Fish and Wildlife. Special exposure/diet pathways were evaluated to assess the potential impacts to tribal and other residents whose traditional living habits and diets could potentially lead to larger exposures to environmental contaminants than those experienced by the hypothetical offsite resident. The foodstuffs and

pathways of specific interest consist of water, produce, game animals and fish, and native vegetation use for medicinal purposes.

To support this analysis, NNSA evaluated radionuclide releases to the environment and radionuclide concentrations in air, water, and soils/vegetation/biota using sampling data from the 2022 ASER (SNL 2023d) and a 2024 technical report, *Decision Basis for Discontinuing Off-Site Terrestrial Surveillance Monitoring at Sandia National Laboratories, New Mexico* (SNL 2024e). NNSA prepared a technical document to support this analysis (Tetra Tech 2025). NNSA concluded that there would be no detectable additional dose to any individuals in the vicinity of SNL/NM whose traditional living habits and diets could lead to larger exposures to environmental contaminants than those experienced by the hypothetical offsite resident.

5.14 ACCIDENT ANALYSIS AND INTENTIONAL DESTRUCTIVE ACTS

This section presents potential accident impacts for the alternatives evaluated in this SWEIS and considers potential IDA impacts. Many SNL/NM activities require use of radioactive materials, hazardous chemicals, energetic materials (explosives), and biological hazards, all of which could, under certain circumstances, be involved in an accident. Activities using these materials onsite involve specialized facilities with appropriate safety equipment and procedures to reduce possibility or severity of accidents. Chapter 2 describes many of these specialized facilities.

5.14.1 Introduction

An accident is a specific event or progression of an event sequence resulting from an initiating event followed by subsequent events that may lead to radioactive or other hazardous material release and/or exposure to a predefined receptor. An accident might cause both prompt and latent health effects (i.e., could take many years to develop and be detected). The sequence usually begins with an initiating event (e.g., human error, equipment failure, or earthquake) followed by a succession of other events that dictate the accident's progression and the extent of materials released. Appendix D, Section D.3, presents initiating events and potential accident scenarios.

The term *accident* can be defined as an unplanned event that has resulted in or suggests failure of a DOE safety management system, barriers, or loss of controls that rises to the threshold criteria specified in Appendix A to DOE O 225.1B (NNSA 2011b). If an accident were to occur involving the release of radioactive, chemical, or biological materials, workers, members of the public, and the environment could be at risk. Workers in the facility where the accident occurs would be particularly vulnerable to the effects of the accident because of their location.

NNSA uses approved computer models to predict dispersion of released hazardous materials and their effects. Prediction of latent potential health effects becomes increasingly difficult to quantify for facility workers as the distance between the accident or release location and the worker decreases. Individual worker exposure cannot be precisely defined because shielding and other protective feature locations with respect to the worker and release cannot be reliably predicted. The facility worker may be injured or killed by physical effects of the accident itself.

This section presents potential impacts to co-located workers (assumed to be at about 328 feet [100 meters] from the accident or release) and the public (both an MOI and the population within

50 miles [80 km] from the site) due to potential accidents associated with SNL/NM operations.¹⁸ Appendix D, Section D.3, presents more details and analysis methodologies. Section 5.14.2 presents accident analyses that apply to continued SNL/NM operations under the No-Action Alternative, which also applies to action alternatives, and covers potential radiological, chemical, energetic, and biological material accidents. Section 5.14.3 covers potential accidents under the Modernized Operations Alternative. Section 5.14.4 covers potential accidents under the Expanded Operations Alternative. Section 5.14.5 covers site-wide accident events (e.g., seismic event, wildfire) that could impact multiple facilities and apply to any alternative. Section 5.14.6 describes IDA analysis.

5.14.2 No-Action Alternative

The No-Action Alternative would use existing capabilities to continue current, ongoing operations to support major NNSA programs and would proceed with projects or activities approved for implementation (refer to Section 3.2). As described in Appendix D, NNSA reviewed existing safety basis documents, including DSAs, hazards analyses, safety assessment documents, and emergency planning hazards assessments (EPHAs) to identify potential accident scenarios at SNL/NM. Each project proposed under the No-Action Alternative was reviewed to determine whether consequences from a radiological, chemical, energetic, or biological materials accident could potentially result in greater consequences than the previous analysis of existing buildings and facilities. As a result, NNSA developed a list of accident scenarios that represent potential risks associated with SNL/NM operations under the No-Action Alternative.

Hazard Categories

Nuclear and radiological facilities are identified by a hazard category (HC), which relates to potential consequences of an accident event (10 CFR Part 830). SNL/NM has no HC-1 nuclear facilities, which are the type of nuclear facilities with potential for significant offsite consequences. Rather, the SNL/NM nuclear facilities are either HC-2 or HC-3. Facilities that handle less than HC-3 threshold quantities (TQs) of radioactive materials are designated as “radiological facilities.”

Criteria for establishing SNL/NM facility HC thresholds are based on DOE-STD1027-92 (DOE 1997b) and NNSA’s supplemental guidance issued in 2011, *Guidance on Using Release Fraction and Modern Dosimetric Information Consistently with DOE STD 1027-92* (NNSA SD 1027 Supplemental Guidance) (NNSA 2011a). As of preparation of this SWEIS, SNL/NM facilities continue to operate under DOE-STD-1027-92, as modified by NNSA SD 1027 Supplemental Guidance, at the direction of DOE.

In 2018, DOE issued DOE-STD-1027-2018, Change Notice No. 1 (DOE 2019a), to take advantage of updated guidance and science in TQ calculation of radionuclides. As of SWEIS preparation, SNL/NM facilities continue to operate under NNSA SD 1027 Supplemental Guidance. Section 5.14.3 discusses potential evolution of this standard, the effect on SNL/NM facilities, and potential impacts from accidents.

5.14.2.1 Radiological Accidents

For potential accidents involving radiological materials, NNSA identified six design-basis accidents (DBAs) for evaluation under the No-Action Alternative. They generally represent the bounding accidents for SNL/NM facilities categorized as HC-2 or HC-3 in accordance with

¹⁸ The 50-mile radius is assumed to be centered on TA-V, where the facilities with the highest potential for offsite radiological consequences are located. In this section (and in Appendix D), this point is referred to as “the site.”

NNSA SD 1027 Supplemental Guidance. The DBAs include potential accident scenarios at the ACRR, Sandia Pulsed Reactor/Criticality Experiments (SPR/CX), and AHCU. In addition, Section 5.14.5 presents potential accident scenarios involving seismic initiators. As identified in Section 5.5.1.2, SNL/NM maintains an SPCC plan that enforces the use of tank and piping primary and secondary containment, detection, and monitoring systems designed to prevent spills and effectively remediate in the event of a spill. Minor radiological spills would be cleaned up in accordance with SNL/NM procedures, and potential health impacts would be minimal and bounded by the DBAs evaluated in this section.

As explained in Appendix D, DBAs were modeled using conservative and average meteorology to determine potential consequence range and risks to co-located workers and the public.

Offsite population dose is based on a population of about 1,075,207 persons residing within 50 miles (80 km) of the site (SNL 2023d). The modeled population is distributed in each of the 16 compass sectors (e.g., north, north-northeast) and in varying distances from the site as described in Appendix D, Section D.3.1.3. For perspective, about 8 percent of this population (about 85,000 persons) resides within 3.1 miles (5 km) of the site. Most of the population (about 75 percent) resides more than 12.4 miles (20 km) from the site. The MOI is a hypothetical individual assumed to remain at a public access area for at least 2 hours after an accident. All HC-2 and HC-3 buildings are in TA-V. DSAs for the HC-2 facilities define an Exclusion Area at 4,429 feet (1,350 meters) from the facilities. For the DSAs and for this SWEIS, the closest MOI location is assumed to remain at 4,429 feet (1,350 meters). Therefore, persons located further away from TA-V than 4,429 feet (1,350 meters) would be expected to receive a smaller dose than the MOI presented in this SWEIS. Calculated radiation doses were then converted to LCFs using the factor of 0.0006 LCF per rem (or person-rem) for both members of the public and workers (DOE 2003e). Appendix D, Section D.2.1.7, provides more details on LCF calculation.

Table 5-55 and Table 5-56 provide estimated accident frequency and potential consequences to receptors under conservative and average meteorological conditions, respectively. Table 5-57 provides estimated accident risk to receptors based on expected frequency of each event.

As illustrated in Table 5-57, maximum offsite population risk (with conservative meteorology) from an ACRR full facility fire (DBA-3) is estimated to be 0.00257 LCF per year, or less than one cancer fatality every 390 years. To put this risk in perspective, in 2022, the total annual death rate from all cancers in New Mexico was 177.1 per 100,000 people (CDC 2024). Within the 50-mile radius of SNL/NM (1,075,720 people), this would equate to over 1,900 deaths within the same population (not related to SNL/NM).

Appendix D describes potential consequences of DBA-2, an experiment malfunction that vaporizes a portion of the provisional experiment MAR limit of Pu-239 equivalent, which would result in the highest consequences to the MOI if unmitigated. Therefore, ACRR operations require containment and thermal neutron shielding as safety features for experiments with significant fissionable material. Accounting for these safety requirements results in a decrease in potential consequences to the MOI from this event; however, potential consequences of DBA-2 to the offsite population would still be the bounding accident. These safety requirements are considered mitigations and are included in Section 5.16.6. The accident with the highest potential consequences not involving experiments would be DBA-1, which is a postulated unmitigated accident involving inadvertent withdrawal of an ACRR control rod. For co-located workers, the

highest consequences are also postulated for DBA-2, followed by DBA-3, a facility fire at the ACRR. After accounting for accident probability, the highest risk to the offsite population would be from an ACRR Facility fire, which would increase LCF risk by 0.00015/year.

Table 5-55. Radiological Accident Frequency and Consequences under the No-Action Alternative – Conservative Meteorology

Accident Scenario	Frequency (per year)	Maximally Exposed Offsite Individual ^{a, b}		Offsite Population ^c		Non-Involved Worker ^{a, d}	
		Dose (rem)	LCFs ^e	Dose (person-rem)	LCFs ^e	Dose (rem)	LCFs ^e
DBA-1: ACRR, TA-V: Control rod bank inadvertent withdrawal ^f	$\leq 1 \times 10^{-4}$ to 1×10^{-6} (extremely unlikely)	3.0	1.8×10^{-3}	6,570	3.94	19	0.0114
DBA-2: ACRR, TA-V: Pulse/transient rod withdrawal experiment malfunction	$\leq 1 \times 10^{-4}$ to 1×10^{-6} (extremely unlikely)	2.4	1.44×10^{-3}	8,370	5.01	51.6	3.09×10^{-2}
DBA-3: ACRR, TA-V: Facility fire	$\leq 1 \times 10^{-2}$ to 1×10^{-4} (unlikely)	1.33	8.0×10^{-4}	4,280	2.57	26	0.0156
DBA-4: SPR/CX, TA-V: Full facility fire during critical experiment	$\leq 1 \times 10^{-4}$ to 1×10^{-6} (extremely unlikely)	1.2	7.2×10^{-4}	2,230	1.34	7.8	4.68×10^{-3}
DBA-5: SPR/CX, TA-V: Excessive reactivity during critical experiment	$\leq 1 \times 10^{-2}$ to 1×10^{-4} (unlikely)	3.5×10^{-3}	2.10×10^{-6}	3.77	2.26×10^{-3}	0.35	2.10×10^{-4}
DBA-6: AHCU TA-V: Facility fire	$\leq 1 \times 10^{-2}$ to 1×10^{-4} (unlikely)	0.14	8.4×10^{-5}	450	0.27	0.11	6.6×10^{-5}

- The MOI and the non-involved worker scenarios each assume that one person was exposed. If more than one person was exposed in either of these scenarios, then that scenario's dose would be per person, and the fatalities would be multiplied by the number of persons exposed.
- The MOI is assumed to be located at the Exclusion Area Boundary, 4,429 feet (1,350 meters) from the accident, regardless of the sector.
- Based on Appendix D, Table D-16.
- A non-involved worker is assumed to be at a distance of 328 feet (100 meters) from the facility.
- Based on LCF risk estimate of 0.0006 LCF per rem or person-rem (DOE 2003e). Scientific notation simplifies presentation; as a clarifying example, 1.80×10^{-3} is the same as 0.0018, one chance of an LCF in 556 years.
- These consequences are for an unmitigated accident. Mitigation measures and controls would not result in fuel melt or cladding damage, and consequences would be significantly lower.

Table 5-56. Radiological Accident Frequency and Consequences under the No-Action Alternative – Average Meteorology

Accident Scenario	Frequency (per year)	Maximally Exposed Offsite Individual ^{a, b}		Offsite Population ^c		Non-Involved Worker ^{a, d}	
		Dose (rem)	LCFs ^e	Dose (person-rem)	LCFs ^e	Dose (rem)	LCFs ^e
DBA-1: ACRR, TA-V: Control rod bank inadvertent withdrawal ^f	$\leq 1 \times 10^{-4}$ to 1×10^{-6} (extremely unlikely)	0.21	1.26×10^{-4}	535	0.32	2.44	1.46×10^{-3}
DBA-2: ACRR, TA-V: Pulse/transient rod withdrawal experiment malfunction	$\leq 1 \times 10^{-4}$ to 1×10^{-6} (extremely unlikely)	0.128	7.71×10^{-5}	504	0.30	1.77	1.06×10^{-3}

Accident Scenario	Frequency (per year)	Maximally Exposed Offsite Individual ^{a, b}		Offsite Population ^c		Non-Involved Worker ^{a, d}	
		Dose (rem)	LCFs ^e	Dose (person-rem)	LCFs ^e	Dose (rem)	LCFs ^e
DBA-3: ACRR, TA-V: Facility fire	$\leq 1 \times 10^{-2}$ to 1×10^{-4} (unlikely)	0.0641	3.85×10^{-5}	257	0.15	1.81	1.09×10^{-3}
DBA-4: SPR/CX, TA-V: Full facility fire during critical experiment	$\leq 1 \times 10^{-4}$ to 1×10^{-6} (extremely unlikely)	0.0365	2.19×10^{-5}	147	0.088	1.03	6.18×10^{-4}
DBA-5: SPR/CX, TA-V: Excessive reactivity during critical experiment	$\leq 1 \times 10^{-2}$ to 1×10^{-4} (unlikely)	4.17×10^{-4}	2.50×10^{-7}	0.41	2.47×10^{-4}	0.16	9.30×10^{-5}
DBA-6: AHCU, TA-V: Facility fire	$\leq 1 \times 10^{-2}$ to 1×10^{-4} (unlikely)	6.76×10^{-3}	4.06×10^{-6}	27.3	0.016	0.19	1.14×10^{-4}

- a. The MOI and the non-involved worker scenarios each assume that one person was exposed. If more than one person was exposed in either of these scenarios, then that scenario's dose would be per person, and the fatalities would be multiplied by the number of persons exposed.
- b. The MOI is assumed to be located at the Exclusion Area Boundary, 4,429 feet (1,350 meters) from the accident.
- c. Based on Appendix D, Table D-16.
- d. A non-involved worker is assumed to be at a distance of 328 feet (100 meters) from the facility.
- e. Based on LCF risk estimate of 0.0006 LCF per rem or person-rem (DOE 2003e). Scientific notation simplifies presentation; as a clarifying example, 1.26×10^{-4} is the same as 0.000126, one chance of an LCF in 7,937 years.
- f. These consequences are for an unmitigated accident. Mitigation measures and controls would not result in fuel melt or cladding damage, and consequences would be significantly lower.

Table 5-57. Radiological Accident Fatality Annual Risk under the No-Action Alternative

Accident Scenario	Conservative Meteorology			Average Meteorology		
	MOI (LCF ^a)	Offsite Population ^b (LCF)	Non-Involved Worker ^c (LCF)	MOI (LCF)	Offsite Population (LCF)	Non-Involved Worker (LCF)
DBA-1: ACRR, TA-V: Control rod bank inadvertent withdrawal	1.80×10^{-8}	3.94×10^{-5}	1.14×10^{-7}	1.26×10^{-9}	3.20×10^{-6}	1.46×10^{-8}
DBA-2: ACRR, TA-V: Pulse/transient rod withdrawal experiment malfunction	1.44×10^{-8}	5.01×10^{-5}	3.09×10^{-7}	7.71×10^{-10}	3.00×10^{-6}	1.06×10^{-8}
DBA-3: ACRR, TA-V: Facility fire	7.98×10^{-7}	2.57×10^{-3}	1.56×10^{-5}	3.85×10^{-8}	1.50×10^{-4}	1.09×10^{-6}
DBA-4: SPR/CX, TA-V: Full facility fire during critical experiment	7.20×10^{-9}	1.34×10^{-5}	4.68×10^{-8}	2.19×10^{-10}	8.81×10^{-7}	6.18×10^{-9}
DBA-5: SPR/CX, TA-V: Excessive reactivity during critical experiment	2.10×10^{-9}	2.26×10^{-6}	2.10×10^{-7}	2.50×10^{-10}	2.47×10^{-7}	9.30×10^{-8}
DBA-6: AHCU, TA-V: Facility fire	8.40×10^{-8}	2.70×10^{-4}	6.60×10^{-8}	4.06×10^{-9}	1.64×10^{-5}	1.14×10^{-7}

- a. Based on LCF risk estimate of 0.0006 LCF per rem or person-rem (DOE 2003e). Scientific notation simplifies presentation; as a clarifying example, 1.80×10^{-8} is the same as 0.000000018.
- b. Based on Appendix D, Table D-16.
- c. A non-involved worker is assumed to be at a distance of 328 feet (100 meters) from the facility.

5.14.2.2 Chemical Accidents

Potential impacts from hazardous chemical accidents depend on chemical quantities that could be in an SNL/NM facility. Hazardous chemical inventories are based on the SNL/NM final chemical list and TQs (SNL 2021c, Appendix C).

Because MESA in TA-I stores and uses quantities of hazardous chemicals and toxic gases that exceed values in the final chemical list and TQs, potential chemical release modeling has been evaluated at three locations within MESA (SNL 2019b). Appendix D, Section D.3.6, identifies the specific chemicals and toxic gases modeled in the evaluation.

The *Microsystems Fabrication Facility and Silicon Fabrication Facility Safety Assessment* (SNL 2023k) detailed chemical modeling evaluation results (SNL 2019b) to evaluate all potential hazards associated with MESA operations. The hazards assessment includes a qualitative risk assessment with initial conditions and controls necessary to ensure that operations continue to minimize potential safety risks to workers (involved and co-located) and the offsite public. The safety assessment, which credits administrative, engineering, and passive controls, identified no scenarios with potential significant offsite (public) consequences (SNL 2023k). Administrative controls include limiting hazardous material quantities to a minimum and “just in time” ordering. Engineering controls include seismic constraints on gas cylinders, 2-hour fire barrier walls around gas storage, and overpressure and under-pressure gas shutdown instrumentation. Passive controls include facility design and restrictive flow orifices on tanks of hazardous or toxic gases.

Under the No-Action Alternative, the MESA Extended Life Program would replace and upgrade internal systems and components but would not adversely affect the current safety basis.

5.14.2.3 Biological Accidents

SNL/NM laboratories have, for decades, performed biological research requiring Biosafety Level (BSL)-1 and BSL-2 safeguards. The facilities are designed for conducting safe and secure research and storage of infectious microorganisms and biologically derived toxins. Operation of these facilities under BSL-1 and BSL-2 requirements and safeguards complies with *Biosafety in Microbiological and Biomedical Laboratories* guidelines (HHS 2020) for BSL-1 and BSL-2 containment laboratories and federal regulations governing select agents and toxins (biosecurity).

Activities related to BSL-1 and BSL-2 materials are normally categorically excluded from further NEPA review in accordance with 10 CFR Part 1021 under B3.12. These categorical exclusions apply as long as facilities are constructed and operated in accordance with applicable requirements and BMPs. The application of a categorical exclusion demonstrates that these types of actions have been determined not to have potential for significant environmental or safety impacts. Accidents involving continued operations of SNL/NM BSL-1 and BSL-2 facilities would be unlikely to result in adverse consequences to co-located workers or the offsite public.

5.14.3 Modernized Operations Alternative

Projects under the Modernized Operations Alternative would replace, add, and support existing facilities with similar capacities at SNL/NM. As detailed in Appendix D, Section D.3.5.2, NNSA reviewed each of the projects proposed under the Modernized Operations Alternatives.

5.14.3.1 Radiological Accidents

Appendix A, Table A-1 identifies SNL/NM nuclear facilities currently categorized as HC-2, HC-3, or below HC-3 (radiological facilities) based on amount of radioactive elements (TQs) authorized to be within that facility. Currently, SNL/NM nuclear facilities operate in accordance with DOE-STD-1027-92 (DOE 1997b), as modified by NNSA SD 1027 Supplemental Guidance (NNSA 2011a). DOE is implementing the Defense Nuclear Facilities Safety Board's (DNFSB's) Recommendation 2020-1 (DNFSB 2020). As part of that implementation, on March 8, 2023, DOE notified DNFSB of the Department's intent to develop a single, updated, and consolidated hazard categorization standard and seek to incorporate it by reference in 10 CFR Part 830 as part of a rulemaking (DOE 2023e). This updated standard would represent the single, acceptable methodology for future or updated hazard categorizations of DOE nuclear facilities.

Considering these evolving standards, Appendix D, Section D.3.3, addresses potential changes associated with operating facilities with revised radioactive element TQs. Radiological facilities (<HC-3) and HC-3 facilities at SNL/NM manage their operations in accordance with the "sum of ratios" for the TQs from NNSA SD 1027 Supplemental Guidance to ensure that each facility stays within its established category. Primary radioactive elements controlled at these facilities include plutonium and tritium. Appendix D, Section D.3.5.2, demonstrates that the HC-2 TQs for Pu-239 would decrease, and tritium TQs would remain unchanged. A reduction in the plutonium TQ would result in smaller quantities of the material that could be handled and stored in an HC-3 facility at any one time without changing the facility's hazard classification.

For facilities currently below HC-3 (e.g., GIF, Ion Beam Laboratory, HERMES III), operations would maintain the sum of ratios below 1 as compared to the HC-3 threshold. Similarly, operations at the AHCU, SNL/NM's only HC-3 facility, would continue to maintain the sum of ratios below 1 as compared to the HC-2 threshold.

Section 3.3.2 identifies that ACRR fuel may undergo recladding under the Modernized Operations Alternative. This could occur at the AHCU, in a hot cell at the proposed CREST facility (if Expanded Operations Alternative is selected), or offsite. Under these scenarios, the recladding operations would be conducted under the facility's safety basis document. The safety basis document for the AHCU ensures that the radiological inventory stays below the HC-2 TQs.

In summary, because the projects proposed under the Modernized Operations Alternative would not introduce unique hazards or result in radiological accident consequences that exceed those identified and analyzed under the No-Action Alternative, accident impacts presented in Section 5.14.2.1 also represent expected accident consequences under this alternative.

5.14.3.2 Chemical Accidents

Under the Modernized Operations Alternative, several proposed facilities would use potentially hazardous chemicals, but all facilities would follow SNL/NM's chemical inventory management procedure to ensure that the facility's chemical inventory is maintained within the established safety basis of the facility. The primary facility that could include increased inventories of hazardous chemicals under the Modernized Operations Alternative would be the support and addition to MESA. Table 3-3 describes that the proposed MESA support facilities would address

fabrication, storage, and laydown yard needs along with enhanced mission capabilities. Significant changes in program or production output are not anticipated; however, if the inventories increased, they would be managed consistently with the current EPHA or safety assessment. Under the Modernized Operations Alternative, the risk of chemical accidents would not be substantively different from that presented for the No-Action Alternative.

5.14.3.3 Biological Accidents

No additional biosafety facilities are proposed at SNL/NM under the Modernized Operations Alternative. Risk of biological accidents would be the same as for the No-Action Alternative.

5.14.4 Expanded Operations Alternative

The Expanded Operations Alternative includes actions in the Modernized Operations Alternative plus actions that would expand operations and missions to respond to future national security challenges and meet increasing requirements. This alternative would expand capabilities at SNL/NM beyond those that currently exist. The new facilities and utility and infrastructure projects are identified in Tables 3-5 and 3-6 and described in Section 3.4 of this SWEIS. In Appendix D, Section D.3.4, NNSA considered each of the additional projects to determine whether the consequences from a radiological, chemical, biological, or other accident could potentially be greater than those identified under the No-Action Alternative.

5.14.4.1 Radiological Accidents

Appendix D identifies that three projects proposed under the Expanded Operations Alternative would be less than HC-3 (radiological facilities). Existing SNL/NM safety management programs would adequately address potential impact posed to human health and the environment from these projects. Potential impacts would be well represented by previous analyses involving radiological accidents under the No-Action Alternative. The three additional (less than HC-3) projects would include the expansion of the RMWMU, expansion of NGE+, and the potential expansion of Z-machine operations.

One or more factory-manufactured, fully assembled, and pre-fueled microreactors or small modular reactors up to 10 MWe are proposed for SNL/NM. Initial siting options include TA-V. These reactors are self-regulating and do not rely on engineered systems to ensure safe shutdown and removal of decay heat. While NNSA has not identified a particular design for a microreactor or small modular reactor at SNL/NM, there are existing analyses of potential hazardous and radioactive material release impacts associated with a microreactor within the DOE Complex. Appendix D, Section D.3.4, presents information about a proposed microreactor at INL and discusses that consequences and risks of an operational accident involving a microreactor would be well represented by consequences and risks of potential reactor excursions at the ACRR. Therefore, a separate DBA was not developed for this proposed project.

Section 3.4.2 identifies that the CREST Complex would include the CREST facility, which would be an HC-2 facility in TA-V and would replace ACRR capabilities associated. The Pre-Conceptual Hazards Analysis (SNL 2018d) expects that the CREST facility would operate under many of the same radioactive material inventory limits as imposed on the ACRR. For example, the higher provisional experiment MAR limit (refer to Section 3.2.2) and the normal

operations experiment limit would be expected to be the same as for the ACRR. Additionally, the CREST facility limit would be expected to be 20.6 kg of Pu-239 equivalent (same as at the ACRR), and the normal operations limit may likely be 2.61 kg. The ACRR accident DBA-3 evaluated in Appendix D, Section D.3.5.1, assumes the 20.6-kg facility limit. Final determined operational inventory limits for the new CREST facility, however, would be developed and established as part of the CREST approved safety basis.

According to the Pre-Conceptual Hazards Analysis (SNL 2018d), the proposed CREST facility design would include safety systems that add to or surpass those in the ACRR design. The differences between potential consequences from accidents associated with the ACRR and the CREST facility would continue to be evaluated and refined as part of CREST's ongoing safety-basis assessment process that would culminate in (and be presented in) the facility's final DSA. The potential accident event suite and associated mitigated consequence levels for those events at CREST would not be discernibly greater than those presently estimated for the ACRR.

NNSA anticipates the possibility that under the Expanded Operations Alternative, the ACRR and CREST facility could operate at the same time. Operation of both facilities at the same time would not increase accident risk associated with either facility individually. They would be independent of each other. The key difference in potential accident risk would be associated with an event that could simultaneously affect both facilities. This would occur only in a potential seismic event or other natural phenomena event of similar expected severity (e.g., tornado). Section 5.14.5 addresses potential site-wide event impacts that could affect multiple facilities.

In summary, except for small increased risk during a site-wide event affecting multiple facilities (refer to Section 5.14.5), little, if any, increased accident risk would be associated with Expanded Operations Alternative implementation.

5.14.4.2 Chemical Accidents

Under the Expanded Operations Alternative, several proposed facilities would use potentially hazardous chemicals, but all facilities would follow SNL/NM's chemical inventory management procedure to ensure that the facility maintains chemical inventory within its established safety basis. Section 3.4.2 presents the proposed MESA Annex in TA-I, which would provide state-of-the-art cleanroom space and capabilities to support current and expanding missions. Similar to the discussion in Section 5.14.3.2, significant changes in program or production output are not anticipated; however, if inventories increased, they would be managed consistently with the current EPA or safety assessment. Other than the MESA Annex, proposed facilities would not be expected to have chemical inventories or potential for chemical accidents that would not be well represented by No-Action Alternative analysis. Under the Expanded Operations Alternative, chemical accident risk would not be substantively different from the No-Action Alternative.

5.14.4.3 Biological Accidents

No additional biosafety facilities are proposed at SNL/NM under the Expanded Operations Alternative. Under the Expanded Operations Alternative, the risk of biological accidents would be the same as that presented for the No-Action Alternative.

5.14.5 Site-Wide Multiple Building Scenarios

This section assesses potential accident scenarios that could involve multiple buildings and evaluates potential seismic events that could engage multiple buildings. Potential frequencies and consequences were derived from SNL/NM safety basis documents. This section also addresses wildfire event potential to involve multiple facilities with radiological or hazardous materials.

5.14.5.1 Seismic Event

Section 4.4.2.2 describes the site's seismicity. Maximum PGA for the TA-V area is estimated at 0.18g (USGS 2014); however, in the ACRR DSA, the design-basis earthquake is a seismic event with a PGA of 0.22g. PGA values cited are based on a 2-percent probability of exceedance in 50 years, corresponding to an annual occurrence probability of about 1 in 2,500 or 0.0001 per year (unlikely).

Consistent with the 1999 SWEIS, this SWEIS evaluates the potential accident consequences of a seismic event that could occur in the region and provides an assessment of the estimated consequence of these natural phenomena hazards for each facility with radiological materials. In addition, this section presents a conservative assessment of the potential offsite consequences if all facilities in TA-V were affected by the same seismic event. This collection of facilities includes the two HC-2 facilities and the HC-3 facility on the site. Because the radiological facilities have radiological inventories less than HC-3 TQs, their contributions to offsite dose consequences even in a site-wide seismic event would be small in comparison to those from the HC-2 and HC-3 facilities. Later, this section discusses the potential consequences of a seismic event affecting multiple facilities with notable inventories of hazardous chemicals.

For the radiological analysis in this SWEIS, the potential population doses and LCFs associated with a seismic event for each of the facilities were summed because the facilities are all located in the same area (TA-V). The analysis also sums the potential doses to the MOI.

Under the No-Action and Modernized Operations Alternatives, the facilities included in this analysis are the ACRR, SPR, and AHCU. Section 5.14.4.1 discusses the possibility that the CREST facility could be operating concurrently with the ACRR for some time under the Expanded Operations Alternative. This SWEIS assumes that operation of the CREST facility would result in additional potential consequences, which conservatively would have the same contribution to a total release as analyzed for the ACRR. (CREST would have a more robust structure since it would be designed to meet SDC-2 seismic design requirements.)

Table 5-58 provides the sum of doses and estimated LCFs from each facility. Table 5-59 shows the radiological fatality annual risk for each facility. These results are presented for the average meteorological conditions. Table 5-59 shows that total accident risk to the offsite population as a result of multiple radiological facilities being involved in a design-basis seismic event (with accompanying fire) would be about 0.000102 more LCF per year. Under the Expanded Operations Alternative, that risk could increase slightly to about 0.000103 more LCF per year.

Potential health effects presented for this design-basis seismic event should also be considered in context of accompanying non-radiological human health impacts that would be expected. The seismic event would cause widespread failures of both non-nuclear SNL/NM structures and

structures outside of SNL/NM. Many more fatalities and injuries from structure collapse would be expected for this seismic event than those that result from radiological exposure.

For a site-wide seismic event, other facilities that include hazardous chemical inventories could also be at risk. For instance, Section 5.14.2.2 and Appendix D, Section D.3.6, address potential consequences of accidents involving facilities in MESA, the SNL/NM facility with the largest hazardous chemical inventory. Two facilities at SNL/NM require the preparation of an EPHA because of their inventory of hazardous chemicals: MESA and HWHU. As stated in the EPHA, the HWHU is a low hazard facility and does not require the preparation of a safety basis document like that prepared for MESA, which is a moderate hazard facility (SNL 2021c and 2023j). Thus, potential offsite consequences from hazardous chemical releases associated with a site-wide seismic event would be dominated by MESA, and HWHU would be a minimal contributor. Under the Expanded Operations Alternative, the risk of offsite consequences from a site-wide seismic event affecting facilities with hazardous chemical inventories would not be substantively different from that for the No-Action Alternative.

Table 5-58. Radiological Accident Frequency and Consequences of Design-Basis Seismic Event – Average Meteorology

Accident Scenario	Frequency (per year)	Maximally Exposed Offsite Individual ^{a, b}		Offsite Population ^c		Co-located Worker ^{b, d}	
		Dose (rem)	LCFs ^e	Dose (person-rem)	LCFs ^e	Dose (rem)	LCFs ^e
Seismic/Fire-1: ACRR, TA-V: Design-basis seismic event collapses ACRR structure, impacts associated equipment with ensuing fire.	$<4 \times 10^{-4}$	0.0641	3.85×10^{-5}	257	0.15	1.81	1.09×10^{-3}
Seismic/Fire-2: SPR/CX, TA-V: Design-basis seismic event collapses SPR structure, impacts associated equipment with ensuing fire.	$<4 \times 10^{-4}$	0.0365	2.19×10^{-5}	147	0.0881	1.03	6.18×10^{-4}
Seismic/Fire-3: AHCU, TA-V: Design-basis seismic event collapses AHCU structure, impacts associated equipment with ensuing fire.	$<4 \times 10^{-4}$	6.76×10^{-3}	4.06×10^{-6}	27.3	0.0164	0.19	1.14×10^{-4}
Dose and LCF Totals for <u>No-Action Alternative</u>		0.107	6.45×10^{-5}	431	0.25	3.03	1.82×10^{-3}
Seismic/Fire-4: CREST Facility, TA-V: Design-basis seismic event causes collapse of CREST facility and ensuing fire.	1×10^{-5}	0.0641	3.85×10^{-5}	257	0.15	1.81	1.09×10^{-3}
Dose and LCF Totals Design-Basis Seismic/Fire Involved Facilities – <u>Expanded Operations Alternative</u>		0.171	1.03×10^{-4}	688	0.405	4.84	2.91×10^{-3}

a. Distance from each facility to its MOI is 4,429 feet (1,350 meters).

b. The MOI and the co-located worker scenarios each assume that one person was exposed. If more than one person was exposed in either of these scenarios, then that scenario's dose would be per person and would be multiplied by the number of persons exposed.

c. Based on Appendix D, Table D-16.

d. Co-located worker is assumed to be at a distance of 328 feet (100 meters) from the facility.

e. Based on an LCF risk estimate of 0.0006 LCF per rem or person-rem (DOE 2003e). Scientific notation is used to simplify the presentation; as a clarifying example, 3.85×10^{-5} is the same as 0.0000385.

Table 5-59. Radiological Accident Fatality Annual Risk of Design-Basis Seismic Event with Average Meteorology

Accident Scenario	MOI ^a (LCF ^b)	Offsite Population ^c (LCF ^b)	Non-Involved Worker ^d (LCF ^b)
Seismic/Fire-1: ACRR, TA-V: Design-basis seismic event collapses the ACRR structure and impacts associated equipment with an ensuing fire.	1.54×10^{-8}	6.00×10^{-5}	4.36×10^{-7}
Seismic/Fire-2: SPR/CX, TA-V: Design-basis seismic event collapses the SPR structure and impacts associated equipment with an ensuing fire.	8.76×10^{-9}	3.52×10^{-5}	2.47×10^{-7}
Seismic/Fire-3: AHCU, TA-V: Design-basis seismic event collapses the AHCU structure and impacts associated equipment with an ensuing fire.	1.62×10^{-9}	6.56×10^{-6}	4.56×10^{-8}
Annual Risk Totals for Design-Basis Seismic/Fire-Involved Facilities – No-Action Alternative	2.58×10^{-8}	1.02×10^{-4}	7.29×10^{-7}
Seismic/Fire-4: CREST Facility, TA-V: Design-basis seismic event causes collapse of the CREST facility and ensuing fire.	3.85×10^{-10}	1.50×10^{-6}	1.09×10^{-8}
Annual Risk Totals for Design-Basis Seismic/Fire-Involved Facilities – Expanded Operations Alternative	2.62×10^{-8}	1.03×10^{-4}	7.40×10^{-7}

a. The distance from each facility to its MOI is 4,429 feet (1,350 meters).

b. Annual risk is based on postulated frequency multiplied by the calculated dose multiplied by an LCF risk estimate of 0.0006 LCF per rem or person-rem (DOE 2003e). Scientific notation is used to simplify the presentation; as a clarifying example, 1.54×10^{-8} is the same as 0.0000000154.

c. Based on Appendix D, Table D-16.

d. Non-involved worker is assumed to be at a distance of 328 feet (100 meters) from the facility.

5.14.5.2 Wildland Fire Events

Appendix D, Section D.3.10.2, discusses potential for wildland fire events to impact SNL/NM facilities. Grass, forest, or range fires could affect individual structures or facilities; Appendix D addresses potential for facility fires at HC-2 and HC-3 facilities. Because the HC-2 and HC-3 facilities are isolated in TA-V, a wildfire event of sufficient intensity to affect multiple nuclear facilities is not considered credible. However, as presented in Section 5.14.5.1 for seismic events, each facility affected by an event is also assumed to be affected by an ensuing facility fire. Therefore, potential site-wide impacts of an extremely unlikely wildland fire scenario that affects all buildings in TA-V would not be expected to be more than impacts in Table 5-58.

5.14.6 Intentional Destructive Acts

Although IDAs (i.e., malevolent acts of sabotage or terrorism) are not accidents, their physical impacts—whether caused by a fire, explosion, missile, or other impact force—may be compared to postulated accident effects. These consequences, involving radioactive and hazardous materials with environmental and/or health risks, caused by an act of sabotage or terrorism, can then be compared to the accident analyses documented in this SWEIS.

The impacts of some terrorist incidents would be similar to the accident impacts described in the SWEIS accident analyses. Appendix D, Section D.4, describes how NNSA assesses the vulnerability of its sites to terrorist threats and then designs its response systems.

Appendix D, Section D.4.3, reports that substantive details of IDA scenarios and security countermeasures are not released to the public because disclosure of this information could be exploited by terrorists planning attacks. Depending on the malevolent, terrorist, or intentionally destructive acts, impacts may be similar to those described in bounding accident impact analyses prepared for this SWEIS.

In accordance with the requirements in DOE Order 470.3C, Change 1 (DOE 2020c), and NNSA SD 470.4-2, Administrative Change 1 (NNSA 2021), SNL/NM has conducted a Security Risk Assessment, which includes various IDAs to hazardous materials, and reported any potential security risks to federal overseers for acceptance or mitigation determination.

5.15 SOCIOECONOMICS

This section evaluates potential socioeconomic impacts for the Proposed Action and alternatives. Key metrics are (1) employment and population changes, (2) economic activity changes (e.g., earnings, monetary value added), (3) housing and community service impacts, and (4) disproportionate and adverse impacts on human health or populations (i.e., impacts or risk of impacts on natural or physical environment in at-risk populations in the socioeconomic ROI that exceed environmental impact on New Mexico's general population). Impacts may be ecological, cultural, human health, economic, or social. The socioeconomic ROI is Bernalillo County, where about 83 percent of SNL/NM employees and their families reside (refer to Section 4.15). Appendix C, Section C.14, details methods to address surrounding population considerations.

5.15.1 No-Action Alternative

Under the No-Action Alternative, ongoing activities (refer to Chapters 2 and 3) would continue at SNL/NM. Facility construction, upgrade/utility/infrastructure projects and environmental remediation activities, DD&D projects, and operational changes are described in Section 3.2. Table 5-60 shows potential impacts on employment, population, and economic activity for the No-Action Alternative.

Population and Housing. The socioeconomic ROI population in 2030 is projected to be 683,372 persons (UNM 2024), which would be a 1.3 percent increase compared to the 2022 baseline population of 674,692 (USCB 2022a). An influx of workers/families due to SNL/NM employment is not expected. Total employment resulting from the No-Action Alternative would not increase above the 2022 baseline of 19,553 total workers (14,378 total workforce at SNL/NM and 5,175 indirect workers), or 2.9 percent of the projected 2030 population in the ROI.

In 2022, 18,598 vacant housing units were in the socioeconomic ROI (USCB 2022b). Because a large influx of workers/families into the ROI is not expected, the No-Action Alternative would not result in notable changes in vacant housing units or median home prices.

Section 4.15.3 identifies median home values in the socioeconomic ROI. This SWEIS does not predict changes in housing prices; however, trends in New Mexico are following other states as median housing prices increase. As workers move into the ROI and use available housing, NNSA expects housing prices would continue to increase, irrespective of the alternative.

Employment and Economic Activity. No-Action Alternative projects assessed under existing NEPA standards and assessment documents include facility construction, existing facility and utility/infrastructure upgrades, and excess/aging facility DD&D. Activities are assumed, for assessment purposes, to occur in a 5-year period (2025–2030). Table 5-60 shows projects would not require more full-time personnel above the baseline of 13,078 by the end of 2030 and would not require more contractor workers for construction, DD&D, and other non-operational work above the baseline of 1,300 contractor workers. Employment at SNL/NM would not increase, so indirect employment¹⁹ and associated economic activity above baseline would be minimal.

In addition to employment impacts generated by the total workforce at SNL/NM, employment at SNL/NM generates indirect employment and associated economic activity in the socioeconomic ROI. Indirect impacts were derived using multipliers for a select region provided from the U.S. Bureau of Economic Analysis Regional Input-Output Modeling System (RIMS II). The multiplier of 1.3685 was used for indirect employment for full-time personnel at SNL/NM under the No-Action Alternative, and a multiplier of 1.2735 was used for other contractor workers (BEA 2025). These multipliers were developed for an aggregation of the socioeconomic ROI. After application of the multipliers to the existing total workforce at SNL/NM, it was estimated that approximately 5,175 indirect jobs are created from the total workforce at SNL/NM.

From 2022–2030, total labor force in the socioeconomic ROI is expected to increase from 336,801 persons to 349,876 persons, which would equate to a 3.9 percent increase (BLS 2023a). By 2030, no additional workforce is anticipated under the No-Action Alternative; therefore, projected labor force increases in the socioeconomic ROI would be associated with employment either not related to SNL/NM activities or only tangentially associated. By the end of 2030, total workforce at SNL/NM, which includes full-time personnel at SNL/NM and other contractor workers needed to implement the No-Action Alternative, is not expected to increase above the baseline of 13,078 full-time personnel at SNL/NM and 1,300 estimated other contractor workers, for a total workforce at SNL/NM of 14,378 workers. The total workforce (14,378 workers) and estimated indirect employment (5,175 indirect workers) in the socioeconomic ROI would account for 5.6 percent of the projected 2030 socioeconomic ROI labor force.

Value added to the local economy from direct economic activity includes employee compensation, production and import tax, proprietary and other property income, and indirect employment compensation. Total value added under the No-Action Alternative is anticipated to be similar to the baseline value and equates to about \$2.63 billion in the socioeconomic ROI. The direct labor income impact would result in a total income impact of over \$1.38 billion in the socioeconomic ROI. About 71 percent of household incomes are used for housing, transportation, food, and health care (BLS 2023b); therefore, NNSA assumes about 71 percent of this increased payroll would enter the local economy as goods and services. It is anticipated that some portion of construction and operational materials would be purchased locally and that most construction/DD&D and operational workers would be drawn from the socioeconomic ROI, resulting in regional increases in jobs. Additional expenditures would generate more income and employment opportunities as expenditures filter throughout the economy.

¹⁹ Indirect employment refers to a type of job that is supported by the demand created by other jobs.

Table 5-60. Socioeconomic Impacts from Activities at SNL/NM under the No-Action Alternative

Resource/Metric	Baseline (Existing Environment) (2022)		Change to Baseline as a Result of the No-Action Alternative (by end of 2030)			No-Action Alternative (by end of 2030)			Percentage Increase over Baseline (%)
	Full-time Personnel at SNL/NM (Operations)	Other Contractor Workers	Full-time Personnel at SNL/NM (Operations)	Other Contractor Workers	Total Change to Workforce	Full-time Personnel at SNL/NM (Operations)	Other Contractor Workers	Total Workforce	
Jobs									
Direct jobs at SNL/NM (persons)	13,078 ^a	1,300	0	0	0	13,078	1,300	14,378	0.0%
Indirect jobs created (persons)	4,819 ^b	356 ^c	0 ^c	0 ^c	0	4,819	356	5,175	0.0%
Total direct and indirect employment	17,897	1,656	0	0	0	17,897	1,656	19,553	0.0%
Total socioeconomic ROI labor force (persons) ^d	336,801 ^e		-	-	-	349,876 ^e		-	3.9%
Earnings/Value Added									
Earnings from direct jobs at SNL/NM (millions of dollars)	\$1,283.7 ^f	\$92.8 ^g	\$0.0 ^f	\$0.0 ^g	\$0.0	\$1,283.7	\$92.8	\$1,376.5	0.0%
Earnings from indirect jobs created in socioeconomic ROI (millions of dollars) ^h	\$473.1	\$25.4	\$0.0	\$0.0	\$0.0	\$473.1	\$25.4	\$498.5	0.0%
Anticipated value added from SNL/NM (millions of dollars)	\$2,456.1 ⁱ	\$177.1 ^j	\$0.0 ⁱ	\$0.0 ^j	\$0.0	\$2,456.1	\$177.1	\$2,633.2	0.0%
Population									
Total socioeconomic ROI population	674,692		0 ^k	0 ^k	0 ^k	683,372 ^l		-	1.3% ^m

a. Direct SNL/NM employment is based on 2022 employment.

b. Indirect employment refers to a type of job that is supported by the demand created by other jobs. Indirect employment for the operational workforce was estimated using a direct-effect employment multiplier of 1.3685 (associated with “Professional, scientific, and technical services”) (BEA 2025).

c. Indirect employment refers to a type of job that is supported by the demand created by other jobs. Indirect employment for construction/DD&D was estimated using a direct-effect employment multiplier of 1.2735 (BEA 2025).

d. ROI labor force increase by the end of 2030 would largely occur independent of SNL/NM activities. The change in direct and indirect employment from SNL/NM activities would contribute a 0.0 percent increase.

e. Calculated using average growth rate of historic labor force in the socioeconomic ROI (BLS 2023a) (refer to Appendix C, Section C.14.2, for methodology).

f. Earnings were estimated using the estimated change in final demand dollars (operational workforce / change in final demand multiplier of 4.5660 [final-demand employment multiplier of 6.2486 / direct-effect employment multiplier of 1.3685]) x final-demand earnings multiplier of 0.4482 for professional, scientific, and technical services. (BEA 2025).

g. Earnings were estimated using the estimated change in final demand dollars (construction workforce / change in final demand multiplier of 5.1609 [final-demand employment multiplier of 6.5724 / direct-effect employment multiplier of 1.2735]) x final-demand earnings multiplier of 0.3686 for construction. (BEA 2025).

h. Derived from earnings from direct jobs / the number of direct jobs (persons) × the number of indirect jobs (persons).

- i. Value added was estimated using the estimated change in final demand dollars (operational workforce / change in final demand multiplier of 4.5660 [final-demand employment multiplier of 6.2486 / direct-effect employment multiplier of 1.3685]) x final-demand value added multiplier of 0.8575 for professional, scientific, and technical services. (BEA 2025).
- j. Value added was estimated using the estimated change in final demand dollars (construction workforce / change in final demand multiplier of 5.1609 [final-demand employment multiplier of 6.5724 / direct-effect employment multiplier of 1.2735]) x final-demand value added multiplier of 0.7031 for construction (BEA 2025).
- k. Based on an average of three persons per household for the socioeconomic ROI (USCB 2021) and the conservative assumption that new direct SNL/NM workers and indirect workers would move with their families.
- l. Population projection for year 2030 for the socioeconomic ROI was taken from New Mexico “State Population Trends” (UNM 2024).
- m. Socioeconomic ROI population increase of 1.3 percent would largely occur independent of SNL/NM activities. The population increase from SNL/NM workers and their families migrating to the ROI would contribute a 0.0 percent increase.

Sources: BEA 2025; BLS 2023a; UNM 2024; and USCB 2022a.

Community Services and Schools. Due to the low potential for impacts on the population, the No-Action Alternative would not affect fire protection, police protection, medical, or public school services. Demand for these services would not change compared to current conditions.

Surrounding Population Considerations. Table 5-64 summarizes potential impacts to surrounding populations. The analysis considers impacts based on income, age, language, and educational attainment to groups in the general population that may be more vulnerable to environmental impacts; impacts to tribes and tribal trust assets; and whether tribes experience impacts to their unique socioeconomic systems, lifestyles, and resources.

Surrounding populations may experience impacts related to visual resources, air quality, noise, traffic, socioeconomics, and human health. Visual resource, air quality, and noise effects would be expected to lessen with increasing distance from SNL/NM as these impacts tend to occur around a general proximity to a disturbance and attenuate farther away from the disturbance.

Primary potential impacts to visual resources from the No-Action Alternative stem from cumulative facility construction, infrastructure projects, laydown areas, and DD&D. Short-term visual effects would be associated with an increase in construction and DD&D activity. Construction activity would result in short-term, minimal adverse effects, but these areas would ultimately be largely restored to their pre-construction visual environments. After construction and DD&D actions conclude, permanent impacts on visual resources are not anticipated. Disproportionate and adverse visual impacts to at-risk populations are not anticipated.

Under this alternative, air emissions would remain consistent with average SNL/NM annual emissions. No radiological emissions would be expected during construction activities. Total radioactive air emissions would be minimal. Non-radiological air emissions from construction, DD&D, environmental remediation, and operations are anticipated to be within regulatory limits. GHG emissions would be consistent with existing SNL/NM annual GHG emissions. Minimal impact to air quality from construction activities and no impact to air quality from operations would occur. SNL/NM will continue to comply with state and local air regulation requirements. Disproportionate and adverse air emissions impacts to at-risk populations are not anticipated.

Noise impacts would be attributed to construction, DD&D, environmental remediation, operations, and associated traffic. Explosive events would conform to approved Explosive Site Plans for safety, require DAF Range Officer approval, and be subject to the requirements identified within the No-Action Alternative. BMPs would be implemented to minimize impacts to nearby areas, including communities with at-risk populations. In most cases, explosive events heard outside of the KAFB boundary resemble a dull thud or a short burst (less than 3 seconds). To minimize these noise impacts to the public, larger explosive test events may be coordinated with the SNL/NM meteorologist to ensure that tests are conducted when atmospheric conditions would minimize sound propagation (SNL 2021a). BMPs are implemented to minimize impacts on the surrounding population in the socioeconomic ROI. Most explosive events are not large and would result in minimal noise impacts. Noise impacts from repetitive UxS activities will occur intermittently and usually away from KAFB borders. UAS flights will be conducted at an altitude as high as practical to reduce noise disturbance. Noise impacts would not constitute a disproportionate and adverse impact on at-risk populations within the ROI.

Under the No-Action Alternative, no workforce increases are anticipated. As a result, no discernible changes to local traffic, onsite traffic, or onsite parking are anticipated as compared to the present baseline. Traffic impacts would not constitute a disproportionate and adverse impact on at-risk populations within the ROI.

Disproportionate and adverse health effects are measured in risks and rates that could result in increases of LCFs and other fatal or non-fatal adverse impacts on human health. Adverse health effects may include bodily impairment, infirmity, illness, or death. Disproportionate and adverse human health effects occur when risk or rate of exposure for at-risk populations appreciably exceeds risk or exposure rate for the general population. Based on the LCF risk analysis for the No-Action Alternative, radiation doses present an insignificant risk to the public compared to other daily risks (refer to Section 5.13.1). Therefore, no disproportionate and adverse human health impacts to at-risk populations would occur within the socioeconomic ROI.

Special exposure/diet pathways were evaluated to assess potential impacts to tribal and other residents whose traditional living habits and diets could potentially cause larger exposures to environmental contaminants than those experienced by the hypothetical offsite resident. Foodstuffs and pathways of specific interest consist of water, produce, game animals, game fish, and native vegetation used for medicinal purposes. NNSA concluded that there would be no detectable additional dose to individuals in the vicinity of SNL/NM whose traditional living habits and diets could potentially cause larger exposures to environmental contaminants than those experienced by the hypothetical offsite resident. Therefore, there would be no disproportionate and adverse special exposure/diet pathway impacts to at-risk populations within the socioeconomic ROI.

5.15.2 Modernized Operations Alternative

Construction and related workforce increases for the Modernized Operations Alternative are assumed to occur over a 15-year period (2026–2040). Table 5-61 shows the potential impacts on employment, population, and economic activity for the Modernized Operations Alternative.

Table 5-61. Socioeconomic Impacts from Activities at SNL/NM under the Modernized Operations Alternative

Resource/Metric	No-Action Alternative (by end of 2030)		Change to the No-Action Alternative as a Result of the Modernized Operations Alternative (by end of 2040)			Modernized Operations Alternative (by end of 2040)			Percentage Increase over No- Action Alternative %
	Full-time Personnel at SNL/NM (Operations)	Other Contractor Workers	Full-time Personnel at SNL/NM (Operations)	Other Contractor Workers	Total Change to Workforce	Full-time Personnel at SNL/NM (Operations)	Other Contractor Workers	Total Workforce	
Jobs									
Direct jobs at SNL/NM (persons)	13,078	1,300	1,882	200	2,082	14,960	1,500	16,460	14.5%
Indirect jobs created (persons)	4,819 ^a	356 ^b	694 ^a	55 ^b	749	5,513	411	5,924	14.5%
Total direct and indirect employment	17,897	1,656	2,576	255	2,831	20,473	1,911	22,384	14.5%
Total socioeconomic ROI labor force (persons) ^c	349,876		-	-	-	366,936 ^d		-	4.9%
Earnings/Value Added									
Earnings from direct jobs at SNL/NM (millions of dollars)	\$1,283.7 ^e	\$92.8 ^f	\$184.7 ^e	\$14.3 ^f	\$199.0	\$1,468.5	\$107.1	\$1,575.6	14.5%
Earnings from indirect jobs created in the socioeconomic ROI (millions of dollars) ^g	\$473.1	\$25.4	\$68.1	\$3.9	\$72.0	\$541.2	\$29.3	\$570.5	14.4%
Anticipated value added from SNL/NM (millions of dollars)	\$2,456.1 ^h	\$177.1 ⁱ	\$353.4 ^h	\$27.2 ⁱ	\$380.6	\$2,809.5	\$204.3	\$3,013.8	14.5%
Population									
Total socioeconomic ROI population	683,372 ^k		7,728 ^j	765 ^j	8,493 ^j	684,461 ^k		-	0.2% ^l

a. Indirect employment refers to a type of job that is supported by the demand created by other jobs. Indirect employment for the operational workforce was estimated using a direct-effect employment multiplier of 1.3685 (associated with “Professional, scientific, and technical services”) (BEA 2025).

b. Indirect employment refers to a type of job that is supported by the demand created by other jobs. Indirect employment for construction/DD&D was estimated using a direct-effect employment multiplier of 1.2735 (BEA 2025).

- c. Socioeconomic ROI labor force increase by the end of 2040 would largely occur independent of SNL/NM activities. The change in direct and indirect employment from SNL/NM activities would contribute a 0.8-percent increase.
- d. Calculated using the average growth rate of the historic labor force in the socioeconomic ROI (BLS 2023a) (refer to Appendix C, Section C.14.2, for methodology).
- e. Earnings were estimated using the estimated change in final demand dollars (operational workforce / change in final demand multiplier of 4.5660 [final-demand employment multiplier of 6.2486 / direct-effect employment multiplier of 1.3685]) x final-demand earnings multiplier of 0.4482 for professional, scientific, and technical services (BEA 2025).
- f. Earnings were estimated using the estimated change in final demand dollars (construction workforce / change in final demand multiplier of 5.1609 [final-demand employment multiplier of 6.5724 / direct-effect employment multiplier of 1.2735]) x final-demand earnings multiplier of 0.3686 for construction (BEA 2025).
- g. Derived from earnings from direct jobs / the number of direct jobs (persons) × the number of indirect jobs (persons).
- h. Value added was estimated using the estimated change in final demand dollars (operational workforce / change in final demand multiplier of 4.5660 [final-demand employment multiplier of 6.2486 / direct-effect employment multiplier of 1.3685]) x final-demand value added multiplier of 0.8575 for professional, scientific, and technical services (BEA 2025).
- i. Value added was estimated using the estimated change in final demand dollars (construction workforce / change in final demand multiplier of 5.1609 [final-demand employment multiplier of 6.5724 / direct-effect employment multiplier of 1.2735]) x final-demand value added multiplier of 0.7031 for construction (BEA 2025).
- j. Based on an average of three persons per household for the socioeconomic ROI (USCB 2021) and the conservative assumption that new direct SNL/NM workers and indirect workers would move with their families.
- k. Population projections for 2030 and 2040 for the socioeconomic ROI were taken from New Mexico “State Population Trends” (UNM 2024).
- l. Socioeconomic ROI population increase of 0.2 percent would largely occur independent of SNL/NM activities. The population increase from SNL/NM workers and their families migrating to the ROI would contribute a 1.2-percent increase.

Sources: BEA 2025; BLS 2023a; UNM 2024; and USCB 2022a.

Population and Housing. The population in the socioeconomic ROI in 2040 is projected to be 684,461 persons (UNM 2024), which would be a 1.4 percent increase compared to the 2022 baseline population of 674,692 (USCB 2022a). In 2040, the total employment resulting from the Modernized Operations Alternative would be 22,384 total workers (16,460 total workforce at SNL/NM and 5,924 indirect workers), which would represent about 3.3 percent of the projected 2040 population in the ROI. The increase in total workers is consistent with the projected population growth in the ROI.

The Modernized Operations Alternative would add 2,831 workers (2,082 total workforce at SNL/NM and 749 indirect workers) to the 2022 baseline of 19,553 total workers. If the 2,831 workers migrated to the ROI with their families, the projected population increase in the ROI would be approximately 8,493 persons, assuming 3 persons per household (or 2,831 multiplied by 3 persons per household),²⁰ or 1.2 percent of the projected 2040 ROI population of 684,461.

In 2022, 18,598 housing units were vacant in the socioeconomic ROI (USCB 2022b). The total employment (by the end of 2040) under this alternative would increase by 2,831 workers (2,082 total workforce at SNL/NM and 749 indirect workers). Most of the total SNL/NM workforce relocating to the ROI would be anticipated to settle in Bernalillo County. While there is a low potential for impacts on the population, the influx of total workers may increase housing needs in Bernalillo County. Current housing statistics discussed in Section 4.15.3, without changes or increase in the 15-year period of analysis, may suggest that the current housing market in the ROI would result in future unmet needs. While housing demand is predicted to increase with population, these projections are being revised to reflect significantly less projected population growth in the next 20 years, specifically in Bernalillo County. A decrease in general population projections would decrease housing demand in Bernalillo County. It is also anticipated that surrounding counties could provide additional housing for direct employees (BERNCO 2024). As a result, NNSA anticipates that by 2040 there would be adequate housing within the ROI.

Section 4.15.3 identifies median home values in the socioeconomic ROI. This SWEIS does not predict changes in housing prices; however, trends in New Mexico are following other states as median housing prices increase. As people move into the ROI and use available housing, NNSA expects housing prices would continue to increase, irrespective of the alternative selected.

Employment and Economic Activity. Table 5-61 shows that projects under this alternative would require an additional 1,882 full-time personnel at SNL/NM and up to 200 contractor workers above the workforce anticipated for the No-Action Alternative (13,078 full-time personnel at SNL/NM and 1,300 other contractor workers) by the end of 2040. This equates to 14,960 full-time personnel at SNL/NM and 1,500 other contract workers for a total workforce at SNL/NM of 16,460 by the end of 2040, a 14.5 percent increase above the No-Action Alternative.

In addition to employment impacts generated by the total SNL/NM workforce, employment at SNL/NM would generate increases in indirect employment and associated economic activity in the socioeconomic ROI. As was done for the No-Action Alternative, these indirect increases were derived using the RIMS II multipliers for the ROI. Based on the same multipliers applied to

²⁰ Assumes one worker per household and an average of three persons per household for the socioeconomic ROI (USCB 2021).

full-time personnel at SNL/NM and contractor workers, approximately 749 indirect jobs would be added to the ROI by the end of 2040.

From 2022–2040, total labor force in the socioeconomic ROI is expected to increase 8.9 percent from 336,801 workers (BLS 2023a) to 366,936 workers (refer to Appendix C, Section C.14.2, for methodology). By 2040, the total employment impact associated with the Modernized Operations Alternative would include total workforce at SNL/NM of 16,460 (14,960 full-time personnel at SNL/NM and up to 1,500 other contract workers) and 5,924 indirect workers, which equates to 22,384 total workers. This is a 14.5 percent increase compared to the No-Action Alternative and would account for 6.1 percent of the projected 2040 ROI labor force.

The value added from direct economic activity to the local economy includes employee compensation, tax on production and imports, proprietary and other property income, and indirect employment compensation. Total value added under the Modernized Operations Alternative equates to about \$3.01 billion in the socioeconomic ROI. The direct labor income impact would result in a total income impact of about \$1.58 billion in the ROI. About 71 percent of household incomes are used for housing, transportation, food, and health care (BLS 2023b); therefore, NNSA assumes that about 71 percent of this increased payroll would enter the local economy as goods and services. Some portion of construction and operational materials would be anticipated to be purchased locally and most construction/DD&D and operational workers would be drawn from within the socioeconomic ROI, resulting in regional increases in jobs. The additional anticipated expenditures by workers would generate more income and employment opportunities within the socioeconomic ROI as the expenditures filter throughout the economy.

Community Services and Schools. Due to the low potential for impacts on the population, the Modernized Operations Alternative would not affect fire protection, police protection, or medical services. This alternative would result in an estimated population increase in the socioeconomic ROI of 8,493 persons, assuming 3 persons per household (or 2,831 multiplied by 3 persons per household),²¹ or 1.2 percent of the projected 2040 ROI population of 684,461 (UNM 2024). This increase is not anticipated to change demand for these services compared to current conditions.

With regard to schools, assuming an average of 0.34 school-age children per housing unit (NAHB 2020), the maximum estimated number of school-age children associated with total employment under the Modernized Operations Alternative of 2,831 workers potentially migrating into the socioeconomic ROI would result in about 963 more children (2,831 multiplied by 0.34 average school-age children per housing unit) by 2040. Compared to the 2022–2023 school year enrollment in the ROI of 90,678 students (NCES 2021), school enrollment would increase by 1.1 percent and represent a small proportion of anticipated future enrollment. This increase in school enrollment would have minimal impacts on school services in the ROI.

Surrounding Population Considerations. Table 5-64 summarizes potential impacts to surrounding populations, which may include visual resource, air quality, noise, traffic, socioeconomic, and human health impacts. NNSA reviewed each proposed Modernized

²¹ Assumes one worker per household and an average of three persons per household for the socioeconomic ROI (USCB 2021).

Operations Alternative project. Potential impacts related to visual resources, air quality, noise and human health on surrounding populations would be similar to the No-Action Alternative.

Under the Modernized Operations Alternative, increases in the number of construction workers at SNL/NM would not impact the LOS on area roads. Once steady-state operating conditions are reached in 2040, 1,882 more workers would be anticipated if all proposed projects and activities were completed, beyond the No-Action Alternative projected level of 13,078 (about a 14 percent increase). An increase of up to 1,882 operational workers would be expected to proportionally increase the annual ADT for weekday trips at and nearby KAFB's present five gate locations. As a representative and likely bounding example of associated nearby offsite traffic effects that may be expected from this increased number of workers, a correlated daily traffic increase along the length of Eubank Boulevard could be as much as 17 percent over present-day baseline ADT value in the area if all additional workers entered and exited the site through the Eubank Gate, which would not be expected to change the LOS designation on/along Eubank Boulevard. Although the Eubank Gate will likely remain the predominant gate of use/choice for these workers through the Modernized Operations Alternative period, KAFB's other gates would also be expected to be used, but at a lesser scale/frequency. Disproportionate and adverse impacts to at-risk populations are not anticipated.

The socioeconomic ROI is anticipated to benefit from employment opportunities associated with this alternative and resulting additional expenditures by workers. While potential for impacts on population is low, the influx of total workers may increase housing needs in Bernalillo County; however, it is anticipated that surrounding counties could provide additional housing for direct employees (BERNCO 2024) and that by 2040 there would be adequate housing in the ROI.

Projected annual LCFs and average annual dose to the public could increase under the Modernized Operations Alternative compared to the No-Action Alternative; however, they would remain well below regulatory limits (refer to Section 5.13.2). Based on LCF risk analysis, radiation doses under this alternative present an insignificant risk to the public compared to other daily risks (driving, accidents, etc.) and illnesses (non-radiation induced cancers, heart disease, etc.). Therefore, there would be no disproportionate and adverse impacts to at-risk populations within the socioeconomic ROI.

5.15.3 Expanded Operations Alternative

Under the Expanded Operations Alternative, workforce increases for construction and operations include those related to the actions under the Modernized Operations Alternative. Construction for the Expanded Operations Alternative is assumed to occur over a 15-year period (2026–2040). Table 5-62 shows the potential impacts on employment, population, and economic activity for the Expanded Operations Alternative.

Population and Housing. The 2040 population in the socioeconomic ROI is projected to be 684,461 persons (UNM 2024), a 1.4 percent increase compared to the 2022 baseline population of 674,692 (USCB 2022a). In 2040, total employment under the Expanded Operations Alternative would be 26,857 total workers (19,750 total workforce at SNL/NM and 7,107 indirect workers), which would represent about 3.9 percent of the projected 2040 population in the ROI. The increase in total workers is consistent with projected population growth in the ROI.

The Expanded Operations Alternative would add 7,304 workers (5,372 total workforce at SNL/NM and 1,932 indirect workers) to the 2022 baseline of 19,553 total workers. If the 7,304 additional workers migrated to the ROI with their families, the projected population increase in the ROI would be about 21,912, assuming 3 persons per household (7,304 multiplied by 3 persons per household),²² or 3.2 percent of the projected 2040 ROI population of 684,461.

Total employment (by the end of 2040) under this alternative would increase by 7,304 workers (5,372 total workforce at SNL/NM and 1,932 indirect workers). NNSA anticipates that impacts to housing under this alternative would be similar to those discussed in Section 5.15.2 for the Modernized Operations Alternative.

Employment and Economic Activity. Table 5-62 shows that fully completed projects under this alternative could add up to an additional 4,872 full-time personnel at SNL/NM and up to 500 contractor workers above the No-Action Alternative (13,078 full-time personnel at SNL/NM and 1,300 other contractor workers) by the end of 2040. This equates to 17,950 full-time personnel at SNL/NM and 1,800 other contractor workers for a total workforce at SNL/NM of 19,750 by the end of 2040. This is a 37.4 percent increase above the No-Action Alternative.

In addition to employment impacts generated by the total workforce at SNL/NM, employment at SNL/NM would generate increases in indirect employment and associated economic activity in the socioeconomic ROI. As was done for the No-Action Alternative, these indirect increases were derived using the RIMS II multipliers for the socioeconomic ROI. Based on the same multipliers applied to full-time personnel at SNL/NM and contractor workers, approximately 1,932 indirect jobs would be added to the ROI by the end of 2040.

From 2022–2040, the total labor force in the socioeconomic ROI is expected to increase 8.9 percent from 336,801 workers to 366,936 workers (BLS 2023a). By 2040, the total employment impact associated with the Expanded Operations Alternative would include the total workforce at SNL/NM of 19,750 (17,950 full-time personnel at SNL/NM and up to 1,800 other contract workers) and 7,107 indirect workers, which equates to 26,857 total workers. This is a 37.4 percent increase compared to the No-Action Alternative and would account for 7.3 percent of the projected 2040 ROI labor force.

Total value added to the local economy under the Expanded Operations Alternative equates to approximately \$3.62 billion in the socioeconomic ROI. The direct labor income impact would result in a total income impact of about \$1.89 billion in the socioeconomic ROI. About 71 percent of household incomes are used for housing, transportation, food, and health care (BLS 2023b); therefore, NNSA assumes that approximately 71 percent of this increased payroll would enter the local economy as goods and services. Some portion of construction and operational materials is anticipated to be purchased locally and that most construction/DD&D and operational workers would be drawn from within the ROI, resulting in regional increases in jobs. The additional anticipated expenditures by workers would generate more income and employment opportunities within the ROI as the expenditures filter throughout the economy.

²² Assumes one worker per household and an average of three persons per household for the socioeconomic ROI (USCB 2021).

Table 5-62. Socioeconomic Impacts from Activities at SNL/NM under the Expanded Operations Alternative

Resource/Metric	No-Action Alternative (by end of 2030)		Change to the No-Action Alternative as a Result of the Expanded Operations Alternative (by end of 2040)			Expanded Operations Alternative (by end of 2040)			Percentage Increase over No-Action Alternative %
	Full-time Personnel at SNL/NM (Operations)	Other Contractor Workers	Full-time Personnel at SNL/NM (Operations)	Other Contractor Workers	Total Change to Workforce	Full-time Personnel at SNL/NM (Operations)	Other Contractor Workers	Total Workforce	
Jobs									
Direct jobs at SNL/NM (persons)	13,078	1,300	4,872	500	5,372	17,950	1,800	19,750	37.4%
Indirect jobs created (persons)	4,819 ^a	356 ^b	1,795 ^a	137 ^b	1,932	6,614	493	7,107	37.3%
Total direct and indirect employment	17,897	1,656	6,667	637	7,304	24,564	2,293	26,857	37.4%
Total socioeconomic ROI labor force (persons) ^c	349,876 ^d		-	-	-	366,936 ^d		-	4.9
Earnings/Value Added									
Earnings from direct jobs at SNL/NM (millions of dollars)	\$1,283.7 ^e	\$92.8 ^f	\$478.2 ^e	\$35.7 ^f	\$513.9	\$1,762.0	\$128.5	\$1,890.5	37.3%
Earnings from indirect jobs from SNL/NM in the socioeconomic ROI (millions of dollars) ^g	\$473.1	\$25.4	\$176.2	\$9.8	\$186.0	\$649.2	\$35.2	\$684.4	37.3%
Value added from SNL/NM (millions of dollars)	\$2,456.1 ^h	\$177.1 ⁱ	\$915.0 ^h	\$68.1 ⁱ	\$983.1	\$3,371.0	\$245.2	\$3,616.2	37.3%
Population									
Total socioeconomic ROI population	683,372 ^k		20,001 ^j	1,991 ^j	21,912 ^j	684,461 ^k		-	0.2% ^l

a. Indirect employment refers to a type of job that is supported by the demand created by other jobs. Indirect employment for the operational workforce was estimated using a direct-effect employment multiplier of 1.3685 (associated with “Professional, scientific, and technical services”) (BEA 2025).

b. Indirect employment refers to a type of job that is supported by the demand created by other jobs. Indirect employment for construction/DD&D was estimated using a direct-effect employment multiplier of 1.2735 (BEA 2025).

c. Socioeconomic ROI labor force increase by the end of 2040 would largely occur independent of SNL/NM activities. The change in direct and indirect employment from SNL/NM activities would contribute a 2.0-percent increase.

d. Calculated using the average growth rate of the historic labor force in the socioeconomic ROI (BLS 2023a) (refer to Appendix C, Section C.14.2, for methodology).

- e. Earnings were estimated using the estimated change in final demand dollars (operational workforce / change in final demand multiplier of 4.5660 [final-demand employment multiplier of 6.2486 / direct-effect employment multiplier of 1.3685]) x final-demand earnings multiplier of 0.4482 for professional, scientific, and technical services (BEA 2025).
- f. Earnings were estimated using the estimated change in final demand dollars (construction workforce / change in final demand multiplier of 5.1609 [final-demand employment multiplier of 6.5724 / direct-effect employment multiplier of 1.2735]) x final-demand earnings multiplier of 0.3686 for construction (BEA 2025).
- g. Derived from earnings from direct jobs / the number of direct jobs (persons) × the number of indirect jobs (persons).
- h. Value added was estimated using the estimated change in final demand dollars (operational workforce / change in final demand multiplier of 4.5660 [final-demand employment multiplier of 6.2486 / direct-effect employment multiplier of 1.3685]) x final-demand value added multiplier of 0.8575 for professional, scientific, and technical services (BEA 2025).
- i. Value added was estimated using the estimated change in final demand dollars (construction workforce / change in final demand multiplier of 5.1609 [final-demand employment multiplier of 6.5724 / direct-effect employment multiplier of 1.2735]) x final-demand value added multiplier of 0.7031 for construction (BEA 2025).
- j. Based on an average of three persons per household for the socioeconomic ROI (USCB 2021) and the conservative assumption that new direct SNL/NM workers and indirect workers would move with their families.
- k. Population projections for 2030 and 2040 for the socioeconomic ROI were taken from New Mexico “State Population Trends” (UNM 2024).
- l. Socioeconomic ROI population increase of 0.2 percent would largely occur independent of SNL/NM activities. The population increase from SNL/NM workers and their families migrating to the ROI would contribute a 3.2 percent increase.

Sources: BEA 2025; BLS 2023a; UNM 2024; and USCB 2022a.

Community Services and Schools. Due to low potential for impacts on the population, the Expanded Operations Alternative would not affect fire protection, police protection, or medical services. This alternative would result in a population increase in the socioeconomic ROI of 21,912, assuming 3 persons per household (or 7,304 multiplied by 3 persons per household),²³ or 3.2 percent of the projected 2040 ROI population of 684,461 (UNM 2024). This increase is not anticipated to change the demand for these services compared to current conditions.

With regard to schools, assuming an average of 0.34 school-age children per housing unit (NAHB 2020), the maximum number of school-age children associated with total employment under the Expanded Operations Alternative of 7,304 potentially migrating into the socioeconomic ROI would be 2,483 children (7,304 multiplied by 0.34 average school-age children per housing unit) by 2040. Compared to the 2022–2023 school year enrollment in the ROI of 90,678 students (NCES 2021), the increase in school enrollment would be 2.7 percent and would represent a small proportion of anticipated future enrollment. This minimal increase in school enrollment would have minimal effect on school services in the ROI.

Surrounding Population Considerations. Table 5-64 summarizes potential visual resource, air quality, noise, traffic, socioeconomic, and human health impacts to surrounding populations.

Primary potential impacts to visual resources during the Expanded Operations Alternative stem from the PV + CSP project; NSTTF PV Field; PV Installation Assemblage; expanded UxS operations; and new facilities, including the NGPP and CREST Complex (refer to Section A.3.4 for detailed discussion of these actions). For the PV + CSP project, the CSP component would introduce a new vertical element into the landscape that could alter the visual balance of the landscape and may reflect sunlight, causing glare or visual disturbances, and contrast with the surrounding environment. The elevation of the viewer relative to the proposed CSP tower would have a notable effect on perceived visual impacts, and the project would generally be visible from longer distances for viewers at higher elevation. Under this alternative, KAFB-West would experience an increase in its VRM class due to the two proposed utility-scale solar installations. These projects would amplify existing visual impacts from SNL/NM operations on adjacent residential developments and Pueblo of Isleta lands. One project proposed in KAFB-East involves installation of 3.3 acres of new fencing that would be associated with the proposed land transfer from the Forest Service to NNSA. This would represent a minimal change to the viewshed, likely only visible to members of the public hiking in this area. Populations adjacent to KAFB-West may experience impacts; however, impacts would not be disproportionate and adverse to at-risk populations within the socioeconomic ROI.

Under the Expanded Operations Alternative, total non-construction-related air emissions are expected to increase by about 62 percent compared to the No-Action Alternative, primarily from the increase in employee commuting. The increase in air emissions would have a minimal negative impact on local air quality. The increase in HAP emissions would be concentrated in existing commuter corridors to and within SNL/NM and are expected to have a minimal negative health impact in these areas. No radiological emissions would be expected during construction activities under this alternative. Once operational, Expanded Operations Alternative projects,

²³ Assumes one worker per household and an average of three persons per household for the socioeconomic ROI (USCB 2021).

specifically the CREST Complex and NGPP Facility, would have potential to generate additional radiological emissions. While potential air quality impacts would increase compared to the No-Action and Modernized Operations Alternatives, impacts would remain minimal. Impacts would not be disproportionate and adverse to at-risk populations within the socioeconomic ROI.

Under this alternative, explosive frequency is anticipated to increase by up to 50 percent, with all types and sizes of explosives; however, magnitude of an explosive event would not change. Requirements for each explosive event would minimize impacts to nearby areas. Under this alternative, the number of UGS days would increase and UAS flight days would increase by almost 60 percent compared to the No-Action Alternative. More frequent flights would not increase the magnitude of noise impact from the UAS. Noise impacts from UAS flights would be perceptible above a conversational level only within 2,900 feet of the UAS. Other UxS events would not be perceptible outside of the KAFB boundary. FAA regulations, DAF Range Officer, and BMPs would be applied to minimize flights and explosive activities during culturally sensitive events. Noise impacts would not constitute a disproportionate and adverse impact on at-risk populations within the socioeconomic ROI.

Under the Expanded Operations Alternative, increases in the number of construction workers at SNL/NM would not impact the LOS on area roads. Once steady-state operating conditions are reached in 2040, 4,872 more workers are expected to be added to the site workforce beyond the No-Action Alternative projected level of 13,078 (about a 37 percent increase). An increase of 4,872 operational workers would be expected to proportionally increase the annual ADT for weekday trips at and nearby KAFB's presently used five gate locations. As a representative and likely bounding example of associated nearby offsite traffic effects that may be expected from this increased number of workers, a correlated daily traffic increase along the length of Eubank Boulevard could be as much as 44 percent over the present-day baseline ADT value in the area, if all additional workers were to enter and exit the site through the Eubank Gate, which could hypothetically be enough to exacerbate traffic and ultimately change the LOS designation on/along Eubank Boulevard. Although the Eubank Gate will likely remain the predominant gate of use/choice for these workers through the Expanded Operations Alternative period, KAFB's other gates would also be expected to be used, but at a lesser scale/frequency. Projected increases in the workforce would also increase onsite traffic and onsite parking needs. To accommodate increased onsite traffic and onsite parking needs, the Expanded Operations Alternative includes proposals to construct four covered-parking structures in TA-I, newly dedicated parking garages within both TA-II and TA-IV, and potential road/lane widenings in certain areas across the site.

The socioeconomic ROI is anticipated to benefit from employment opportunities associated with this alternative and additional expenditures by workers. While the influx of total workers may increase housing needs in Bernalillo County, it is anticipated that surrounding counties could provide additional housing for direct employees (BERNCO 2024) and that by 2040 there would be adequate housing within the ROI.

Projected annual LCFs and average annual dose to the public could increase compared to the No-Action Alternative; however, they would remain well below regulatory limits (refer to Section 5.13.3). Based on LCF risk analysis, radiation doses under this alternative present insignificant risk to the public compared to other daily risks (driving, accidents, etc.) and illnesses (non-radiation induced cancers, heart disease, etc.). No disproportionate and adverse impacts to at-risk populations are expected in the socioeconomic ROI.

5.15.4 Summary of Socioeconomic Impacts for the Alternatives

Operations and proposed projects under all alternatives would produce mostly positive impacts in the socioeconomic ROI. Under all alternatives, SNL/NM would continue to make significant economic contributions to the ROI by directly supporting thousands of jobs and enhancing the local economy through annual earnings that increase consumer spending. SNL/NM adds value to the regional economy, boosting overall economic activity and tax revenues. SNL/NM is also dedicated to strengthening national and regional economics by providing contracting opportunities for small and disadvantaged businesses and facilitating networking and collaboration with larger organizations. Additionally, SNL/NM invests in local education and workforce development, preparing residents for high-demand jobs, and encourages infrastructure growth that attracts more businesses to the area (SNL 2023l). As summarized in Table 5-63, annual earnings from total employment at SNL/NM and indirect jobs would increase under both the Modernized Operations and Expanded Operations Alternatives compared to the No-Action Alternative. Earnings from total employment at SNL/NM and indirect jobs under the Modernized Operations Alternative would increase by about \$271 million (14.4 percent) compared to the No-Action Alternative. In contrast, the Expanded Operations Alternative would increase earnings from total employment at SNL/NM and indirect jobs by about \$699.9 million (37.3 percent) compared to the No-Action Alternative.

As discussed in Section 4.15.5, percentages for income, age, language, educational attainment, and tribal populations in the ROI are lower than for New Mexico as a whole. NNSA analyzed each resource area for potentially disproportionate and adverse impacts to surrounding populations, including tribes, in Table 5-63 and Table 5-64. Recognizing that tribal populations may use or value potentially affected resources differently, potential impacts to tribes are minimal and would not be disproportionate to those that would be experienced by the general population. Additionally, SNL/NM use of BMPs would also minimize or reduce operational and proposed projects' potential impacts. These BMPs are discussed in Section 5.16 for several resource areas.

Based on the analysis of impacts for the resource areas in this SWEIS, and as shown in Table 5-64, disproportionate and adverse impacts to at-risk populations from activities proposed under any of the alternatives would be unlikely. Potential impacts related to visual resources, air quality, noise, traffic, socioeconomics, and human health would not constitute a disproportionate and adverse impact to the at-risk populations in the ROI compared to impacts to the general population of New Mexico.

Table 5-63. Potential Socioeconomic Impacts for the Alternatives

Resource/ Metric	Existing Environment (2022 Baseline)	No-Action Alternative (by end of 2030)	No-Action Alternative Increase over 2022 Baseline (%)	Modernized Operations Alternative (by end of 2040)	Modernized Operations Alternative Increase over No-Action Alternative (%)	Expanded Operations Alternative (by end of 2040)	Expanded Operations Alternative Increase over No-Action Alternative (%)
Net Increase in Direct SNL/NM Jobs	14,378 ^a	14,378	0.0%	16,460	14.5%	19,750	37.4%
Net Increase in Indirect Jobs	5,175	5,175	0.0%	5,924	14.5%	7,107	37.3%
Total Socio-economic ROI Labor Force	336,801	349,876	3.9%	366,936	4.9%	366,936	4.9%
Annual Earnings from Direct Jobs at SNL/NM (millions of dollars)	\$1,376.5	\$1,376.5	0.0%	\$1,575.6	14.5%	\$1,890.5	37.3%
Annual Earnings from Indirect Jobs (millions of dollars)	\$498.5	\$498.5	0.0%	\$570.5	14.4%	\$684.4	37.3%
Total Annual Value Added to the Socioeconomic ROI Economy (millions of dollars)	\$2,633.2	\$2,633.2	0.0%	\$3,013.8	14.5%	\$3,616.2	37.3%
Additional School Children Added to the Socioeconomic ROI	6,648	6,648	0.0%	963	14.5%	2,483	37.4%
Housing Units Occupied by SNL/NM Workforce ^b	14,378	14,378	0.0%	16,460	14.5%	19,750	37.4%

a. Baseline direct SNL/NM employment is based on 2022 employment.

b. Assuming one SNL/NM worker per household.

Table 5-64. Summary of Potential Impacts to At-Risk Populations for the Alternatives

Resource/ SWEIS Section	No-Action	Modernized Operations	Expanded Operations
Land use and airspace/5.2	Land use designations would not change. Enduring land disturbance from permanent facilities is compatible with existing and planned land uses at SNL/NM. Activities under each alternative represent a continuation of existing land uses, so they would be compatible with existing and approved future SNL/NM land uses. Increase in facility square footage would be consistent with historical growth at SNL/NM. No proposed projects or actions would change, disrupt, or otherwise impact current use, management, or operational procedures of existing airspace under all alternatives. Disproportionate and adverse impacts to at-risk populations in the socioeconomic ROI are not anticipated.		
Visual resources/5.3	VRM class would not change in the long-term. Potential visual resource impacts under the No-Action Alternative stem from cumulative facility construction, infrastructure projects, laydown areas, and DD&D. Modernized Operations Alternative projects would continue past and present industrial and commercial uses and would not introduce visual change in the built environment. Short-term visual effects would be associated with increased construction and DD&D in some areas. TA-III, TA-V, and KAFB-East would not have short-term rises in VRM class due to restrained number and size of proposed facilities and actions under each alternative. After construction and DD&D, permanent impacts on visual resources are not anticipated. Disproportionate and adverse impacts on at-risk populations in the socioeconomic ROI are not anticipated.		KAFB-West could see both short-term and long-term reclassifications to its VRM rating. Actions with potential for adverse visual impacts include the PV + CSP project; NSTTF PV Field; PV Installation Assemblage; expanded UxS operations; and new facilities, including the NGPP and CREST Complex (refer to Section A.3.4 for details on these actions). These projects would amplify existing visual impacts from SNL/NM operations on sites adjacent to residential developments and Pueblo of Isleta lands. One project proposed in KAFB-East would represent a minimal change to the viewshed, likely only visible to members of the public hiking in this area. The populations adjacent to KAFB-West may experience impacts; however, impacts would not be disproportionate and adverse to at-risk populations in the socioeconomic ROI.
Geology and soils/5.4	About 13.1 acres of soil would be disturbed on undeveloped land under the No-Action Alternative; 42 acres under the Modernized Operations Alternative; and 1,542.1 acres (73.8 acres for facilities, 3 acres for a utility corridor, 1 acre for a substation, 20 acres for roads, 3.3 acres for fencing, and 1,441 acres for expanded energy projects and infrastructure) under the Expanded Operations Alternative. No activities would significantly impact soil erosion potential, legacy contamination level would not increase, and no known mineral resources would be adversely affected. Disproportionate and adverse impacts on at-risk populations in the socioeconomic ROI are not anticipated.		
Water resources/5.5	Surface water impacts due to increased sediment load, increased water flow volumes, contamination released to surface water and floodplains, and potential for contaminant releases under all alternatives would be minimal. Surface water, groundwater, drinking water, and outfall water quality monitoring would continue as required. Disproportionate and adverse impacts on at-risk populations in the socioeconomic ROI are not anticipated.		

Resource/ SWEIS Section	No-Action	Modernized Operations	Expanded Operations
Air quality/5.6	A small emissions increase would occur compared to the current average annual emissions at SNL/NM. No radiological emissions would be expected due to construction activities. Total radioactive air emissions would be small (refer to Table 5-15). Non-radiological air emissions from construction, DD&D, environmental remediation, and operations are anticipated to be within regulatory limits (with additional projected emissions within the Modernized Operations Alternative). GHG emissions would decrease slightly for the No-Action Alternative and increase slightly for the Modernized Operations Alternative compared to existing SNL/NM annual GHG emissions. There would be minimal impact to air quality from construction activities and operations. No disproportionate and adverse impacts on at-risk populations in the socioeconomic ROI are anticipated.		A small emissions increase would occur compared to average annual emissions at SNL/NM. Annual operation emissions are expected to increase more than under the No-Action and Modernized Operations Alternatives due to increased fuel usage and employee commuting. Total non-construction-related air emissions are expected to increase by about 62 percent compared to the No-Action Alternative, mostly from increased employee commuting. Explosive events would increase compared to the No-Action and Modernized Operations Alternatives. The small increase in air emissions would have minimal negative impact on local air quality. Increased HAP emissions would be concentrated in existing commuter corridors to and in SNL/NM and are expected to have minimal negative health impact in these areas. No radiological emissions would be expected due to Expanded Operations Alternative construction. Once operational, projects, specifically the CREST Complex and NGPP Facility, could generate additional radiological emissions. Compared to No-Action Alternative radiological emissions, radioactive air emissions for this alternative are expected to increase by about 35 Ci per year, with tritium and noble gases accounting for most of the increase. A small GHG emissions increase would be associated with ongoing operations compared to the No-Action Alternative. New facility construction and existing facility upgrades would temporarily increase GHG emissions, but additional projects reducing GHG emissions would offset this by producing energy, including the EDAF, ECIL, and PV + CSP projects. Potential air quality impacts would increase compared to the No-Action and Modernized Operations Alternatives, but air quality impacts would remain minimal. Impacts would not be disproportionate and adverse to at-risk populations in the socioeconomic ROI.
Noise/5.7	Noise impacts for all alternatives would be attributed to construction, DD&D, environmental remediation, operations, and associated traffic. Maximum construction noise is expected to be the same under all alternatives. Noise impacts from repetitive UAS activities will occur intermittently and be conducted at an altitude as high as practical to reduce noise disturbance.		

Resource/ SWEIS Section	No-Action	Modernized Operations	Expanded Operations
Noise/5.7	Given the remote location of explosives test sites, noise is expected to attenuate before reaching residential areas. Explosive events heard outside KAFB mostly resemble a dull thud or short burst (less than 3 seconds). To minimize noise impacts, explosive test events expected to produce noise levels exceeding 140 dB offsite may be coordinated with the SNL/NM meteorologist to minimize sound propagation (SNL 2021a). UAS flights and explosive activities would be minimized during culturally sensitive events. Other testing, such as rocket motors, gun firing, and sled track and aerial cable collisions, would generate less noise than explosive detonations (SNL 1994). Explosive event or collisions vibration radius would depend on explosion size and test area geology. No facility or structure damage is expected beyond KAFB. Noise impacts would not constitute a disproportionate and adverse impact on at-risk populations in the socioeconomic ROI.	Temporary noise impact frequency would increase compared to the No-Action Alternative and is not expected to exceed 91 dBA. Expected explosive frequency, magnitude of explosives used, or UAS frequency or use would not change compared to the No-Action Alternative. UAS flights and explosive activities would be minimized during culturally sensitive events. Noise impacts would not constitute a disproportionate and adverse impact on at-risk populations in the socioeconomic ROI.	NNSA anticipates explosive frequency to increase by up to 50 percent under this alternative, with all types and sizes of explosives; however, there is no change in the magnitude of any explosive event. Management controls for each explosive event would minimize impacts to nearby areas. The number of UAS flights within this alternative would increase compared to the No-Action Alternative. More frequent flights would not increase the magnitude of noise impact from the UAS. As detailed in the No-Action Alternative, noise impacts from UAS flights would be perceptible above a conversational level only within 2,900 feet of the UAS. Other UxS events are not perceptible outside of the KAFB boundary. Flights and explosive activities would be minimized during culturally sensitive events. Noise impacts would not constitute a disproportionate and adverse impact on at-risk populations in the socioeconomic ROI.
Biological resources/5.8	Clearing previously undisturbed vegetation for SNL/NM facility construction and infrastructure would be the primary impact. Potential impacts would occur onsite, so disproportionate and adverse impacts on at-risk populations in the socioeconomic ROI are not anticipated.		Expanded energy projects on 1,441 acres would impact vegetation, wildlife, and special status species on grasslands. Potential impacts would occur onsite, so disproportionate and adverse impacts on at-risk populations within the socioeconomic ROI are not anticipated.
Cultural and paleontological resources/5.9	No direct impacts are expected on prehistoric or historic archaeological sites and paleontological resources; disproportionate and adverse impacts on at-risk populations within the socioeconomic ROI are not anticipated.		Development activities could impact historic properties, but archaeological surveys and/or monitoring and New Mexico SHPO consultation and reporting would alleviate impacts. Disproportionate and adverse impacts on at-risk populations in the socioeconomic ROI are not anticipated.

Resource/ SWEIS Section	No-Action	Modernized Operations		Expanded Operations																																								
Traffic and transportation/ 5.10	Under the No-Action Alternative, no workforce increases are anticipated; no discernible changes to local traffic, onsite traffic, or onsite parking are anticipated as compared to the present baseline. Under the Modernized Operations and the Expanded Operations Alternatives, increased number of construction workers at SNL/NM would not impact LOS on area roads. Once steady-state operating conditions are reached in 2040, increased workforce would increase onsite traffic and onsite parking needs. An increased number of workers under the Modernized Operations Alternative would not change the Eubank Boulevard LOS, but an increased number of workers under the Expanded Operations Alternative would exacerbate traffic and could change the Eubank Boulevard LOS. To accommodate increased onsite traffic and onsite parking needs, the Expanded Operations Alternative includes proposals to construct four covered-parking structures in TA-I. Impacts from transporting radioactive materials and waste over each alternative’s proposed 15-year duration are summarized in the following table for all three alternatives. Under all alternatives, annualized risk of a traffic accident fatality is greater than annualized risk of an additional LCF due to potential radiological exposure from an accident.																																											
<table><tr><th rowspan="3">Alternative</th><th colspan="4">Incident-Free ^a</th><th colspan="2">Accident ^a</th></tr><tr><th colspan="2">Crew</th><th colspan="2">Population</th><th rowspan="2">Annualized Radiological Risk (LCFs/yr)</th><th rowspan="2">Non-Radiological Risk (# of traffic-accident fatalities/yr)</th></tr><tr><th>Total Dose (person-rem)</th><th>Total Risk (LCFs)</th><th>Total Dose (person-rem)</th><th>Total Risk (LCFs)</th></tr><tr><td>No-Action – 15 years of shipping, total</td><td>6.18</td><td>0.0037</td><td>2.50</td><td>.00015</td><td>0.00000054</td><td>0.00075</td></tr><tr><td>Modernized Operations – 15 years of shipping, total</td><td>6.28</td><td>0.0038</td><td>2.53</td><td>0.0015</td><td>0.00000054</td><td>0.00076</td></tr><tr><td>Expanded Operations – 15 years of shipping, total</td><td>10.4</td><td>0.0062</td><td>4.01</td><td>0.0024</td><td>0.000000081</td><td>0.0011</td></tr></table>							Alternative	Incident-Free ^a				Accident ^a		Crew		Population		Annualized Radiological Risk (LCFs/yr)	Non-Radiological Risk (# of traffic-accident fatalities/yr)	Total Dose (person-rem)	Total Risk (LCFs)	Total Dose (person-rem)	Total Risk (LCFs)	No-Action – 15 years of shipping, total	6.18	0.0037	2.50	.00015	0.00000054	0.00075	Modernized Operations – 15 years of shipping, total	6.28	0.0038	2.53	0.0015	0.00000054	0.00076	Expanded Operations – 15 years of shipping, total	10.4	0.0062	4.01	0.0024	0.000000081	0.0011
Alternative	Incident-Free ^a				Accident ^a																																							
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a. Cumulative risks from shipments over the entire action period (15 years for all alternatives) are shown for incident-free transportation; annualized risks over the action period are presented for accidents.																																												
Based on radioactive materials and waste transportation impacts under all three alternatives, potential impacts on at-risk populations in the socioeconomic ROI would not be disproportionate and adverse compared to impacts on the general population, as potential impacts would be experienced across all populations.																																												
Infrastructure/ 5.11	For all alternatives, water and electricity consumption would increase to meet needs for construction, DD&D, environmental remediation, and operations. However, SNL/NM’s infrastructure has sufficient capacity to meet all requirements, and the need for these utilities would not disproportionately impact at-risk populations. Consumption of fuel is expected to minimally increase with each of the alternatives. Natural gas usage is expected to increase for both the Modernized Operations and Expanded Operations Alternatives as compared to the No-Action Alternative. Utility consumption and infrastructure are not expected to result in a disproportionate and adverse impact to at-risk populations within the socioeconomic ROI.																																											
Waste management/ 5.12	Annual waste projections would increase under all alternatives for radioactive and hazardous wastes generated at SNL/NM. Use and presence of radioactive/hazardous materials at SNL/NM would increase to some extent, but additional radioactive/hazardous materials likely would be the same or similar to materials already used at SNL/NM. Thus, potential additional radioactive and hazardous wastes generated at SNL/NM are not expected to result in a disproportionate and adverse impact to the at-risk populations within the socioeconomic ROI.																																											

Resource/ SWEIS Section	No-Action	Modernized Operations	Expanded Operations	
Human health/5.13	Potential radiological impacts to human health are summarized in the following table for all populations in the socioeconomic ROI. Exposures of special receptors, which could include at-risk populations, are slightly higher than for the offsite MEI.			
	Resource/Metric	No-Action Alternative	Modernized Operations Alternative	Expanded Operations Alternative
	Offsite MEI risk (LCF)	0.0000000039	0.0000000099	0.000000015
	Population within 50 miles (LCF)	0.000014	0.00002	0.00003
	Collective total effective dose to workers (person-rem)	2.38	9.5	21.1
	Total annual radiological risk to workers (LCFs)	0.0014	0.0057	0.013
	Lost days due to injury/illness per year	384	440	524
	Number of occupational fatalities per year	1.0	1.1	1.3
	SNL/NM continuously monitors, evaluates, and reports all radioactive emissions from its site that could impact the public. The calculated radiation doses from air emissions to the offsite MEI under the No-Action Alternative (0.0066 mrem in a year) and the Expanded Operations Alternative (0.025 mrem in a year) are significantly less than all regulatory limits (10 mrem in a year for the air pathway). To compare these doses to the annual average naturally occurring background dose (no man-made sources) of 346 mrem in Albuquerque, New Mexico (about 1 mrem a day), 40 years of dose from SNL/NM operations would equal 1 day of naturally occurring background radiation dose. Average annual dose to the public (all people in a 50-mile radius of SNL/NM) under the No-Action Alternative is 0.023 person-rem. This could increase in the future under the Expanded Operations Alternative to 0.05 person-rem. Based on LCF risk analysis, these radiation doses present an insignificant risk to the public compared to other daily risks (driving, accidents, etc.) and illnesses (non-radiation-induced cancers, heart disease, etc.). No disproportionate and adverse impact to at-risk populations in the socioeconomic ROI would occur. Special exposure/diet pathways were evaluated to assess the potential impacts to tribal and other residents whose traditional living habits and diets could potentially result in greater exposure to environmental contaminants than for the hypothetical offsite resident. The foodstuffs and pathways of specific interest consist of water, produce, game animals, game fish, and native vegetation used for medicinal purposes. NNSA concluded that there would be no detectable additional dose to any individuals in the vicinity of SNL/NM whose traditional living habits and diets could potentially result in greater exposure to environmental contaminants than for the hypothetical offsite resident. Therefore, there would be no disproportionate and adverse impact to at-risk populations within the socioeconomic ROI.			
Accident analysis and IDAs/5.14	For all alternatives, potential risk to the population within 50 miles of the site would depend on total population and relative proximity to the site. Impacts to at-risk populations are expected to be similar to those that would be experienced by the general population; therefore, accidents and IDAs are not anticipated to result in disproportionate and adverse impact to at-risk populations within the socioeconomic ROI.			
Socioeconomics/5.15	Increases of direct and indirect employment from construction and operation activities at SNL/NM for all alternatives would add to regional population and housing needs. Such increases in employment throughout the socioeconomic ROI would result in increased economic growth. While housing demand is predicted to increase with population, these projections are being revised to reflect significantly less projected population growth in the next 20 years in Bernalillo County (BERNCO 2024), potentially making more housing available for direct employees. Potential impacts to populations in the socioeconomic ROI include increases in demand for housing and community services. Potential impacts to at-risk populations in the socioeconomic ROI may occur related to visual resources, air quality, noise, and traffic. However, potential impacts are not anticipated to be disproportionate and adverse to at-risk populations in the socioeconomic ROI.			

5.16 DESIGN FEATURES, BEST MANAGEMENT PRACTICES, AND MITIGATION MEASURES

This section describes mitigation measures by resource area, including proactive measures NNSA could implement to address potential impacts of continuing to operate SNL/NM. Mitigation includes avoiding the impact altogether by not taking a certain action or parts of an action; minimizing impacts by limiting the degree or magnitude of the action and its implementation; rectifying the impact by repairing, rehabilitating, or restoring the existing environment; reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; and compensating for the impact by replacing or providing substitute resources or environments.

Each alternative may affect one or more resource areas, but most impacts would not pose potential for substantial harm to the environment or public. NNSA routinely implements measures to avoid, minimize, or reduce potential impacts of activities and proposed projects via activity planning, environmentally focused project design, and BMPs (policies, practices, and measures that reduce environmental impacts of proposed activities, functions, or processes).

All NNSA sites, including SNL/NM, operate under existing programs and controls, including BMPs, regulations, policies, contractual requirements, and administrative procedures, many of which mitigate environmental impacts from construction and operations. Existing programs and controls are too numerous to list completely (many are listed in Chapter 4 and Appendix A). Examples include fire protection, waste minimization, water conservation, and natural resource management planning programs. These programs and controls effectively reduce the need for more mitigation measures in most resource areas evaluated. All existing and planned activities would be conducted in accordance with all applicable permits, requirements, safety, and environmental controls. At SNL/NM, NNSA will also implement appropriate KAFB BMPs, standard operating procedures, and permit requirements to mitigate environmental impacts.

For new projects, NNSA would implement design features and BMPs to avoid or reduce potential environmental impacts, including on human health and safety. For example, nuclear facility designs would include features such as high-efficiency particulate air (HEPA) filtration, shielding, and seismically qualified confinement structures that minimize potential impacts to worker and public safety. Other new building construction designs could include state-of-the-art features that meet Federal Building Performance standards, including LEED Gold standards.

Table 5-65 shows potential design feature and BMP examples for new projects and identifies environmental resource areas that could benefit from them. Projects and activities would be conducted following standard practices, such as BMPs that minimize impacts on environmental resources, and according to all regulations, permits, and other applicable requirements. For all alternatives, NNSA would implement stewardship practices to protect air, water, land, and other natural and cultural resources according to an environmental management system established pursuant to DOE Order 436.1A (DOE 2023f). Appendix A, Tables A.5 and A.6, list UxS BMPs. NNSA optionally could implement more proactive mitigation measures to further avoid or minimize potential environmental impacts. Table 5-65 and Table 5-66 show examples for resource areas that could potentially benefit. If NNSA implements mitigation measures, as appropriate, NNSA would prepare a Mitigation Action Plan.

Table 5-65. Design Features and BMPs Related to Construction, DD&D, or Environmental Remediation

Design Feature or BMP	Land Use & Visual Resources	Geology and Soils	Water Resources	Air Quality & Noise	Biological Resources	Cultural Resources	Socioeconomics	Transportation	Infrastructure	Materials Management & Waste Management	Human Health and Safety	Accidents/Intentional Destructive Acts
Erosion and sediment control plans		✓	✓		✓	✓			✓			
Sequencing or scheduling of work		✓		✓	✓	✓	✓	✓	✓			
Spill prevention, control, and countermeasures		✓	✓		✓	✓					✓	
Use of low-sulfur, more-refined fuels				✓	✓			✓			✓	
Dust suppression measures	✓	✓		✓	✓						✓	
HEPA filters, ventilation systems				✓	✓						✓	✓
Silencers/mufflers, hearing protection programs				✓							✓	
Preconstruction characterization/ surveys of site		✓	✓		✓	✓					✓	
Personal protective equipment											✓	
Audits and surveys					✓	✓						

Table 5-66. Design Features and BMPs Related to Operations

Design Feature or BMP	Land Use & Visual Resources	Geology and Soils	Water Resources	Air Quality & Noise	Biological Resources	Cultural Resources	Socioeconomics	Transportation	Infrastructure	Materials Management & Waste Management	Human Health and Safety	Accidents/Intentional Destructive Acts
Water conservation practices			✓						✓			
Spill prevention, control, and countermeasures		✓	✓		✓	✓					✓	✓
Personal protective equipment				✓							✓	
Confinement and shielding systems				✓							✓	✓
Ventilation and filter systems			✓	✓	✓						✓	✓
Emergency preparedness and response plans								✓			✓	✓
Radiological protection and ALARA program		✓						✓			✓	✓
High-efficiency electric equipment/off-peak use									✓			
Waste minimization			✓					✓	✓	✓	✓	
Public outreach and training			✓		✓	✓	✓		✓		✓	
Scheduling, carpooling				✓				✓	✓			
Audits and surveys			✓	✓	✓	✓			✓			

5.16.1 Geology and Soils

The analysis in Section 5.4 shows a low potential for adverse impacts to geology and soils under all alternatives. The analysis indicates that BMPs would be employed to reduce potential for short-term impacts of construction and forest thinning on soil stability.

5.16.1.1 Construction Activities

All construction activities at SNL/NM exceeding 1 acre in area are permitted under EPA's CGP and the City of Albuquerque's fugitive dust permit. The CGP requires identification of BMP documentation to minimize erosion and other impacts to ground surface and to stabilize disturbed areas in the construction envelope when construction ends. During construction, BMPs to minimize ground surface impacts typically include perimeter fencing to constrain the project footprint, silt fencing to prevent soil loss, topsoil stockpiling and preservation, and waddle use throughout the site to slow and spread runoff to minimize erosion. Depending on project-specific locations and requirements, additional BMPs are considered. For example, using above-ground cable housing in cable trays rather than below ground trenching can decrease impacts on geology and soils within solar energy facilities (Sinha et al. 2018 and DOI 2013).

Before construction permits are terminated, all exposed ground surface is stabilized to prevent erosion and loss of soil by water or wind. Stabilization within developed portions of campus is typically done through a combination of hardscaping (paving, concrete), landscaping (xeriscaping), gravel or mulch, and native revegetation. Stabilization in remote areas or for projects that do not include buildings or above-ground facilities (e.g., utility trenches, erosion control projects, temporary fire breaks, dirt roadways) is done using native revegetation. A revegetation plan is developed that considers soil type, native vegetation type and density, ground surface terrain/slope, and climate. An erosion control contractor follows project-specific SNL/NM revegetation specification to apply a specified seed mix, soil amendments, and protective mulch layer for each individual project area (SNL 2025).

In compliance with EISA Section 438, pre-existing hydrologic conditions (runoff) are maintained with onsite water detention and reuse designs, including infiltration basins, rain gardens, curb cuts, and xeriscape features. SNL/NM development activities do not increase or otherwise alter runoff characteristics or allow for significant soil loss in or around project areas.

5.16.1.2 Forest Thinning Activities

SNL/NM does not currently conduct forest thinning. Prior to initiating forest thinning, a comprehensive forest thinning plan would be developed. SNL/NM would be anticipated to work closely with KAFB to review established practices in similar KAFB forest areas. SNL/NM would also maintain discussion with the Forest Service to conduct forest thinning in a manner that is safe and protective of the environment. Forest thinning practices should minimize disturbance to soil and retained vegetation. This should include avoiding surface disturbance practices involving heavy equipment and using hand-crews with hand-operated equipment instead. Retained vegetation would be protected from disturbance wherever possible. Temporary soil stabilization measures, such as mulching and waddles, can be used to prevent erosion during thinning operations. BMPs such as contour tree felling and lop and scatter of thinned trees across

the project area could function for both temporary and permanent soil stabilization. Permanent measures to prevent erosion and soil loss include use of riprap, boulders, and seeding as needed to establish additional vegetation to stabilize slopes.

5.16.2 Water Resources and Hydrology

Section 5.5 describes several projects adjacent to the Tijeras Arroyo and TA-III runoff pathways that could impact intermittent surface water and nearby floodplains under the Modernized and Expanded Operations Alternatives. All these are dry except for direct runoff that occurs for short durations in response to high intensity rainfall events. For proposed facilities, construction and DD&D activities could increase potential for erosion, stormwater runoff, and alteration of drainage patterns. Once operational, additional impervious surfaces could cause long-term alteration of existing surface-water drainage. Potential mitigation measures include:

- Employing low-impact development controls and facility designs, in accordance with EISA Section 438, that would incorporate permanent controls for proper stormwater management and minimize impacts to receiving waterbodies and existing hydrology during construction and operations. These measures could maintain water temperatures, flow rates, flow volumes, and durations that were present before development. Examples of appropriate controls include vegetated swales, infiltration basins, permeable pavement, vegetated strips, rain barrels, and cisterns. The goal would be to manage runoff through infiltration, evapotranspiration, or harvest and reuse.
- Developing and implementing site-specific SWPPPs to help minimize erosion and any pollution that might leave the site by stormwater.

5.16.3 Noise

Section 5.7.3 discusses that under the Expanded Operations Alternative, no change is expected in peak noise levels from aircraft, operations within SNL/NM, noise generated by explosive events, and rocket motor and gun firings. Increasing testing frequency would increase the number of explosions heard outside SNL/NM, but not the magnitude of the noise. Potential measures to mitigate these noise impacts may include continuing to coordinate explosive test events with the KAFB Range Officer to avoid potential conflicts, such as with Pueblo of Isleta cultural practices, and coordinating explosive test events with the SNL/NM meteorologist via the SNL/NM Weather Watch Program to ensure that tests are conducted when atmospheric conditions would minimize sound propagation.

5.16.4 Biological Resources

Analyses in Section 5.8 show a potential for impacts to biological resources from land disturbing activities under all alternatives, with the greatest potential under the Expanded Operations Alternative, which would have the greatest disturbed area. Proposed expanded energy projects pose risks to wildlife through land disturbance and direct impacts. These facilities could result in direct mortality to birds, bats, and other wildlife (e.g., from CSP solar flux, collisions with project hardware, increased vehicle collisions with more roads and traffic), as well as indirect impacts from loss and fragmentation of grassland habitats. Developments in Areas B, C, G, H, and I (refer to Appendix A, Figure A-14) could impact grassland-reliant wildlife, including birds;

bats; and sensitive species such as prairie dogs, migratory birds, and raptors. Section 5.8 describes mitigation measures that could reduce potential impacts of proposed projects under all alternatives on these and other biological resources. Mitigation measures could include:

- If required, developing a BBCS for each expanded energy project to minimize impacts to migratory birds and bats for solar and wind projects.
- Using underground distribution lines to minimize electrocution hazards to migratory birds, especially raptors.
- Employing bird-friendly lighting and other design features at expanded energy facilities.
- Using bird-friendly glass in new construction to minimize bird mortality from window strikes or adding bird-friendly glass retrofits to existing structures.
- Planning and conducting more bird and bat species monitoring in consultation with resource management agencies to assess baseline and potential future impacts.
- Conducting pre-construction surveys of breeding birds to avoid disruption of breeding and seasonal impacts from construction activities.
- Implementing BMPs to avoid mowing, construction, burrow filling, and poisoning during breeding season in burrowing owl inhabited areas to minimize impacts to special status species such as the western burrowing owl.
- Using wildlife-friendly fence design, including features to protect transient animals.
- Developing and implementing an invasive plant management plan to monitor and control detrimental vegetation and transport of invasive species during construction.
- Developing and implementing pollinator-friendly habitat management and conservation strategies and practices, such as using seed mixes that support Monarch butterflies, increasing flower diversity in planting, limiting mowing practices, avoiding the use of pesticides in sensitive pollinator habitats, and other measures.
- Implementing prairie dog monitoring, relocation, and best management strategies to minimize the impacts to this special status species, particularly in and adjacent to the TAs and Eubank Corridor, and to potentially reduce bird and wildlife aircraft strike hazard risks near flight lines. These measures may also reduce risks to raptors.
- Developing and implementing an INCRMP, which could benefit species that have experienced population declines at SNL/NM and may include measures in addition to those described previously (refer to Appendix A, Section A.3.4.14, for more details).
- Implementing other appropriate measures from the Association of Fish and Wildlife Agencies Solar Beneficial Management Practice Database (AFWA 2022).
- Implementing measures for UxS, including those in Appendix A, Tables A-5 and A-6.

5.16.5 Cultural Resources

Section 5.9 discusses SNL/NM activities that could impact archaeological sites, both prehistoric and historic, primarily in less developed areas, and historic properties related to SNL/NM's

evolving missions, most of which are in previously developed areas (TA-I–TA-V). Both cultural resource types are managed according to NHPA Section 106 and in consultation with the New Mexico SHPO, ACHP, tribes/pueblos with cultural affiliation, and, when appropriate, the public.

Under all alternatives, surface-disturbing activities, such as new facility construction, DD&D, and modernizations and upgrades, have potential to impact these resources. As described in Section 5.9, in addition to conducting audits and surveys, existing protocols for avoiding, minimizing, and otherwise mitigating adverse effects to historic properties, archaeological sites, and TCPs would continue to be followed under all alternatives. SNL/NM protocols include:

- (1) Avoidance of any identified existing cultural and archaeological resources;
- (2) Additional archaeological inventory prior to any ground-disturbing activities;
- (3) Evaluation of historic sites for their eligibility for listing in the NRHP, in consultation with the New Mexico SHPO and implementation of mitigation measures if an undertaking is determined;
- (4) Avoidance, minimization, or mitigation of adverse effects on historic properties;
- (5) Evaluation of newly identified sites for their eligibility for listing in the NRHP, in consultation with the New Mexico SHPO and the tribes;
- (6) Redocumentation and reevaluation of previously documented archaeological sites prior to ground-disturbing activities, in consultation with the New Mexico SHPO and the tribes;
- (7) Cessation of activities in the immediate vicinity of unexpected discoveries of indigenous cultural materials during construction or other ground disturbing operations until the significance and disposition of the resource could be determined after consultation with Department of the Air Force Cultural Resources, the New Mexico SHPO, tribes with cultural affiliation, and ACHP; and
- (8) Consultation with the appropriate Indigenous American tribes and their designated tribal historic preservation office to develop an agreement and procedure for access to TCPs.

As an additional mitigation measure, NNSA proposes to develop and implement an INCRMP to provide specific procedures and guidance to mitigate potential impacts on cultural resources.

5.16.6 Human Health

Section 5.13 analyses show that routine risks to workers and the public from ionizing radiation exposure attributable to SNL/NM operations for all alternatives are extremely small, but NNSA policy is to reduce potential exposures to as low as reasonably achievable (ALARA) levels.

Section 5.14 describes that wildfire presents a persistent threat to SNL/NM personnel, structures, infrastructure, and adjacent communities, which can be mitigated through forest management practices. Goals of forest management actions are to address ignition risk from roads, power lines, and other right-of-way infrastructure and to use mitigation treatments to remove and thin the forest to align with BMPs due to historic fire suppression that drove dangerous fuel

accumulation. Generally, this mitigation would strategically reduce dense, continuous fuels and wildland fire risk by creating a mosaic of openings, groups, and clumps and would occur in the Withdrawn Area. As described in Section 3.4.3 and Appendix A, Section A.3.4.11, NNSA plans to implement wildland fire risk reduction measures, such as strategically reducing dense, continuous fuels. NNSA would collaborate with KAFB, mimicking the KAFB Wildland Fire Management Plan 2022–2023 (KAFB 2022) to develop an SNL/NM Wildland Fire Management Plan to establish policy, procedures, and responsibilities for wildland fire management and to outline procedures, controls, and duties specific to fire suppression operations at SNL/NM.

Section 5.14.2 also identifies required mitigation measures to protect human health from potential accident consequences associated with operation of the ACRR Facility that could approach the Evaluation Guideline.²⁴ These mitigation measures would include use of experiment containment and thermal neutron shielding, which are addressed as follows:

- **Experiment Containment:** The safety function of experiment containment is to limit or reduce the release of radioactive material from experiment malfunctions that occur during reactor operations. These mitigation measures must be implemented in accordance with the active DSA for the ACRR Facility (SNL 2024f).
- **Thermal Neutron Shielding:** For experiments with greater than 12 grams Pu-239 equivalent actinides or other fissionable materials, boron-loaded shielding or equivalent thermal neutron shielding material must be installed as part of the experiment package shielding the MAR during irradiation. The shielding material will have shielding properties sufficient to limit vaporization of MAR to less than or equal to 12 grams Pu-239 equivalent for all experiments.

5.17 UNAVOIDABLE ADVERSE IMPACTS

Potential unavoidable adverse impacts of ongoing activities under each alternative generally would be minimal and incremental. This section discusses residual adverse impacts considered unavoidable after design features, BMPs, and mitigation measures are credited.

New facility, utility, and infrastructure development would affect currently undisturbed land. Activities under each alternative represent a continuation of existing land uses, so they would be compatible with existing and approved future land uses at and around SNL/NM-managed lands.

Normal SNL/NM operations release minimal radioactive material and activation products (refer to Section 4.13). Section 5.13 shows that radiation dose received by a member of the public from SNL/NM emissions is small, barely distinguishable from naturally occurring background

²⁴ Per DOE-STD-3009-2014, the concept of an Evaluation Guideline was developed to help DOE determine the rigor of controls (including defense-in-depth) needed to avoid the potential dose from an accident, the level of planning necessary to respond to given accidents, or the training needed for individuals that may be placed in situations where such doses might occur. The use of an Evaluation Guideline helps to identify and evaluate the effectiveness of safety-class structures, systems, and components that are required to minimize potential doses from an accident to offsite receptors (DOE 2014).

radiation. Even with a strong ALARA program and engineering and administrative controls, some radiological exposures to workers are anticipated but are not expected to result in LCFs.

SNL/NM operations under each alternative would have unavoidable adverse impacts from air emissions, which include various chemical or radiological constituents in routine emissions typical of nuclear facility operations. DD&D of excess buildings would result in the onetime generation of radioactive and non-radioactive waste material that would impact waste management (refer to Section 5.12). Section 5.7 discusses that noise from operations detectable at close residential locations could not be avoided under all the alternatives. The frequency and magnitude of noise impacts would be greatest under the Expanded Operations Alternative.

Temporary construction impacts, including fugitive dust generation, noise, and increased construction vehicle traffic, of SNL/NM facility construction also would be unavoidable.

Under any alternative, many different materials and waste streams would continue to be transported to and from SNL/NM facilities, which would have unavoidable adverse consequences. Transporting materials along public routes imposes unavoidable effects on the environment, including health effects from radioactive materials and truck emissions, but these effects are estimated to be small (unlikely to result in adverse health effects, such as an LCF), (refer to Section 5.10). Appendix D has more information on SNL/NM transportation operations.

5.18 RELATIONSHIP BETWEEN SHORT-TERM USES AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

Ongoing SNL/NM operations under each alternative would require short-term²⁵ and permanent commitments of certain resources (e.g., energy). Environmental resources have already been committed to continuing SNL/NM operations. More commitments would maintain existing environmental conditions with little or no impact on long-term environmental productivity.

Short-term commitments of resources would include space and materials for new buildings, new operations support facilities, transportation, and continued operations. Workers, the public, and the environment could be exposed to increased amounts of hazardous and radioactive materials over the 15-year period of this SWEIS analysis due to process emissions, DD&D and environmental remediation activities, and management of radioactive and hazardous waste.

Regardless of changes in activity levels at SNL/NM facilities, additional air emissions could introduce small amounts of radiological and non-radiological constituents to the air in the region around SNL/NM-managed lands. These emissions would result in a potential for additional exposure but would not be expected to result in an LCF and would not impact compliance with air quality or radiation exposure standards at SNL/NM. These emissions do not pose a potential for significant residual environmental effects on long-term environmental viability.

²⁵ “Short term” refers to resource commitments (e.g., land) that could last decades but ultimately be reversed. For example, a newly constructed office facility could undergo DD&D and the land put to other productive purpose. “Long term” refers to resource commitments not easily reversed, (e.g., actions resulting in contamination, rendering land unusable indefinitely for other purposes). SNL/NM does not plan to make such long-term land commitments.

Management and disposal of additional sanitary solid waste and nonrecyclable radiological waste would require use of energy and space at SNL/NM treatment and storage facilities or at offsite disposal facilities. Regardless of location, SNL/NM's solid waste needs would require a long-term commitment of terrestrial resources. Activities considered on SNL/NM-managed land, such as modernization or expansion of facilities, capabilities, or infrastructure, would result in further disturbance, use, and commitment of previously undisturbed land.

5.19 IRREVERSIBLE AND IRRETRIEVABLE RESOURCE COMMITMENTS

Continued SNL/NM operations under each alternative would require irreversible/irretrievable resource commitment (i.e., impacts from use would limit future use options; the change cannot be reversed, reclaimed, or repaired). Irreversible commitments generally occur to nonrenewable resources (e.g., minerals, energy sources, or cultural resources) and resources renewable only over a long time. For example, facilities where contaminated soils may exist would not be available for other productive use unless NNSA performed DD&D per applicable regulations.

Irretrievable commitment is use or consumption of a resource that is neither renewable nor recoverable for future generations' use. This section discusses major resources (water, land, material, and energy) committed irreversibly or irretrievably under the alternatives.

5.19.1 Water

Groundwater meets all SNL/NM water needs. Regional Aquifer demand has exceeded recharge potential in recent years, but through conservation and proper environmental reuse management, the Regional Aquifer has been recovering. Some of the water consumed by SNL/NM operations released through stormwater and wastewater conveyances may contribute to recharge of the Regional Aquifer. Water is a renewable resource globally, but large portions of water resources that support SNL/NM operations represent locally finite resource expenditure. Maximum water consumption would vary between 359 million gallons per year under the No-Action Alternative to about 411 million gallons per year under the Expanded Operations Alternative.

5.19.2 Land

Twenty-five ER sites have completed corrective action and attained the status of corrective action complete with controls (Section 4.14.3); they have been remediated to meet industrial risk-based standards. Future land uses associated with 25 ER sites are limited to industrial uses to protect human health and the environment. Additionally, industrial and use restrictions are maintained at the post-closure care units (i.e., CAMU and CWL), which require continued monitoring, controls inspection, limited access, limited use, and potentially other future corrective actions over an extended period of time.

5.19.3 Material

During the 15-year period of this SWEIS, irreversibly and irretrievably committed resources include construction, maintenance, and operational support materials, depending on the alternative. Consumption of these widely available materials is not expected to result in critical shortages. SNL/NM recycles and reuses materials to the maximum extent practicable. SNL/NM personnel are required to procure environmentally preferable products and services in a manner

that promotes expanded use of green products, reduces GHG emissions, and protects the health and well-being of building occupants and visitors. NNSA proposes to use hydrogen instead of helium in balloon applications to conserve helium, a nonrenewable resource in short supply.

5.19.4 Energy

Irretrievable resource commitment during SNL/NM facility construction and operation would include nonrenewable fuels to generate heat and power and contribute to selected R&D activities. Energy in the form of electricity and natural gas would be consumed. Electricity consumption is estimated to range from about 340,000 to 481,000 MWh per year, depending on the alternative. NNSA is pursuing options to generate more electrical power onsite from a number of proposed expanded energy sources. NNSA also fosters GHG reduction by requiring a formal approval process for all new construction over 25,000 square feet. Starting in 2026 at SNL/NM, an estimated 20 percent reduction in electrical energy use and associated GHG emissions is anticipated from purchased electrical power from the Foxtail Flats solar project.

Natural gas is planned to be continually used onsite, and usage is estimated to increase from 325 million standard cubic feet per year under the No-Action Alternative to 469 million cubic feet per year under the Expanded Operations Alternative.

6.0 REASONABLY FORESEEABLE EFFECTS OF PROPOSED ACTIONS

6.1 INTRODUCTION

This chapter discusses effects from NNSA's Proposed Action and other reasonably foreseeable proposed actions. "Reasonably foreseeable" means sufficiently likely to occur such that a person of ordinary prudence would take it into account in reaching a decision. Reasonably foreseeable effects on the environment, resulting from incremental impacts of NNSA's Proposed Action added to impacts of other reasonably foreseeable proposed actions, include ecological (resources, component structure, and functioning ecosystem), aesthetic, historic/cultural, economic, social (including disproportionate impacts on communities), or health. Reasonably foreseeable effects can also result from proposed actions that take place in the same geographic area and in the same timeframe as the NNSA Proposed Action. This SWEIS considers reasonably foreseeable actions that could occur in the same ROIs as the resource analyses in this SWEIS (refer to Section 4.1) and over the same timeframe (i.e., within approximately 2025–2040).

6.2 METHODOLOGY AND ASSUMPTIONS

Reasonably foreseeable effects are assessed for all resource areas with impacts, considering baseline Existing Environment (impacts of past actions and current SNL/NM operations; Chapter 4); impacts of the No-Action, Modernized Operations, and Expanded Operations Alternatives (Chapter 5); and other past, current, and reasonably foreseeable future actions likely to occur in the same ROIs identified in this SWEIS and over the same timeframe (Section 6.3).

Reasonably foreseeable effects are presented by combining impacts of the alternatives with reasonably foreseeable impacts of other past, current, and reasonably foreseeable future proposed actions. NNSA realizes that proposed actions may occur at different times and locations and that potential impacts may not be truly additive. For example, proposed actions affecting air quality may occur at different times and locations across an ROI; therefore, it is unlikely that the impacts would be completely additive. To envelop uncertainties in projected activities and their effects, the analysis combines effects irrespective of time and location of the impact; thus, assessed reasonably foreseeable effects would be higher than reality supports. This approach produces a conservative estimate of reasonably foreseeable effects for the proposed actions considered.

6.3 CURRENT AND REASONABLY FORESEEABLE FUTURE ACTIONS

Information on current and reasonably foreseeable future proposed actions that could contribute to reasonably foreseeable effects on the ROIs considered in the SWEIS was obtained by reviewing publicly available information and relevant NEPA documents. Because actions that occur in close proximity to NNSA's Proposed Action at SNL/NM are generally more likely to meaningfully contribute to reasonably foreseeable effects than actions farther away, NNSA grouped the current and reasonably foreseeable future actions into two categories: (1) Actions on KAFB and (2) Actions off KAFB. Table 6-1 and Table 6-2 summarize actions on KAFB and off KAFB, respectively, considered in this analysis of reasonably foreseeable effects and identify the status/schedule of the actions and the resource areas that they are most likely to affect.

Table 6-1. Actions on KAFB Considered in the Analysis of Reasonably Foreseeable Effects

Project Name	Summary of Project	Status/ Schedule	Resource Areas Most Likely Affected
Continued Operation of KAFB	KAFB operations will continue for the foreseeable future and include many construction projects, demolition activities, and infrastructure improvements over the next 15 years. Notable proposals include: • Demolish and construct, operate, and maintain several military personnel support facilities. Facility demolition would total about 498,000 square feet and construction would total about 389,000 square feet. About 36 acres would be impacted. • Construct, operate, and maintain a 42,500-square-foot security forces complex for adequate space and modern facilities for all 377th Security Forces Group functions. • Develop and operate a satellite communications ground terminal facility on about 15 acres of previously disturbed land in the northwestern portion of KAFB. • Consolidate high-energy laser effects and numerical simulation R&D activities into a 67,970-square-foot building and demolish eight facilities more than 50 years old. • Rebuild Substation 10 with upgrades and in a central location to better handle the electrical loads of both Substations 3 and 10. • Construct a solar PV array up to 500 acres in size, which would generate up to 20 MW annually (KAFB 2018). • Continue current and future test activities and infrastructure improvements at the Conventional High Explosive SimulaTed NUclear Test (CHESTNUT) Site and Joint Use Area on KAFB (DAF 2024).	Current and Reasonably Foreseeable	Land Use, Airspace, Visual, Geology and Soils, Water Resources, Air Quality, Biological Resources, Cultural Resources, Socioeconomics, Infrastructure, Waste Management
DAF Permit to NNSA OST for KAFB Land Use	DAF proposes to issue a new 25-year permit to NNSA to use 17 acres of KAFB land to support potential mission growth for the NNSA Office of Secure Transportation (OST). Additionally, OST plans to prepare an EA to analyze potential impacts for this action.	Reasonably Foreseeable	Land Use
United States Space Force STARCOM Delta 11 and 12 Beddown	U.S. Space Force proposes to locate three Space Delta units (Deltas 10, 11, and 12) of the Strategic Training and Readiness Command (STARCOM) at USAF installations on KAFB as the preferred alternative for locating Delta 11 Headquarters and an alternative location for the Delta 12 beddown. If relocated to KAFB, the Proposed Action would include renovation and reuse of Buildings 20362 (28,500 square feet), 20363 (29,300 square feet), and 20364 (29,500 square feet) (DAF 2023a).	Reasonably Foreseeable	Land Use, Transportation
AC-130 Formal Training Unit Relocation	DAF is relocating the Special Operations Command AC-130J Ghost Rider Formal Training Unit from Hurlburt Field, Florida, to KAFB. Students operating the AC-130J aircraft would train from the installation and in existing Special Use Airspace (both military operations area and Restricted Areas) and would receive live fire training at Melrose Air Force Range, New Mexico (DAF 2023b).	Reasonably Foreseeable	Land Use, Airspace, Visual, Noise, Socioeconomics

Project Name	Summary of Project	Status/ Schedule	Resource Areas Most Likely Affected
Zia Park Area Development	Zia Park, a former housing area encompassing about 300 acres of land on KAFB, is likely to be developed over the next 15 years. Construction would include administrative buildings, infrastructure improvements, medical facilities, community services, residential lodging, outdoor recreation space, and facility demolition (DAF 2023c).	Reasonably Foreseeable	Land Use, Visual
Kansas City National Security Campus Activities in the Albuquerque Area	NNSA's Kansas City National Security Campus conducts work at several locations in the Albuquerque area, including specific properties within KAFB, to support the security, development, and manufacture of the non-nuclear components of nuclear weapons. In October 2023, NNSA prepared DOE/EA-2231 (NNSA 2023) to evaluate the proposed continued operation and potential expansion of operations in New Mexico.	Current and Reasonably Foreseeable	Land Use

Table 6-2. Actions off KAFB Considered in the Analysis of Reasonably Foreseeable Effects

Project Name	Summary of Project	Status/ Schedule	Resource Areas Most Likely Affected
Enhanced Use Lease	KAFB has leased about 70 acres of DAF property along Gibson Boulevard to a private entity for mixed-use development that could include office, retail/commercial, corporate apartments, hotel, gasoline station, and restaurant space uses. Roadways for access and vehicular movement through development, parking, and landscape areas and utility infrastructure would be constructed. Existing recreation facilities would be demolished.	Reasonably Foreseeable	Land Use, Transportation
CNF Land Management Plan (Forest Plan)	The Cibola National Forest (CNF) revised its Forest Plan and prepared an EIS (USFS 2021) to evaluate potential impacts of implementation. The Forest Plan provides strategic, program-level guidance for managing CNF resources and uses over the next 10–15 years.	Current and Reasonably Foreseeable	Land Use, Visual, Geology and Soils, Water Resources, Air Quality, Biological Resources, Cultural Resources, Socioeconomics, Infrastructure
NMDOT Projects in the Albuquerque Area	Many New Mexico Department of Transportation (NMDOT) projects are under way in the Albuquerque metropolitan area and expected to continue in the foreseeable future.	Current	Air Quality, Visual, Noise, Biological Resources, Transportation
Mesa del Sol Development	Mesa del Sol's master plan called for 40 years of development covering 9,000 acres of the 12,900-acre site. The remaining 3,200 acres was proposed for parks and open space. The project is expected to house 100,000 people, with a downtown area; 37,500 homes; 18,000,000 square feet of office space; 4,400 acres for residential and supporting retail; and 800 acres for schools including university branches. The master plan includes two new interchanges for access to I-25 financed as part of development (Metcalf 2008).	Current and Reasonably Foreseeable	Land Use, Visual, Geology and Soils, Air Quality, Biological Resources, Cultural Resources, Transportation

Project Name	Summary of Project	Status/ Schedule	Resource Areas Most Likely Affected
General Economic Growth in the Albuquerque Metropolitan Area	Economic growth in the Albuquerque metropolitan area is estimated to continue over the next 15 years. This economic growth would increase the population and development in the region and contribute to reasonably foreseeable effects. The City of Albuquerque and Bernalillo County recently developed an update to the Albuquerque/Bernalillo County Comprehensive Plan (CABQ 2024) that discussed how development will take shape in the Albuquerque area while also preserving history and traditions and respecting the environment (ABQ 2020).	Current and Reasonably Foreseeable	Land Use, Airspace, Visual, Geology and Soils, Water Resources, Air Quality, Noise, Biological Resources, Cultural Resources, Socioeconomics, Infrastructure, Waste Management
Albuquerque International Sunport Sustainable Airport Master Plan	The airport master plan (ABQ 2020) evaluates the airport’s capabilities and role, reviews future aviation demand forecasts, and plans for timely facility improvement to best meet demand and maintain compatibility with environs. It provides systematic guidelines for the airport’s overall development, maintenance, and operation for the next 20 years and is consistent with the Albuquerque/Bernalillo County Comprehensive Plan policies.	Current and Reasonably Foreseeable	Land Use, Airspace, Air Quality, Infrastructure
Continued Operation of LANL	LANL, which has operated in Los Alamos, New Mexico, since the 1940s, is about 60 miles north of SNL/NM. LANL’s primary mission is to function as a nuclear weapons research, development, and engineering laboratory. Portions of the socioeconomics, radiological transportation, and human health ROIs overlap. NNSA has prepared a Draft SWEIS for continued and expanded operations at LANL (NNSA 2024a).	Current and Reasonably Foreseeable	Socioeconomics, Radiological Transportation, Waste Management, Human Health
DOE and Non-DOE Actions Related to Radiological Waste Disposal and Radiological Transportation	LANL operations include transport of radiological materials and waste for disposal. This SWEIS presents the reasonably foreseeable effects of the SWEIS alternatives and other proposed actions that would generate the same waste types. For radiological transportation, the analysis considers past, present, and reasonably foreseeable future shipments of radiological material.	Current and Reasonably Foreseeable	Transportation, Waste Management

6.4 REASONABLY FORESEEABLE EFFECTS BY RESOURCE AREA

Chapter 5 presents potential environmental impacts associated with the No-Action Alternative and the two action alternatives. Potential reasonably foreseeable effects combining Chapter 5 impact information with potential impacts from other reasonably foreseeable future actions in Table 6-1 and Table 6-2 are presented in Table 6-3 in the same order as the resource analyses in Chapter 5. The analyses supporting these identified impacts are in Appendix A, Section A.6.

Table 6-3. Reasonably Foreseeable Environmental Consequences

Resource	Section	Environmental Consequences
Land Use	5.2	(1) On KAFB, reasonably foreseeable effects of SNL/NM proposed activities under each alternative represent continuation of existing land uses. Increases in development footprints associated with the alternatives would be consistent with existing land uses at and near SNL/NM-managed lands. Land disturbance from the alternatives (342.1 acres) and other actions on KAFB (2,210 acres) would affect about 4.9 percent of currently undisturbed land within KAFB. (2) Off KAFB, actions would result in increased land disturbances, including anticipated Albuquerque and Bernalillo County growth and Mesa del Sol and Sunport developments, and would follow city or county zoning and permitting requirements. Planned city, county, Mesa del Sol, and Sunport developments are anticipated to remain consistent with community values and land perception. (3) Reasonably foreseeable effects of SNL/NM proposed operations, KAFB expanded operations, and off-KAFB development activities would likely include increased competition for land area. Total land disturbance will remain a small fraction of total undisturbed land within KAFB, and off-KAFB land disturbance is unlikely to change overall land use and development balance.
Airspace	5.2	(1) On KAFB, SNL/NM proposed UAS activity expansions would continue to adhere to FAA requirements, to deconflict with KAFB operations, and to be mostly imperceptible beyond KAFB boundaries, creating minor impacts to airspace. Airspace operations within KAFB would include growth in operations from KAFB. (2) Off KAFB, airspace will see increased traffic as the Sunport expands. (3) The combined expansions of activity by SNL/NM, KAFB, and Sunport would be consistent and compatible with airspace use and, thus, there are no additional reasonably foreseeable environmental effects beyond those identified in Chapter 5.
Visual Resources	5.3	(1) On KAFB, SNL/NM proposed expanded energy projects would likely affect visual impacts and could change VRM classification. Other activities under all alternatives would retain VRM. Continued KAFB operations, AC-130 Formal Training Unit relocation, and Zia Park Area Development would likely impact visual resources, but overall landscape and VRM would stay the same. (2) Off KAFB, construction for CNF Land Management, NMDOT projects, and general growth in Albuquerque would produce close and temporary visual impacts. Long-term viewshed would be similar to current views. (3) SNL/NM and KAFB plans and off-KAFB construction would likely result in short-term reasonably foreseeable effects. Overall, visual resources would likely remain the same in the Albuquerque area, except for SNL/NM proposed expanded energy projects.
Geology and Soils	5.4	(1) On KAFB, soil disturbance from the alternatives (342.1 acres) and other actions on KAFB from proposed projects for continued KAFB operations (2,210 acres) would affect about 4.9 percent of currently undisturbed soils within KAFB. (2) Off KAFB, Mesa del Sol development plans (9,000 acres) and economic growth in the Albuquerque Metropolitan Area would increase soil disturbances. New CNF management would likely positively impact soils with 14,900 acres of more wilderness areas. (3) Reasonably foreseeable environmental effects on soils from SNL/NM and KAFB plans, and off-KAFB disturbances would be minimal. Planned SNL/NM and KAFB activities would follow individual BMPs to limit stormwater runoff and other soil impacts, and off-KAFB disturbances by city growth would be conducted per city or county zoning and permitting requirements as applicable, causing minimal or no additional foreseeable impacts. CNF designations of wilderness areas would protect undeveloped lands. Overall, the net reasonably foreseeable effects on soils of all of these land-disturbing activities would be minimal.

Resource	Section	Environmental Consequences
Water Resources and Hydrology	5.5	(1) On KAFB, increases in impervious surfaces on SNL/NM-managed lands and in KAFB through projects supporting continued KAFB operations would not significantly impact stormwater effects such as runoff and surface/groundwater contamination. Applicable permit and requirement compliance would assure protection of water resources. There are no known project-associated effluents. Potential floodplain impacts could require mitigations if necessary for protection of other structures in KAFB. (2) Off KAFB, Albuquerque and Bernalillo County growth and development could result in increased impervious surfaces, but these actions would be conducted per city or county zoning and permitting requirements including the 2024 Comprehensive Plan goals. (3) Proposed new construction from SNL/NM activities, other on-KAFB development, and off-KAFB development are unlikely to cause additional adverse impacts to water resources and hydrology. New construction would limit impacts to surface water through SWPPPs. If surface water discharges on or off KAFB are proposed, they would be subject to permitting requirements to limit their impacts. Potential floodplain impacts could require mitigations if necessary for protection of other structures within KAFB. Within Albuquerque and Bernalillo County, floodplain impacts are unlikely as a result of the two goals of the 2024 Comprehensive Plan.
Air Quality	5.6	(1) On KAFB, air quality from alternatives and other actions would be compliant via adherence to applicable permitting requirements. (2) Off KAFB, some air emissions would likely increase due to NMDOT projects and Mesa del Sol and Sunport development. Those actions would be conducted per city or county zoning and permitting requirements including 2024 Comprehensive Plan goals. (3) SNL/NM proposed activities, KAFB plans for continued operation, and off-KAFB activities noted are all likely to increase some air emissions within the Albuquerque area. Even so, air quality is likely to remain in compliance with applicable requirements.
Noise	5.7	(1) On KAFB, most noise from alternatives and other actions would be less than 65 dBA, but SNL/NM explosives testing and KAFB operations would likely increase frequency of events that could be heard in short bursts outside KAFB. Noises above 65 dBA would likely remain infrequent, and mitigations such as KAFB Range Officer management of testing schedules and preference for louder experiments being limited to lower impact conditions are likely to reduce noise impacts outside of KAFB boundaries. (2) Off KAFB, localized NMDOT and Albuquerque-area growth projects likely would temporarily contribute to noise. (3) Reasonably foreseeable effects of proposed SNL/NM and KAFB activities and off-KAFB projects are anticipated to be minimal. SNL/NM expanded operations and increases in KAFB explosives testing would likely increase frequency of short noise events audible off KAFB, which would attenuate with distance and would be so short that they would not likely result in reasonably foreseeable effects combined with anticipated increases in temporary noise events from off-KAFB development by NMDOT and Albuquerque growth projects. Off KAFB, actions would generally result in increased ambient noise levels but would be conducted per city or county noise ordinances. Reasonably foreseeable effects of noise will be minimal and close to KAFB boundaries.
Biological Resources	5.8	(1) On KAFB, construction proposed on SNL/NM-managed lands and other development in support of KAFB operations would result in adverse impacts on wildlife species from habitat loss or disturbance. These potentially significant impacts could be avoided or minimized via implementation of a variety of measures (e.g., INCRMP development and implementation) (refer to Section 5.16.4). (2) Off KAFB, Mesa del Sol development, Albuquerque growth, and NMDOT projects could have adverse impacts on wildlife habitat via loss or disturbance. CNF proposed actions would positively impact wildlife via ecological resource preservation and protection. (3) Together, reasonably foreseeable effects of SNL/NM proposed actions, KAFB development, and development plans within Albuquerque and Bernalillo County, dependent on locations of development, could increase negative impacts to wildlife if habitat is decreased or disturbed. Additional measures could be taken to avoid or minimize adverse effects.

Resource	Section	Environmental Consequences
Cultural and Paleontological Resources	5.9	(1) On KAFB, proposed SNL/NM construction and continued KAFB operations could result in reasonably foreseeable adverse effects on cultural resources. INCRMP development and other measures could avoid or minimize these effects (refer to Section 5.16.5). (2) Off KAFB, proposed CNF Land Management and Mesa del Sol development could result in adverse impacts on cultural resources. (3) SNL/NM, KAFB operations, and off-KAFB development plans could add up to reasonably foreseeable adverse effects on cultural resources. In all cases, compliance with applicable cultural resource laws and regulations could reduce impacts resulting from these proposed actions. Additional measures to avoid or reduce potential impacts are described in Section 5.16.5.
Traffic and Transportation (Non-Radiological)	5.10	(1) On KAFB, proposed SNL/NM and KAFB operations are likely to cause increasing traffic and could eventually exacerbate traffic levels on area roads near KAFB, particularly during peak commuting hours, but they should not degrade the LOS on such roads. (2) Off KAFB, economic growth in the Albuquerque area and Mesa del Sol and mixed-used development along Gibson Avenue would likely increase local traffic. ROI population growth is expected to increase by about 0.2 percent annually, which would increase local daily vehicle counts by 3 percent over 15 years. Traffic increases would change area road LOS, especially Eubank Boulevard. (3) Reasonably foreseeable effects of proposed SNL/NM and KAFB operations and off-KAFB development may have a negative impact on traffic via increased congestion, particularly during peak commuting hours. NMDOT projects would improve transportation and reduce road congestion. Flexible start times, duty hours, and telework could help alleviate peak traffic volume.
Traffic and Transportation (Radiological)	5.10	(1) On KAFB, proposed SNL/NM and KAFB operations involving radiological material transportation would result in extremely small risks to workers or the public from radiation exposure. Radiological risks to members of the public attributable to SNL/NM transportation activities under the Expedited Operations Alternative would be 0.0081 LCFs. Transportation impacts from any alternative would account for less than 0.01 percent of reasonably foreseeable transportation effects to crews or the population, and other proposed activities within KAFB are not anticipated to add significantly to radiological transportation risks. (2) Off KAFB, radiological transportation actions would not result in significant reasonably foreseeable radiological risks to the public. Appendix A, Table A-47, shows that radiological risks from SNL/NM are extremely small in absolute terms and relative to radiological risks from all other past, present, and reasonably foreseeable transportation by DOE/NNSA (including LANL) and non-DOE activities. (3) Reasonably foreseeable radiological transportation effects from SNL/NM, KAFB, LANL, and other activities would be minimal.
Infrastructure	5.11	(1) On KAFB, proposed SNL/NM and KAFB activities in any alternative would increase utility/energy use. If constructed, SNL/NM proposed expanded energy projects could increase onsite energy production and reduce the need for external energy sources. (2) Off KAFB, increased development anticipated in Albuquerque and Bernalillo County will increase utility/energy use. Proposed actions at CNF would not substantially change any current utility or energy usage within CNF. (3) Reasonably foreseeable effects from ongoing SNL/NM and KAFB operation and Albuquerque and Bernalillo County growth would increase utility/energy use. Even so, infrastructure capacity is expected to continue to meet infrastructure demand.

Resource	Section	Environmental Consequences
Materials Management and Waste Management	5.12	(1) On KAFB, SNL/NM proposed activities in any alternative would increase LLW generated, accounting for 1.1 percent of LLW capacity at the disposal site (NNSS). SNL/NM operations would increase MLLW generated, and in the Expanded Operations Alternative, would account for 5 percent of total MLLW sent to NNSS annually. SNL/NM largest anticipated TRU waste from any alternative would generate much less than 0.1 percent capacity at the disposal site. SNL/NM operations would increase in hazardous waste generated and make up about 31 percent of hazardous waste generated in New Mexico. Operations at KAFB generate hazardous waste but no radioactive waste. (2) Off KAFB, LANL operations account for about 16 percent of LLW/MLLW disposed of at NNSS annually, and this amount may increase to 25 percent of NNSS capacity or more. LANL sends TRU waste to WIPP; in the future this would represent about 8.6 percent of WIPP capacity. LANL is forecast to increase generation of hazardous waste in the future, and hazardous waste treatment at permitted commercial facilities should be able to accommodate that increase based on their total capacities. (3) Reasonably foreseeable effects from activities associated with ongoing SNL/NM, KAFB, and LANL operation, would be minimal. Potential impacts include increases in hazardous waste generated in New Mexico, but hazardous waste management capacity at permitted commercial facilities can accommodate these increases. SNL/NM and LANL operations would have small but reasonably foreseeable effects on LLW and MLLW amounts. Combined activities would have little to no effect on impacts of TRU waste generated in the area. For TRU waste and all other waste types, the capacity and capability of the existing waste management systems are adequate to safely accommodate any expected increases from SNL/NM and other generators.
Human Health and Safety	5.13	(1) On KAFB, radiological risks to the public from routine SNL/NM proposed activities in the Modernized Operations and Expanded Operations Alternatives would be extremely small. The anticipated number of LCFs among the general population would be 0.00003; the risk that a hypothetical maximally exposed individual would incur a fatal cancer would be 0.000000015. Other KAFB activities are not expected to increase radiological risk to the public. NNSA has concluded that there is no measurable health risk to the public from exposure to non-radiological air emissions and/or non-radiological effluents. (2) Off KAFB, no sources in the ROI would add measurably to the extremely small radiological risks to the public from routine SNL/NM operations. LANL operations are not likely to increase radiological risk to the population or workers in the Albuquerque area due to its distance of about 60 miles from SNL/NM. (3) No reasonably foreseeable health impacts would be expected from ongoing SNL/NM and LANL operation. Even under the extremely conservative assumption that the entire 50-mile population around SNL/NM (1,075,207 persons) also received the full annual collective dose from LANL operations, the population dose would be 6.78 person-rem per year. An annual dose of 6.78 person-rem would result in an LCF risk of 0.004. (Statistically, this means that 1 LCF could be expected every 250 years.)

Resource	Section	Environmental Consequences
Accidents and Intentional Destructive Acts	5.14	(1) On KAFB, potential accident risks to the offsite population from proposed activities in any SWEIS alternative were estimated through analysis of a range of accident scenarios, including a postulated scenario involving multiple radiological facilities being involved in a design-basis seismic event (with accompanying fire). This scenario could result in about 0.0001 additional LCFs per year and represents the maximum reasonably foreseeable accident, or the “bounding” accident, which is an accident with the most severe consequences reasonably foreseeable to occur. (2) Off KAFB, no accidents associated with non-SNL/NM activities or projects have the potential to result in reasonably foreseeable effects from radiological accidents that would add to accident risks of on-KAFB accidents. This conclusion results because there are no identified off-KAFB accident scenarios that have the potential for additive or synergistic effects that could amplify the consequences of on-KAFB accidents analyzed in this SWEIS. Postulated accidents at LANL are not likely to increase risks to the Albuquerque population due to its distance of about 60 miles from SNL/NM, which is outside of the ROI for accidents. (3) Together, reasonably foreseeable effects from activities associated with the ongoing operation of SNL/NM and KAFB, as well as operation of LANL, are not likely to result in any reasonably foreseeable effects of radiological or non-radiological accidents that exceed those analyzed in Chapter 5.
Socioeconomics	5.15	(1) On KAFB, proposed activities by SNL/NM are likely to have positive socioeconomic impacts through value added to the local economy by increases to the workforce, direct economic activity, tax on production and imports, and indirect employment compensation. Continued KAFB operations would likely add to, but not notably change, overall positive impacts from already occurring KAFB activities. (2) Off KAFB, growth in the Albuquerque population and in LANL operations are likely to have minor positive socioeconomic impacts within Bernalillo County. (3) Together, SNL/NM, KAFB operations, and off-KAFB development plans are likely to have reasonably foreseeable positive effects on socioeconomics in Bernalillo County and the Albuquerque area through increases to jobs, direct economic activity, and indirect employment compensation. As described in Chapter 5, analyses for the alternatives indicate no disproportionate and adverse human health and environmental effects on at-risk populations within the socioeconomic ROI. Also, as described in Section 5.15, the activities evaluated in this SNL/NM SWEIS are not expected to substantively add to reasonably foreseeable effects on human health to any member of the general public. Therefore, SNL/NM activities are not expected to substantially contribute to reasonably foreseeable adverse effects.

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