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ANNUAL SITE ENVIRONMENTAL REPORT

2017

U.S. DEPARTMENT OF ENERGY

National Nuclear Security Administration

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U.S. Department of Energy, National Nuclear Security Administration,
Sandia Field Office, Albuquerque, New Mexico

2017 Annual Site Environmental Report for Sandia National Laboratories, Tonopah Test Range, Nevada, and Kauaʻi Test Facility, Hawaiʻi

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for
Department of Energy
National Nuclear Security Administration
Sandia Field Office

Abstract

Sandia National Laboratories is a multimission laboratory managed and operated by National Technology & Engineering Solutions of Sandia, LLC, a wholly owned subsidiary of Honeywell International Inc., for the U.S. Department of Energy (DOE), National Nuclear Security Administration. The National Nuclear Security Administration's Sandia Field Office administers the contract and oversees contractor operations at the Sandia National Laboratories Tonopah Test Range (SNL/TTR) in Nevada and the Sandia National Laboratories Kauaʻi Test Facility (SNL/KTF) in Hawaiʻi. Activities at SNL/TTR are conducted in support of DOE weapons programs and have operated at the site since 1957. SNL/KTF has operated as a rocket preparation launching and tracking facility since 1961.

DOE and its management and operating contractor for Sandia are committed to safeguarding environmental protection, compliance, and sustainability and to ensuring the validity and accuracy of the monitoring data presented in this *Annual Site Environmental Report*. This report summarizes environmental monitoring information and compliance activities at SNL/TTR and SNL/KTF for calendar year 2017. Environmental topics include air quality, ecology, environmental restoration, oil storage, site sustainability, terrestrial surveillance, waste management, water quality, and implementation of the National Environmental Policy Act. This report is prepared in accordance with and as required by DOE O 231.1B, Admin Change 1, *Environment, Safety, and Health Reporting*, and has been approved for public distribution.

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We wish to thank the following individuals who provided their time and expertise assisting in the production of the Sandia National Laboratories Tonopah Test Range, Nevada, and Sandia National Laboratories, Kauaʻi Test Facility, Hawaiʻi, annual report:

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Note to the Reader

The Sandia National Laboratories Tonopah Test Range and Sandia National Laboratories Kauaʻi Test Facility *Annual Site Environmental Report* presents summary data from environmental program activities and compliance status with environmental standards and requirements. In addition, the U.S. Department of Energy views this document as a valuable tool for maintaining a dialogue with our community about the environmental health of these sites and the commitment to protect our valuable resources. We continually strive to improve the quality of the contents of this report as well as to include information that is important to you. Please provide feedback, comments, questions, or requests for copies of this report to:

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The Sandia National Laboratories Tonopah Test Range, Nevada, and Kauaʻi Test Facility, Hawaiʻi, *Annual Site Environmental Report* can be found at the following website:
http://www.sandia.gov/news/publications/environmental/index.html

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Acronyms and Abbreviations

Term	Definition
A	
AP	air permit
B	
BD	below detection
C	
CAU	Corrective Action Unit
CEMP	Community Environmental Monitoring Program
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CO	carbon monoxide
D	
DoD	U.S. Department of Defense
DOE	U.S. Department of Energy
DRI	Desert Research Institute
E	
EO	Executive Order
EPA	U.S. Environmental Protection Agency
EPCRA	Emergency Planning and Community-Right-to-Know Act
ES&H	Environment, Safety, and Health
F	
FDID	Fire Department Identification
FFACO	Federal Facility Agreement and Consent Order
FIN	facility identification number
FY	fiscal year
H	
HAP	hazardous air pollutant
I	
IOC	inorganic compound
ISO	International Organization for Standardization
J	
J	estimated quantity
K	
KTF	Kaua'i Test Facility

Term	Definition
M	
MBTA	Migratory Bird Treaty Act
MDC	minimum detectable concentration
N	
N/A	not applicable
NAC	Nevada Administrative Code
NAFR	Nellis Air Force Range
ND	not detected
NDEP	Nevada Division of Environmental Protection
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NOx	nitrogen oxides
NRS	Nevada Revised Statute
NTTR	Nevada Test and Training Range
NV	Nevada
O	
O&M	Operation and Maintenance
ORPS	Occurrence Reporting and Processing System
P	
PCB	polychlorinated biphenyl
Permit, the	Department of the Air Force Permit to the National Nuclear Security Administration to Use Property Located on the Nevada Test and Training Range, Nevada
pH	potential of hydrogen
PL	Public Law
PM_{10}	particulate matter that has a diameter equal to or less than 10 microns
PMRF	Pacific Missile Range Facility
Pu	plutonium
R	
RCRA	Resource Conservation and Recovery Act
S	
SARA	Superfund Amendments and Reauthorization Act
SC	significance category
SHPO	State Historic Preservation Office
SNL	Sandia National Laboratories

Term	Definition
SNL/KTF	Sandia National Laboratories, Kaua'i Test Facility, Hawai'i
SNL/NM	Sandia National Laboratories, New Mexico
SNL/TTR	Sandia National Laboratories, Tonopah Test Range, Nevada
SO_2	sulfur dioxide
SOC	synthetic organic compound
SPCC	Spill Prevention, Control, and Countermeasure
SWPPP	Stormwater Pollution Prevention Plan
T	
TLD	thermoluminescent dosimeter
TTR	Tonopah Test Range
U	
U	analyte not detected
USAF	U.S. Air Force
USC	U.S. Code
V	
VOC	volatile organic compound

Units of Measure

Unit	Definition
Bq/m^3	Becquerel per cubic meter
Ci/m	curies per meter
°F	degrees Fahrenheit
kg	kilogram
m	meter
mg/kg	milligrams per liter
mR	milliroentgen
µ	micron
µCi/mL	microcuries per milliliter
mR/year	milliroentgen per year
$µg/m^3$	micrograms per cubic meter
mph	miles per hour
mrem/year	millirems per year
pCi/g	picocuries per gram
ppb	parts per billion
ppm	parts per million

SNL/TTR and SNL/KTF Executive Summary

Kaua'i Test Facility

Sandia National Laboratories (hereinafter referred to as Sandia) is a multimission laboratory managed and operated by National Technology & Engineering Solutions of Sandia, LLC, a wholly owned subsidiary of Honeywell International Inc., for the U.S. Department of Energy's (DOE) National Nuclear Security Administration. DOE and its management and operating contractor for Sandia are committed to safeguarding environmental protection, compliance, and sustainability and to ensuring the validity and accuracy of the monitoring data presented in this report.

Sandia personnel manage and operate the Tonopah Test Range (TTR) in Nevada and the Kaua'i Test Facility (KTF) in Hawai'i for DOE. DOE National Nuclear Security Administration Sandia Field Office personnel administer the contract and oversee contractor operations at the sites. This *Annual Site Environmental Report* was prepared in accordance with and as required by DOE O 231.1B, Admin Change 1, *Environment, Safety, and Health Reporting* and is approved for public release.

This report summarizes the environmental protection and monitoring programs in place at Sandia National Laboratories/TTR (SNL/TTR) and Sandia National Laboratories/KTF (SNL/KTF) for calendar year 2017. While all 2017 program activities were performed continuously, they are reported in this *Annual Site Environmental Report* on a calendar year basis unless noted otherwise (programs based on the fiscal year (FY) operate from October 1 through September 30, annually).

This report also discusses compliance with environmental statutes, regulations, and permit provisions, and it highlights significant environmental programs and efforts. Sandia environmental and waste management programs comply with the requirements of federal, state, and local environmental regulations, as well as with DOE directives in the Sandia Prime Contract.

This report is a key component of DOE efforts to keep the public informed about environmental conditions throughout the DOE complex.

Sandia National Laboratories, Tonopah Test Range

Sandia personnel conduct operations at SNL/TTR in support of the DOE weapon programs. Sandia activities at TTR involve research and development as well as testing weapon components and delivery systems. Many of these activities require a remote testing range with a long flight corridor for airdrops and rocket launches, which TTR can provide. Navarro Research and Engineering personnel perform most of the environmental programs activities at SNL/TTR. The National Nuclear Security Administration's Nevada Field Office retains responsibility for cleanup and management of SNL/TTR environmental restoration sites. There were no reportable environmental occurrences at SNL/TTR in 2017, although there was one near miss to an otherwise reportable event. See Section 2.17.

Environmental Management System

Sandia has a robust Environmental Management System in place to help personnel fulfill their responsibility of protecting the environment, preventing pollution, and conserving natural resources. The system is International Organization for Standardization (ISO) 14001 certified for Sandia's primary operating locations. This management approach is followed at all locations, as verified by an internal assessment to the ISO 14001 standard (ISO 2004) every three years. The last ISO 14001 assessment of SNL/TTR operations was conducted in 2017. See Section 2.1 for more information.

Environmental Performance Measures

Environmental performance and performance measures are assessed as part of Sandia's Performance Evaluation Measurement Plan. In the most recent evaluation, Sandia earned a site-wide excellent rating, exceeded expectations in several areas, and overall met expectations for delivering effective, efficient, and responsive environment, safety, and health management and processes. See Section 2.3 for more information.

Site Sustainability Plan

Sustainability strategies and goals are defined in an annual Site Sustainability Plan. As of FY 2017, Sandia is meeting or exceeding sustainability goals in several key areas. See Section 2.2 for more information.

Air Quality Compliance Program

Air Quality Compliance Program personnel support Sandia in complying with air quality regulations promulgated by state and federal government in accordance with the Clean Air Act and the Clean Air Act Amendments of 1990. Program personnel maintain compliance with Title 40 Code of Federal Regulations Part 60 (40 CFR 60) Subpart H and the SNL/TTR Class II Air Quality Operating Permit from the State of Nevada. See Chapter 2 and Chapter 3 for more information.

National Emission Standards for Emissions of Radionuclides Other than Radon from Department of Energy Facilities

Subpart H of the National Emission Standards for Hazardous Air Pollutants (NESHAP) regulates radionuclide air emissions from DOE facilities, with the exception of naturally occurring radon. The only radionuclide sources at SNL/TTR are the three Clean Slate environmental remediation sites, which are sources of diffuse radionuclide emissions as a result of the resuspension of contaminated soils. In 2017, calculated doses were well below the 10 mrem/year standards set by the U.S. Environmental Protection Agency (EPA) and DOE. See Section 3.5 for more information.

Environmental Restoration Project

Environmental Restoration Project activities at SNL/TTR and the Nevada Test and Training Range (NTTR) are conducted through the DOE National Nuclear Security Administration Nevada Field Office. Environmental restoration sites that are scheduled for remediation or that have been closed

at SNL/TTR include areas impacted from target tests and detonations, including nonimpacted surface debris and areas impacted by ordnance, depleted uranium, heavy metals, and fuel spills. Environmental Restoration Project activities in 2017 included remediating, characterizing, and packaging waste and low-level waste from Clean Slate 2, which is managed by DOE.

Other Environmental Restoration Project activities conducted on the SNL/TTR and NTTR sites in 2017 consisted of the annual post-closure inspections of closed and use-restricted industrial sites and inspections of radiological postings at the Clean Slate and Double Tracks sites. Air samples were collected routinely throughout the year at various locations on the SNL/TTR and NTTR sites. See Section 3.5 for more information.

National Environmental Policy Act Program

At SNL/TTR, National Environmental Policy Act (NEPA) compliance is coordinated between personnel from SNL/TTR, SNL/New Mexico (SNL/NM), and the DOE National Nuclear Security Administration Sandia Field Office. Personnel from SNL/TTR and the SNL/NM NEPA team support DOE in analyzing projects at SNL/TTR, including preparations for the next series of B61-12 flight tests. See Section 3.6 for more information.

In addition to these activities, the SNL/NM NEPA team completed six NEPA checklists for SNL/TTR, three of which were transmitted to DOE for review and completion.

Oil Storage Program

The SNL/TTR Spill Prevention Control and Countermeasures Plan (required under the Clean Water Act) describes the oil storage facilities on-site and the mitigation controls in place to prevent inadvertent discharges of oil. Additional oil storage capacity in 55-gallon drums, mobile and portable containers, mobile refuelers, and oil-filled operational equipment (transformers, hydraulic elevators, etc.) occurs throughout the site on an as-needed basis. In 2017, there were seven stationary aboveground storage tanks, two mobile refuelers (one truck and one trailer), a bulk storage area for drums, a transformer storage area, and numerous mobile generators. See Section 3.7 for more information.

Terrestrial Surveillance Program

The Terrestrial Surveillance Program at SNL/TTR is designed and conducted to address the requirements of DOE O 458.1, Admin Change 3, *Radiation Protection of the Public and the Environment,* which establishes standards and requirements to protect the public and the environment from undue risk of exposure to radiation associated with radiological activities under the control of DOE. Environmental media (soil) samples are collected and then analyzed for radiological constituents, as required. As a best management practice, samples are also collected for analysis of metals. In addition to the environmental media samples, ambient external gamma radiation levels are measured using thermoluminescent dosimeters (TLD). These surveillance activities are conducted at designated locations that are on-site, off-site, and around the perimeter of SNL/TTR. Results of the 2017 sampling events are consistent with previous years. See Section 3.8 for more information.

Waste Management Program

Waste generated during 2017 at SNL/TTR included hazardous waste regulated by the Resource Conservation and Recovery Act (RCRA) and nonhazardous industrial and sanitary solid waste. All hazardous waste was shipped to permitted treatment, storage, and disposal facilities. Waste minimization and recycling efforts are integrated into the Waste Management Program. Waste generated at SNL/TTR, with the exception of waste generated by environmental restoration activities, is handled by Navarro Research and Engineering. See Section 3.9 for more information.

Water Quality Programs

The Nevada Division of Environmental Protection (NDEP) permits the public water system at SNL/TTR as a Non-Transient Non-Community Water System under identification number NV003014. Production Well 6 supplies potable water for the Main Compound Area 3 Drinking Water Distribution System and the Area 3 Fire Protection Water Distribution System. See Section 3.10 for more information.

The public water system is routinely sampled and analyzed per the NDEP requirements to demonstrate conformance with primary drinking water standards. In 2017, all public water system sample results were below the maximum contaminant levels established for the substances monitored.

Five septic tank systems owned by DOE are located on-site at SNL/TTR (the newest of which is inactive); they are sampled as needed. In 2017, there were no sewer system or septic tank excursions or violations to the U.S. Air Force (USAF)-held National Pollutant Discharge Elimination System permit.

Sandia National Laboratories, Kaua'i Test Facility

SNL/KTF is located on the island of Kaua'i within the boundaries of the U.S. Department of Defense (DoD) Pacific Missile Range Facility (PMRF). The site, which has been an active rocket-launching location since 1962, provides a high-quality integrated facility for conducting a wide range of test operations. These operations support materials research, components development, advanced reentry-vehicle technologies, water entry-and-recovery systems, missile defense testing, and onboard-sensor research and development testing. There were no reportable environmental occurrences at SNL/KTF in 2017.

Environmental Management System

Sandia has a robust Environmental Management System in place to help personnel fulfill their responsibility of protecting the environment, prevent pollution, and conserve natural resources. The system is ISO 14001 certified for Sandia's primary operating locations. This management approach is followed at all locations, as verified by an internal assessment to the ISO 14001 standard (ISO 2004) every three years. An Environmental Management System ISO 14001 assessment of SNL/KTF operations was conducted in 2017. See Section 7.1 for more information.

Site Sustainability Plan

Sustainability strategies and goals are defined in an annual Site Sustainability Plan. As of FY 2017, Sandia is meeting or exceeding sustainability goals in several key areas. See Section 7.2 for more information.

Environmental Performance Measures

Environmental performance and performance measures are assessed as part of Sandia's Performance Evaluation Measurement Plan. In the most recent evaluation, Sandia earned a site-wide excellent rating, exceeded expectations in several areas, and overall met expectations for delivering effective, efficient, and responsive environment, safety, and health management and processes. See Section 7.3 for more information.

Air Quality Compliance Program

Air Quality Compliance Program personnel support Sandia in complying with air quality regulations promulgated by state and federal government in accordance with the Clean Air Act and the Clean Air Act Amendments of 1990. Program personnel maintain compliance with the SNL/KTF

Noncovered Source Permit from the State of Hawai'i, Department of Health. See Chapter 7 and Chapter 8 for more information.

Meteorology Program

Due to the infrequency of launches, no formal meteorological monitoring equipment is in place for at SNL/KTF. See Section 8.5 for more information

National Environmental Policy Act Program

At SNL/KTF, NEPA compliance is coordinated between personnel from SNL/KTF, SNL/NM, and the DOE National Nuclear Security Administration Sandia Field Office. In 2017, the NEPA Program team provided support to several programmatic activities performed at either SNL/KTF or the PMRF. See Section 8.6 for more information.

In addition to these activities, the SNL/NM NEPA team completed six NEPA checklists for SNL/KTF, five of which were transmitted to DOE for review and completion in 2017. An update to the SNL/KTF Site-Wide Environmental Assessment was requested by DOE and is in progress.

Oil Storage Program

SNL/KTF programs operate under the PMRF Spill Prevention Control and Countermeasures Plan (required under the Clean Water Act), which describes the oil storage facilities at the SNL/KTF site and the mitigation controls in place to prevent inadvertent discharges of oil. In 2017, there were four DOE-owned storage tanks at SNL/KTF: one underground storage tank, one aboveground storage tank, and two generator base tanks. There is also a used oil storage area. See Section 8.7 for more information.

Terrestrial Surveillance Program

Terrestrial surveillance is conducted approximately every five years at SNL/KTF. Surface soil sampling was conducted in 2012, which confirmed that SNL/KTF operations made no detectable environmental impact to soil. Sampling was not conducted in 2017. See Section 8.8 for more information.

Waste Management Program

Hazardous waste may be generated through normal operations at SNL/KTF. Sandia is classified as a conditionally exempt small-quantity generator, and follows applicable RCRA requirements. See Section 8.9 for more information.

Water Quality Program

In 2017, there were no compliance issues with respect to any state or federal water pollution regulations at SNL/KTF. See Section 8.10 for more information.

Drinking water at SNL/KTF is obtained through local facilities and commercial suppliers. There are no wells providing drinking water at the site.

The limited quantity of sanitary sewage released at the facility does not impact any protected waters. In 2017, all three on-site septic tanks were inspected. No contaminants have been identified above the reporting limits from past sampling events.

PART ONE

SANDIA NATIONAL LABORATORIES
TONOPAH TEST RANGE, NEVADA

Chapter 1. SNL/TTR Introduction

Great Basin fritillary (*Speyeria egleis*)

OVERVIEW ■ Sandia manages and operates TTR in Nevada for the DOE. TTR is located on approximately 280 square miles (179,200 acres) of withdrawn land within the boundaries of the NTTR. Sandia personnel conduct operations at SNL/TTR in support of the DOE Weapons Ordnance Program. The site has never been used for detonation of nuclear weapons.

This *Annual Site Environmental Report* was prepared in accordance with and as required per DOE O 231.1B, Admin Change 1, *Environment, Safety, and Health Reporting*. Sandia is a multimission laboratory managed and operated by National Technology & Engineering Solutions of Sandia, LLC, a wholly owned subsidiary of Honeywell International Inc., for the DOE National Nuclear Security Administration. Sandia personnel manage and operate TTR in Nevada for DOE. DOE owns TTR, and DOE personnel in Albuquerque, New Mexico, oversee contractor operations.

Part One of this *Annual Site Environmental Report* summarizes the environmental protection and monitoring programs in place at SNL/TTR during calendar year 2017 unless otherwise noted. This report is made available to the public in electronic form.

1.1 Mission

Sandia—providing the synergy and interdependence between our nuclear deterrence mission and broader national security missions to forge a robust capability base and empower us to solve complex national security problems—accomplishes our mission by anticipating and resolving emerging national security challenges, innovating and discovering new technologies to strengthen our nation's technological superiority, creating value through products and services that solve important national security challenges, and informing the national debate for which technology policy is critical to preserving security and freedom throughout the world. Information about recent technologies developed at Sandia can be found at the following website:

http://www.sandia.gov/news/index.html

1.1.1 Operating Contract and DOE Directives

The Prime Contract for management and operations at Sandia defines the corporation's contractual obligations. The DOE directives that pertain to environmental protection and management are as follows:

- DOE O 231.1B, Admin Change 1, *Environment, Safety, and Health Reporting,* ensures that DOE receives information about the events that have affected or could adversely affect the health, safety, and security of the public or workers, the environment, the operations of DOE facilities, or DOE credibility. This *Annual Site Environmental Report* is prepared in accordance with this directive.
- DOE O 232.2, Admin Change 1, *Occurrence Reporting and Processing of Operations Information*, requires timely notification to the DOE complex about events that could adversely affect the health and safety of the public or workers, the environment, DOE missions, or DOE credibility.
- DOE O 435.1, Change 1, *Radioactive Waste Management*, ensures that all DOE radioactive waste is managed in a manner that is protective of worker and public health and safety and of the environment. Under this directive, contractors who manage and operate DOE facilities are required to plan, document, execute, and evaluate the management of DOE radioactive waste.
- DOE O 436.1, *Departmental Sustainability*, places environmental management systems and site sustainability at the forefront of environmental excellence. Sandia personnel implement this directive through an ISO 14001-certified Environmental Management System. SNL/TTR operations do not need to be included in the ISO 14001 certification, provided that an internal assessment to the ISO 14001 standard (ISO 2004) is conducted at the site every three years. Conformance to the standard is verified through internal Environmental Management System assessments. SNL/TTR assessments were conducted in 2011, 2014, and 2017.
- DOE O 458.1, Admin Change 3, *Radiation Protection of the Public and the Environment*, establishes requirements to protect the public and the environment against undue risk from radiation associated with radiological activities under the control of DOE pursuant to the Atomic Energy Act.

1.2 Location Description

SNL/TTR is located on approximately 280 square miles (179,200 acres) of withdrawn land (Figure 1-1), which is permitted from the USAF within the boundaries of the NTTR. Sandia personnel use the land to support DOE and USAF activities and missions.

The area north of the SNL/TTR boundary is comprised of sparsely populated public lands jointly administered by the U.S. Bureau of Land Management and the U.S. Forest Service. Cattle graze this land in winter and spring. There is also a substantial irrigated farming operation north of the range. SNL/TTR lies within a portion of the Nevada Wild Horse Range herd area, which is administered by the U.S. Bureau of Land Management.

1.3 History and Operations

In 1940, President Franklin Delano Roosevelt withdrew approximately 5,000 square miles of federal land in Nevada. In 1950, the Nellis Bombing and Gunnery Range (now referred to as the NTTR) was established, which is part of Nellis Air Force Base. In 1951, the site was named the Nevada Test Site and supported nuclear testing from 1951 to 1992 (NSTec 2017).

Prior to 1957, Sandia personnel used three ranges as test sites: the Los Lunas Test Site (Kirtland Air Force Base Practice Bombing Range) in New Mexico, the Salton Sea Test Site in California, and the Yucca Flat Test Site in Nevada. As testing parameters changed, these sites were deemed inadequate.

Cactus Flats, located in the northwest corner of the Nellis Bombing and Gunnery Range near the town of Tonopah, was identified as a temporary site for testing ballistic and non-nuclear features of atomic weapons (SNL/NM 1996). Initially known as Tonopah Ballistics Range, the site was open, dry, and isolated and had been used as a bombing site during World War II (SNL/NM 1996). In 1956, a land use permit was obtained from the USAF. In 1957, TTR was established for the U.S. Atomic Energy Commission (now DOE) and became operational for testing new weapon systems.

In 1940, President Franklin Delano Roosevelt withdrew approximately 5,000 square miles of federal land in Nevada to establish what is now the Nevada Test and Training Range, which is part of Nellis Air Force Base.

The facilities built at SNL/TTR were designed and equipped to gather data on aircraft-delivered inert test vehicles. As technologies changed, the facilities and capabilities at SNL/TTR were expanded to accommodate tests related to the DOE Weapons Ordnance Program.

Today, Nellis Air Force Base Complex includes several auxiliary small arms ranges and the NTTR, which is divided into the North Range and the South Range (Figure 1-1). The Nevada National Security Site, formerly known as the Nevada Test Site, is located between the North and South ranges at the NTTR. The entire Nellis Air Force Base Complex is comprised of approximately 3 million acres. SNL/TTR is located 32 miles southeast of Tonopah, Nevada.

In April 2002, the USAF and the National Nuclear Security Administration signed a land use permit, "Department of the Air Force Permit to the National Nuclear Security Administration to Use Property Located on the Nevada Test and Training Range, Nevada" (the Permit) (USAF/DOE/NNSA 2002). The Permit is valid from April 26, 2002, until October 5, 2019. The Permit reduced the size of SNL/TTR from approximately 335,655 acres to approximately 179,200 acres.

1.4 Activities and Facilities

SNL/TTR personnel provide research and development test support for DOE weapons programs. SNL/TTR also offers a unique test environment for use by other government agencies and their contractors. Capabilities such as modern electronic tracking instrumentation and data acquisition systems assure complete and accurate test data. The facilities, large land area, and site security are available for conducting a wide variety of tests.

Operations at SNL/TTR are conducted in support of the DOE Weapons Ordnance Program. Activities involve research and development as well as testing weapon components and delivery systems. Many of these activities require a remote testing range with a long flight corridor for airdrops and rocket launches, which SNL/TTR can provide. Other activities include explosives tests and gun firings. The site has never been used for detonation of nuclear weapons. However, in 1963, the Atomic Energy Commission carried out Operation Roller Coaster. This operation involved nuclear weapons destruction tests (using conventional explosives) that dispersed plutonium in soil.

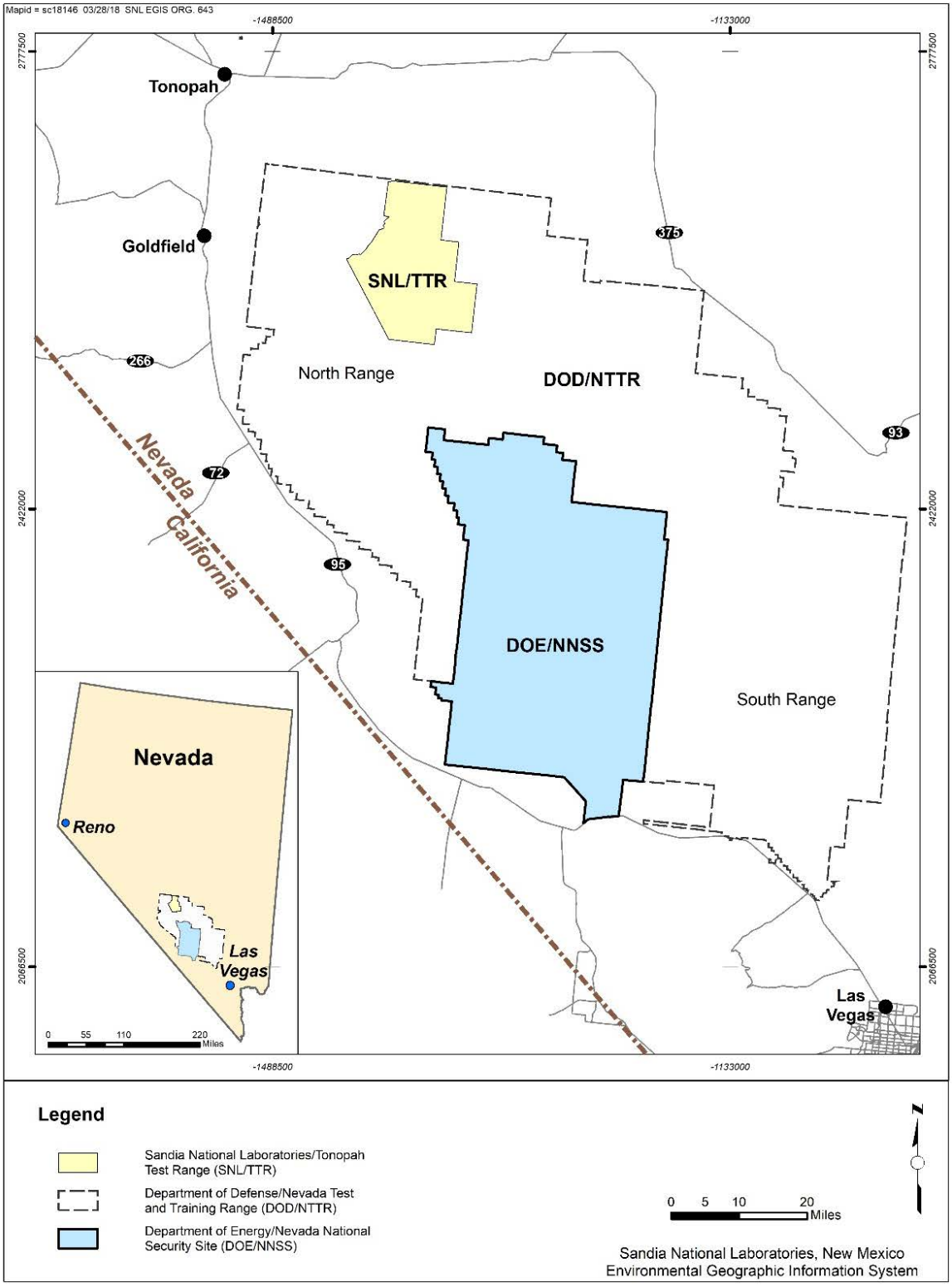


Figure 1-1. SNL/TTR location within the boundaries of the NTTR

Current DOE activities at SNL/TTR include:

- Air drop operations (test units dropped from aircraft)
- Explosives operations (render-safe operations, including handling, transporting, and storing explosives)
- Missile operations (ground- and air-launched missiles)

These activities require a remote range for both public safety and maintenance of national security. The majority of test activities at SNL/TTR occur within Cactus Flat, a valley with almost no topographical relief flanked by mountains and hills.

Navarro Research and Engineering personnel perform or support most environmental program functions at SNL/TTR on behalf of the management and operating contractor for Sandia, including air monitoring, Environmental Restoration Project activities, NEPA compliance, spill response, waste management operations, and water quality monitoring. Navarro Research and Engineering personnel also support SNL/TTR personnel during tests by operating optics equipment, radar units, and recovering test objects.

1.4.1 Mission Control Center

The SNL/TTR Mission Control Center tower is a four-story structure that affords a 360-degree view of the site. It houses mission critical systems that coordinate all test activities during testing operations. The control tower houses the test director, camera control operators, Range Safety Officer, telemetry control operators, test engineer, computer operator, Test and Evaluation Command and Control System operator, telemetry personnel, and visitors during test operations.

SNL/TTR is instrumented with a wide array of signal-tracking equipment, including video, high-speed cameras, telemetry, and radar tracking devices that are used to characterize ballistics, aerodynamics, and parachute performance of test units.

1.4.2 Environmental Restoration Project

The Environmental Restoration Project at SNL/TTR was initiated in 1980 to address contamination resulting primarily from the 1963 nuclear weapons destruction testing and related support activities. In late 1992 and early 1993, an agreement was reached between DOE headquarters and the Albuquerque and Nevada field offices to designate the DOE Nevada Field Office as responsible for all environmental restoration sites at SNL/TTR. The National Nuclear Security Administration was established in 2000, and responsibility for all environmental restoration sites in Nevada still resides with the National Nuclear Security Administration Nevada Field Office, with the exception that NESHAP compliance and reporting for environmental restoration activities is currently being addressed by DOE. However, environmental program management at SNL/TTR is a joint effort between SNL/TTR and SNL/New Mexico personnel, with oversight from DOE. For more information on the Environmental Restoration Project, see Chapter 3.

1.5 Demographics

The nearest residents are located in the towns of Goldfield, Nevada, population 268 and Tonopah, Nevada, population 2,478 (Census 2012a). Goldfield and Tonopah are located approximately 22 miles west, and 32 miles northwest of the site boundary, respectively. Las Vegas, population 583,756 (Census 2012a), the largest municipality by population, is located approximately 140 miles southeast of the site boundary.

1.6 Environmental Setting

The topography at SNL/TTR is characterized by a broad, flat valley bordered by two north- and south-trending mountain ranges: the Cactus Range to the west (occurring mostly within the boundaries of SNL/TTR) and the Kawich Range to the east. Cactus Flat is the valley floor, where the main operational area of SNL/TTR is located. An area of low hills outcrops in the south. Elevations range from 5,347 feet at the valley floor to 7,482 feet at Cactus Peak. The elevation of the town of Tonopah is 6,047 feet.

1.6.1 Geology

SNL/TTR is located in the western part of the Basin and Range geophysical province. This area is marked by horst and graben topography, a system of mountains and down-dropped fault valleys formed through regional extension. SNL/TTR is northeast of the Walker Lane lineament, a zone of transcurrent faulting and shear, and northwest of the Las Vegas Valley shear zone (Sinnock 1982).

The Cactus Range to the west of SNL/TTR is the remnant of a major volcanic center consisting of relatively young (six million years old) folded and faulted Tertiary volcanics. This range is one of at least five northwest trending, raised structural blocks that lie along the Las Vegas Valley/Walker Lane lineaments (ERDA 1975).

1.6.2 Surface Water

Drainage patterns within and near SNL/TTR are intermittent (ephemeral stream channels) and end in closed basins. Ephemeral streams occasionally carry spring runoff to the center of Cactus Flat, where there is a string of north–south trending dry lake beds; however, due to the high rate of evaporation, little is recharged to the groundwater (DRI 1991).

There are several small springs within the Cactus and Kawich ranges. Three occur within SNL/TTR boundaries: Cactus Spring, Antelope Spring, and Silverbow Spring. Water from these springs does not travel more than approximately 100 feet before it dissipates through evaporation and infiltration. The effect on the landscape is purely local.

An *ephemeral spring* flows only briefly in the immediate locality in response to precipitation.

1.6.3 Groundwater

SNL/TTR personnel obtain water from local wells. The U.S. Geological Survey has recorded groundwater depths from 21 to 454 feet below ground surface at the site. Approximate groundwater levels have been recorded as follows:

- Antelope Mine Well in the Cactus Range at 21 feet below ground surface
- EH2 Well near the TTR Airport at 454 feet below ground surface
- Area 9 Well located near the northern end of the site at 131 feet below ground surface
- Production Well 6 in Area 3 at 350 feet below ground surface

1.6.4 Ecology

An ecosystem is a network of living organisms and nonliving components that interact with one another to comprise an overall environment. The ecosystem at SNL/TTR includes the interactions of human, animal, insect, plant, fungal, and many other living component varieties within several habitat types. Nonliving components within the ecosystem include air, water, mineral soil, buildings, structures, roads, and paved surfaces. The habitats of the SNL/TTR ecosystem include

dwarf shrub and saltbrush shrubland in the lower elevations, Great Basin mixed desert scrub in the intermediate elevations, and an abundance of Joshua tree (*Yucca brevifolia*) and junipers (*Juniperus spp.*) with increased elevations. The SNL/TTR ecosystem is a dynamic entity that is impacted by external and internal factors. External factors include such things as climate, time, topography, and biota. Internal factors include the introduction of nonnative species to the ecosystem, and human disturbance and interactions (through development) within the various habitats.

An *ecosystem* is a network of living organisms and nonliving components (e.g., air, water, mineral soil, buildings, and roads) that interact to comprise an overall environment.

In general, the NTTR land withdrawal has had a positive effect on local plant and animal life at SNL/TTR. Since much of the withdrawal area is undisturbed by human activity, large habitat areas are protected from the effects of public use. For more information on the ecology at SNL/TTR, see Chapter 4.

1.6.5 Climate

The climate at SNL/TTR is typical of high desert, midlatitude locations, with large diurnal and seasonal changes in temperature and little total rainfall. Temperature extremes at the test range vary from highs near 104°F in summer, with lows approaching −22°F in winter. July and August are the hottest months, with highs generally in the 90s°F during the day and dropping to the 50s°F at night. January conditions vary from highs in the 40s°F to lows in the 10s°F.

Average annual precipitation at the town of Tonopah Airport (the closest station with 30 or more years of data), elevation 5,426 feet, is 5.08 inches (WRCC 2018a). Typically, the months of May and July have the highest averages of 0.54, and 0.53 inches, respectively, and December has the lowest with 0.27 inches.

Temperature extremes at the test range vary from highs near 104°F in summer, with lows approaching −22°F in winter.

Winds are generally from the northwest in winter and early spring, switching to southerly directions during summer. The mountain-and-valley system channels the wind such that the wind seldom blows from eastern or southwestern directions. Dust storms are common in the spring, when monthly average wind speeds reach 15 miles per hour. During the spring and fall, there may be a diurnal wind cycle, bringing northwest winds in the early hours and shifting to southerly winds by afternoon.

Chapter 2. SNL/TTR Compliance Summary

Pronghorn antelope (*Antilocapra americana*)

OVERVIEW ■ Sandia operations at SNL/TTR comply with federal, state, and local environmental regulations. Releases and occurrences are reported according to numerous permit requirements. Regular audits, appraisals, and inspections identify areas for improvement as well as noteworthy practices.

Sandia operations at the SNL/TTR are in compliance with federal, state, and local environmental requirements, including DOE directives and Presidential Executive Orders (EOs). As a part of this compliance, personnel adhere to strict reporting and permitting requirements.

All SNL/TTR operations and activities, including those that are part of environmental programs, are performed under the Environment, Safety, and Health (ES&H) policy, ESH100, which states:

> It is the policy of Sandia to perform work safety, in a manner that ensures adequate protection for the worker, the public, and the environment; to be accountable for safe performance of work; and to integrate environment, safety, and health management into work planning and execution processes.

An Integrated Safety Management System is used to incorporate safety into management and work practices at all levels so that missions are accomplished while protecting the public, the worker, and the environment. Thus the management of safety functions becomes an integral part of mission accomplishment and meets the requirements outlined DOE. The following five core functions guide management in integrating safety into all work practices: define the scope of work, analyze the hazards, develop and implement hazard controls, perform work within controls, and provide feedback and continuous improvement.

2.1 Environmental Management System

Sandia management takes the responsibility of protecting the environment seriously and requires employees, contractors, and visitors to prevent pollution and conserve natural resources by adhering to the ES&H policy. An Environmental Management System—the primary management approach to minimizing environmental impact and supporting environmental compliance and sustainability practices—is implemented through environmental programs.

The Environmental Management System encompasses all activities, products, and services that have the potential to interact with the environment. Specifically, the Environmental Management System is referenced to establish policy, objectives, and targets that enable personnel to reduce environmental impacts and increase operating efficiencies through a continuing cycle of planning, implementing, evaluating, and improving processes.

DOE O 436.1, *Departmental Sustainability*, was established to ensure that environment management systems and site sustainability are at the forefront of environmental excellence. Sandia personnel implement this directive through an ISO 14001-certified (ISO 2004) Environmental Management System. Sandia received initial ISO 14001 certification in June 2009 for primary operating locations and retained certification in a 2015 recertification audit. SNL/TTR operations do not need to be included in the ISO 14001 certification provided that an internal assessment to the ISO 14001 standard (ISO 2004) is conducted every three years.

An Environmental Management System ISO 14001 assessment of SNL/TTR operations was conducted in 2017. Additional information can be found on the Sandia external Environmental Management System website:

www.sandia.gov/about/environment/environmental_management_system/index.html

The benefits of the Environmental Management System include:

- Improved environmental performance
- Enhanced compliance with environmental regulations
- Strengthened pollution prevention efforts
- Improved resource conservation
- Increased efficiencies and reduced costs
- Enhanced image with the public, regulators, and potential new hires
- Heightened personnel awareness of environmental issues and responsibilities

For FY 2017, the Environmental Management System identified natural resource use, hazardous materials use, and hazardous waste production as the top three significant aspects of operations. When significant aspects and negative impacts have been identified, objectives and measurable targets—at all operating levels—are established to guide efforts toward minimizing those aspects and impacts.

Aspects are any elements of activities, products, or services that can interact with the environment, and *impacts* are any changes in the environment, whether adverse or beneficial, wholly or partially resulting from activities, products, or services.

2.2 Site Sustainability Plan

Sustainability strategies and goals are defined in an annual Site Sustainability Plan, and many of these efforts have been adopted as Environmental Management System objectives and targets. The FY 2017 Site Sustainability Plan (SNL/NM 2016a) articulates the performance status and planned actions for meeting DOE Strategic Sustainability Performance Plan (DOE 2017) goals and requirements of the broader sustainability program set forth in EO 13693, *Planning for Federal Sustainability in the Next Decade*. As of FY 2017, sustainability goals are being met or exceeded in several key areas.

2.3 Environmental Performance Measures

Environmental performance is tracked through various measures and indicators. The results are reported through the internal ES&H Assurance Dashboard, the Sandia Performance Scorecard, the management review process, and management reports.

Environmental performance is assessed as part of the Sandia Performance Evaluation Measurement Plan with DOE. On the basis of the Performance Evaluation Measurement Plan, DOE prepares the Performance Evaluation Report (DOE/NNSA/SFO 2017a). The management and operating contractor's performance was assessed and reported for October 1, 2016, through April 30, 2017. Sandia earned a site-wide excellent rating, exceeded expectations in several areas, and overall met expectations for delivering effective, efficient, and responsive ES&H management and processes.

2.4 Clean Air Act

The Clean Air Act of 1970, as amended, is the comprehensive federal law that regulates air emissions from stationary and mobile sources. The EPA is responsible for describing and regulating air pollutants from stationary and mobile sources and for setting ambient air quality standards. Emissions at SNL/TTR are regulated by State of Nevada air quality regulations. See Chapter 3 for further information on compliance with air quality regulations.

2.4.1 Nonradiological Emissions

Air emissions from nonradionuclide sources, such as a portable screen or maintenance shop activities, are permitted under a Class II Air Quality Operating Permit issued by NDEP. Emissions are tracked, and payment of the standard permit fee is presented to the State of Nevada on an annual basis.

2.4.2 Radionuclide Emissions

The EPA retains compliance authority for all radionuclide air releases, which are regulated by NESHAP and implemented under 40 CFR Part 61, Subpart H (40 CFR 61). Additional requirements pertaining to radionuclide emissions are contained in DOE O 458.1, Admin Change 3, *Radiation Protection of the Public and the Environment*. An annual NESHAP report summarizes radionuclide air emission releases at SNL/TTR and the results of the annual dose assessment.

2.5 Chemical Management

Chemicals are managed through compliance with several requirements. Reporting is specified in these requirements, which are summarized in the following sections.

2.5.1 Emergency Planning and Community Right-to-Know Act

The Emergency Planning and Community Right-to-Know Act (EPCRA) of 1986, also known as the Superfund Amendments and Reauthorization Act (SARA) Title III, requires the submittal of a Toxic Release Inventory report for chemical releases over a given threshold quantity and establishes emergency planning requirements. Table 2-1 lists EPCRA reporting requirements.

Emergency Release Notification

The Emergency Release Notification requirements were established under Section 304 of EPCRA. An accidental release of an extremely hazardous substance that exceeds the applicable reporting quantity must be reported. In 2017, there were no reportable quantity releases of an extremely hazardous substance requiring notification.

Toxic Release Inventory Reporting

The Toxic Release Inventory reporting requirement was established under Section 313 of EPCRA. Environmental releases and other waste management quantities of chemicals on the EPCRA Section 313 list of toxic chemicals must be reported for certain facilities in covered industry sectors if more than established threshold quantities of these chemicals are manufactured, processed, or otherwise used in the facilities.

In 2017, no releases resulting from SNL/TTR operations were reported above the threshold requiring a Toxic Release Inventory report.

Table 2-1. SNL/TTR applicable EPCRA reporting requirements, 2017

Section	EPCRA Section Title	Requires Reporting?		Description
		Yes	No	
301–303	Emergency Planning	✓		Prepare an annual report that lists chemical inventories above the reportable Threshold Planning Quantities listed in 40 CFR 355 (Appendix B), including the location of the chemicals and emergency contacts. DOE distributes the report to the required entities.
304	Emergency Release Notification		✓	Submit notification of reportable quantity releases of an extremely hazardous substance, as defined by CERCLA, to the required entities.
311–312	Hazardous Chemical Inventory	✓		Report on two "Community Right-to-Know" requirements: • Complete EPA Tier II forms for (1) all hazardous chemicals present at the SNL/TTR facility at any one time in amounts equal to or greater than 10,000 pounds and (2) all extremely hazardous substances present at the facility in amounts equal to or greater than 500 pounds or the Threshold Planning Quantity, whichever is lower. This report is provided to DOE for distribution to the required entities. • Record Safety Data Sheets for each chemical entry on an EPA Tier II form and provide the report to DOE prior to distribution to the required entities.
313	Toxic Release Inventory		✓	Submit a Toxic Release Inventory report to the required entities for facilities that release toxic chemicals listed in SARA Title III over a threshold value.

CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act
CFR = Code of Federal Regulations
DOE = U.S. Department of Energy
EPA = U.S. Environmental Protection Agency
EPCRA = Emergency Planning and Community Right-to-Know Act
SARA = Superfund Amendments and Reauthorization Act
SNL/TTR = Sandia National Laboratories, Tonopah Test Range

2.5.2 Federal Insecticide, Fungicide, and Rodenticide Act

The Federal Insecticide, Fungicide, and Rodenticide Act, enacted in 1910 and amended in 1972, governs the registration, distribution, sale, and use of pesticides in the U.S. Herbicides are used to control weeds, rodenticides to control mice, and insecticides to control insects in food service and work areas. All these chemicals are EPA-approved and are applied in accordance with applicable label guidelines and regulations. Records of the quantities and types of insecticides and pesticides that are used as well as Safety Data Sheets for each pesticide are retained. There were no violations of the Federal Insecticide, Fungicide, and Rodenticide Act in 2017.

2.5.3 Toxic Substances Control Act

The Toxic Substances Control Act, enacted in 1976 and later amended, provides regulations regarding the manufacture, processing, distribution, use, and disposal of specific chemical substances and/or mixtures. At SNL/TTR, compliance with Toxic Substances Control Act primarily involves management of asbestos and polychlorinated biphenyls (PCBs).

There are no PCB-contaminated transformers at SNL/TTR. Asbestos abatement-related activities are conducted in accordance with applicable regulatory requirements, as needed.

Indian paintbrush (*Castilleja ssp.*)

2.6 Comprehensive Environmental Response, Compensation, and Liability Act

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, and amended in 1986, also known as the "Superfund," defines assessment activities and reporting requirements for inactive waste sites at federal facilities. As required by CERCLA, a Preliminary Assessment was submitted in 1988 for all facilities listed on the federal agency hazardous waste compliance docket. Sites with significant contamination were put on the National Priorities List for cleanup (EPA 2013). There are no National Priorities List, or Superfund, sites located at SNL/TTR. SARA Title III amended CERCLA requirements for reportable quantity releases and chemical inventory reporting.

2.7 Cultural and Natural Resources

Cultural and natural resources are protected at SNL/TTR.

2.7.1 Cultural Resources Acts

Cultural resources management responsibilities are applicable at SNL/TTR. The three primary cultural acts applicable at SNL/TTR are:

- National Historic Preservation Act, enacted in 1966 and amended in 2000
- American Indian Religious Freedom Act, enacted in 1978 and amended in 1994
- Archaeological Resources Protection Act, enacted in 1979 and amended in 1988

NEPA Program personnel coordinate cultural resources compliance. Actions that could adversely affect cultural resources are analyzed initially in a NEPA checklist review. DOE National Nuclear Security Administration Sandia Field Office is responsible for ensuring that impacts to cultural resources are assessed and appropriate actions are taken to mitigate impacts. In 2017, no operations generated impact on cultural resources at SNL/TTR.

Old settlement at TTR

Historic Building Assessment

In 2011, DOE completed consultation with the Nevada State Historic Preservation Office (SHPO), reaching an agreement on the SNL/TTR Historic District. The district includes 60 structures and represents the key functions included in testing at the site during the Cold War. In 2012, DOE provided the Nevada SHPO with samples of the documentation created to mitigate the effect of future demolition of properties within the SNL/TTR Historic District. The Nevada SHPO reviewed the sample documentation and agreed with its suitability. In 2016, DOE met with the Nevada SHPO to finalize details of a memorandum of agreement covering the SNL/TTR Historic District and mitigative efforts for future demolition and renovation at the site. Negotiation is ongoing.

Once the memorandum of agreement is signed, the Historic American Buildings Survey/Historic American Engineering Record Western Region office will provide instructions on the format for the final report on the SNL/TTR Historic District. Sandia personnel will then produce the report.

Archaeological Survey

In 2017, preparatory to the proposed installation of a fiber-optic cable line to improve communications between Areas 3 and 9 at SNL/TTR, an archaeological survey of the affected area was initiated. The report from that survey will be completed and consultation with the Nevada SHPO will occur in 2018.

2.7.2 Bald and Golden Eagle Protection Act

The Bald and Golden Eagle Protection Act (16 U.S. Code [USC] § 668-668d), enacted in 1940, prohibits the taking or possession of and commerce in bald and golden eagles, with limited exceptions. At SNL/TTR, Ecology Program personnel coordinate compliance with this act. This act is a major component of the SNL/TTR Avian Protection Plan.

2.7.3 Endangered Species Act

The Endangered Species Act (ESA) of 1973, amended in 1982, applies to both private individuals and federal agencies. Federal agencies must ensure that any action authorized, funded, or carried out by them will not jeopardize the continued existence of a threatened or endangered species, or result in adverse modifications of its habitat. At SNL/TTR, NEPA and Ecology Program personnel address ESA compliance. If potentially significant impacts to sensitive species or habitats are found as a result of a proposed action, an environmental assessment or an environmental impact statement must be prepared. See Chapter 4 for more information on the ESA and Sandia's Ecology Program.

2.7.4 Fish and Wildlife Conservation Act

The Fish and Wildlife Conservation Act (Public Law [PL] 96-366), enacted in 1980, and the Lacey Act Amendments (PL 97-79), enacted in 1981, were established so that wildlife will receive equal consideration with other natural resources in regard to maintaining the ecosystem. Relevancy toward an ecological program is stated in 16 USC § 661; the purpose is: "(1) to provide assistance to, and cooperate with, Federal, State, and public or private agencies and organizations in the development, protection, rearing, and stocking of all species; (2) to make surveys and investigations of the wildlife public domain." Ecology Program personnel consider Fish and Wildlife Conservation Act compliance when evaluating NEPA checklists.

2.7.5 Floodplain Management

As amended, EO 11988 of 1977, *Floodplain Management*, requires federal agencies to consider impacts associated with the occupancy and modification of floodplains; reduce the risk of flood loss; to minimize the impact of floods on human safety, health, and welfare; and restore and preserve the natural and beneficial values served by floodplains. There are no floodplains or significant wetlands at SNL/TTR; however, some very limited wetlands exist in the vicinity of several springs. These provide an important source of drinking water for wildlife in the area.

2.7.6 Memorandum of Understanding between the U.S. Department of Energy and the U.S. Fish and Wildlife Service Regarding Implementation of Executive Order 13186, "Responsibilities of Federal Agencies to Protect Migratory Birds"

The purpose of the Memorandum of Understanding between DOE and the U.S. Fish and Wildlife Service Regarding Implementation of EO 13186, *Responsibilities of Federal Agencies to Protect Migratory Birds*, signed in 2013, is to strengthen migratory bird conservation through enhanced collaboration between the two federal agencies in coordination with state, tribal, and local governments. This Memorandum of Understanding identifies specific areas in which cooperation between DOE and the Fish and Wildlife Service will contribute substantially to the conservation and management of migratory birds and their habitats. At SNL/TTR, Ecology Program personnel coordinate responsibilities under this Memorandum of Understanding with requirement of the Migratory Bird Treaty Act (MBTA) through NEPA reviews.

2.7.7 Migratory Bird Treaty Act

The MBTA of 1918 (and amendments) implemented the 1916 Convention for the Protection of Migratory Birds. The original statute implemented the agreement between the U.S. and Great Britain (for Canada), and later amendments implemented treaties between the U.S. and Mexico, the U.S. and Japan, and the U.S. and Russia. The MBTA prevents taking, killing, possessing, transporting, and importing migratory birds, their eggs, parts, or nests. Federal institutions are not exempt from the MBTA. At SNL/TTR, Ecology Program personnel coordinate the MBTA through NEPA reviews and program activities.

2.7.8 Planning for Federal Sustainability in the Next Decade

Issued in March 2015, EO 11988 establishes an integrated strategy toward sustainability to safeguard the health of the environment and make the reduction of greenhouse gas emissions and enhanced climate resilience a priority for all federal agencies. EO 13693 sets goals in the areas of promoting sustainable buildings, increasing renewable energy, reducing water use, promoting electronics stewardship through sustainable acquisition, preventing pollution, and reducing solid waste. Sustainability-related data for SNL/TTR was reported to the Site Sustainability Plan team for submittal to DOE.

2.7.9 Protection of Wetlands

As amended, EO 11990 of 1977, *Protection of Wetlands*, requires federal agencies to minimize the destruction, loss, or degradation of wetlands and preserve and enhance the natural and beneficial values of wetlands. There are no floodplains or significant wetlands at SNL/TTR; however, some very limited wetlands exist in the vicinity of several springs. These provide an important source of drinking water for wildlife in the area.

2.7.10 Sikes Act

The Sikes Act of 1960 (PL 86-97), enacted in 1960, and the amendments of 1986 (PL 99-561) and 1997 (PL 105-85 Title XXIX), was reauthorized in 2013. The Sikes Act protects and enhances fish, wildlife, and other natural resources that exist on and are associated with military lands in the U.S. Ecology Program personnel consider Sikes Act compliance when evaluating NEPA checklists.

2.7.11 Wild Free-Roaming Horses and Burros Act

The Wild Free-Roaming Horses and Burros Act (PL 92-195), enacted in 1971, and amendments declare that wild free-roaming horses and burros are living symbols of the historic and pioneer spirit of the West, that they contribute to the diversity of life forms within the nation, and that they enrich the lives of the American people. The policy states that wild free-roaming horses and burros shall be protected from capture, branding, harassment, or death. To accomplish this, areas where they are presently found are to be considered an integral part of the natural system of the nation's public lands. The Bureau of Land Management's Las Vegas District is responsible for management of wild horses at TTR.

2.8 Hazardous Waste

Hazardous waste at SNL/TTR is handled and managed in compliance with the following requirements.

2.8.1 Federal Facility Agreement and Consent Order

The Federal Facility Agreement and Consent Order (FFACO) is an ongoing action with the State of Nevada that started in 1996. This agreement was implemented in May 1996 between the State of Nevada, DOE, and the DoD (DoD, DOE, and State of Nevada 1996). All DOE cleanup activities at

certain specified facilities in the State of Nevada must be conducted in conformance with the requirements of this agreement. The FFACO is an enforceable agreement with stipulated penalties for violations. The environmental restoration sites subject to the FFACO for which DOE has assumed responsibility are:

- Nevada National Security Site
- Areas within SNL/TTR
- Areas within the NTTR
- Central Nevada Test Area
- Project Shoal Area (east of Carson City in Churchill County)

A summary of DOE environmental restoration sites in Nevada can be found in the FFACO document (DoD, DOE, and State of Nevada 1996). The list of sites has been modified for consistency with Nevada Division of Environmental Protection (NDEP) requirements and grouped into Corrective Action Units (CAUs), which are listed by Corrective Action Site numbers. Each CAU and Corrective Action Site is listed in the FFACO in the following appendices:

- Appendix II, "Corrective Action Sites/Units" (includes inactive CAUs and Corrective Action Sites)
- Appendix III, "Corrective Action Investigations/Corrective Actions" (includes active CAUs and Corrective Action Sites)
- Appendix IV, "Closed Corrective Action Units" (lists CAUs and Corrective Action Sites where corrective actions are complete)

The FFACO is updated every six months. A discussion of environmental restoration sites located at SNL/TTR is provided in Chapter 3.

2.8.2 Federal Facility Compliance Act

The Federal Facility Compliance Act of 1992 requires federal facilities to comply with all federal, state, and local requirements for hazardous and solid waste, including full compliance with the restrictions and prohibitions on extended storage of wastes that do not meet the applicable hazardous waste treatment standards. Extended storage at DOE facilities is typically associated with mixed wastes (wastes that have hazardous and radioactive components) that have been generated on-site. Since SNL/TTR operations do not generate mixed waste and there is currently no mixed waste stored on-site, these requirements are not applicable to operations at SNL/TTR.

The Resource Conservation and Recovery Act regulates the generation, transportation, treatment, storage, and disposal of hazardous chemical waste and nonhazardous solid wastes.

2.8.3 Resource Conservation and Recovery Act

The RCRA, enacted in 1976, and the Nevada Revised Statutes regulate the generation, transportation, treatment, storage, and disposal of hazardous chemical waste and nonhazardous solid wastes. Applicable regulations, including Nevada implementing regulation, are listed in the References section ("State of Nevada Environmental Regulations").

SNL/TTR operations usually generate a small quantity of hazardous waste through normal operations each month, which classifies the site for small-quantity generator status requirements. (See Chapter 3 for a summary of hazardous waste management activities during 2017.) During the 2015 NDEP hazardous waste audit, it was discovered that SNL/TTR was listed incorrectly as a large-quantity generator in the state's records. The NDEP auditor recommended that Sandia

personnel submit an EPA 8700-12 form to NDEP in order to change SNL/TTR back to small-quantity generator status. Sandia personnel submitted the EPA form to NDEP in February 2016, and confirmation of SNL/TTR status as a small-quantity generator was received from NDEP on March 7, 2016. Effective October 26, 2011, small-quantity generators and conditionally exempt small-quantity generators of RCRA hazardous waste in Nevada are no longer required to file a biennial hazardous waste report.

Under the small-quantity generator designation, hazardous waste can only be stored on-site for 180 days before it must be shipped off-site for treatment and disposal at an EPA-permitted facility. SNL/TTR hazardous waste shipments are scheduled to occur at least two to three times a year (as needed).

Sanitary solid waste, which is also regulated under RCRA, is disposed of at the SNL/TTR Class II sanitary landfill (operated by a USAF operations and maintenance contractor). All organizations at SNL/TTR use the landfill cooperatively.

2.9 National Environmental Policy Act

The 1969 NEPA requires federal agencies to consider human health and environmental issues associated with proposed actions, be aware of the potential environmental impacts associated with these issues, and include this information in early project planning and decision-making. Proposed actions that would not significantly impact the human environment are categorically excludable from additional NEPA documentation (as identified in 10 CFR 1021, *National Environmental Policy Act Implementing Procedures*). Other proposed actions may fit within a class of actions that have environmentally significant impacts associated with them. For this class of proposed actions, the agency must prepare an environmental assessment or an environmental impact statement before making an irretrievable commitment of resources or funding. Although a major NEPA objective is to preserve the environment for future generations, the law does not require an agency to choose a course of action with the least environmental impacts. At SNL/TTR, DOE coordinates NEPA compliance with personnel from SNL/NM and SNL/TTR. NEPA activities are discussed in Chapter 3.

The National Environmental Policy act requires federal agencies to consider environmental issues during project planning and decision-making.

2.10 Nevada State Regulations

The State of Nevada administers most environmental regulations applicable to SNL/TTR (Table 2-2). Specific state administrative regulations (State of Nevada Environmental Regulations) include those governing air quality, solid and hazardous waste management, wildlife, water quality, and radiation control. The EPA administers radionuclide air emissions directly.

Table 2-2. SNL/TTR applicable State of Nevada administrative regulations

Chapter and Provisions	Applicable Sources or Activities	
Chapter NAC-444, *Sanitation*		
NAC-444.570 to NAC-444.980, Solid Waste Disposal	• Disposal of construction debris • Disposal of routine nonhazardous solid wastes • Disposal of septic sludge	• Disposal of hazardous waste • PCB • Asbestos
Chapter NRS-444A, *Programs for Recycling*		
NRS-444A.010 to NRS-444A.120, Programs for Recycling	• Recyclables (including waste tires)	

Table continued on next page.

Table 2-2. SNL/TTR applicable State of Nevada administrative regulations (continued)

Chapter and Provisions	Applicable Sources or Activities
Chapter NAC-445A, *Water Controls*	
NAC-445A.9656 to NAC-445A.9706, Septic Tanks	• Septic tanks
NAC-445A.228 to NAC-445A.272, Discharge Permits	• Surface water runoff
NAC-445A.450 to NAC-445A. 6731, Public Water Systems	• Water wells • Operator certification • Treatment of water • Distribution of water • Storage structures • Water conservation plan
Chapter NAC-445B, *Air Controls*	
NAC-445B.001 to NAC-445B.3477, Air Pollution	• Open burning • Class II operating permit • Hazardous air pollutants from stacks and vents • Disturbance of soils during construction (particulate matter)
NAC-445B.400 to NAC-445B.774, Emissions from Engines	• Generators • Mobile sources
Chapter NAC-459, *Hazardous Materials*	
NAC-459.9921 to NAC-459.999, Storage Tanks	• Spill reporting
Chapter NAC-477, *State Fire Marshall*	
NAC-477.323, Permit to Store Hazardous Material	• Hazardous material storage
Chapter NAC-504, *Wildlife Management and Propagation*	
NAC-504	• Management of all plants and wildlife, including state listed threatened, endangered, protected, and sensitive species
Chapter NAC-534, *Underground Water and Wells*	
NAC-534.010 to NAC-534.500, Underground Water and Wells	• Drilling, construction, operation, and plugging (abandonment) of wells and boreholes

NOTE: The Nevada Administrative Code is accessed through https://www.leg.state.nv.us/NAC/CHAPTERS.HTML. The Nevada Revised Statute is accessed through https://www.leg.state.nv.us/NRS/.
NAC = Nevada Administrative Code
NRS = Nevada Revised Statute
PCB = polychlorinated biphenyl
SNL/TTR = Sandia National Laboratories, Tonopah Test Range

2.11 Pollution Prevention and Waste Minimization

Pollution prevention concepts first appeared in RCRA. An expressed concern was to minimize the generation of hazardous waste through process substitution, materials recovery, recycling, reuse, and treatment. RCRA established the reduction or elimination of hazardous waste as national policy (Pollution Prevention Act), and required that hazardous waste generators and RCRA permit holders have a program in place to minimize waste. As required, waste generation and recycling information is reported annually to DOE through the Site Sustainability Plan.

2.11.1 Pollution Prevention Goals

The Site Sustainability Plan establishes a commitment to meet pollution prevention goals identified in the DOE Strategic Sustainability Performance Plan and EO 13693, *Planning for Federal Sustainability in the Next Decade*. Pollution prevention and waste minimization data are reported in the annual Site Sustainability Plan. Additional information about pollution prevention activities is provided in Chapter 3.

2.11.2 Pollution Prevention Act

The Pollution Prevention Act of 1990 declares, as national policy, that pollution should be prevented or reduced at the source (42 USC § 13101 et seq.). A toxic chemical source reduction and recycling report is required for facilities that meet the reporting requirements under EPCRA, Section 313. See Section 2.5.1 for additional information on EPCRA reporting requirements.

2.12 Radiation Protection and the Atomic Energy Act

The purpose of the Atomic Energy Act of 1946 is to assure the proper management of source, special nuclear, and byproduct materials (42 USC § 2011 et seq.). The DOE sets radiation protection standards and retains authority for radionuclides through Department directives and CFRs. Operations at SNL/TTR are subject to DOE requirements established in DOE O 435.1, Change 1, *Radioactive Waste Management*, DOE O 458.1, Admin Change 3, *Radiation Protection of the Public and the Environment, 10 CFR 830 Nuclear Safety Management*, and 10 CFR 835*, Occupational Radiation Protection.*

The radiation protection standards are set for DOE operations so that radiation exposures to members of the public and the environment are as low as reasonably achievable and are maintained within established limits. DOE O 458.1 limits the annual total effective dose of all potential exposure pathways to the public (including air, water, and the food chain) to 100 mrem/year. Pathway guidelines are as follows:

- **Water pathways.** For a drinking water system operated by DOE, DOE facilities must provide a level of radiation protection equivalent to that provided to members of the public by the community drinking water standards in 40 CFR 141, i.e., not exceed the radionuclide maximum contaminant levels. DOE O 458.1 references the derived concentration technical standards for radionuclides in drinking water that could be consumed continuously (365 days a year). This is a conservative approach, which assumes that a member of the public resides at the location continuously. Currently, there is no water pathway for radionuclides in drinking water at SNL/TTR; therefore, the DOE derived concentration standards for a water pathway are not applicable. See Chapter 3 for information about the public water system at SNL/TTR.
- **Air pathways.** DOE facilities are required to comply with EPA standards for radiation protection as regulated by NESHAP and implemented in 40 CFR Part 61 Subpart H, specific to radionuclides emitted from DOE facilities (with the exception of radon). This rule sets a limit on the emissions of radionuclides from DOE facilities that ensures no member of the public receives an effective dose equivalent of more than 10 mrem/year. At SNL/TTR, the only current pathway for potential exposure is through air (see Chapter 3 for details).

In addition to requirements in DOE 458.1, DOE O 435.1 also establishes requirements for managing radioactive waste in a manner that protects worker and public health and safety and the environment. Under this order, DOE contractor-operated facilities are required to plan, document, execute, and evaluate the management of radioactive waste (see Chapter 3 for details).

Sandia manages radioactive waste in a manner that protects workers, the public, and the environment.

The control and clearance of real and personal property with residual radioactivity is specified in DOE O 458.1. Personal property can include vehicles, equipment, materials, and trackable property (equipment with an acquisition value of $10,000 or greater). Personal property with residual radioactivity above the limits specified in DOE O 458.1 is not cleared from radiological control. Pursuant to written procedures, personal property that is potentially contaminated or activated is surveyed prior to clearance, or a process knowledge evaluation is conducted to verify that the personal property has not been exposed to radioactive material or to energy capable of inducing radioactivity in the material. In some cases, both a radiological survey and a process knowledge evaluation are performed. In 2017, Radiation Protection Department personnel did not process any personal property clearance surveys (including trackable property).

DOE issued a moratorium in January 2000 that prohibited the clearance of volume-contaminated metals, and subsequently in July 2000 suspended the clearance of metals from DOE radiological areas for recycling purposes.

Excess property with residual radioactivity above the limits set in DOE O 458.1 is either retained for continued use within DOE facilities or transferred to the SNL/NM Radioactive and Mixed Waste Management Unit for disposal as radioactive waste.

Property clearance activities in 2017 include the following:

- Radiation Protection Department personnel did not process any personal property clearance surveys.
- No trackable property was cleared.
- No metals subject to the moratorium or the suspension were cleared.
- No real property was cleared.

Protection of biota, as specified in DOE O 458.1, ensures that radiological activities having the potential to impact the environment must be conducted in a manner that protects aquatic animal, terrestrial plant, and terrestrial animal populations in local ecosystems from adverse effect due to radiation and radioactive material released from DOE operations. Currently, no biota sampling is conducted due to the low-impact operations at SNL/TTR. However, if changing operations or conditions warrant, sampling will be initiated on a case-specific basis to ensure compliance with DOE O 458.1. See Chapter 3 for Terrestrial Surveillance Program activities.

2.13 Water Quality and Protection

SNL/TTR operations are subject to the requirements of the Clean Water Act and corresponding State of Nevada requirements.

Playa lake, TTR

2.13.1 Clean Water Act

The Clean Water Act of 1972 and amendments established a permitting structure and regulatory direction to protect the "waters of the United States" by restoring and maintaining the chemical, physical, and biological integrity of U.S. waters; protecting fish, wildlife, and recreation; and reducing pollutant discharges. At SNL/TTR, the Clean Water Act applies to sanitary and septic system wastewater effluents, stormwater runoff, and surface water discharges.

2.13.2 Oil Pollution Act

As required under the Oil Pollution Act of 1990 (Clean Water Act §311) (and codified in 40 CFR 112, *Oil Pollution Prevention*), Sandia personnel maintain and implement a Spill Prevention, Control, and Countermeasure Plan that describes oil handling operations, spill prevention practices, discharge or drainage controls, and the personnel, equipment, and resources that are used to prevent oil spills from reaching waters of the U.S. Bulk oil storage containers and oil-filled operational equipment with

a capacity of 55 gallons or more are subject to regulations found in 40 CFR 112 and 40 CFR 110, *Discharge of Oil*. See Chapter 3 for additional information regarding oil storage at SNL/TTR.

2.13.3 Safe Drinking Water Act

SNL/TTR meets standards for drinking water as defined in the Safe Drinking Water Act of 1974 and NDEP public water system regulations. Production Well 6 normally provides all drinking water for the Main Compound in Area 3. SNL/TTR operates under two permits issued by NDEP: one for the public water system and one for the arsenic treatment system. The USAF public water system and the SNL/TTR public water system are designed such that they can, on an as-needed basis, provide backup drinking water to each other. Monitoring activities are discussed in Chapter 3. The NDEP Bureau of Safe Drinking Water characterizes this public water system as a Non-Transient Non-Community Water System.

2.13.4 Stormwater

The issuance of a National Pollution Discharge Elimination System stormwater permit is generally based on whether or not stormwater runoff is discharged to "waters of the United States," as defined in the Clean Water Act. The SNL/TTR site is primarily a closed basin, with runoff evaporating or infiltrating to the ground. The State of Nevada has determined that there are no industrial activities at SNL/TTR that require permitting. New construction activities that exceed one acre of soil disturbance require permitting under the Construction General Permit. On October 9, 2014, SNL/TTR personnel submitted a Notice of Intent to operate under Nevada Stormwater Construction General Permit NVR100000 for a project titled "Tonopah Test Range Fiber Optic Cable Installation." On March 13, 2017, a Notice of Termination was submitted to NDEP after completion of the project.

On March 24, 2016, SNL/TTR personnel submitted a Notice of Intent to operate under Nevada Stormwater Construction General Permit NVR100000 for a project titled "TTR Test Unit Recovery Operations." A Stormwater Pollution Prevention Plan (SWPPP) for construction activities was developed for this project and will be maintained until a Notice of Termination is submitted to NDEP.

2.13.5 Wastewater

SNL/TTR wastewater discharges are controlled by NDEP, which administers regulations relevant to water pollution and sanitary waste systems. Wastewater that enters the sanitary sewer system is treated in the USAF TTR sewage lagoons. The USAF operates these lagoons under a National Pollution Discharge Elimination System permit issued by NDEP. Five Sandia septic tank systems (the newest of which is inactive) are in remote areas at SNL/TTR, and are used for domestic sanitary sewage collection only. Three of the tanks are located in areas now controlled by the USAF (Station 36, the Firing Range, and the Main Gate). The only septic tank being used by Sandia personnel at this time is located at Building 24-01. Additional information can be found in Chapter 3.

Wastewater is the spent or used water from a home, community, farm, or industry that contains dissolved or suspended matter.

2.14 Energy Independence and Security Act

The Energy Independence and Security Act of 2007, Section 438 of the Clean Water Act, requires federal agencies to manage stormwater runoff from federal development projects for the protection of water resources.

2.15 Department of Energy Directives

DOE directives in the Management and Operating Contract for Sandia define the primary contractual obligations for management and operating of SNL/TTR. Directives that pertain to environmental protection and management are discussed in Chapter 1. In 2017, the management and operating contractor for Sandia adhered to all requirements stated in these DOE directives.

2.16 Audits, Appraisals, and Inspections in 2017

Environmental programs at SNL/TTR are routinely subjected to audits, appraisals, and/or inspections by external agencies. Table 2-3 summarizes the 2017 audits, including the findings, notices of violation, and other environmental occurrences. The Sandia internal audit group also conducts assessments, including reviews of implementation of applicable policies, processes, or procedures; evaluations of corrective action validation assessments; and surveillances and walkthroughs. Self-assessments evaluate performance and compliance and identify deficiencies and opportunities for improvement as well as noteworthy practices and lessons learned.

Table 2-3. Environmental-related external audits, appraisals, inspections, and violations, 2017

Appraising Agency	Title	Date	Summary
NDEP - Bureau of Safe Drinking Water	Biennial Sanitary Survey	June 2017	Noted that gaskets were not installed on top man hatches of elevated water tower as required. Gaskets were installed as soon as materials were obtained and weather permitted.

NDEP = Nevada Division of Environmental Protection

2.17 Occurrences and Release Reporting

Under DOE O 232.2, Admin Change 1, the current order for occurrence reporting, an *occurrence* is defined as "one or more (i.e., recurring) events or conditions that adversely affect, or may adversely affect, DOE (including the National Nuclear Security Administration) or contractor personnel, the public, property, the environment, or the DOE mission. Events or conditions meeting the criteria thresholds identified in this Order or determined to be recurring through performance analysis are occurrences." There are environmental releases that may not meet DOE O 232.2 reporting thresholds; however, they may still be reportable to outside agencies.

All 2017 occurrences at SNL/TTR that meet DOE O 232.2 criteria were entered into the DOE Occurrence Reporting and Processing System (ORPS) database. Corrective actions and closure of occurrence reports are also tracked in ORPS. For this *Annual Site Environmental Report*, the ORPS database was queried for SNL/TTR occurrences in the following groups (as defined by DOE O 232.2):

- Group 5, Environmental
- Group 9, Noncompliance Notifications
- Group 10, Management Concerns and Issues
- Any occurrence that involved any of the environmental programs at SNL/NM

Qualifying occurrences that took place within a building are not provided in this report.

During 2017, one occurrence met the query criteria for reporting in the *Annual Site Environmental Report*, as described previously. Table 2-4 lists the occurrence that was categorized as Significance Category 2 (circumstances that reflected degraded safety margins—necessitating prompt

management attention along with modified normal operations—to prevent an adverse effect on safe facility operations; worker or public safety and health, including significant personnel injuries; regulatory compliance; or public/business interests). Table 2-4 also cross-references DOE O 232.2 reportable occurrences that were reportable to an outside agency, if applicable.

Table 2-4. Occurrence reports per DOE O 232.2, 2017

Reporting Criteria	Month	Significance Category	Report Number and Title	Also Reported to Outside Agency
Group 10, Management Concerns and Issues 10(3c)—A near miss to an otherwise ORPS reportable event, where something physically happened that was unexpected or unintended, or where no or only one barrier prevented an event from having a reportable consequence.	January	SC2	NA--SS-SNL-2000-2017-0001 TTR Snow Plow Accident	N/A

DOE = U.S. Department of Energy
N/A = not applicable
ORPS = Occurrence Reporting and Processing System
SC = significance category
TTR + Tonopah Test Range

On January 23, 2017, a Sandia personnel was involved in an on-site vehicle (snow plow) accident. The driver has a commercial driver's license and was the sole occupant; no other vehicles were involved. Road conditions were icy and snow covered. The driver was clearing snow when the vehicle with plow blade attachment departed the roadway and initiated a sliding spin. The vehicle slid across the road and then tipped and rolled onto its top. The driver turned off the ignition and exited the vehicle with minor cuts and bruises. USAF Fire Department personnel initiated control of leaking fuel until a subcontractor arrived and completed the cleanup. All soil, oil, and fuel were contained in a single 55-gallon drum (less than half full). The State of Nevada does not require reporting if petroleum releases to the soil do not exceed 25 gallons or if cleanup does not exceed 3 cubic yards or more of soil. All environmental concerns (minor fuel spill, quantity not recorded) were addressed to meet Sandia and NDEP requirements.

Per DOE, an *occurrence* is defined as "one or more (i.e., recurring) events or conditions that adversely affect, or may adversely affect, DOE (including the National Nuclear Security Administration) or contractor personnel, the public, property, the environment, or the DOE mission. Events or conditions meeting the criteria thresholds identified in this Order, or determined to be recurring through performance analysis, are occurrences"

2.18 Summary of Environmental Permits

Environmental compliance permits for SNL/TTR include those for hazardous materials storage, public water supply, stormwater, RCRA, and air quality. The State of Nevada issues permits for these SNL/TTR activities directly to DOE, and Navarro Research and Engineering administers them on behalf of the Sandia management and operating contractor. Sandia and Navarro Research and Engineering personnel ensure that all permit conditions are met. Table 2-5 lists all permits and registrations in effect at SNL/TTR in 2017.

Table 2-5. SNL/TTR permits, 2017

Permit Type and Location	Permit Number	Issue Date	Expiration Date	Comments
Air Quality				
Class II Air Quality Operation Permit	AP 8733-0680.03 FIN A0025	August 2011 (amended with corrections October 2011 and administratively amended to update Surface Area Disturbance Conditions/Fugitive Dust Control Plan 2014)	July 23, 2016 (permit application submitted to NDEP May 2016, and renewal is still pending NDEP approval)	• Portable screen • Welding operation • Carpenter area • Paint booth • Generators (four logged systems) • Surface area disturbance (< 5 acres)
Hazardous Waste (RCRA)				
Hazardous Waste Generator	NV1890011991[a]	January 7, 1993	Indefinite	State of Nevada
Hazardous Waste (Nevada State Fire Marshal)				
Hazardous Materials Permit	FDID Number: 13007 Permit Number: 63377	February 29, 2017	February 28, 2018	State of Nevada
Stormwater Construction General Permit				
Fiber-Optic Cable Installation	DOE Number CSW-40066 SNL Number CSW-39893	October 16, 2014	Notice of Termination submitted March 13, 2017	State of Nevada
TTR Test Unit Recovery Operations	DOE Number CSW-41616 SNL Number CSW-41615	March 24, 2016	Pay permit fee by July 1 each year until Notice of Termination is submitted	State of Nevada
Production Well (Drinking Water)				
Production Well 6	NY-3014-12NTNC[b]	August 25, 2017	September 30, 2018	State of Nevada
Permit to Operate a Treatment Plant	NY-3014-TP11-12NTNC	August 25, 2017	September 30, 2018	State of Nevada
Water Conservation Plan	Reviewed and approved by Nevada Department of Conservation and Natural Resources, Division of Water Resources	February 25, 2016	February 24, 2021	State of Nevada Required by NRS540.131

[a]Generator identification number (not a permit number).
[b]The State of Nevada Bureau of Health Protection Services renews the permit for Production Well 6 (NV-3014-12NTNC) annually.

AP = air permit
DOE = U.S. Department of Energy
FDID = Fire Department Identification
FIN = facility identification number
NDEP = Nevada Division of Environmental Protection
NRS = Nevada Revised Statute
NTNC = non-transient non-community
NV = Nevada
RCRA = Resource Conservation and Recovery Act
SNL = Sandia National Laboratories
SNL/TTR = Sandia National Laboratories, Tonopah Test Range
TTR = Tonopah Test Range

Chapter 3. SNL/TTR Environmental Programs

Cactus Peak, TTR

OVERVIEW ■ Sandia personnel take the responsibility of protecting the environment seriously. Numerous program teams monitor the air, water, and soil at SNL/TTR to help prevent pollution and conserve natural resources.

Sandia personnel conduct terrestrial, water, and air monitoring as part of environmental programs at SNL/TTR in Nevada. These programs comply with federal, state, and local requirements.

3.1 Environmental Programs

Environmental programs personnel collect data at SNL/TTR to determine and report the impact of existing Sandia operations on the environment. Environmental programs include monitoring and surveilling air, water, and soil. These activities meet or exceed federal, state, and local environmental requirements, as well as DOE directives in Sandia's Prime Contract. Presidential EOs and DOE guidance documents are also used to establish program criteria.

The following environmental programs and focus areas are presented in this chapter:

- Air Quality Compliance Program
- Chemical Information System and Chemical Exchange Program
- Environmental Life-Cycle Management Program
- Environmental Restoration Project
- NEPA Program
- Oil Storage Program
- Terrestrial Surveillance Program
- Waste Management Program
- Water quality programs

3.2 Air Quality Compliance Program

Air Quality Compliance Program personnel support Sandia in complying with air quality regulations promulgated by the state and federal government in accordance with the Clean Air Act and the Clean Air Act Amendments of 1990. Air Quality Compliance Program personnel maintain compliance with 40 CFR Part 60 Subpart H and the SNL/TTR Class II Air Quality Operating Permit issued by the State of Nevada. In Nye County, the Nevada Department of Environmental Protection implements air quality regulations and standards established by the EPA and the State of Nevada.

3.2.1 Nonradiological Air Emissions

The Class II Air Quality Operating Permit for SNL/TTR requires emission reports from the following permitted significant nonradionuclide sources: a portable screen, paint booth, welding shop, carpentry area, and generators. In 2017, emissions from the permitted sources were in compliance with permitted limits. Table 3-1 summarizes the permitted source emission data for 2017.

Table 3-1. Summary of permitted source emission data, 2017

Emissions[a]					
NOx	**CO**	**PM_{10}**	**SO_2**	**VOC**	**HAP**
7.42E-01	1.89E-01	3.72E-02	1.08E-02	2.94E-02	2.21E-03

[a]Measured in tons per year.
CO = carbon monoxide
HAP = hazardous air pollutant
NOx = nitrogen oxides
PM_{10} = particulate matter that has a diameter equal to or less than 10 microns
SO_2 = sulfur dioxide
VOC = volatile organic compound

3.2.2 Radionuclide Air Emissions

The Radionuclide NESHAP Program reports radionuclide emission releases at SNL/TTR and annual dose assessments in the *Radionuclide NESHAP Annual Report for CY 2017, Sandia National Laboratories, Tonopah Test Range* (SNL/NM 2018).

Currently, operations at SNL/TTR do not involve activities that release radioactive emissions from either point sources (stacks and vents) or new diffuse sources. However, diffuse radiological emissions are produced from the resuspension of americium and plutonium, which are present at the Clean Slate environmental restoration sites (see Section 3.5.1).

Initial Radionuclide NESHAP compliance activities included calculating the dose from resuspension of the Clean Slate source term to a maximally exposed individual using the 1988 Clean Air Act Assessment Package dose code. The resuspension calculations were conservative and demonstrated the need for air monitoring of the Clean Slate sites (SNL/NM 1995).

In June 2017, soil removal activities were conducted at Clean Slate 2, and approximately 3,800 cubic feet of contaminated soil was packaged and shipped to the Nevada National Security Site for disposal. Air monitoring was conducted during the soil removal activities at the Clean Slate 2 site. See Section 3.5.2 and Appendix A, "2017 SNL/TTR Air Monitoring Stations," for further information on air- monitoring activities.

The Clean Air Act Assessment Package dose code was used to evaluate applicability with radiological NESHAP guidelines. The maximum release values obtained from the monitoring results were used in the Clean Air Act Assessment Package dose code (Table 3-2).

Table 3-2. Summary of reported radionuclide releases, 2017

Source, Name, Location	Description	Source Type	Monitoring Method	Radionuclide	Releases (curies)
Soil disturbance at Clean Slate 2 site	Approximately 3 acres of soil was disturbed	Area	Periodic	Plutonium-238	2.7E -12
				Plutonium-239/240	1.8E -10

The Nellis USAF airport located off-site and to the west of SNL/TTR, is currently used as the location of the maximally exposed individual. The dose to the non-Sandia public maximally exposed individual at the airport location was calculated to be 1.02E-10 mrem/year, which is significantly below the annual NESHAP limit of 10 mrem/year (SNL/NM 2018).

3.2.3 Other Air Quality Monitoring Activities at SNL/TTR

In addition to Sandia environmental program personnel, other entities perform environmental monitoring activities at SNL/TTR, as described in the following sections.

U.S. Environmental Protection Agency

The EPA Environmental Monitoring Systems Laboratory in Las Vegas, Nevada, monitored background radiation in the area of SNL/TTR as part of its Off-Site Radiation Monitoring Reports Program (EPA 1999), which is now conducted by Desert Research Institute (DRI).

Desert Research Institute of the Nevada System of Higher Education

DRI personnel train and provide monitoring station managers through the Community Environmental Monitoring Program (CEMP) to collect samples from off-site air monitoring stations set up at 23 locations within communities surrounding the Nevada National Security Site. These include the towns of Tonopah and Goldfield, which are near SNL/TTR. DRI, the environmental research arm of the Nevada System of Higher Education, maintains the air-monitoring equipment and sends collected samples to TestAmerica Laboratories in St. Louis, Missouri, for analysis and reporting of gross alpha and gross beta activity of individual filters, and for gamma spectroscopy on quarterly composite samples from each station. Stations also record real-time gamma readings measured in a pressurized ion chamber, and an environmental TLD is analyzed quarterly to confirm gamma readings.

DRI provides external quality assurance on samples collected at CEMP stations through duplicate sampling of 10 percent of the station samples. Duplicate samples are analyzed at the University of Nevada, Las Vegas radioanalytical laboratory. Data collected at CEMP stations are reported in the Nevada National Security Site *Annual Site Environmental Report*.

Five DRI portable monitoring stations were in use at SNL/TTR in 2017, modeled in part after the CEMP stations:

- Station 400 is located near the SNL/TTR Range Operations Center.
- Station 401 is located near Clean Slate 3.
- Station 402 was located near Clean Slate 1 until April 2017 when it was moved to Clean Slate 3 and renamed Station 403.
- Stations 404 and 405 were newly installed in 2017 at Clean Slate 2 (see Section 3.5.4).

3.3 Chemical Information System and Chemical Exchange Program

The Chemical Information System is a comprehensive chemical information tool used to track workplace chemical and biological containers by location. The primary drivers for the Chemical Information System are state and federal regulations, among them the implementing regulations for the EPCRA. The Chemical Information System compiles information concerning chemical hazards and appropriate protective measures for the workforce, Emergency Management Operations, and other ES&H programs.

3.4 Environmental Life-Cycle Management Program

The mission of the Environmental Life-Cycle Management Program is to ensure long-term protection of human health and the environment. This is achieved by implementing environmental life-cycle management practices that focus on sustainable use and protection of natural and cultural resources.

Using the NEPA process, Environmental Life-Cycle Management Program personnel review proposed projects and activities that have the potential to impact the environment. In 2017, Environmental Life-Cycle Management Program personnel reviewed two projects and then documented the environmental impacts.

3.5 Environmental Restoration Project

Environmental Restoration Project activities at SNL/TTR and the NTTR were initiated in 1980 to address contamination resulting primarily from nuclear weapons testing and related support activities. DOE is responsible for all SNL/TTR and NTTR environmental restoration sites.

Since 1996, cleanup activities for selected sites located in the State of Nevada have been regulated by the FFACO of 1996, as amended. (See Chapter 2.) The FFACO was negotiated between the State of Nevada, DoD, and DOE (DoD, DOE, and State of Nevada 1996).

FFACO took effect in 1996 and accomplished the following:

- Established a framework for identifying Corrective Action Sites
- Grouped Corrective Action Sites into CAUs
- Prioritized CAUs
- Implemented corrective action activities

Three environmental restoration activities are addressed by CAUs located at SNL/TTR and NTTR:

- **Industrial sites activity.** Activity at sites historically used to support nuclear testing and Sandia activities. Industrial sites include historical septic tank systems, landfills, sewage lagoons, depleted uranium sites, and ordnance testing sites.
- **Soil activity.** Activity at areas where nuclear testing has resulted in surface and/or shallow subsurface soil contamination. Soil sites include large-area soil contamination from plutonium dispersal testing.
- **Long-term monitoring activity.** Activity at areas where closed FFACO sites have land use restrictions or contamination left in place and require some form of post-closure monitoring.

Environmental restoration site contamination includes radiological constituents (e.g., depleted uranium and plutonium) and nonradiological constituents (e.g., munitions, solvents, pesticides, septic sludge, and heavy metals).

3.5.1 Corrective Action Site Identification

The initial identification, description, and listing of Corrective Action Sites at SNL/TTR and NTTR were derived from the Preliminary Assessment and the Federal Facility Preliminary Assessment Review (E&E 1989). Twelve additional potential Corrective Action Sites, not included in the Preliminary Assessment, were identified using the following methods: environmental restoration site inventory processes, ordnance removal activities, geophysical surveys, former worker interviews, archive reviews, site visits, and aerial radiological and multispectral surveys.

In 2017, activities at the Clean Slate and Double Tracks sites (Operation Roller Coaster) continued. These sites are listed under soil CAUs/Corrective Action Sites in Table 3-3 as CAUs 411, 412, 413, and 414. Project 57 (located on Nellis Range 4808A) is listed under soil CAUs (CAU 415) in Table 3-3. CAU 415 was closed in 2017. A listing of closed CAUs/Corrective Action Sites is available in FFACO appendices II, III, and IV (DoD, DOE, and State of Nevada 1996).

Table 3-3. SNL/TTR status of CAUs remediation activities, 2017

Corrective Action Units/Corrective Action Sites		
Corrective Action Site Number	**Corrective Action Site Description**	**General Location**
CAU 411— *Closed.* Double Tracks plutonium dispersion (NAFR)		
NAFR-23-01	Pu contaminated soil	Nellis Range 71
CAU 412— *Closed.* Clean Slate 1 plutonium dispersion (SNL/TTR)		
TA-23-01CS	Pu contaminated soil	Tonopah Test Range
CAU 413—*Remediation phase.* Clean Slate 2 plutonium dispersion (SNL/TTR)		
TA-23-02CS	Pu contaminated soil	Tonopah Test Range
CAU 414— *Remediation phase.* Clean Slate 3 plutonium dispersion (SNL/TTR)		
TA-23-03CS	Pu contaminated soil	Tonopah Test Range
CAU 415—*Closed.* Project 57 No. 1 plutonium dispersion (NTTR)		
NAFR-23-02	Pu contaminated soil	Nellis Range 13
CAU 541—*Closed.* Small Boy		
05-23-04	Atmospheric tests (six), BFa[a] site	BFa, NTTR
05-45-03	Atmospheric test site, Small Boy	Frenchman Flat, Area 5, NTTR

NOTE: A listing of closed CAUs/Corrective Action Sites is available in FFACO appendices II, III, and IV (DOD, DOE, and State of Nevada 1996).

[a]BFa is the site name and not an acronym.
CAU = Corrective Action Unit
FFACO = Federal Facility Agreement and Consent Order
NAFR = Nellis Air Force Range
NTTR = Nevada Test and Training Range
Pu = plutonium
SNL/TTR = Sandia National Laboratories, Tonopah Test Range
TA = technical area

3.5.2 Environmental Restoration Project Activities in 2017

Environmental restoration activities in 2017 included characterizing, packaging, and shipping approximately 3,800 cubic feet of low-level waste (soil) from Clean Slate 2 to the Nevada National Security Site. This waste was generated during site remediation activities. DOE manages all waste generated from environmental restoration activities. Final approval of closure from NDEP was received for Project 57 (CAU 415).

Other environmental restoration activities conducted on the SNL/TTR and NTTR sites in 2017 consisted of the annual post-closure inspections of closed and use-restricted industrial sites and the inspections of radiological postings at the Clean Slate and Double Tracks sites. The inspections were conducted in May 2017.

Air samples were also collected throughout the year at various locations on SNL/TTR and NTTR, and are summarized in the following sections.

3.5.3 Air Monitoring at Double Tracks and Clean Slate Sites

In May and June 1963, Operation Roller Coaster was conducted and included a series of four nuclear weapons destruction tests that resulted in plutonium dispersal in surrounding soils. Three of these tests were conducted within the boundaries of SNL/TTR; the fourth was conducted at NTTR just west of SNL/TTR. The three Operation Roller Coaster test sites at SNL/TTR are referred to as Clean Slate 1, Clean Slate 2, and Clean Slate 3. The fourth test site at NTTR is referred to as Double Tracks. In 1996 and 1997, interim corrective actions were performed at Double Tracks and Clean Slate 1. In 2016, DOE completed the remaining corrective actions at Double Tracks and Clean Slate 1, and NDEP approved the Final Closure Report. These two sites have been determined to be Clean Closed as defined in the FFACO. Clean Slate 2 is currently being remediated by removal of contaminated soils. Clean Slate 3 is currently being investigated to determine the nature and extent of contamination. This information will be used to determine the appropriate corrective action alternative. These sites are currently fenced and have signage posted. The areas are inspected each year to determine whether any fence repairs or sign replacement is required.

DOE is responsible for remediation of these and all other environmental restoration sites at SNL/TTR. DOE and Sandia personnel will continue to be responsible for all other environmental compliance at these sites.

3.5.4 Air Monitoring at Environmental Restoration Sites

Remediation activities were conducted at Clean Slate 1 in 1997. DRI personnel collected air monitoring data from several locations in the vicinity of Clean Slate 1 before, during, and after remediation activities. The data were presented to DOE in the form of a draft report (DRI 1997). The report documented the as-left condition at the site, but did not require follow-up action.

The *environment* is the sum of all external conditions affecting an organism's life, development, and survival.

During 2017, at the request of DOE, DRI maintained five portable environmental monitoring stations at SNL/TTR as part of the Project Soils, an environmental restoration activity (Figure 3-1). The primary objective of the monitoring stations is to evaluate whether, and under what conditions, there is wind transport of radiological contaminants from any of the soil CAUs associated with Operation Roller Coaster at SNL/TTR.

The TTR monitoring stations collect data on selected meteorological and environmental parameters (e.g., wind speed and direction, and airborne particulate concentration as a function of particulate size). In addition, airborne particulate samplers are deployed at each location to collect particulate samples for radiological analyses. Data are provided to the Western Regional Climate Center for management and incorporation into a TTR-specific database.

Monitoring Station Locations

Monitoring Station 400 was established in 2008 and is located in the general vicinity of the TTR Range Operations Center. It measures potential radionuclide concentrations associated with airborne particulates at the location closest to regular site workers. Station 401 was also installed in 2008 and is located on the fenced perimeter of the north edge of Clean Slate 3.

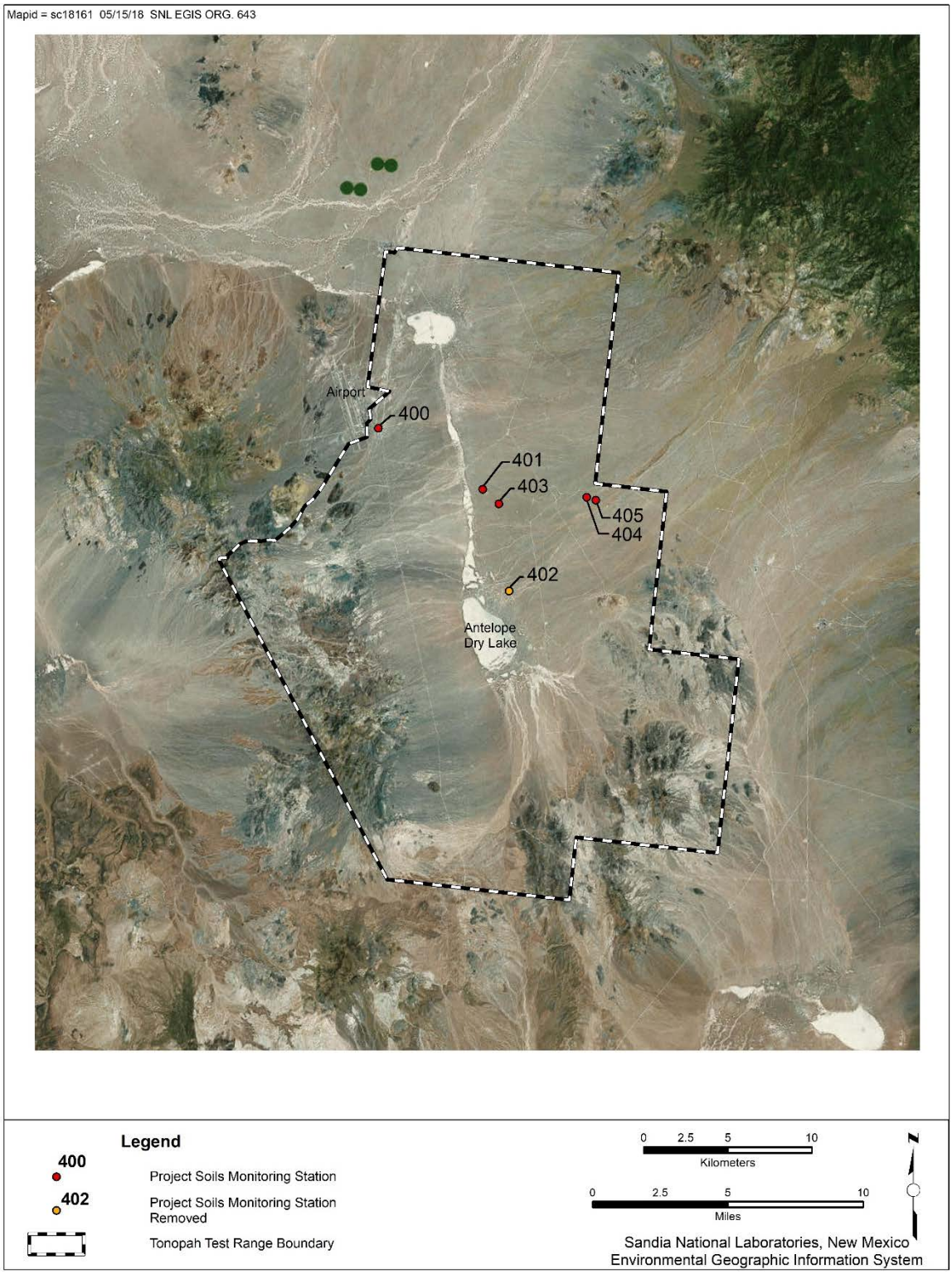


Figure 3-1. Project Soils air monitoring station location

Station 402 was located on the fenced perimeter of the north edge of Clean Slate 1 between May 2011 and April 2017, when it was moved to the fenced perimeter at the south end of Clean Slate 3 and renamed Station 403. Two new monitoring stations were also installed on April 25, 2017: Station 404 on the fenced perimeter of the north end of Clean Slate 2 and Station 405 on the fenced perimeter of the south end of Clean Slate 2. The stations at Clean Slate 3 and Clean Slate 2 measure the radionuclide concentration associated with airborne particulates at the boundaries of the sites in the predominant upwind and downwind directions.

The orientations of the locations relative to the Clean Slate sites were initially selected based on a review of wind speed and direction data collected at the Tonopah Airport (Engelbrecht et al. 2008), as well as for ease of access. Though the Tonopah Airport wind data are of limited time duration, the topographic setting is more similar to the Clean Slate sites than stations with longer periods of record located within the town of Tonopah. On-site wind direction measurements have since confirmed the appropriateness of the station locations. Figure 3-1 shows the location of the monitoring stations at SNL/TTR.

Monitoring Station Capabilities

Station 400 uses line power to operate the instruments. Stations 401,403, 404, and 405 are solar-powered with battery backup power; the batteries are recharged during daylight hours by solar panels. All five stations consist of two primary components: an air sampler and an auxiliary meteorological tower.

All five monitoring stations are equipped with continuous low-volume air samplers having a flow rate of approximately 2 cubic feet per minute. Filters are collected routinely every two weeks for laboratory analysis. These filters are initially delivered to the Radiological Services Laboratory at the University of Nevada, Las Vegas, for analyses. Standard analyses include gross alpha and gross beta measurements and gamma spectral analysis; samples may undergo alpha spectral analysis if initial gamma results indicate the presence of americium-241, which could indicate that plutonium particles are being transported. Two samples from each station are selected per quarter to undergo alpha spectroscopy analysis for Pu-238 and Pu-239/240 by TestAmerica Laboratories in St. Louis, Missouri.

Detailed presentation and discussion of the air monitoring results for the Clean Slate monitoring stations is provided in an annual report, *Tonopah Test Range Air Monitoring: CY 2017 Meteorological, Radiological, and Wind Transported Particulate Observations* (Chapman et al. 2018 in progress). A summary of air monitoring stations and 2017 results is provided in Appendix A, "2017 SNL/TTR Air Monitoring Stations."

3.6 National Environmental Policy Act Program

NEPA compliance is coordinated between DOE, SNL/TTR, and SNL/NM personnel.

Personnel from SNL/TTR and the SNL/NM NEPA team support projects at SNL/TTR, including ES&H preparations for the next series of B61-12 flight tests. This support includes continued collaboration with the DOE National Nuclear Security Administration Sandia Field Office, SNL/TTR, SNL/NM, and Los Alamos National Laboratory personnel.

In 2017, the SNL/NM NEPA team completed six NEPA checklists for SNL/TTR, three of which were transmitted to the DOE National Nuclear Security Administration Sandia Field Office for review and completion.

3.7 Oil Storage Program

The *Spill Prevention Control and Countermeasures (SPCC) Plan for SNL Tonopah Test Range* (SNL/NM 2014b) pertains to oil storage containers, equipment, and secondary containment structures subject to 40 CFR 112, *Oil Pollution Prevention*, and 40 CFR 110, *Discharge of Oil*. The SPCC Plan is reviewed and updated at least every five years.

In 2017, the inventory of oil storage containers at SNL/TTR included seven stationary aboveground storage tanks, two mobile refuelers (one truck and one trailer), a bulk storage area for drums, a transformer storage area, and numerous mobile generators. Inspections were conducted monthly, per the SPCC Plan. Any issues identified during the inspections are corrected promptly or are tracked via the work request process.

The following SPCC-related activities occurred during 2017:

- There were no reportable spills in 2017.
- There was an issue with small-quantity hydraulic leaks from hydraulic equipment on two of the three high-speed telescope trailers over several months. Drip pans were deployed and monitored. The units are scheduled for maintenance in early 2018.

3.8 Terrestrial Surveillance Program

Terrestrial Surveillance Program personnel collect environmental media (soil) samples and send them for off-site laboratory analysis of the radiological constituents, as required. As a best management practice, samples are also collected for analysis of metals. In addition to the environmental media samples, ambient external gamma radiation levels are measured using TLDs. These surveillance activities are conducted at designated locations that are on-site, off-site, and around the perimeter of SNL/TTR. Soil sampling is conducted annually, and the TLDs are collected and exchanged quarterly.

Terrestrial surveillance began at SNL/TTR in 1992. A large-scale baseline sampling was conducted from 1994 through 2005 and reported in *Chemical Analyses of Soil Samples Collected from the Sandia National Laboratories, Tonopah Test Range Environs, 1994–2005* (SNL/NM 2006). In 2000, a single analytical laboratory with lower detection capabilities than those previously available for many of the metals was contracted. The same database has been used for statistical analysis from 2000 to the present.

3.8.1 Regulatory Criteria

The Terrestrial Surveillance Program is designed and conducted to address DOE O 458.1, Admin Change 3, *Radiation Protection of the Public and the Environment,* which establishes standards and requirements to protect the public and the environment from undue risk from radiation associated with radiological activities under the control of DOE.

The Terrestrial Surveillance Program is also conducted to satisfy implementation of Sandia's Environmental Management System, which is certified to the ISO 14001 standard. Reporting is done in accordance with DOE O 231.1B, Admin Change 1, *Environment, Safety and Health Reporting.*

3.8.2 Sample Locations and Media

Three sample location classifications are used: on-site, perimeter, and off-site (the latter previously referred to as "community" locations). Sampling locations have been selected based on locations of previous and ongoing activities. Environmental TLDs, deployed and collected quarterly, are used to

measure cumulative ambient external radiation dose and to closely approximate the dose potentially received from natural and unnatural sources.

The on-site sample locations (Table 3-4, Figure 3-2) are in areas of known contamination Corrective Action Sites and areas of potential release (sites with current outdoor testing activities). On-site location S-48, North/south Mellan Airstrip–Antelope Tuff, was removed in 2017 due to potential hazards to personnel in accessing the location.

Table 3-4. SNL/TTR on-site terrestrial surveillance locations, sample media, and parameters

Surveillance Location	Location Number	Sample Location	Soil[a]	TLD[b]
Range Operations Center	S-40	Wastewater monitoring station	X[c]	
	S-41	"Danger Powerline Crossing" sign	X[c]	
	S-42	Main Road/Edward's Freeway	X[c]	
	S-43	Range Operation Center (southwest corner)	X[c]	
	S-44	Range Operation Center (northeast corner)	X[c]	
	S-45	Storage shelters 03-38 and 03-39	X[c]	
	S-46	Sand Building	X[c]	
	S-47	Generator storage area	X[c]	
South Plume Area	S-48	North/south Mellan Airstrip–Antelope Tuff	Discontinued in 2017	
	S-49	North/south Mellan Airstrip–southwest of S-48	X[d]	
	S-50	North/south Mellan Airstrip–signpost	X[d]	
	S-51	North/south Mellan Airstrip–northeast of S-50	X[d]	
	S-52	Northeast of Mellan Airstrip	X[d]	
Various on-site	S-01	Antelope Lake area fence, cultural area sign	X[d]	X
	S-02	North/south Mellan Airstrip (south fencepost)	X[d]	X
	S-03	TLD at Clean Slate 2	X[d]	X
	S-04	TLD at Clean Slate 3	X[d]	X
	S-09	Roller Coaster Decontamination Area	X[d]	X
	S-10	Brownes Road/Denton Freeway	X[d]	X
	S-13	Area 3 between Building 100 and "Caution" sign		X
	S-14	Area 3 control point southwest side of fence		X
Various on-site	S-15	Moody Avenue by cattle guard and entrance to chow hall and airport		X
	S-16	Area 9, near Well 7		X
	S-17	Main Lake–south, near Neutron Bunkers		X
	S-38	Mellan Hill–Rock Mound/Orange Block	X[d]	
	S-39	Mellan Hill–north	X[d]	
	S-53	Main Road/Lake Road southeast	X[d]	

[a]Soil samples are analyzed for radionuclides by gamma spectroscopy annually.
[b]TLDs are analyzed for gamma radiation.
[c]Soil samples are analyzed for Target Analyte List metals every five years (last sampled in 2013).
[d]Soil samples are analyzed for Target Analyte List metals annually.
SNL/TTR = Sandia National Laboratories, Tonopah Test Range
TLD = thermoluminescent dosimeter

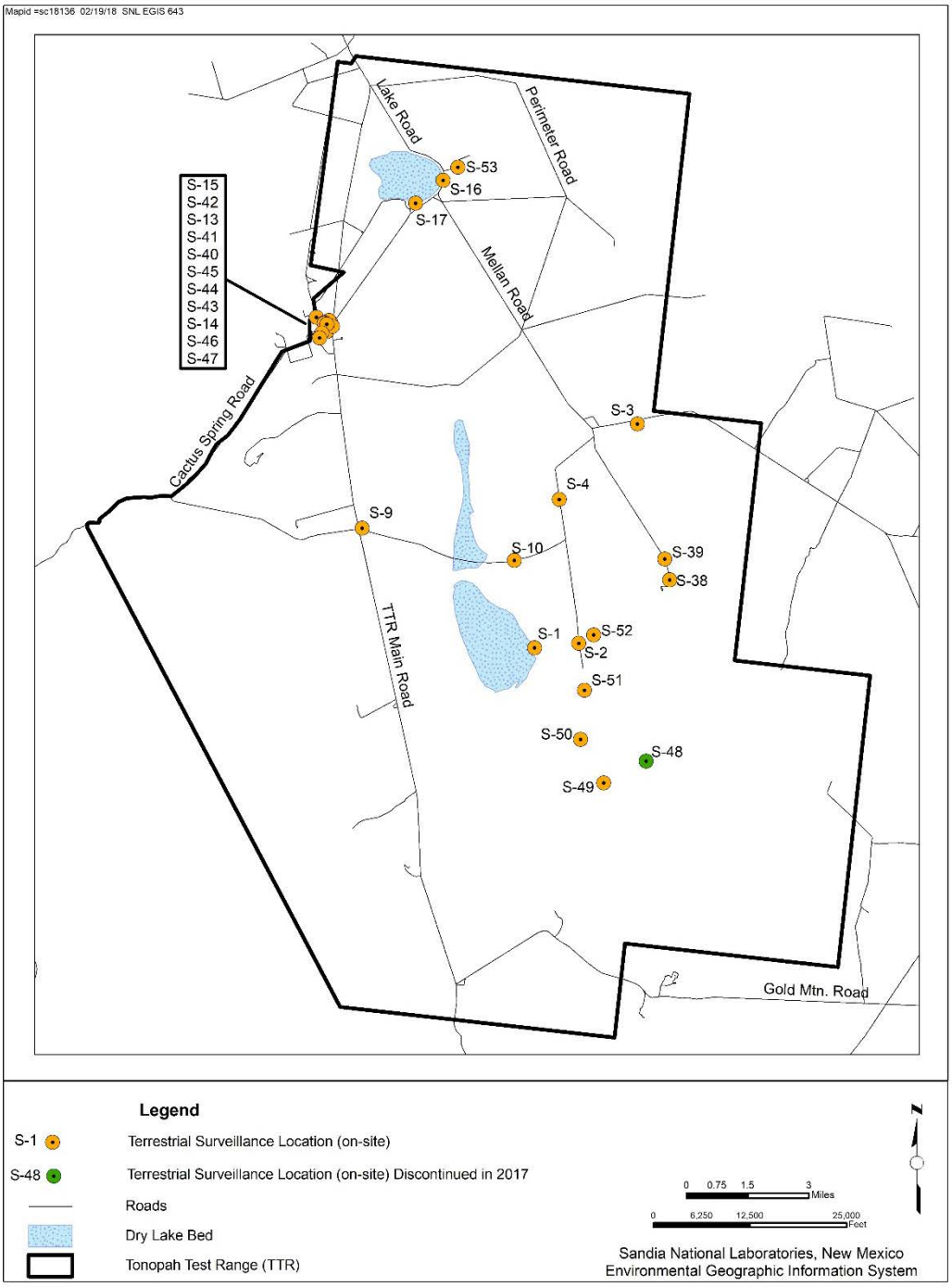


Figure 3-2. SNL/TTR on-site terrestrial surveillance locations

Perimeter sample locations (Table 3-5, Figure 3-3) are located around the boundaries of SNL/TTR. Off-site sample locations (Table 3-6, Figure 3-4) are located in remote areas, areas near local population, and along major roadways. Off-site sample results are used for comparison to the on-site and the perimeter sample results. Off-site and perimeter locations are sampled every five years and were not sampled in 2017 (the next sampling will be in 2018).

Table 3-5. SNL/TTR perimeter terrestrial surveillance locations, sample media, and parameters

Surveillance Location	Location Number	Sample Location	Soil[a,b]	TLD[c]
Perimeter	P-05	O&M Complex–Site 4 entrance gate		X
	P-06	Cedar Pass Road guard station	X	X
	P-07	On-base housing–south of power pole 55-11		X
	P-08	On-base housing (main guard gate/power pole CP17)	X	X
	P-11	Cactus Springs (TLD south of P-35)	X	X
	P-12	TLD at "U.S. Government Property" sign	X	X
	P-34	O&M Complex–Owan Drive post	X	
	P-35	Cactus Springs (north fencepost)	X	
	P-36	On-base housing (northeast fence line)	X	
	P-37	On-base housing (guard station)	X	

[a]Soil samples are analyzed for radionuclides by gamma spectroscopy annually.
[b]Soil samples are analyzed for Target Analyte List metals every five years (last sampled in 2013).
[c]TLDs are analyzed for gamma radiation.
O&M = Operation and Maintenance
SNL/TTR = Sandia National Laboratories, Tonopah Test Range
TLD = thermoluminescent dosimeter
U.S. = United States

Table 3-6. SNL/TTR off-site terrestrial surveillance locations, sample media, and parameters

Surveillance Location	Location Number[a]	Sample Location	Soil[b,c]	TLD[d]
Off-Site	C-19	Mining Museum, north Goldfield		X
	C-20	State Road 6 rest area	X	
	C-21	State roads 6 and 95 Ely rest area	X	X
	C-22	Rocket	X	X
	C-23	Alkali and Silver Peak turnoff	X	
	C-24	Cattle guard	X	
	C-25	Tonopah Rangers Station	X	
	C-26	Gabbs Pole Line Road	X	
	C-27	State roads 6 and 376 junction	X	
	C-28	Stone Cabin and Willow Creek on State Road 6	X	
	C-29	State roads 6 and 375 junction	X	
	C-30	State Road 375 ranch cattle gate	X	
	C-31	Golden Arrow and Silver Bow on State Road 6	X	
	C-32	Mile marker 6 on Sandia Drive	X	
	C-33	Mile marker 10 on Sandia Drive	X	

[a]Off-site samples were previously called "community" samples, thus the *C* label in the location number (maintained for the database).
[b]Soil samples are analyzed for radionuclides by gamma spectroscopy annually.
[c]Soil samples are analyzed for Target Analyte List metals every five years (last sampled in 2013).
[d]TLDs are analyzed for gamma radiation.
SNL/TTR = Sandia National Laboratories, Tonopah Test Range
TLD = thermoluminescent dosimeter

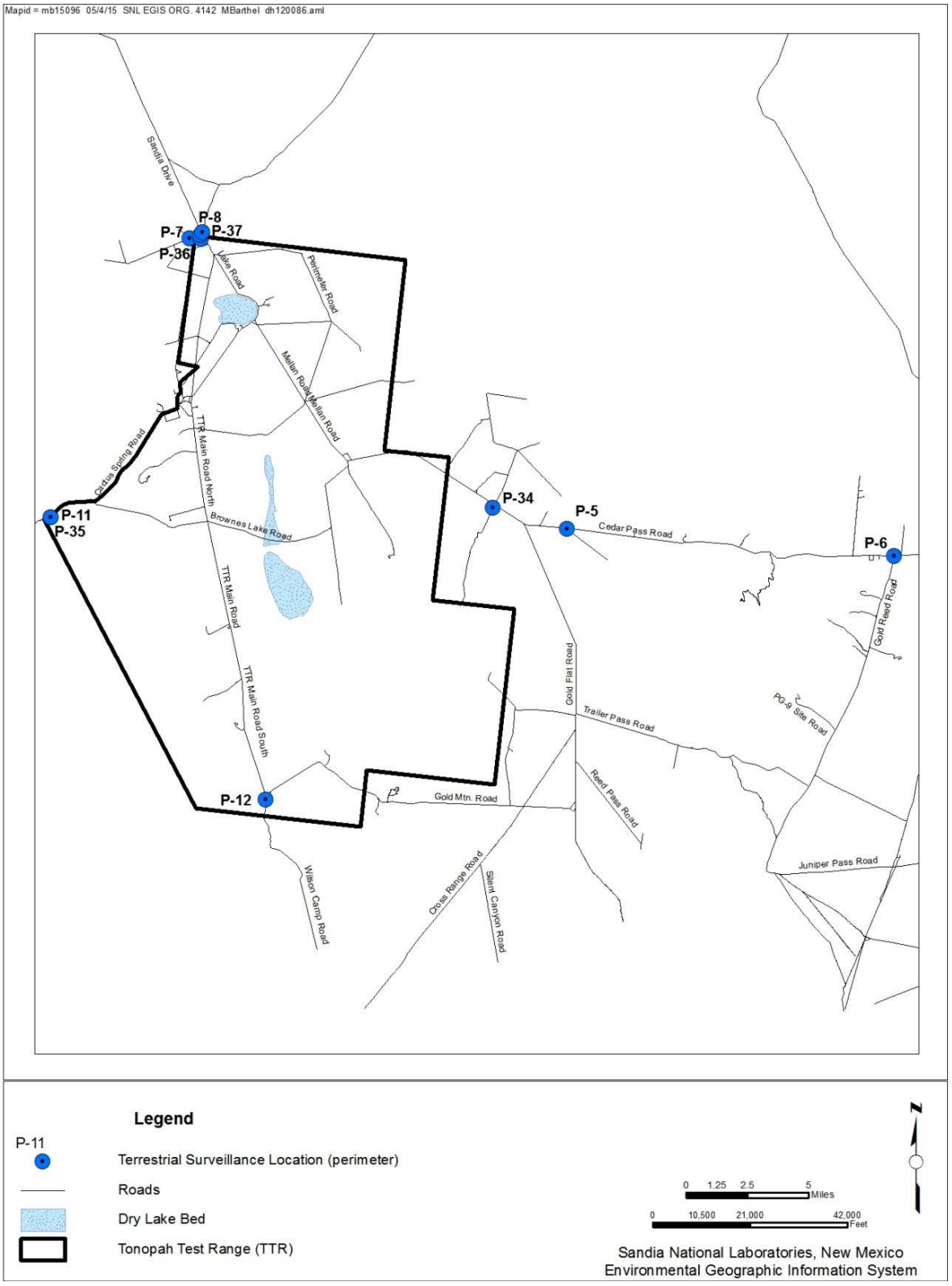


Figure 3-3. SNL/TTR perimeter terrestrial surveillance locations

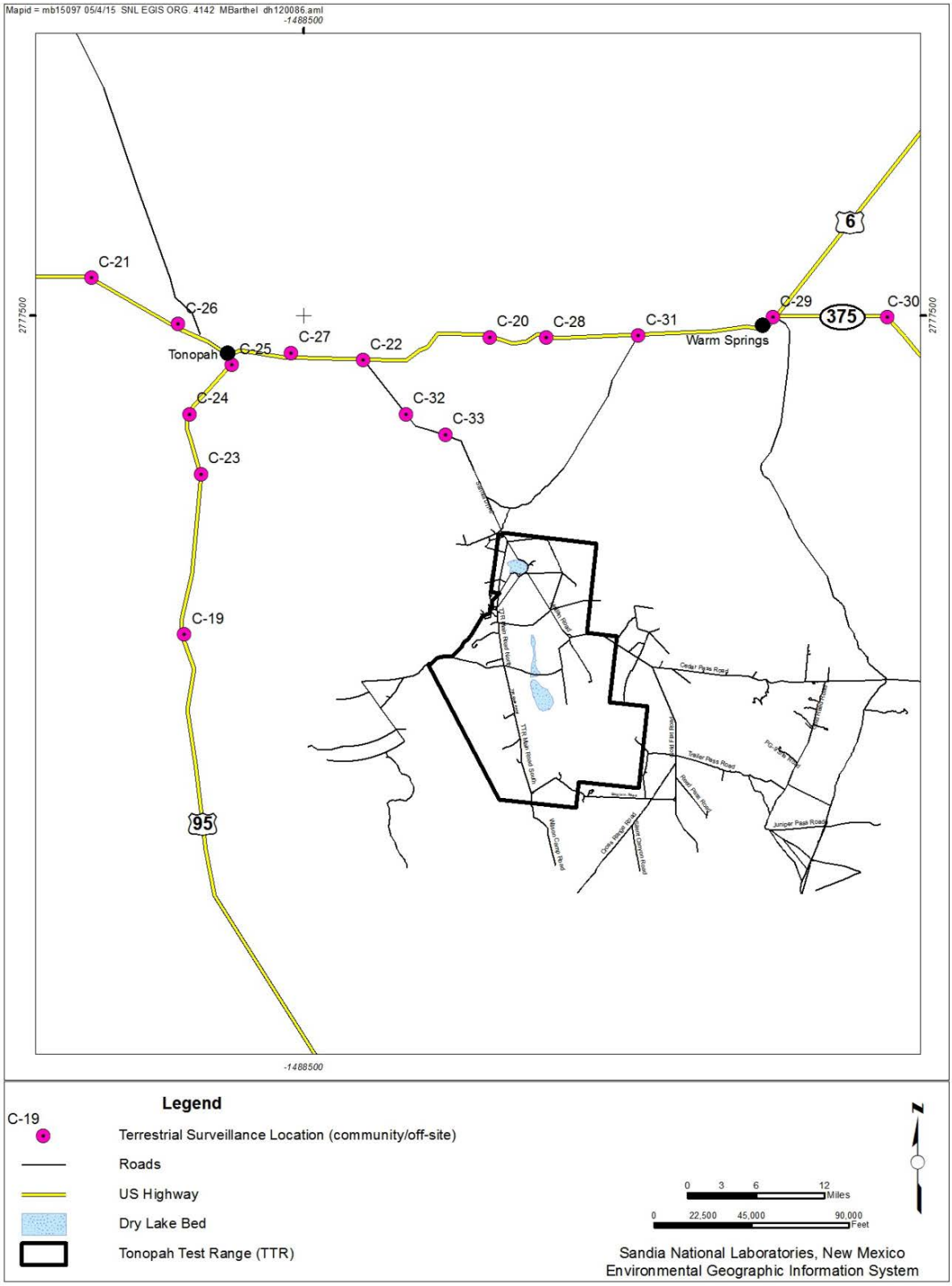


Figure 3-4. SNL/TTR off-site terrestrial surveillance locations

3.8.3 Field Methods, Analytical Parameters, and Quality Control Procedures

All SNL/TTR samples were collected in accordance with applicable SNL/NM field operating procedures for soil sampling activities and with the *Quality Assurance Project Plan for Terrestrial Surveillance at Sandia National Laboratories, New Mexico* (SNL/NM 2016b).

Off-site laboratories analyzed all samples in accordance with applicable EPA analytical methods. All chemical data were reviewed and qualified in accordance with Administrative Operation Procedure 00-03, *Data Validation Procedure for Chemical and Radiochemical Data* (SNL/NM 2014a).

Soil samples were analyzed for modified Target Analyte List metals and radiological parameters, including gamma-emitting radionuclides, plutonium, and uranium. Details of the radiological parameters pertinent to SNL/TTR are as follows:

- **Gamma-emitting radionuclides.** Gamma spectroscopy is used to detect the emission of gamma radiation from radioactive materials. Radionuclide identification is possible by measuring the spectrum of gamma energies associated with a sample, since each radionuclide has a unique and consistent series of gamma emissions. Cesium-137 is an example of a long-lived gamma emitter that is prevalent in the environment at SNL/TTR (as fallout from historical nuclear weapons testing in that area). Other gamma emitters of interest at SNL/TTR are americium-241 and depleted uranium from past explosives testing.
- **Plutonium.** Due to past explosives testing, plutonium is present in some limited areas at SNL/TTR. One indicator of the presence of weapons-grade plutonium is the radionuclide americium-241. Isotopic plutonium analysis is performed on any sample for which gamma spectroscopy identified americium-241 in concentrations greater than its minimum detectable activity.
- **Uranium.** Uranium occurs naturally in soils and may also be present as a pollutant in the environment at SNL/TTR due to past testing conducted there. Total uranium analysis is used to measure all uranium isotopes present in a sample. An isotope-specific analysis may be performed to determine the possible source of uranium (i.e., natural, man-made, enriched, or depleted).

The Radiation Protection Dosimetry Program at SNL/NM issues and processes environmental TLDs. The TLD sampling locations were established to determine the regional gamma exposure rate at SNL/TTR due to natural sources and to determine the impact, if any, of operations on those exposure rates. The technical basis for the environmental TLD monitoring program is provided in *Description and Procedures of the Environmental Radiation Dosimetry Program* (SNL/NM 1987). Dosimeters are issued and processed following established Radiation Protection Dosimetry Program protocols

Field quality control samples collected at SNL/TTR included triplicate environmental samples. These samples were prepared in accordance with applicable field operating procedures. Laboratory-quality control samples were prepared and analyzed as specified in accordance with established methods.

3.8.4 Sample Result Analysis and Methodology

No regulatory limits are available to directly compare concentrations of radiological or nonradiological constituents in surface soils. Statistical analyses are conducted to compare the results from on-site and perimeter samples to off-site results, and to establish any trends that may indicate the potential for a release of contaminant(s).

Statistical Analysis and Methodology

Samples are collected from specified locations to effectively enable statistical comparisons with results from previous years. Statistical analyses are performed to determine whether a specific on-site or perimeter sample result differs from off-site sample results and to identify trends at a particular sampling location.

The results of the statistical analyses are used to prioritize possible follow-up actions, such as resampling, additional investigation, and/or notifications to applicable entities. A decision-making tool is used to help determine the appropriate level of concern for each sample result. The statistical analysis prioritization methodology (Shyr, Herrera, and Haaker 1998) is based on a matrix of four priority levels. The decision matrix is shown in Table 3-7.

Table 3-7. SNL/TTR priority decision matrix and actions

Priority[a]	Are Results Higher Than Off-Site?	Is There an Increasing Trend?	Action
1	Yes	Yes	Immediate attention is needed. Specific investigation is planned and/or notifications will be made to applicable entities.
2	Yes	No	Some concern is warranted. Further investigation and/or notifications may be necessary.
3	No	Yes	A minor concern. Further investigation and/or notifications may be necessary.
4	No	No	No concern. No investigation will be required.

[a]Based on a statistical analysis prioritization methodology (Shyr, Herrera, and Haaker 1998).
SNL/TTR = Sandia National Laboratories, Tonopah Test Range

Other Standards for Comparison for Soil Samples

In addition to the statistical analysis, analytical results for metals in soil and sediment samples may be compared to values in the following references (presented in Table 3-8):

- Local and regional soil concentrations (Dragun and Chekiri 2005)
- EPA risk-based screening levels for soil (EPA 2017)
- U.S. surface soil surface concentrations (Kabata-Pendias 2000)

In some instances, a qualitative inspection of the data may be augmented by the graphical evaluation methodology described and documented in *Chemical Analyses of Soil Samples Collected from the Sandia National Laboratories, Tonopah Test Range Environs, 1994–2005* (SNL/NM 2006).

No regulatory limits are available to directly compare concentrations of radiological or nonradiological constituents in surface soil.

Standards for Comparison for Thermoluminescent Dosimeters

Results from CEMP (see Section 3.2.3) monitoring stations may be used for comparison.

Estimated annual exposures from the CEMP stations were reported in the Nevada National Security Site Environmental Report (NSTec 2017). The estimated annual exposure in Las Vegas (2,025-foot elevation) was 100 mR. Estimated annual exposures at other CEMP locations ranged from 85 mR at Pahrump, Nevada (2,400-foot elevation) to 145 mR at Milford, Utah (4,900-foot elevation). There is a relationship between increasing natural background exposure and elevation, generally due to cosmic radiation.

Table 3-8. SNL/TTR various reference values for metals in soil (all units in mg/kg)

Analyte	Nevada Soil Concentrations[a]		EPA Risk-Based Screening Levels[b]		U.S. Soil Concentrations[c]	
	Lower Limit	Upper Limit	Residential Soil	Industrial Soil	Lower Limit	Upper Limit
Aluminum	5,000	100,000	77,000	1,100,000	4,500	100,000
Antimony	< 1.0	1.0	31	470	0.25	0.60
Arsenic	2.9	24	0.68	3.0	1	93
Barium	150	3,000	15,000	220,000	20	1,500
Beryllium	ND	5.0	160	2,300	0.04	2.54
Cadmium	ND	11	—	—	0.41	0.57
Calcium	600	320,000	—	—	—	—
Chromium (III)	7.0	150	120,000	1,800,000	7	1,500
Cobalt	ND	20	23	350	3	50
Copper	7.0	150	3,100	47,000	3	300
Iron	1,000	100,000	55,000	820,000	5,000	50,000
Lead	ND	70	400	800	10	70
Magnesium	300	100,000	—	—	—	—
Manganese	30	5,000	1,800	26,000	20	3,000
Nickel	5.0	50	1,500	22,000	5	150
Potassium	1,900	63,000	—	—	—	—
Selenium	< 0.1	1.1	390	5,800	0.10	4.0
Silver	0.5	5.0	390	5,800	0.20	3.2
Sodium	500	100,000	—	—	—	—
Strontium	100	1,500	47,000	700,000	7	1,000
Thallium	—	—	0.78	12	0.02	2.8
Vanadium	30	150	390	5,800	0.7	98
Zinc	25	128	23,000	350,000	13	300

[a]Dragun and Chekiri 2005.
[b]EPA Risk-Based Screening Levels (Target Hazard Quotient = 1.0), EPA, updated November 2017.
[c]Kabata-Pendias 2000.
— = not available
EPA = U.S. Environmental Protection Agency
ND = not detected
SNL/TTR = Sandia National Laboratories, Tonopah Test Range
U.S. = United States

3.8.5 Summary of Terrestrial Surveillance Program Activities and Results in 2017

The following Terrestrial Surveillance Program activities occurred in 2017:

- The annual sampling of soil at on-site locations occurred in June 2017 at designated locations.
- Environmental TLDs were deployed, collected, and analyzed at designated locations quarterly. The results are reported as an estimated annual exposure (the average of the quarterly annualized values).

The analytical results for radiological (including environmental TLDs) and nonradiological parameters for the 2017 sampling event are summarized in the following subsections, and the data are provided in Appendix B, "2017 SNL/TTR Terrestrial Surveillance Results."

Radiological Results

The summary statistics for radiological results for 2000 through 2017 are presented in Table 3-9. The respective radiological analytes are discussed in the following subsections, which list the locations identified as Priority-1 and Priority-2. Statistical values for uranium (total) are also shown on Table 3-9.

Table 3-9. SNL/TTR summary statistics, 2000–2017

Analyte	Location Classification	Number of Samples	Mean (pCi/g)	Median (pCi/g)	Standard Deviation (pCi/g)	Minimum (pCi/g)	Maximum (pCi/g)
Americium-241	Perimeter	150	0.021	0.022	0.053	−0.24 U	0.15 BD
	On-site	363	0.35	0.053	1.2	−0.23 U	11
	Off-site	258	0.024	0.025	0.045	−0.20 U	0.16
Cesium-137	Perimeter	150	0.19	0.16	0.15	0.012	0.89
	On-site	374	0.23	0.20	0.18	0.0 U	1.5
	Off-site	258	0.20	0.16	0.15	−0.0017 BD	0.93
Plutonium-238	Perimeter	17	0.0042	0.0028	0.0080	−0.0056 U	0.030
	On-site	111	0.17	0.021	0.86	−0.010 U	8.4
	Off-site	34	0.0028	0.00094	0.0050	−0.0037 U	0.020
Plutonium-239/240	Perimeter	17	0.021	0.016	0.017	0.0014 U	0.070
	On-site	111	16	0.59	115	−0.0082 U	1,200 J
	Off-site	34	0.014	0.011	0.013	−0.0011 U	0.05
Plutonium-242	On-site	5	3.5	3.5	0.032	3.5	3.6
Uranium-235	Perimeter	150	0.076	0.072	0.056	−0.059 U	0.25
	On-site	374	0.087	0.079	0.062	−0.071 BD	0.39
	Off-site	258	0.083	0.076	0.059	−0.10 BD	0.29
Uranium-238	Perimeter	150	1.3	1.3	0.53	0.0029 U	3.1 R
	On-site	373	1.3	1.3	0.51	−0.052 BD	3.1
	Off-site	254	1.3	1.2	0.51	0.14 BD	3.1 J
Analyte	**Location Classification**	**Number of Samples**	**Mean (mg/kg)**	**Median (mg/kg)**	**Standard Deviation (mg/kg)**	**Minimum (mg/kg)**	**Maximum (mg/kg)**
Uranium, total	Perimeter	72	0.71	0.70	0.18	0.43	1.5
	On-site	276	0.73	0.72	0.15	0.44	1.5
	Off-site	126	0.75	0.70	0.20	0.46	1.6

BD = below detection limit as used in radiochemistry to identify results that are not statistically different from zero (data validation qualifier)
J = the associated numerical value is an estimated quantity (data validation qualifier)
R = the data are unusable, not used in statistical analysis
SNL/TTR = Sandia National Laboratories, Tonopah Test Range
U = the analyte was analyzed for but was not detected; the associated numerical value is the sample quantitation limit (laboratory qualifier)

Americium-241

The results of the statistical analysis for americium-241 identified one Priority-1 on-site location (S-51 soil) with a value of 10 pCi/g (Table 3-10).

Americium-241 at location S-51 continues to be identified as Priority-1. This location is at the edge of South Plume Area and is expected to have elevated readings. This is consistent with the hot particle theory, where the presence of americium-241 or plutonium-239/240 in a heterogeneous sample skews the apparent average concentration, making it appear greater. Sampling and trend analyses will continue for americium-241 (and plutonium-239/240) at this location.

All other locations were identified as Priority-4 for americium-241.

Table 3-10. SNL/TTR radiological summary statistics for Priority-1, Priority-2, and Priority-3 soil sample locations, 2017

Priority	Analyte	Location	Mean (pCi/g)	Median (pCi/g)	Standard Deviation (pCi/g)	Minimum (pCi/g)	Maximum (pCi/g)	2017 Result
Priority-1	Americium-241	S-51	3.9	4.1	3.5	−0.0095	11	10
Priority-2	Plutonium-239/240	S-51	29	9.5	46	0.15	132	16
Priority-3	Plutonium-238	S-51	0.51	0.079	0.85	0.0054	2.8	0.24

SNL/TTR = Sandia National Laboratories, Tonopah Test Range

Plutonium-238

The results of the statistical analysis for plutonium-238 identified one Priority-3 on-site location (S-51 soil) with a result of 0.24 pCi/g.

Plutonium-239/240

The results of the statistical analysis for plutonium-239/240 identified one Priority-2 on-site location (S-51 soil) with a result of 16 pCi/g.

The result for S-51 is consistent with historical values. This is related to the elevated americium-241 results discussed previously. Sampling and trend analysis will continue for plutonium-239/240 (and americium-241) at S-51.

Thermoluminescent Dosimeter Statistical Results

TLDs were deployed, collected, and analyzed at SNL/TTR on a quarterly basis in 2017. TLD summary statistics for FY 2001–2017 are provided in Table 3-11 and Figure 3-5.

Table 3-11. SNL/TTR TLD exposure rate summary statistics by location classification, 2001–2017

Location Classification	Number of Observations	Mean (mR/year)	Median (mR/year)	Standard Deviation (mR/year)	Minimum (mR/year)	Maximum (mR/year)	2017[a] Mean Result (mR/year)
On-site	171	163	161	14	130	219	187
Perimeter	95	163	160	17	131	218	189
Off-site	50	145	148	18	116	186	171

[a]TLD data is reported on a fiscal year basis.
SNL/TTR = Sandia National Laboratories, Tonopah Test Range
TLD = thermoluminescent dosimeter

During 2017, the mean of the estimated annual exposure rates for the on-site, perimeter, and off-site locations was 187 mR, 189 mR, and 171 mR, respectively. The results for on-site and perimeter locations were statistically different, with higher values, from the off-site locations. The values for all three location types were higher than values in 2016. The elevations at TTR range from 5,347 feet at the valley floor to 7,482 feet at Cactus Peak and are higher than elevations of the CEMP stations. The higher estimated annual exposure rates for TTR may be attributed to the higher elevations of the site.

There was an increase in average annual dose for all three location classifications in FY 2016 and FY 2017. This was due to an update that Radiation Protection Dosimetry Program made in the dose calculation, which caused dose results to increase by approximately 15 percent. In addition, the background calculation was adjusted to account for how the controls were being stored. The raw signal values, background values, and calculation methods for the past three years were reviewed in

detail and were similar. The apparent increasing trend in FY 2017 is due to iterative improvements in calculations and methods, and in storage procedures.

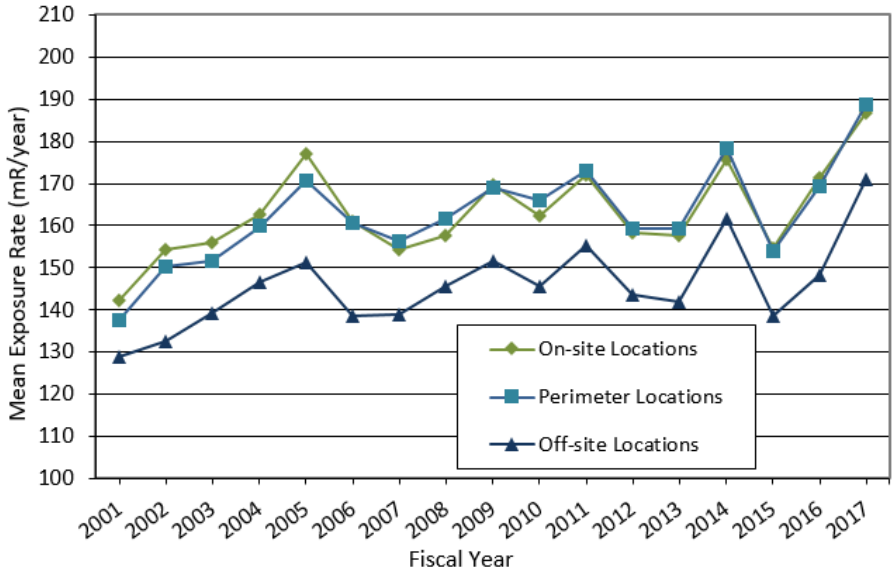


Figure 3-5. SNL/TTR TLD exposure rates by year and location classification

Nonradiological Parameters and Results

Nonradiological parameters include modified Target Analyte List metals. In addition to the statistical analysis, results may also be compared to values from the references listed in Section 3.8.4 and provided in Table 3-8.

In 2017, soil samples were collected at the locations listed in Table 3-4, Table 3-5, and Table 3-6 for specified parameters. Designated locations were sampled for metals analysis; other locations are only sampled for metals every five years and were not sampled in 2017 (the next sampling will be in 2018). The results of the statistical analyses for metals are provided in Table 3-12.

Table 3-12. SNL/TTR metals summary statistics for Priority-3 sample locations, 2017

Priority	Analyte	Location	Sample Matrix	Mean (mg/kg)	Median (mg/kg)	Standard Deviation (mg/kg)	Minimum (mg/kg)	Maximum (mg/kg)	2017 Result (mg/kg)
Priority-3	Uranium, total	S-38	Soil	0.65	0.66	0.12	0.51	0.86	0.82

SNL/TTR = Sandia National Laboratories, Tonopah Test Range

Uranium, Total

The results of the statistical analysis for total uranium identified one Priority-3 on-site location (S-38 soil) with a result of 0.82 mg/kg. The result was within the range of on-site values for uranium, total, as shown in Table 3-9.

All other locations were identified as Priority-4 for the Target Analyte List metals.

Additional Activities and Variances

There were no other Terrestrial Surveillance Program activities at SNL/TTR in 2017. There was one variance from the planned activities. As stated in Section 3.8.2, sampling location S-48 was removed in 2017 due to potential hazards to personnel in accessing the location.

3.9 Waste Management Program

Navarro Research and Engineering manages all waste generated at SNL/TTR—which excludes any waste generated by environment restoration activities—under the Waste Management Program. Waste categories include radioactive waste, RCRA hazardous waste, other chemical waste, and nonhazardous solid waste. Waste minimization and recycling efforts are integrated into Waste Management Program activities.

Waste generated and shipped from SNL/TTR to approved facilities in 2017 is presented in Table 3-13 and Table 3-14, respectively. All regulated waste was shipped off-site to permitted treatment, storage, and disposal facilities.

Table 3-13. SNL/TTR waste generated, 2017

Waste Type	Weight (kg)	Weight (pounds)
Total RCRA hazardous waste	616	1,355
Total non-RCRA-regulated waste	549	1,208
Total recycled materials	2,623	5,771
Toxic Substances Control Act waste (PCB)	199	438
Toxic Substances Control Act waste (asbestos)	21	46
Radioactive waste	0	0

PCB = polychlorinated biphenyl
RCRA = Resource Conservation and Recovery Act
SNL/TTR = Sandia National Laboratories, Tonopah Test Range

Table 3-14. SNL/TTR waste shipped, 2017

Waste Type/Facility	Weight (kg)	Weight (pounds)
Sanitary landfill (USAF Sanitary Landfill)	10,618	23,360
Construction debris (USAF Construction Landfill)	1,485,673	3,268,480
Tires (Lunas Tire Recycling)	0	0
Battery recycling (National Automotive Parts Association and Veolia)	1,114[a]	2,450

[a]This total is also included in the "Total recycled materials" total located in Table 3-13.
SNL/TTR = Sandia National Laboratories, Tonopah Test Range
USAF = U.S. Air Force

Waste Minimization Program

SNL/TTR is committed to achieving significant reductions in the amount of chemical and hazardous wastes generated on-site. Waste minimization includes recycling and recovering the following materials:

- Antifreeze (on-site recycling unit)
- E-waste, including computers, monitors, radios, and electronics
- Fluorescent and sodium bulbs
- Freon (on-site recovery unit)
- Fuels and oil
- Lead acid batteries
- Mercury-containing equipment
- Solvents
- Tires

Recyclables and used oil are sent for recycling or are disposed of through a waste disposal contractor. Recycled or energy-recovered quantities shipped off-site in 2017 are presented in Table 3-15.

Table 3-15. SNL/TTR material recycled or energy-recovered and shipped off-site, 2017

Recycled or Energy-Recovered Waste	Shipped (kg)	Shipped (pounds)
Automotive type batteries	1,114	2,450
Universal waste batteries	61	134
Universal waste lamps	487	1,071
Mercury-containing articles	0.2	0.44
Non-PCB light ballasts	366	805
Antifreeze	0	0
Used oil	469	1,032
Used oil filters	126	277
Tires	0	0
Total	**2,623[a]**	**5,769[a]**

[a]Weights have been rounded to nearest integer.
PCB = polychlorinated biphenyl
SNL/TTR = Sandia National Laboratories, Tonopah Test Range

Radioactive Waste Management

There were no radioactive waste shipments in 2017.

3.10 Water Quality Programs

The SNL/TTR water quality programs focus on monitoring potable water, conserving water, sampling wastewater effluent, and implementing SWPPP requirements.

3.10.1 Production Well Monitoring

SNL/TTR personnel use three active wells: Production Well 6 (Figure 3-6), Well 7, and the Roller Coaster Well. The most active are Production Well 6 and the Roller Coaster Well. Production Well 6 is a public water system well that supplies drinking water to the Main Compound in Area 3 and the Area 3 Fire Protection Water Distribution System. Production Well 6 is the only well at SNL/TTR that has been sampled for contaminants. Outlying areas and buildings without water service use bottled water. The other wells are not used for potable purposes (construction and dust suppression only), and there are no regulatory sampling requirements for them.

Figure 3-6. SNL/TTR Production Well 6 pump house provides Area 3 drinking water

All public water system drinking water sampling and quality assurance practices were conducted in accordance with requirements set by NDEP. Analytes are sampled at different intervals, as shown in Table 3-16. NDEP currently provides public monitoring and reporting requirements for each public water system around March annually. The public water system at SNL/TTR is permitted by NDEP as a Non-Transient, Non-Community Water System under identification number NV003014. The well water is sampled and analyzed routinely per NDEP requirements to demonstrate conformance with primary drinking water standards.

The State of Nevada maintains information on the SNL/TTR public water system—including water system details, sample schedules, sample results, and any violation or enforcement actions—at the following location:

https://ndep.nv.gov/water/drinking-water

Sampling parameters include (but are not limited to) total coliform, arsenic, nitrates, total trihalomethanes and haloacetic acids, lead and copper, phthalate, and secondary inorganic compounds (aluminum, color, copper [free], iron, magnesium, manganese, methylene blue active substances foaming agent [surfactant], odor, potential of hydrogen [pH], silver, total dissolved solids, and zinc).

Table 3-16. SNL/TTR routine production well parameters

Analyte	Reporting Frequency
Coliform, total	Quarterly
Arsenic	Quarterly
Disinfectant, residual	Quarterly (checked daily)
Total trihalomethanes and haloacetic acids (5)	Annually
Di(2-ethylhexyl) phthalate (DEHP) *also known as* Bis(2-ethylhexyl) phthalate	As required by NDEP, usually every three years
Nitrate	Annually
IOCs Phase II, IOCs Phase V, nitrite, nitrate and nitrite (total) SOCs Phase II, SOCs Phase V, VOCs Phase I and II, VOCs Phase V	As required by NDEP, usually every three years
Lead and copper	As required by NDEP, usually every three years
Dioxin	As required by NDEP, usually every three years
Secondary (13) drinking water standards	As required by NDEP, usually every three years

IOC = inorganic compound
NDEP = Nevada Division of Environmental Protection
SNL/TTR = Sandia National Laboratories, Tonopah Test Range
SOC = synthetic organic compound
VOC = volatile organic compound

There is also an NDEP-permitted treatment system for arsenic removal (permit number NV-3014 TP-11-12NTNC) at SNL/TTR. The arsenic removal system has performed well since the installation of a carbon dioxide (pH adjustment) system in June 2008. The untreated water is required to be between 6.5 and 7.0 on the pH scale for efficient and effective operation of the arsenic removal system, as defined by the NDEP permit.

Summary of Production Well Monitoring Activities and Results in 2017

In 2017, no SNL/TTR public water system Drinking Water Public Notice warnings were issued, and all sample results were below the NDEP maximum contaminant levels established for the substances monitored.

Four compliance samples were collected from Production Well 6 for arsenic analysis in 2017. Results for all samples were 4.5 ppb arsenic or less. The maximum contaminant level for arsenic in drinking

water is 10 ppb as a running annual average. The running annual average for arsenic in the drinking water at SNL/TTR during 2017 was 3.0 ppb.

During 2017, Production Well 6 produced 635,100 gallons of water that was chlorinated and sent to the elevated water storage tower. This equals an average monthly production of approximately 52,925 gallons during 2017. Daily production during 2017 averaged approximately 1,740 gallons.

3.10.2 Water Conservation

The State Water Resources Division regulations require a water conservation plan for permitted water systems and major water users in Nevada (DOE/NV 1992). The SNL/TTR Water Conservation Plan provides education, conservation measures, and an estimate of the amount of water that may be conserved each year as a result of the adoption of this plan. To date, the amount of water estimated to be conserved has been met. The plan must be updated every five years (the next revision is due in March 2021).

3.10.3 Sewage System and Septic Tank Monitoring

Wastewater discharges from activities conducted at facilities in the Main Compound at Area 3 go to the USAF facultative sewage lagoon for treatment. As a best management practice, either Sandia or Navarro Research and Engineering personnel take annual wastewater samples from Area 3 at the point where wastewater leaves SNL/TTR property and enters the USAF system. All sampling and quality assurance practices were conducted in accordance with program-specific sampling and analysis plans and Quality Assurance Plans (see Chapter 5).

The USAF is responsible for the National Pollutant Discharge Elimination System permit for wastewater discharges. The USAF takes samples from the headwater end of the lagoon. In the past, Sandia personnel provided quarterly sampling results to the USAF for inclusion into their USAF Discharge Monitoring Report; however, the National Pollutant Discharge Elimination System permit was modified in 1997 and quarterly data is no longer required. Therefore, Sandia personnel now only provide annual wastewater sampling results. These systems are sampled as a best management practice and do not require sampling per the NDEP. During 2017, there were no excursions or violations of concentration limits. The 24-hour composite wastewater samples are collected on an annual basis, and the following parameters are analyzed:

- Chemical oxygen demand
- Metals (arsenic, cadmium, chromium, copper, nickel, silver, zinc, lead, selenium, and mercury)
- Oil and grease
- pH
- Phenolic compounds (phenol-containing compounds are not used at SNL/TTR)
- Semivolatile organic compounds
- Total cyanide (cyanide-containing compounds are not used at SNL/TTR)
- Total petroleum hydrocarbons
- Total suspended solids
- Tritium, gamma spectroscopy, and gross alpha and gross beta
- Volatile organic compounds

The analytical results for wastewater sampled at Area 3 are provided in Appendix C, "2016 SNL/TTR Wastewater Sampling Results."

Septic tank systems are sampled as needed. DOE owns five septic tank systems located on-site at SNL/TTR: 36-01, 09-52 (inactive/never used), 24-01, Firing Range, and SNL/TTR Main Gate (Point Able Guard Station). The USAF currently occupies the facilities, using the septic tanks at 36-01, the Firing Range, and at the TTR Main Gate. Sewage from these locations flows into septic tank systems and associated drain fields. None of these systems required maintenance, sampling, or pumping in 2017. All other remaining septic tank systems have been closed or are undergoing closure and are being addressed by Environmental Restoration Project personnel.

3.10.4 Stormwater Sampling

Currently, stormwater sampling is not required at SNL/TTR.

Chapter 4. SNL/TTR Ecology Program

Coyote (*Canis latrans*)

OVERVIEW ■ Ecology Program personnel monitor biota as an element of the overall environmental monitoring process. Ecological data is collected on plants and wildlife to support documentation, land use decisions, and ecological and wildlife awareness campaigns to ensure safe work environments and sustainable decision-making strategies. The Ecology Program helps operations comply with wildlife regulations and laws by providing biological evaluations and surveys in support of site activities.

At SNL/TTR, Ecology Program personnel support site activity and project compliance with wildlife requirements by providing biological evaluations and inventory surveys. The surveys, primarily for birds, are conducted in late spring to measure species diversity, abundance, and land use patterns. As part of the Avian Protection Plan for TTR, utility poles associated with Sandia projects are also surveyed for any potential risks to birds that may roost or nest on the poles.

The data are used to support NEPA documentation, land use decisions, ecological and wildlife awareness campaigns, and sustainable decision-making strategies, and to help ensure safe work environments.

4.1 Ecological Setting

The topography at SNL/TTR is characterized by a broad, flat valley with two north- and south-trending mountain ranges: the Cactus Mountain Range to the west (occurring mostly within the boundaries of SNL/TTR) and the Kawich Mountain Range to the east. Cactus Flat is the name given to the valley floor where the main operational area of SNL/TTR is located. To the south, the landscape consists of low hills and outcrops. Elevations range from 5,347 feet at the valley floor to 7,482 feet at Cactus Peak (USAF 1997).

The area north of the SNL/TTR boundary is comprised of public lands administered by the U.S. Bureau of Land Management and the U.S. Forest Service. The land is currently used to graze

cattle. There is a substantial irrigated farming operation north of TTR. To the east of SNL/TTR is the Nevada Wild Horse Range, which is administered by the Bureau of Land Management (USAF 1997).

SNL/TTR, in general, is situated within the Great Basin biogeographic province, as described by Brown (Brown 1982). A biogeographic province is a large region characterized as distinct from other regions, mostly on the basis of different dominant vegetation and wildlife habitat types.

4.1.1 Vegetation

Most of the SNL/TTR vegetation can be subdivided into several general types. The vegetation of the lower elevation portions, such as Cactus Flat, is primarily dwarf shrub and saltbrush shrubland (vegetation height of less than or equal to 0.5 m), and is typified by shadscale (*Atriplex confertilfolia*), budsage (*Artemisia spinescens*), winter fat (*Krasheninnikovia lanata*), and Indian ricegrass (*Achnatherum hymenoides*). Intermediate elevation slopes are dominated by Great Basin mixed desert scrub, and the shrub cover tends to be taller (greater than or equal to 0.5 m) with some grassland characterized by various species of horsebrush (*Tetradymia spp.*), rabbitbrush (*Chrysothamnus vicidiflorus* and *Ericameria nauseosa*), hopsage (*Grayia spinosa*), shadscale (*Atriplex confertilfolia*), and budsage (*Artemisia spinescens*). As the elevation increases, Joshua tree (*Yucca brevifolia*) and junipers (*Juniperus spp.*) start to show up and increase in abundance. The understory becomes that of black sagebrush (*Artemisia nova*) and rabbitbrush. Of note, there is a small (half acre or less) man-made pond known as the Roller Coaster Construction Pond. The water from this pond is primarily used for dust suppression and construction at SNL/TTR. The vegetation associated with this pond is typical of a wetland. There are at least two naturally occurring ephemeral springs—Cactus Spring and Antelope Spring—within the DOE-controlled portion of SNL/TTR. These springs have been altered extensively by man over time. Portions of these springs stay wet enough throughout the year to support emergent vegetation and a few deciduous trees.

A *biogeographic province* is a large region characterized as distinct from other regions, mostly on the basis of different dominant vegetation and wildlife habitat types.

4.1.2 Wildlife

The wildlife that is known to occur at SNL/TTR is fairly typical of the Great Basin biogeographic province. With the exception of the Roller Coaster Construction Pond, there are no sites with fish at SNL/TTR. The fish in this pond are tui chub (*Gila bicolor*) and mosquitofish (*Gambusia spp.*), which have been introduced.

A notable species is feral horses (*Equus ferus*), often called wild horses or mustangs. Horses were introduced to the area in the seventeenth and eighteenth centuries. Though wild horses compete with livestock and wildlife for limited forage, they are protected under the Wild Free-Roaming Horses and Burros Act.

The bird species typically found in the valley floor are those associated with the sagebrush community and include Horned Lark (*Eremophila alpestris*), Common Raven (*Corvus corax*), Sagebrush Sparrow (*Artemisiospiza nevadensis*), Sage Thrasher (*Oreoscoptes montanus*), Green-tailed Towhee (*Pipilo chlorurus*), Mourning Dove (*Zenaida macroura*), and Common Nighthawk (*Chordeiles minor*).

From the valley floor, going up in elevation, the vegetation changes to include Joshua trees and junipers, and the bird diversity increases. Common birds in this zone include Loggerhead Shrikes (*Lanius ludovicianus*), Mourning Doves (*Zenaida macroura*), Black-throated Sparrows (*Amphispiza bilineata*), Scott's Orioles (*Icterus parisorum*), Western Kingbirds (*Tyrannus verticalis*), and Ash-throated

Flycatchers (*Myiarchus cinerascens*). Several of these species can be observed nesting in the Joshua trees. At even higher elevations, where there are steep rocky slopes, Chukars (*Alectoris chukar*) (introduced into the area) and Rock Wrens (*Salpinctes obsoletus*) can be encountered. Common Ravens (*Corvus corax*) are widespread across all of SNL/TTR.

Although SNL/TTR is a high desert, the playas will have standing water if there is plenty of precipitation. During seasonal migrations, and should the playas have water, ducks, geese, and water birds can be found at these playas and at the man-made retention ponds. A few waterfowl and other water birds may breed at the small permanent man-made bodies of water. At Roller Coaster Construction Pond, the deciduous trees and wetland obligate vegetation and attract several bird species that would not otherwise be found at SNL/TTR. Common Yellowthroats (*Geothlypis trichas*) and Bullock's Orioles (*Icterus bullockii*) are known to nest at this pond. Other bird species that have been encountered at this pond, and potentially could nest there, include Western Kingbird *(Tyrannus verticalis*), Vermillion Flycatcher (*Pyrocephalus rubinus*), Western Wood Pewee (*Contopus sordidulus*), and Red-winged Blackbird (*Agelaius phoeniceus*).

Several raptor species are known to use the SNL/TTR area for hunting, roosting, and breeding. Some of these birds include Red-tailed Hawks (*Buteo jamaicensis*), Golden Eagles (*Aquila chrysaetos*), Prairie Falcons (*Falco mexicanus*), American Kestrels (*Falco sparverius*), Barn Owls (*Tyto alba*), Great Horned Owls (*Bubo virginianus*), Swainson's Hawks (*Buteo swainsoni*), and Ferruginous Hawks (*Buteo regalis*).

Reptile species that have been observed include: Coachwhip (*Masticophis flagellum*), Western Patch-nosed Snake (*Salvadora hexalepis*), Great Basin Gopher Snake (*Pituophis catenifer deserticola*), Sagebrush Lizard (*Sceloporus graciosus*), Long-nosed Leopard Lizard (*Gambelia wisilenii*), and Great Basin Rattlesnake (*Crotalus viridis luteosus*). Mule deer (*Odocoileus hemionus*), pronghorn (*Antilocapra americana*), desert bighorn (*Ovis canadensis*), mountain lion (*Puma concolor*), and feral horses (*Equus ferus*) are the notable large mammal species that occur at SNL/TTR. In general, mule deer, desert bighorn, and mountain lions reside in the higher elevations of the mountain ranges. Pronghorn are usually seen in the open, short-grass/scattered brush habitat of the valley floor. Feral horses are more opportunistic and are found in practically all habitat types within the SNL/TTR area.

Common medium-sized mammals found within the SNL/TTR area include coyote (*Canis latrans*), American badger (*Taxisdea taxus*), black-tailed jackrabbit (*Lepus californicus*), bobcat (*Lynx rufus*), and kit fox (*Vulpes macrotis*).

The smaller mammals and rodents that are common at SNL/TTR include desert cottontail (*Sylvilagus audubonii*), white-tailed antelope ground squirrel (*Ammospermophilus leucurus*), Merriam kangaroo rat (*Dipodomys merriami*), desert woodrat (*Neotoma lepida*), and deer mouse (*Peromyscus spp.*).

Six species of bats have been identified as occurring at the DoD NTTR (USAF 1997). These bat species are likely to be found at SNL/TTR. All of these bat species primarily use caves, abandoned mines, trees, and buildings for roosts: long-legged myotis (*Myotis volans*), fringe-tailed myotis (*M. thysanodes*), California myotis (*M. californicus*), canyon bat (*Parastrellus hespereus*), Townsend's big-eared bat (*Plecotus townsendii*), and pallid bat (*Antrozous pallidus*).

4.2 Federal and State, Threatened, Endangered and Species of Concern

As stated in Chapter 2, the purpose of the ESA is to protect all animal, plant, and insect species that are federally listed as threatened or endangered. The State of Nevada has its own regulations for the protection of various species of plants and animals (Nevada Administrative Code 504).

Currently there are no known federally listed threatened or endangered species found at SNL/TTR. The only federally listed species found on the NTTR is the Mojave Desert Tortoise (*Gopherus agassazii*) (USAF 1997). Table 4-1 lists federally- protected species under the ESA that are known to occur in Nye County, Nevada.

There are, however, a few plant and animal species protected by the State of Nevada that occur at SNL/TTR, including several cacti/succulents, such as cottontop cactus (*Echinocactus polycephalus*), spinystar/beehive cactus (*Escobaria vivipara*), and branched pencil cholla (*Cylindropuntia ramosissima*). Table 4-1 includes those species that may potentially occur in Nye County, Nevada, and those species that have been observed at SNL/TTR.

Table 4-1. Federal and state threatened and endangered species and other State of Nevada protected species potentially occurring in Nye County, Nevada

Common Name	Scientific Name	Federal ESA Status	Nevada Status	Observed at SNL/TTR
Plants				
Amargosa niterwort	*Nitrophila mohavensis*	Endangered	Endangered	
armored hedgehog cactus	*Echinocereus engelmannii var. armatus*	—	Protected	
Ash Meadows blazingstar	*Mentzelia leucophylla*	Threatened	Endangered	
Ash Meadows gumplant	*Grindelia fraxinopratensis*	Threatened	Endangered	
Ash Meadows milkvetch	*Astragalus phoenix*	Threatened	Endangered	
Ash Meadows mousetails	*Ivesia kingii var. eremica*	Threatened	Endangered	
Ash Meadows sunray	*Enceliopsis nudicaulis var. corrugata*	Threatened	Endangered	
Blaine pincushion	*Sclerocactus blainei*	—	Protected	
branched pencil cholla	*Cylindropuntia ramosissima*	—	Protected	✓
Clokey pincushion	*Coryphantha vivipara var. rosea*	—	Protected	
cottontop cactus	*Echinocactus polycephalus*	—	Protected	✓
Eastwood milkweed	*Asclepias eastwoodiana*	—	Protected	✓
Joshua tree	*Yucca brevifolia*	—	Protected	✓
Mojave barrel cactus	*Ferocactus cylindraceus var. lecontei*	—	Protected	
mountain cactus	*Pediocactus simpsonii*	—	Protected	
Nye pincushion cactus	*Sclerocactus nyensis*	—	Protected	
old-man pricly-pear	*Opuntia erinacea*	—	Protected	✓
pineapple cactus	*Sclerocactus polyancistrus*	—	Protected	✓
sand/sagebrush cholla	*Grusonia pulchella*	—	Protected	✓
silver cholla	*Cylindropuntia echinocarpa*	—	Protected	✓
Sodaville milkvetch	*Astragalus lentiginosus var. sesquimetralis*	—	Endangered	
spinystar/beehive cactus	*Escobaria vivipara*	—	Protected	✓
spring-loving centaury	*Centaurium namophilum*	Threatened	Endangered	
sunnyside green gentian	*Frasera gypsicola*	—	Endangered	
Williams combleaf	*Polyctenium williamsiae*	—	Endangered	
Animals				
Invertebrates				
Ash Meadows naucorid	*Ambrysus amargosus*	Threatened	—	
Fishes				
Ash Meadows Amargosa pupfish	*Cyprinodon nevadensis mionectes*	Endangered	Threatened	
Ash Meadows speckled dace	*Rhinichthys osculus nevadensis*	Endangered	Endangered	

Table continued on next page.

Table 4-1. Federal and state threatened and endangered species and other State of Nevada protected species potentially occurring in Nye County (continued)

Common Name	Scientific Name	Federal ESA Status	Nevada Status	Observed at SNL/TTR
Animals (continued)				
Fishes (continued)				
Big Smoky Valley speckled dace	*Rhinichthys osculus lariversi*	—	Sensitive	
Big Smoky Valley tui chub	*Gila bicolor spp 8*	—	Sensitive	
Devils Hole pupfish	*Cyprinodon diabolis*	Endangered	Endangered	
Lahontan cutthroat trout	*Oncorhynchus clarkii henshawi*	Threatened	Threatened	
Moapa dace	*Moapa coriacea*	Endangered	Endangered	
Monitor Valley speckled dace	*Rhinichthys osculus spp 5*	—	Sensitive	
Moorman White River springfish	*Crenichthys baileyi thermophilus*	—	Protected	
Oasis Valley speckled dace	*Rhinichthys osculus spp 6*	—	Sensitive	
Railroad Valley springfish	*Crenichthys nevadae*	Threatened	Threatened	
Railroad Valley tui chub	*Gila bicolor spp 7*	—	Sensitive	
Warm Springs Amargosa pupfish	*Cyprinodon nevadensis pectoralis*	Endangered	Endangered	
White River desert sucker	*Catostomus clarkia intermedius*	—	Protected	
White River spinedace	*Lepidomeda albivallis*	Endangered	Endangered	
Reptiles/Amphibians				
Amargosa Toad	*Anaxyrus nelsonii*	—	Protected	
Columbia Spotted Frog	*Rana luteiventris*	—	Protected	
Gila Monster	*Heloderma suspectum*	—	Protected	
Mojave Desert Tortoise	*Gopherus agassizii*	Threatened	Threatened	
Northern Leopard Frog	*Lithobates pipiens*	—	Protected	
Short-horned Lizard	*Phrynosoma douglasii*	—	Sensitive	
Sonoran Mountain Kingsnake	*Lampropeltis pyromelana*	—	Protected	
Mammals				
Allen's big-eared bat	*Idionycteris phyllotis*	—	Protected	
American pika	*Ochotona princeps*	—	Protected	
Ash Meadows montane vole	*Microtus montanus nevadensis*	—	Sensitive	
California leaf-nosed bat	*Macrotus californicus*	—	Sensitive	
dark kangaroo mouse	*Microdipodops megacephalus*	—	Protected	
Mexican free-tailed bat	*Tadarida brasiliensis*	—	Protected	
pale kangaroo mouse	*Microdipodops pallidus*	—	Protected	
pallid bat	*Antrozous pallidus*	—	Protected	
Palmer's chipmunk	*Neotamias palmeri*	—	Sensitive	
fringed myotis	*Myotis thysanodesw*	—	Protected	
spotted bat	*Euderma maculatum*	—	Threatened	
Townsend's big-eared bat	*Corynorhinus townsendii*	—	Sensitive	
western red bat	*Lasiurus blossevillii*	—	Sensitive	
Birds				
Bald Eagle	*Haliaeetus leucocephalus*	—	Endangered	
Brewer's Sparrow	*Spizella breweri*	—	Sensitive	✓
Golden Eagle	*Aquila chrysaetos*	—	Sensitive	✓
Loggerhead Shrike	*Lanius ludovicianus*	—	Sensitive	✓

Table continued on next page.

Table 4-1. Federal and state threatened and endangered species and other State of Nevada protected species potentially occurring in Nye County (continued)

Common Name	Scientific Name	Federal ESA Status	Nevada Status	Observed at SNL/TTR
Animals (continued)				
Birds (continued)				
Northern Goshawk	*Accipiter gentilis*	—	Sensitive	
Peregrine Falcon	*Falco peregrinus*	—	Endangered	
Sage Thrasher	*Oreoscoptes montanus*	—	Sensitive	✓
Southwestern Willow Flycatcher	*Empidonax traillii extimus*	Endangered	Endangered	
Yellow-billed Cuckoo	*Coccyzus americanus*	Threatened	Sensitive	
Yuma Clapper Rail	*Rallus longirostris yumanensis*	Endangered	Endangered	

— = no designation
ESA = Endangered Species Act
SNL/TTR = Sandia National Laboratories, Tonopah Test Range

4.3 Avian Surveillance

Avian surveys were established in 2004 to monitor patterns of bird richness and abundance in the basic habitats found within the DOE-controlled land at SNL/TTR. There are eight bird survey routes/locations; see Table 4-2 for location and habitat descriptions. Six of these locations consist of driving routes/transects, and two locations are single points. One of the single point locations is the Roller Coaster Construction Pond; the other is in association with office and maintenance buildings.

Surveys were conducted annually from 2004 through 2016 (with the exception of three years) during late spring (mid-May to early June). Scheduling conflicts (e.g., restricted site access during testing activities) prevented surveys in 2006, 2015, and 2017. From these surveys, 114 species of birds have been recorded at SNL/TTR. Table 4-3 lists those bird species and the survey locations where they were encountered. It should be noted that some of the species listed were seen in other places at SNL/TTR that are not covered by the bird surveys. Many of the waterfowl and most of the water birds were seen on the various playas when rain or snow events produced standing water.

Over the 13 years that these surveys have been run, two bird species have been encountered at every survey location at least once (Horned Lark and Common Raven). Both of these species are year-round residents. Horned Larks are the most abundant species at SNL/TTR. On average across the 11 years and all the survey locations, 65 Horned Larks were encountered per year. Common Ravens, being large black birds, are quite conspicuous and are likely to be seen or heard practically every day. However, their overall abundance is much lower than that of Horned Larks. On average across the 11 years, 9 Common Ravens were encountered per year.

As these surveys were conducted in late spring, many of the species encountered were migrants. As seen in Table 4-3, a large percentage of the total number of species encountered during these surveys were found at the Roller Coaster Construction Pond (76 of the 114 bird species [67 percent]) and at Cactus Spring (33 of the 114 species [29 percent]). The surface water along with the associated emergent vegetation and tall deciduous trees provide for major stop habitat for migrant birds as well as the resident birds.

Table 4-2. SNL/TTR bird survey locations and habitat descriptions

Approximant Location of the Bird Surveys	Habitat Description
Antelope Peak (AP)	Scattered Joshua tree/juniper and mixed desert shrub
Antelope Spring (AS)	Mixed desert scrub (greater than or equal to 0.5 m), some grassland
Area 3 (A3)	Buildings and other structures
Area 9 (A9)	Dwarf shrub (less than or equal to 0.5 m)
Area 49 (A49)	Dwarf shrub (less than or equal to 0.5 m)
Cactus Spring (CS)	Scattered Joshua tree/juniper and mixed desert shrub. **Note:** An ephemeral spring with emergent vegetation and two deciduous trees is close to one point of this survey.
Mellon Airstrip (MA)	Dwarf shrub (less than or equal to 0.5 m)
Roller Coaster Construction Pond (CP)	Small open water pond with emergent vegetation and numerous deciduous trees

SNL/TTR = Sandia National Laboratories, Tonopah Test Range

Table 4-3. SNL/TTR bird species encountered

Common Name	Scientific Name	A3	A9	A49	AP	AS	CP	CS	MA	Other
American Avocet	*Recurvirostra americana*						●			●
American Coot	*Fulica americana*						●			
American Kestrel	*Falco sparverius*				●					●
American Pipit	*Anthus rubescens*						●	●		
American Robin	*Turdus migratorius*						●	●		
Ash-throated Flycatcher	*Myiarchus cinerascens*		●							
Barn Swallow	*Hirundo rustica*	●								●
Belted Kingfisher	*Ceryle alcyon*						●			
Black Phoebe	*Contupus nigrican*						●			
Black-crowned Night Heron	*Nycticorax nycticorax*						●			
Black-headed Grosbeak	*Pheucticus melanocephalus*						●	●		
Black-necked Stilt	*Himantopus mexicanus*						●			●
Black-throated Gray Warbler	*Setophaga nigrescens*						●			
Black-throated Sparrow	*Amphispiza bilineata*		●	●	●	●		●		
Blue Grosbeak	*Passerina caerulea*						●			
Blue-gray Gnatcatcher	*Polioptila caerulea*						●			
Bonaparte's Gull	*Chroicocephalus philadelphia*									●
Brewer's Blackbird	*Euphagus cyanocephalus*						●	●		
Brewer's Sparrow	*Spizella breweri*				●	●	●	●		

Table continued on next page.

Table 4-3. Bird species encountered at SNL/TTR (continued)

Common Name	Scientific Name	A3	A9	A49	AP	AS	CP	CS	MA	Other
Brown-headed Cowbird	*Molothrus ater*						●			
Buflehead	*Bucephala albeola*									●
Bullock's Oriole	*Icterus bullockii*			●			●	●		
Burrowing Owl	*Athene cunicularia*									●
Calliope Hummingbird	*Selasphorus calliope*							●		
Canvasback	*Aythya valisineria*									●
Canyon Wren	*Catherpes mexicanus*				●			●		
Cassin's Kingbird	*Tyrannus vociferans*		●							
Cassin's Sparrow	*Peucaea cassinii*				●					
Cassin's Vireo	*Vireo cassinii*						●			
Chipping Sparrow	*Spizella passerina*						●	●		
Chukar	*Alectoris chukar*				●			●		
Cinnamon Teal	*Anas cyanoptera*						●			
Cliff Swallow	*Petrochelidon pyrrhonota*	●					●			●
Common Raven	*Corvus corax*	●	●	●	●	●		●	●	●
Common Yellowthroat	*Geothlypis trichas*						●			
Cooper's Hawk	*Accipiter cooperii*						●			
Dusky Flycatcher	*Empidonax oberholseri*						●	●		
Eared Grebe	*Podiceps nigricollis*									●
Eurasian Collared-Dove	*Streptopelia decaocto*	●					●			
European Starling	*Sturnus vulgaris*	●					●			
Ferruginous Hawk	*Buteo regalis*									●
Gadwall	*Anas strepera*						●			●
Golden Eagle	*Aquila chrysaetos*			●				●		●
Gray Flycatcher	*Empidonax wrightii*						●	●		
Great Egret	*Ardea alba*						●			●
Great Horned Owl	*Bubo virginianus*	●	●							
Great-tailed Grackle	*Quiscalus mexicanus*	●					●			
Green-tailed Towhee	*Pipilo chlorurus*				●					
Green-winged Teal	*Anas crecca*						●			●
Hermit Thrush	*Catharus guttatus*						●			
Herring Gull	*Larus argentatus*									●
Horned Grebe	*Podiceps auritus*									●
Horned Lark	*Eremophila alpestris*	●	●	●	●	●	●	●	●	●
House Finch	*Carpodacus mexicanus*	●				●		●		
House Sparrow	*Passer domesticus*	●								●
House Wren	*Troglodytes aedon*						●			
Killdeer	*Charadrius vociferus*						●			

Table continued on next page.

Table 4-3. Bird species encountered at SNL/TTR (continued)

Common Name	Scientific Name	A3	A9	A49	AP	AS	CP	CS	MA	Other
Ladder-backed Woodpecker	*Picoides scalaris*							●		
Lark Sparrow	*Chondestes grammacus*	●	●				●			
Lazuli Bunting	*Passerina amoena*					●	●			
Lincoln's Sparrow	*Melospiza lincolnii*						●			
Loggerhead Shrike	*Lanius ludovicianus*		●	●	●	●		●		
MacGillivray's Warbler	*Geothlypis tolmiei*						●			
Mourning Dove	*Zenaida macroura*	●					●	●		
Nashville Warbler	*Oreothlypis ruficapilla*						●			
Northern Mockingbird	*Mimus polyglottos*		●		●	●		●		
Northern Pintail	*Anas acuta*						●			●
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	●					●			●
Northern Shoveler	*Anas clypeata*						●			
Northern Waterthrush	*Parkesia noveboracensis*						●			
Olive-sided Flycatcher	*Contupus cooperi*				●		●			
Orange-crowned Warbler	*Oreothlypis celata*						●			
Pacific-slope Flycatcher	*Empidonax difficilis*						●			
Palm Warbler	*Setophaga palmarum*						●			
Pine Siskin	*Carduelis pinus*							●		
Prairie Falcon	*Falco mexicanus*				●	●	●		●	
Redhead	*Aythya americana*									●
Red-tailed Hawk	*Buteo jamaicensis*	●	●	●	●		●			●
Red-winged Blackbird	*Agelaius phoeniceus*						●			
Ring-billed Gull	*Larus delawarensis*									●
Rock Wren	*Salpinctes obsoletus*				●	●		●		
Ruby-crowned Kinglet	*Regulus calendula*			●			●	●		
Sagebrush Sparrow	*Artemisiospiza nevadensis*		●			●			●	
Sage Thrasher	*Oreoscoptes montanus*				●	●		●		
Savannah Sparrow	*Passerculus sandwichensis*						●		●	
Say's Phoebe	*Sayornis saya*	●	●						●	
Scott's Oriole	*Icterus parisorum*				●			●		
Sharp-shinned Hawk	*Accipiter striatus*						●			
Snowy Egret	*Egretta thula*						●			●

Table continued on next page.

Table 4-3. Bird species encountered at SNL/TTR (continued)

Common Name	Scientific Name	A3	A9	A49	AP	AS	CP	CS	MA	Other
Sora	*Porzana carolina*						●			
Spotted Sandpiper	*Actitis macularia*						●			●
Spotted Towhee	*Pipilo maculatus*						●			
Summer Tanager	*Piranga rubra*						●			
Swainson's Hawk	*Buteo swainsoni*	●		●	●					●
Townsend's Warbler	*Setophaga townsendi*						●	●		
Tree Swallow	*Tachycineta bicolor*	●					●			●
Turkey Vulture	*Cathartes aura*	●	●				●		●	
Vermilion Flycatcher	*Pyrocephalus rubinus*						●			
Vesper Sparrow	*Pooecetes gramineus*			●				●		
Violet-green Swallow	*Tachycineta thalassina*	●	●				●			●
Virginia Rail	*Rallus limicola*						●			
Virginia's Warbler	*Oreothlypis virginiae*						●			
Warbling Vireo	*Vireo gilvus*						●			
Western Kingbird	*Tyrannus verticalis*	●	●	●						
Western Tanager	*Piranga ludoviciana*				●		●			
Western Wood Pewee	*Contopus sordidulus*				●	●	●	●		
White-crowned Sparrow	*Zonotrichia leucophrys*				●		●	●	●	
White-faced Ibis	*Plegadis chihi*									●
White-winged Dove	*Zenaida asiatica*	●					●			
Wilson's Phalarope	*Phalaropus tricolor*						●			●
Wilson's Warbler	*Cardellina pusilla*						●	●		
Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*						●		●	
Yellow-rumped Warbler	*Setophaga coronata*			●	●		●	●	●	
Yellow Warbler	*Setophaga petechia*						●	●		

A3 = Area 3
A9 = Area 9
A49 = Area 49
AP = Antelope Peak
AS = Antelope Spring
CP = Roller Coaster Construction Pond
CS = Cactus Spring
MA = Mellon Airstrip
SNL/TTR = Sandia National Laboratories, Tonopah Test Range

Chapter 5. SNL/TTR Quality Assurance

Bighorn sheep (*Ovis canadensis*)

OVERVIEW ■ Sandia quality assurance teams monitor environmental impacts of the work done at SNL/TTR. Personnel in various programs collect environmental samples and analyze them for radiological and nonradiological constituents. Quality control samples are sent to contract laboratories to ensure that the samples meet statistically established control criteria or prescribed acceptance control limits. No findings for SNL/TTR samples were issued in 2017 during quality assurance audits.

Sandia personnel take responsibility and assume accountability for implementing quality assurance for operations as specified in International Organization for Standard 9001 (ISO 2008), the Contractor Requirements Document of the U.S. Department of Energy (DOE) Order 414.1D (DOE O 414.1D Admin Change 1), *Quality Assurance*, and Title 10 CFR Part 830 (10 CFR 830) Subpart A, *Quality Assurance*, via policy statements, processes, and procedures, and by executing the actions specified in those processes and procedures. Sandia management is responsible for ensuring the quality of the company's products; for assessing its operations, programs, projects, and business systems; and for identifying deficiencies and effecting continuous improvements.

5.1 Environmental Monitoring for Quality Assurance

Environmental monitoring (which includes sampling) is conducted in accordance with program-specific sampling and analysis plans, work plans, or quality assurance plans, which contain applicable quality assurance elements. These documents meet appropriate federal, state, and local requirements for conducting sampling and analysis activities. Personnel in various programs collect environmental samples and submit them for analysis of radiological and nonradiological constituents. Sampling and monitoring performed by Sandia personnel (and contractors) follow quality assurance measures described in this section. Although, DRI personnel follow their own quality control measures for activities they perform.

Project sampling and analysis plans (or equivalent) include critical elements, such as procedures for sample collection, sample preservation and handling, sample control, laboratory quality control, required limits of detection, field quality control, health and safety, schedules and frequency of sampling, data review, data acceptability, and reporting, along with references to analytical methods and analyte lists and known potential matrix interference.

5.1.1 Sample Management Office

Sample Management Office personnel, located at SNL/NM, package, ship, and track environmental samples to off-site (contracted) laboratories. Radiation Protection Sample Diagnostics laboratory personnel, also located at SNL/NM, process and analyze samples for radiological constituents in accordance with Radiation Protection Sample Diagnostics procedures.

Sample Management Office personnel provide guidance and sample management support for field activities. However, program leads are responsible for each distinct program's overall adherence to and compliance with any sampling and analysis activity performed.

There are instances when SNL/TTR personnel ship samples directly to off-site laboratories, rather than to the Sample Management Office at SNL/NM. The Terrestrial Surveillance Program soil samples collected annually are shipped from SNL/TTR directly to an off-site laboratory.

5.1.2 Contract Laboratory Selection

All off-site contract laboratories are selected based on performance objectives, licenses and accreditations, and appraisals (pre-award assessments) as described in the *Quality Assurance Project Plan (QAPP) for the Sample Management Office* (SNL/NM 2016b). All laboratories must employ EPA test procedures whenever possible; when these are not available, other suitable and validated test procedures are applied. Laboratory instruments must be calibrated in accordance with established procedures, methods, and the Sample Management Office Statement of Work for Analytical Laboratories (SNL/NM 2013b). All calibrations and detection limits must be verified before analyzing samples and reporting data. Once a laboratory has passed an initial appraisal and has been awarded a contract, Sample Management Office personnel are responsible for continuously monitoring laboratory performance to ensure that the laboratory meets its contractual requirements during annual audits.

Sample Management Office contract laboratories perform work in compliance with the Sample Management Office Statement of Work for Analytical Laboratories. Contract laboratories are required to participate in applicable DOE and EPA programs for blind audit check sampling to monitor the overall accuracy of analyses routinely performed on SNL/TTR samples. Sample Management Office contract laboratories are required to participate in the DOE Mixed Analyte Performance Evaluation Program. Contract laboratories also participate in commercial vendor programs designed to meet the evaluation requirements given in the proficiency testing section (Chapter II) of the National Environmental Laboratory Accreditation Conference Standard.

5.1.3 Quality Control for Samples

Project-specified quality control samples are submitted to contract laboratories in order to meet project data quality objectives and sampling and analysis plan requirements. Various field quality control samples may be collected to assess data quality and final usability. Errors, some of which are unavoidable, can be introduced into the sampling process, including potential contamination of samples in the field or during transportation. Additionally, sample results can be affected by the variability present at each sample location.

With each sample batch, laboratory quality control samples are prepared concurrently at defined frequencies and analyzed in accordance with established methods. Contract laboratory personnel determine the analytical accuracy, precision, contamination, and matrix effects associated with each analytical measurement.

Quality control sample results are compared either to statistically established control criteria or to prescribed acceptance control limits. Analytical results generated concurrently with quality control

sample results within established limits are considered acceptable. If quality control analytical results exceed control limits, the results are qualified and corrective action is initiated if warranted. Reanalysis is then performed for samples in the analytical batch as specified in the Statement of Work and laboratory procedures. Quality control sample summaries are included in analytical reports prepared by contract laboratory personnel.

The Radiation Protection Dosimetry Program at SNL/NM own the thermoluminescent dosimeters used to measure gamma radiation, and program personnel issue and process the dosimeters.

Radiation Protection Dosimetry Program personnel (located at SNL/NM) issue and process TLD used to measure gamma radiation. The technical basis for the environmental dosimeter monitoring program is provided in *Description and Procedures of the Environment Radiation Dosimetry Program* (SNL/NM 1987). Dosimeters are issued to SNL/TTR personnel quarterly following established protocols and quality assurance/quality control requirements specified in the Radiation Protection Dosimetry Program operating procedures and the Radiation Protection Dosimetry Program Quality Plan (SNL/NM 2016d). Automated dosimeter equipment is used to manage environmental dosimeters. Radiation Protection Dosimetry Program external dosimetry technical personnel manage the data and perform dose calculations.

5.1.4 Data Validation and Records Management

Sample collection, analysis request, chain of custody documentation, and measurement data are reviewed and validated for each sample collected. Analytical data reported by contract laboratories are reviewed to assess laboratory and field precision, accuracy, completeness, representativeness, and comparability with respect to the method of compliance and data quality objectives of a particular program.

The data are validated at a minimum of three levels as follows:

- The analytical laboratory validates data according to the laboratory's quality assurance plan, standard operating procedures, and client-specific requirements.
- Sample Management Office personnel review the analytical reports, corresponding sample collection, and analysis request and chain of custody documentation for completeness and laboratory contract compliance.
- A program lead reviews program objectives, regulatory compliance, and project-specific data quality requirements, and makes the final decision regarding the data's usability and reporting.

Additionally, Terrestrial Surveillance Program data are validated to detailed method-specific requirements.

5.2 Sample Management Office Activities in 2017

Sample Management Office activities in 2017 included sample packaging, shipping, and tracking to off-site contracted laboratories, and reviewing all data deliverables for compliance with contract and data quality requirements.

5.2.1 Sample Handling and Analyses

In 2017, Sample Management Office personnel processed a total of 153 samples in support of the SNL/TTR Terrestrial Surveillance Program. Of these, 10 samples were submitted as field and analytical quality control samples to assist with data validation and decision-making.

During 2017, General Engineering Laboratories in Charleston, South Carolina, was employed to analyze SNL/TTR soil samples. Dosimetry Laboratory personnel at SNL/NM were employed to analyze TLD.

In 2017, Sample Management Office personnel processed 153 samples in support of the SNL/TTR Terrestrial Surveillance Program.

5.2.2 Laboratory Quality Assurance Assessments and Validation

In 2017, Sample Management Office personnel continued independent, on-site assessments and validation at the National Environmental Laboratory Accreditation Conference-approved laboratories used by Sandia personnel. Specific checks were made for documentation completeness, proper equipment calibration, proper laboratory practices, and batch quality control data.

5.2.3 Quality Assurance Audits

The DOE Consolidated Audit Program conducted audits in 2017 at the primary Sample Management Office contract laboratories using DOE/DoD *Consolidated Quality Systems Manual* requirements. The audit reports, laboratory responses, and closure letters are all posted and tracked through the DOE Consolidated Audit Program website. Sample Management Office personnel worked closely with the contract laboratories to resolve audit findings expeditiously. Decisions regarding sample distribution to contract laboratories were based on audit information, including outstanding corrective actions.

No findings for SNL/TTR samples were issued in 2017 in either the DOE Consolidated Audit Program audit or the Mixed Analyte Performance Evaluation Program audit.

PART TWO

SANDIA NATIONAL LABORATORIES
KAUAʻI TEST FACILITY, HAWAIʻI

Chapter 6. SNL/KTF Introduction

Kilauea, Kaua'i

OVERVIEW ■ KTF has been an active rocket-launching facility since 1962. The facilities and personnel support a variety of missions, including research and development, operational training, and test and evaluation and conducts launch projects for other organizations or government agencies on a noninterference basis.

This *Annual Site Environmental Report* was prepared in accordance with and as required by DOE per DOE O 231.1B, Admin Change 1, *Environment, Safety, and Health Reporting*. Sandia is a multimission laboratory managed and operated by National Technology & Engineering Solutions of Sandia, LLC, a wholly owned subsidiary of Honeywell International Inc., for the DOE National Nuclear Security Administration. Sandia personnel manage and operate KTF in Hawai'i for DOE. The DOE National Nuclear Security Administration Sandia Field Office in Albuquerque, New Mexico, administers the contract and oversees contractor operations at the site.

Part Two of this *Annual Site Environmental Report* summarizes the environmental protection and monitoring programs in place at SNL/KTF during calendar year 2017 unless otherwise noted (programs based on the fiscal year [FY] operate from October 1 through September 30, annually). This report is made available to the public in electronic form at the following website:

http://www.sandia.gov/news/publications/environmental/index.html

6.1 Mission

Sandia—providing the synergy and interdependence between our nuclear deterrence mission and broader national security missions to forge a robust capability base and empower us to solve complex national security problems—accomplishes our mission by anticipating and resolving emerging national security challenges, innovating and discovering new technologies to strengthen our nation's technological superiority, creating value through products and services that solve important national security challenges, and informing the national debate for which technology policy is critical to

preserving security and freedom throughout the world. Information about recent technologies developed at SNL can be found at the following website:

http://www.sandia.gov/news/index.html

6.1.1 Operating Contract and DOE Directives

The Prime Contract for management and operations at Sandia defines the corporation's contractual obligations. The DOE directives that pertain to environmental protection and management at SNL/KTF are as follows:

- DOE O 231.1B, Admin Change 1, *Environment, Safety, and Health Reporting,* ensures that DOE receives information about events that have affected or could adversely affect the health, safety, and security of the public or workers, the environment, the operations of DOE facilities, or DOE credibility. This *Annual Site Environmental Report* is prepared in accordance with this directive.
- DOE O 232.2, Admin Change 1, *Occurrence Reporting and Processing of Operations Information*, requires timely notification to the DOE complex about events that could adversely affect the health and safety of the public or workers, the environment, DOE missions, or DOE credibility.
- DOE O 435.1, Change 1, *Radioactive Waste Management*, ensures that all radioactive waste is managed in a manner that is protective of worker and public health and safety and of the environment. Under this directive, contractors who manage and operate DOE facilities are required to plan, document, execute, and evaluate the management of DOE radioactive waste.
- DOE O 436.1, *Departmental Sustainability*, places environmental management systems and site sustainability at the forefront of environmental excellence. Sandia personnel implement this directive through an ISO 14001-certified Environmental Management System. Although it is not part of the scope of the certification, Sandia personnel implement an Environmental Management System at SNL/KTF that is consistent with the ISO 14001 standard (ISO 2004). Conformance to the standard is verified through internal assessments. SNL/KTF assessments were conducted in 2011, 2014, and 2017.

SNL/KTF, located on the island of Kauaʻi, exists as a facility within the boundaries of the U.S. Department of Defense Pacific Missile Range Facility.

6.2 Location Description

KTF is located on the western coast of Kauaʻi, Hawaiʻi. SNL/KTF is a tenant of the DoD PMRF, and is located within the boundaries of PMRF. The facility is bounded on the north and east by agricultural fields, on the northwest and southwest by the Pacific Ocean, and on the south by PMRF (Figure 6-1).

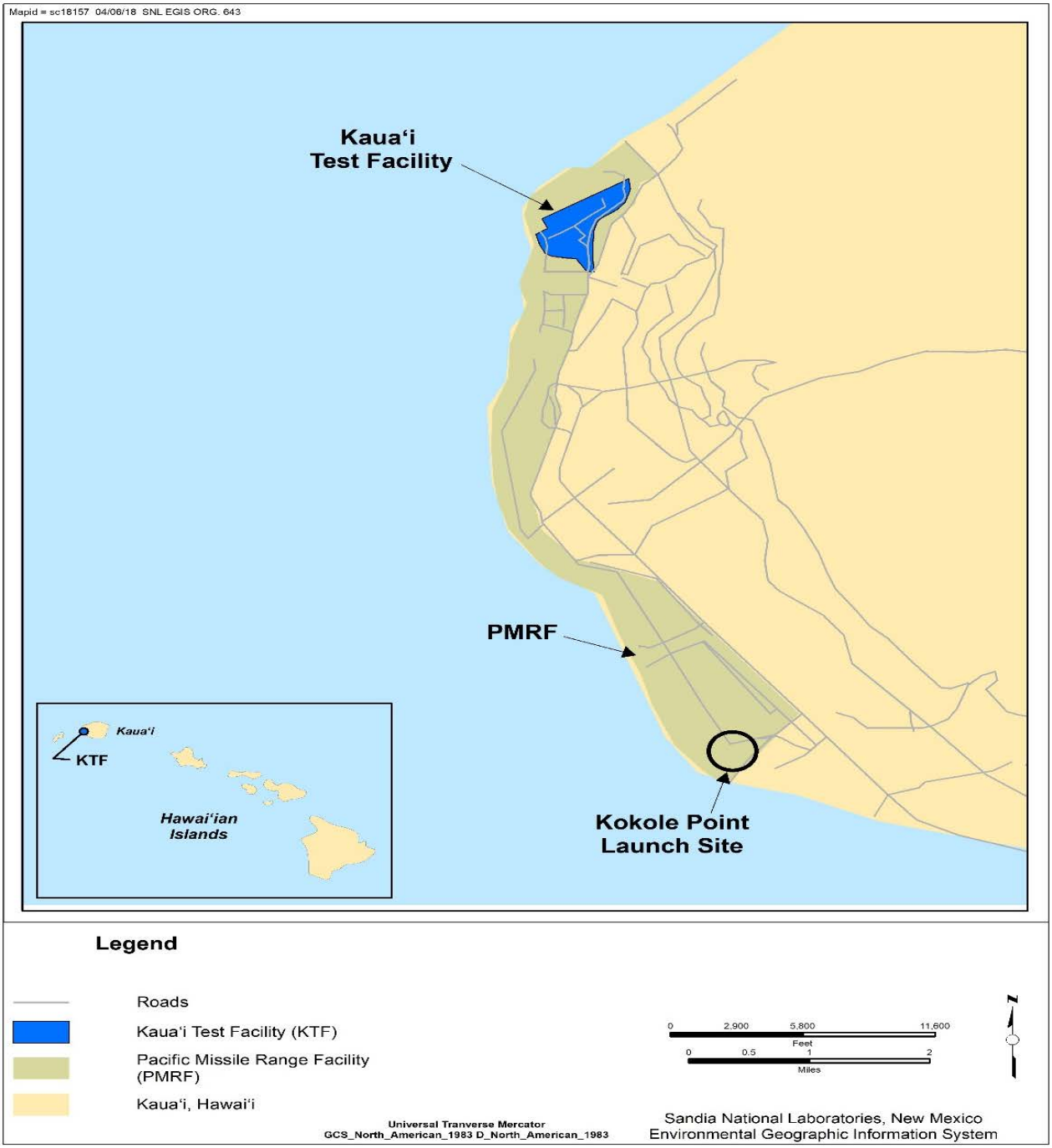


Figure 6-1. KTF location on Kaua'i, Hawai'i

6.3 Facilities and Operations

SNL/KTF has been an active rocket-launching facility since 1962. The facilities and personnel support a variety of missions, including research and development, operational training, and testing and evaluation. Personnel conduct launch projects for other organizations or government agencies on a noninterference basis. SNL/KTF provides a high-quality integrated facility for conducting a wide range of test operations. These operations support materials research, components development, advanced reentry-vehicle technologies, water entry-and-recovery systems, missile defense testing, and onboard-sensor research and development testing. Resources are available for assembling, testing, and launching instrumented rockets and rocket payloads; receiving, recording, and processing telemetry; and transferring data with remote airborne and ship-borne instrumentation platforms. Operations do not (currently or in the past) involve radioactive materials.

The first facilities at KTF were constructed in the early 1960s to support the National Readiness Program. Later construction, completed in March 2005, extended the Missile Service Tower to support DOE and the Missile Defense Agency. The most recent construction has been an upgrade of the launch field power system. From 1992 to 2017, SNL/KTF personnel have supported 98 launches from SNL/KTF, PMRF, or other mission assets.

The KTF launch field was originally designed to accommodate 40 launchpads, but only 15 pads were constructed. Of these, 11 have had their launchers removed. Beyond the original plan, two additional launchpads were constructed: one at Pad 41 (Kokole Point [Figure 6-1]) and one at Pad 42 (Missile Service Tower). In addition to rocket launchpad sites, facilities include missile and payload assembly buildings, launch operations and data acquisition facilities, maintenance shops, and a trailer dock compound for administration and other office processing.

The administrative area of SNL/KTF, known as the Main Compound, and the launch field are located within fenced areas near the North Nohili access road at PMRF. Inside the compound, a number of trailers and structures are connected with a network of concrete docks and covered walkways. Most of these facilities are used during mission operations to support customer, defense contractor personnel, and technical staff from SNL/NM; general maintenance activities are performed during noncampaign operations. Additionally, there are a number of permanent buildings and shelters in the Main Compound and launch field, some of which are in use year-round to support and maintain SNL/KTF facilities.

Current remote facilities include Mount Haleakala (Maui), where there is one building. In 2015, a Mount Haleakala Advanced Actions Decontamination and Demolition Pre-Action Study was signed as SNL/KTF personnel no longer support missions at this site. The Kokole Point launch complex and associated facilities were transferred to the U.S. Navy in 2013.

6.4 Rocket Launches in 2017

SNL/KTF personnel supported five rocket launches in 2017. The launches were covered by the SNL/KTF Environmental Assessment, published in July 1992 (DOE/AL 1992), and the U.S. Navy Hawai'i Range Complex Environmental Impact Statement (U.S. Navy 2008) and include the following:

- February 5, 2017, Missile Defense Agency, SFTM-01 (launched from PMRF)
- March 15, 2107, Aegis Ballistic Missile Defense, AMDR-B (launched from SNL/KTF)
- June 22, 2017, Missile Defense Agency, SFTM-02 (launched from PMRF)
- August 29, 2017, Aegis Ballistic Missile Defense, FTM-27e2 (launched from SNL/KTF)
- October 30, 2017, U.S. Navy, CPS/FE-1 (RRP) (launched from SNL/KTF)

6.5 Demographics

There were 15 permanent on-site personnel at SNL/KTF in 2017. During campaign operations when rocket launches occurred, approximately 100 additional people worked there. The closest towns are Kekaha and Waimea, with populations of 3,537 and 1,855, respectively (Census 2012b), approximately ten miles southeast of the site.

6.6 Environmental Setting

Kauaʻi is the oldest, northernmost, and fourth-largest island of the main island chain within the volcanic Hawaiʻian Archipelago. Kauaʻi's varied geographic and topographic features include Waimea Canyon, cliffs of the Na Pali Coast, twin peaks of the old volcano (Mount Kawaikini and Mount Waialeale, elevation 5,243 feet and 5,148 feet, respectively), the Alakaʻi Swamp, the flat-lying coastal Mana Plain, and the Barking Sands dune field (SNL/NM 1992a).

Kauaʻi is the oldest, northernmost, and fourth-largest island of the main island chain within the volcanic Hawaiʻian Archipelago.

The low-lying coastal Mana Plain flanks the western slope of the island, forming gentle slopes from the volcanic uplands to the coastal margin (U.S. Navy 2010). The area is relatively flat, ranging in elevation from approximately 5 to 20 feet above mean sea level. Beach dunes parallel the Pacific Ocean rise above the launch field to a maximum elevation of approximately 100 feet above mean sea level. SNL/KTF is bounded to the north and northwest by these beach dunes, to the west by the Pacific Ocean, and to the east by a drainage-ditch network and numerous agricultural fields.

6.6.1 Ecology

A description of the ecological setting including vegetation types, wildlife, protected species, and threatened and endangered species at PMRF and SNL/KTF is detailed in Chapter 9.

6.6.2 Geology

Kauaʻi consists of a single massive shield volcano, located at the island's center, which built up from the sea floor by many thousands of thin flows of basaltic lava. The volcanic deposits are now deeply eroded and partly veneered with subsequent volcanic flows. Volcanic rocks exposed in the western half of the island are the oldest and are composed of Pliocene basaltic flows of the Waimea Volcanic Series (U.S. Navy 2010).

Toward the end of the growth of the shield volcano, a period of collapse, faulting, erosion, and subsequent volcanism affected the original surface. The collapse created a broad caldera that is 10 to 12 miles across. Erosion has since destroyed the original surface, but slightly dissected remnants are occupied by the Alakaʻi Swamp.

The rocks of Kauaʻi are all volcanic, except for minor amounts of sediments derived from the volcanic rocks by erosion, and a narrow, discontinuous fringe of calcareous reef and beach deposits (MacDonald, Davis, and Cox 1960). The Mana Plain is composed of a wedge of terrestrial and marine sediments (alluvium, lagoon, beach, and dune deposits) that overlie the volcanic basement (DOE 1992).

6.6.3 Surface and Groundwater Hydrology

There are no natural surface water drainages on SNL/KTF, as the sand at the surface is too permeable for rainwater to accumulate and travel laterally (DOE 1992).

The three geologic units underlying SNL/KTF (volcanic bedrock, alluvium, and dune deposits) constitute three different but hydraulically connected aquifers. The groundwater from all three units tends to be brackish, not potable, and is not suitable for irrigation (DOE 1992). There are no groundwater wells located on SNL/KTF.

6.7 Climate

The climate at SNL/KTF is typical of maritime subtropical islands. Average yearly temperatures range between 84°F and 69°F. August is the warmest month of the year, with daytime highs averaging 85°F and lows averaging 75°F. January is the coolest month, with daytime highs averaging 78°F and lows averaging 65°F. The region is strongly influenced by the Pacific subtropical high-pressure system. There are two main seasons in tropical and subtropical areas: a wet season and a dry or windy season.

SNL/KTF is located on the lee side of the island, which reduces the amount of annual rainfall as compared to the eastern and mountainous areas of Kauaʻi. The lee side exhibits desert-like conditions, with an average annual rainfall of approximately 22 inches. The wet season generally starts in November and extends into March. June and July are the driest months of the year, when less than one-half an inch of rain is recorded for each month (WRCC 2018b).

Winds are mostly from easterly directions on Kauaʻi. The northeast and southeast trade winds generally blow between 15 and 25 miles an hour. This global subtropical trade-wind pattern occasionally becomes disrupted in the winter when cool, wet systems approach the island from the west or northwest. Relative humidity ranges from 60 to 70 percent in the summer to near 80 percent during the wet season. Direct hits from typhoons or hurricanes are rare in the Hawaiʻian Islands, though damage from nearby storms may occur. The last direct impact and most destructive hurricane to hit Kauaʻi was Hurricane Iniki in September 1992.

Chapter 7. SNL/KTF Compliance Summary

Island of Kaua'i

OVERVIEW ■ Sandia operations at SNL/KTF comply with federal, state, and local environmental requirements. Releases and occurrences are reported according to numerous permit requirements. Regular audits, appraisals, and inspections identify areas for improvement as well as noteworthy practices.

Sandia operations at SNL/KTF are in compliance with federal, state, and local environmental requirements, including DOE directives and Presidential EOs. As a part of this compliance, personnel adhere to strict reporting and permitting requirements.

All SNL/KTF operations and activities, including those that are part of environmental programs, are performed under the ES&H policy, ESH100, which states:

> It is the policy of Sandia to perform work safely, in a manner that ensures adequate protection for the workers, the public, and the environment; to be accountable for the safe performance of work; and to integrate environment, safety, and health management into work planning and execution processes.

An Integrated Safety Management System is used to incorporate safety into management and work practices at all levels so that missions are accomplished while protecting the public, the worker, and the environment. Thus the management of safety functions becomes an integral part of mission accomplishment, and meets the requirements outlined by DOE. The following five core functions guide management in integrating safety into all work practices: define the scope of work, analyze the hazards, develop and implement hazard controls, perform work within controls, and provide feedback and continuous improvement.

7.1 Environmental Management System

Sandia management takes the responsibility of protecting the environment seriously and requires employees, contractors, and visitors to prevent pollution and conserve natural resources by adhering

to the ES&H policy. An Environmental Management System—the primary management approach to minimizing environmental impact and supporting environmental compliance and sustainability practices—is implemented through environmental programs.

The Environmental Management System encompasses all activities, products, and services that have the potential to interact with the environment. Specifically, the Environmental Management System is referenced to establish policy, objectives, and targets that enable personnel to reduce environmental impacts and increase operating efficiencies through a continuing cycle of planning, implementing, evaluating, and improving processes.

DOE O 436.1, *Departmental Sustainability*, was established to ensure that environmental management systems and site sustainability are at the forefront of environmental excellence. Sandia personnel implement this directive through an ISO 14001-certified (ISO 2004) Environmental Management System. Sandia received initial ISO 14001 certification in June 2009 for the primary operating locations and retained certification in a 2015 recertification audit. SNL/KTF operations do not need to be included in the ISO 14001 certification provided that an internal assessment to the ISO 14001 standard (ISO 2004) is conducted at the site every three years.

An Environmental Management System ISO 14001 assessment of SNL/KTF operations was conducted in 2017. Additional information can be found on the external Environmental Management System website:

www.sandia.gov/about/environment/environmental_management_system/index.html

The benefits of the Environmental Management System include:

- Improved environmental performance
- Enhanced compliance with environmental regulations
- Strengthened pollution prevention efforts
- Improved resource conservation
- Increased efficiencies and reduced costs
- Enhanced image with the public, regulators, and potential new hires
- Heightened personnel awareness of environmental issues and responsibilities

For FY 2017, the Environmental Management System identified natural resource use, hazardous materials use, and hazardous waste production as the top three significant aspects of operations. When significant aspects and negative impacts have been identified, objectives and measurable targets—at all operating levels—are established to guide efforts toward minimizing those aspects and impacts.

Aspects are any elements of activities, products, or services that can interact with the environment, and *impacts* are any changes in the environment, whether adverse or beneficial, wholly or partially resulting from activities, products, or services.

7.2 Site Sustainability Plan

Sustainability strategies and goals are defined in an annual Site Sustainability Plan, and many of these efforts have been adopted as Environmental Management System objectives and targets. The Site Sustainability Plan (SNL/NM 2016a) articulates the performance status and planned actions for meeting DOE Strategic Sustainability Performance Plan (DOE 2017) objectives and broader

requirements of the sustainability program set forth in EO 13693, *Planning for Federal Sustainability in the Next Decade*. As of FY 2017, sustainability goals are being met or exceeded in several key areas.

7.3 Environmental Performance Measures

Environmental performance is tracked through various measures and indicators. The results are reported through the internal ES&H Assurance Dashboard, the Sandia Performance Scorecard, the management review process, and management reports.

Environmental performance is assessed as part of the Sandia Performance Evaluation Measurement Plan with DOE. On the basis of the Performance Evaluation Measurement Plan, DOE prepares the Performance Evaluation Report (DOE/NNSA/SFO 2017a). The management and operating contractor's performance was assessed and reported for October 1, 2016 through April 30, 2017. Sandia earned a site-wide excellent rating, exceeded expectations in several areas, and overall met expectations for delivering effective, efficient, and responsive ES&H management and processes.

7.4 Clean Air Act

Per the Clean Air Act of 1970 and the Clean Air Act Amendments of 1990, ambient air quality at SNL/KTF is regulated by Hawai'i Administrative Rules, Title 11, Chapter 59 under the jurisdiction of the Hawai'i Department of Health, Clean Air Branch.

The two electrical generators at SNL/KTF are permitted for operation by the State of Hawai'i under a Noncovered Source Permit (Hawaii DOH 2015). These generators are subject to the provisions of the following federal regulations (the specific requirements of these standards are detailed in special conditions within the permit):

- 40 CFR 60, *Standards of Performance for New Stationary Sources,* Subpart A, "General Provisions"
- 40 CFR 60, *Standards of Performance for New Stationary Sources*, Subpart IIII, "Standards of Performance for Stationary Compression Ignition Internal Combustion Engines"

Rocket launches are considered mobile sources of air emissions, and rocket launch emissions are included in the review against Toxic Release Inventory reporting thresholds.

7.5 Chemical Management

Chemicals are managed through compliance with several requirements. Reporting is specified in these requirements.

7.5.1 Emergency Planning and Community Right-to-Know Act

The EPCRA of 1986, also known as the SARA Title III, establishes emergency planning and reporting requirements for federal, state, and local governments and industry. SARA Title III amended CERCLA requirements for releases to the environment and chemical inventory reporting as directed by EPCRA, sections 304, 311, and 312. All required information has been submitted to the State of Hawai'i. There were no reportable releases at SNL/KTF under EPCRA in 2017. Table 7-1 lists EPCRA reporting requirements.

Emergency Release Notification

The Emergency Release Notification requirements were established under Section 304 of EPCRA. An accidental release of an extremely hazardous substance that exceeds the applicable reporting quantity must be reported. In 2017, there were no reportable quantity releases of an extremely hazardous substance requiring notification.

Toxic Release Inventory Reporting

The Toxic Release Inventory reporting requirement was established under Section 313 of EPCRA. Environmental releases and other waste management quantities of chemicals on the EPCRA Section 313 list of toxic chemicals must be reported for certain facilities in covered industry sectors if more than established threshold quantities of these chemicals are manufactured, processed, or otherwise used in the facilities. In 2017, no releases resulting from SNL/KTF operations were reported above the threshold requiring a Toxic Release Inventory report.

Table 7-1. SNL/KTF applicable EPCRA reporting requirements, 2017

Section	EPCRA Section Title	Requires Reporting?		Description
		Yes	No	
301–303	Emergency Planning	✓		Prepare an annual report that lists chemical inventories above the reportable Threshold Planning Quantities listed in 40 CFR 355 (Appendix B), including the location of the chemicals and emergency contacts. DOE distributes the report to the required entities.
304	Emergency Notification		✓	Submit notification of reportable quantity releases of an extremely hazardous substance, as defined by CERCLA, to the required entities.
311–312	Safety Data Sheet Chemical Purchase Inventory Report	✓		Report on two "Community Right-to-Know" requirements: • Complete EPA Tier II forms for (1) all hazardous chemicals present at the SNL/KTF facility at any one time in amounts equal to or greater than 10,000 pounds and (2) all extremely hazardous substances present at the facility in amounts equal to or greater than 500 pounds or the Threshold Planning Quantity, whichever is lower. This report is provided to DOE for distribution to the required entities. • Record Safety Data Sheets for each chemical entry on a EPA Tier II form and provide the report to DOE prior to distribution to the required entities.
313	Toxic Chemical Release Form		✓	Submit a Toxic Release Inventory report to the required entities for facilities that release toxic chemicals listed in SARA Title III over a threshold value.

CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act
DOE = U.S. Department of Energy
EPA = U.S. Environmental Protection Agency
EPCRA = Emergency Planning and Community Right-to-Know Act
SARA = Superfund Amendments and Reauthorization Act
SNL/KTF = Sandia National Laboratories, Kaua'i Test Facility

7.5.2 Federal Insecticide, Fungicide, and Rodenticide Act

The Federal Insecticide, Fungicide, and Rodenticide Act, enacted in 1910 and amended in 1972, controls the distribution and application of pesticides including herbicides, insecticides, and rodenticides. All pesticide use at SNL/KTF follows EPA requirements. There were no violations of the Federal Insecticide, Fungicide, and Rodenticide Act in 2017.

7.5.3 Toxic Substances Control Act

The Toxic Substances Control Act, enacted in 1976 and later amended, provides regulations regarding the manufacture, processing, distribution, use, and disposal of specific chemical substances and/or mixtures. At SNL/KTF, compliance with Toxic Substances Control Act primarily involves management of asbestos and PCBs. The transformers on the SNL/KTF site have been tested and are free of PCBs (IT 1993). The SNL/NM Asbestos Management Team conducted a comprehensive asbestos survey in July 2008. A total of 110 cubic yards of asbestos-containing materials were identified at SNL/KTF, and 91 cubic yards were identified at the Mount Haleakala site on Maui.

In July 2017, several on-site structures with asbestos-containing materials were decontaminated, demolished, and removed. Approximately 4.5 cubic yards of asbestos-containing materials were removed and disposed of in accordance with regulatory requirements.

7.6 Comprehensive Environmental Response, Compensation, and Liability Act

The CERCLA of 1980, and amended in 1986, also known as the "Superfund," addresses areas of past spills and releases. No current environmental restoration sites are located on-site at SNL/KTF.

EPA designated ongoing oversight of SNL/KTF to the Hawai'i Department of Health Hazard Evaluation and Emergency Response Office. The EPA recommended continued reevaluation for environmental contamination due to ongoing activities at the rocket-launching facility at SNL/KTF (EPA 1996).

7.7 Cultural and Natural Resources

Cultural and natural resources are protected at SNL/KTF.

7.7.1 Cultural Resources Acts

Cultural resources management responsibilities are applicable at SNL/KTF. The three primary cultural resources acts applicable at SNL/KTF are:

- National Historic Preservation Act, enacted in 1966 and amended in 2000
- American Indian Religious Freedom Act, enacted in 1978 and amended in 1994
- Archaeological Resources Protection Act, enacted in 1979 and amended in 1988

NEPA Program personnel coordinate cultural resources compliance. Actions that could adversely affect cultural resources are analyzed initially in a NEPA checklist review. DOE is responsible for ensuring that impacts to cultural resources are assessed and appropriate actions are taken to mitigate impacts. In 2017, no historic properties were threatened, and no buildings previously unassessed were modified or demolished. DOE did not have occasion to consult with the Hawai'i State Historic Preservation Officer.

7.7.2 Natural Resources Acts

The following natural resources acts are applicable to SNL/KTF (for additional information on these acts see Chapter 2):

- ESA (Section 7.7.3)
- Fish and Wildlife Coordination Act (Section 2.7.4)
- MBTA (Section 2.7.7)
- Sikes Act (Section 2.7.10)

At SNL/KTF, these acts are coordinated through Ecology Program personnel and NEPA reviews.

7.7.3 Endangered Species Act

The ESA of 1973, amended in 1982, applies to both private individuals and federal agencies. Federal agencies must ensure that any action they authorize, fund, or carry out will not jeopardize the continued existence of a threatened or endangered species or result in adverse modifications of its habitat. At SNL/KTF, ESA compliance is addressed under the NEPA Program and the Ecology Program. If potentially significant impacts to sensitive species or habitats are found as a result of a

proposed action, an environmental assessment or an environmental impact statement must be prepared. See Chapter 9 for a discussion and list of threatened or endangered species potentially occurring on Kauaʻi.

7.7.4 Floodplain Management

As amended, EO 11988 of 1977, *Floodplain Management*, requires federal agencies to consider impacts associated with the occupancy and modification of floodplains; reduce the risk of flood loss; minimize the impact of floods on human safety, health, and welfare; and restore and preserve the natural and beneficial values served by floodplains.

7.7.5 Planning for Federal Sustainability in the Next Decade

Issued in March 2015, EO 13693, *Planning for Federal Sustainability in the Next Decade*, establishes an integrated strategy toward sustainability to safeguard the health of the environment and make the reduction of greenhouse gas emissions and enhanced climate resilience a priority for all federal agencies. EO 13693 sets goals in the areas of promoting sustainable buildings, increasing renewable energy, reducing water use, promoting electronics stewardship through sustainable acquisition, preventing pollution, and reducing solid waste. Sustainability-related data for SNL/KTF was reported to the Site Sustainability Plan team for submittal to DOE.

7.7.6 Protection of Wetlands

As amended, EO 11990 of 1977, *Protection of Wetlands*, requires federal agencies to minimize the destruction, loss, or degradation of wetlands and preserve, and enhance the natural and beneficial values of wetlands.

7.8 Hazardous Waste

Hazardous waste at SNL/KTF is handled and managed in compliance with the following requirements.

7.8.1 Federal Facility Compliance Act

The Federal Facilities Compliance Act of 1976 requires federal facilities to comply with all federal, state, and local requirements for hazardous and solid waste, including full compliance with the restrictions and prohibitions on extended storage of wastes that do not meet the applicable hazardous waste treatment standards. Extended storage at DOE facilities is typically associated with mixed wastes (wastes that have hazardous and radioactive components) that have been generated on-site. SNL/KTF operations do not generate mixed waste, and no mixed waste is currently stored on-site; therefore, these requirements are not applicable at SNL/KTF.

7.8.2 Resource Conservation and Recovery Act

The RCRA, enacted in 1976, and the Hawaiʻi Revised Statutes regulate the generation, transportation, treatment, storage, and disposal of hazardous chemical waste and nonhazardous solid wastes. Applicable regulations, including Hawaiʻi implementing regulations, are listed in the References section ("State of Hawaiʻi Environmental Regulations"). Some hazardous waste is generated through normal operations at SNL/KTF. SNL/KTF is classified as a conditionally exempt small-quantity generator and is subject to the applicable requirements.

7.9 National Environmental Policy Act

The 1969 NEPA requires federal agencies to consider human health and environmental issues associated with proposed actions, be aware of the potential environmental impacts associated with

these issues, and include this information in early project planning and decision-making. Proposed actions that would not significantly impact the human environment are categorically excludable from additional NEPA documentation (as identified in DOE 10 CFR 1021, *National Environmental Policy Act Implementing Procedures*). Other proposed actions may fit within a class of actions that have environmentally significant impacts associated with them. For this class of proposed actions, the agency must prepare an environmental assessment or an environmental impact statement before making an irretrievable commitment of resources or funding. Although a major objective of NEPA is to preserve the environment for future generations, the law does not require an agency to choose a course of action with the least environmental impacts. DOE coordinates NEPA compliance at SNL/KTF with personnel from SNL/NM and SNL/KTF. NEPA activities are discussed in Chapter 8.

7.10 Pollution Prevention and Waste Minimization

Pollution prevention concepts first appeared in RCRA. An expressed concern was to minimize the generation of hazardous waste through process substitution, materials recovery, recycling, reuse, and treatment. RCRA established the reduction or elimination of hazardous waste as national policy (Pollution Prevention Act), and required that hazardous waste generators and RCRA permit holders have a program in place to minimize waste. As required, waste generation and recycling information is reported annually to DOE through the Site Sustainability Plan.

7.10.1 Pollution Prevention Goals

The Site Sustainability Plan establishes a commitment to meet pollution prevention goals identified in the DOE Strategic Sustainability Performance Plan and EO 13693, *Planning for Federal Sustainability in the Next Decade*. Pollution prevention and waste minimization data are reported in the annual Site Sustainability Plan.

7.10.2 Pollution Prevention Act

The Pollution Prevention Act of 1990 declares, as national policy, that pollution should be prevented or reduced at the source (42 USC § 13101 et seq.). A toxic chemical source reduction and recycling report is required for facilities that meet the reporting requirements under EPCRA, Section 313. See Section 7.5.1 for additional information on EPCRA reporting requirements.

7.11 Water Quality and Protection

SNL/KTF operations are subject to the requirements of the Clean Water Act and corresponding State of Hawai'i requirements.

7.11.1 Clean Water Act

The Clean Water Act of 1972 and amendments established a permitting structure and regulatory direction to protect the "waters of the United States" by restoring and maintaining the chemical, physical, and biological integrity of U.S. waters; protecting fish, wildlife and recreation; and reducing pollutant discharges. There were no compliance issues at SNL/KTF with respect to any federal, state, or local water pollution regulations in 2017.

7.11.2 Oil Pollution Act

Bulk oil storage containers and oil-filled operational equipment with a capacity of 55 gallons or more are subject to EPA regulations 40 CFR 112, *Oil Pollution Prevention*, and 40 CFR 110, *Discharge of Oil*. Underground storage tanks are regulated under the Hawai'i Administrative Rules,

Title 11, Chapter 281, *Underground Storage Tanks*. See Chapter 8 for additional information regarding oil storage at SNL/KTF.

7.11.3 Safe Drinking Water Act

The Safe Drinking Water Act of 1974 and amendments do not apply directly to activities at SNL/KTF because all drinking water at the site is either supplied by the PMRF drinking water system or purchased from commercial suppliers.

7.12 Energy Independence and Security Act

The Energy Independence and Security Act of 2007, Section 438 of the Clean Water Act, requires federal agencies to manage stormwater runoff from federal development projects for the protection of water resources.

7.13 Department of Energy Directives

DOE directives in the Management and Operating Contract define the primary contractual obligations for management and operating of SNL/KTF. Directives that pertain to environmental protection and management are discussed in Chapter 6. In 2017, the management and operating contractor for Sandia adhered to requirements stated in these DOE directives.

7.14 Occurrence and Release Reporting

Under DOE O 232.2, Admin Change 1, the current order for occurrence reporting, an *occurrence* is defined as "one or more (i.e., recurring) events or conditions that adversely affect, or may adversely affect, DOE (including the National Nuclear Security Administration) or contractor personnel, the public, property, the environment, or the DOE mission. Events or conditions meeting the criteria thresholds identified in this Order or determined to be recurring through performance analysis are occurrences." Some environmental releases may not meet DOE O 232.2 reporting thresholds; however, they may still be reportable to outside agencies. There were no DOE O 232.2 reportable occurrences at SNL/KTF in 2017.

7.15 Summary of Environmental Permits

Table 7-2 lists the applicable permits in effect at SNL/KTF in 2017.

Table 7-2. SNL/KTF permits, 2017

Type	Permit Number	Issue Date	Expiration Date	Regulatory Agency
Noncovered Source Permit (two stand-by diesel generators)	NSP 0429-01-N	September 28, 2015	September 27, 2020	State of Hawai'i Department of Health
Underground storage tank (2,500 gallons)	P-2016-064	June 8, 2016	June 8, 2021	State of Hawai'i Department of Health

NSP = Noncovered Source
SNL/KTF = Sandia National Laboratories, Kaua'i Test Facility

Chapter 8. SNL/KTF Environmental Programs

Raccoon butterflyfish (*Chaetodon lunula*) off the coast of Kaua'i

OVERVIEW ■ Sandia personnel take the responsibility of protecting the environment seriously. Numerous program teams monitor the environment and perform activities to help prevent pollution and conserve natural resources.

Sandia personnel conduct environmental monitoring and other program activities at SNL/KTF in Hawai'i. SNL/KTF programs comply with federal, state, and local requirement.

The following environmental programs and focus areas are presented in this chapter:

- Air Quality Compliance Program
- Chemical Information System and Chemical Exchange Program
- Environmental Life-Cycle Management Program
- Environmental Restoration Project
- Meteorology Program
- NEPA Program
- Oil Storage Program
- Terrestrial Surveillance Program
- Waste Management Program
- Water quality programs

Environmental surveillance activities at SNL/KTF in 2017 included wastewater, air emission, meteorological, and noise monitoring.

8.1 Air Quality Compliance Program

As required, the 2017 Annual Emissions Report for air emissions was submitted to the State of Hawai'i (DOE/NNSA/SFO 2017b). The annual fee was submitted to the State of Hawai'i for 2017,

as required by the Noncovered Source Permit. All operations at SNL/KTF were in compliance with permitted operating limits.

Additionally, two monitoring reports for the Noncovered Source Permit were submitted to the State of Hawai'i in 2017 within the required timelines (DOE/NNSA/SFO 2017b; DOE/NNSA/SFO 2017c). The highest total combined operating hours for a rolling 12-month period was 3,968.30 hours, which occurred in the period from November 2016 to October 2017.

Hawai'i

8.2 Chemical Information System and Chemical Exchange Program

The Chemical Information System is a comprehensive tool that tracks workplace chemical and biological containers by location. State and federal regulations are the primary drivers for the Chemical Information System, including implementing regulations for EPCRA. The Chemical Information System compiles information concerning chemical hazards and appropriate protective measures for the workforce, Emergency Management personnel, and other ES&H programs.

8.3 Environmental Life-Cycle Management Program

The Environmental Life-Cycle Management Program mission is to ensure long-term protection of human health and the environment. This is achieved by implementing practices that focus on sustainable use and protection of natural and cultural resources.

Using the NEPA process, Environmental Life-Cycle Management Program personnel review proposed SNL/KTF projects and activities that have the potential to impact the environment. This review provides a process for minimizing adverse environmental impacts from ongoing and future activities. In 2017, Environmental Life-Cycle Management Program personnel reviewed four projects and documented the environmental impacts.

8.4 Environmental Restoration Project

Currently there are no environmental restoration sites at SNL/KTF. On September 30, 1996, the EPA granted a Site Evaluation Accomplished determination for the three environmental restorations sites identified in 1995 (EPA 1996). This confirmed that SNL/KTF operations met all CERCLA requirements and no additional sampling or remediation would be necessary at the three sites.

8.5 Meteorology Program

Due to the infrequency of launches, no formal meteorological monitoring equipment is in place for SNL/KTF. On-site meteorological instruments are used during test periods only to characterize ground-level and atmospheric wind conditions that will affect a rocket's flight. Climatic information representative of SNL/KTF is obtained from PMRF personnel, and severe weather notifications are automatically issued by the PMRF Emergency Operations Center to all SNL/KTF resident personnel.

8.6 National Environmental Policy Act Program

In 2017, the NEPA Program team supported several customers with associated programmatic activities performed at either SNL/KTF or the PMRF and provided support for decontamination and demolition of various facilities.

The NEPA team completed six NEPA checklists for SNL/KTF, five of which were transmitted to DOE National Nuclear Security Administration Sandia Field Office for review and completion in 2017. One checklist was terminated. In 2017, DOE began the process of conducting an analysis for a SNL/KTF Site-Wide Environmental Assessment, which is now being developed.

8.7 Oil Storage Program

SNL/KTF programs operate under the PMRF SPCC Plan (DoN 2012), as required under the Clean Water Act. The SPSS Plan describes the oil storage facilities at the SNL/KTF site and the mitigation controls in place to prevent inadvertent discharges of oil. Additional oil storage capacity in 55-gallon drums, mobile and portable containers, mobile refuelers, and oil-filled operational equipment (transformers, hydraulic elevators, etc.) occurs throughout the site on an as-needed basis. There are four DOE-owned storage tanks at SNL/KTF: one underground storage tank, one aboveground storage tank, and two generator base tanks. In addition, a used oil storage area consists of four 55-gallon drums located within covered secondary containment safety packs. The underground storage tank (2,500 gallons) is permitted with the State of Hawai'i, Department of Health. There were no reportable spills in 2017.

8.8 Terrestrial Surveillance Program

Terrestrial Surveillance Program personnel collect and analyze surface soil samples at SNL/KTF approximately every five years. The EPA recommended reevaluation for environmental contamination at SNL/KTF due to its continued use as a rocket-launching facility (EPA 1996). Rocket exhaust can potentially be a source of metals and other emissions. The EPA recommendation is addressed by the collection surface soil samples for Target Analyte List metal analysis.

The last sampling event was conducted in 2012, confirming that operations made no detectable environmental impact (from metals) to the soil. The results and the baseline concentrations at the SNL/KTF site were presented in the *Calendar Year 2012 Annual Site Environmental Report for Tonopah Test Range, Nevada and Kaua'i Test Facility, Hawai'i* (SNL/NM 2013a). The next sampling event will be conducted in 2018 using a modified sampling and analysis plan.

8.9 Waste Management Program

Some hazardous waste is generated through normal operations at SNL/KTF. Sandia is classified as a conditionally exempt small-quantity generator, and personnel follow applicable requirements. EPA

Region 9 and the State of Hawai'i Department of Health issued a generator identification (HI-0000-363309) to the corporation on September 23, 1994.

8.10 Water Quality Programs

Water quality-related programs at SNL/KTF include wastewater and stormwater discharges. There are no drinking water or groundwater monitoring wells at SNL/KTF. All drinking water at SNL/KTF is either supplied by the PMRF drinking water system or purchased from commercial suppliers.

8.10.1 Stormwater Program

Stormwater runoff is directed into two French drains and four area drains with pumping systems. Stormwater permits, inspections, and sampling are not required.

8.10.2 Wastewater Discharge Program

Activities at SNL/KTF produce only sanitary sewage, which is directed into three DOE-owned and state-registered septic tanks; all the tanks are currently in use. The first septic tank was built in 1965 and was replaced in 2004. Two additional septic tanks were built in 1990 to serve other areas. The septic tank systems are pumped periodically and inspected by licensed, state-certified contractors. No contaminants have been identified above the reporting limits from past sampling events. During 2017, all three septic tank systems were inspected.

Chapter 9. SNL/KTF Ecology Program

Laysan albatross (*Phoebastria immutabilis*) with egg

OVERVIEW ■ Ecology Program personnel monitor biota as an element of the overall environmental monitoring process. Ecological data is collected on plants and wildlife to support documentation, land use decisions, and ecological and wildlife awareness campaigns to ensure safe work environments and sustainable decision-making strategies. Ecology Program personnel help operations comply with wildlife regulations and laws by providing biological evaluations and surveys in support of site activities.

At SNL/KTF, the Ecology Program's primary functions are to support site activity and project compliance with wildlife requirements by providing biological evaluations and surveys. Ecology Program personnel conduct limited biological inventory surveys at SNL/KTF.

The island of Kauaʻi has numerous species protected by the Endangered Species Act. Many of these are forest species for whom SNL/KTF has little or no suitable habitat. These species would not likely occur at SNL/KTF; however, their historical or future occurrence at SNL/KTF cannot be ruled out. Table 9-1 presents the Endangered Species Act and MBTA list of threatened or endangered species that may potentially occur on Kauaʻi.

9.1 Vegetation

There are seven recognized vegetation types on the undeveloped portions of the PMRF, which include SNL/KTF: kiawe/koa-haole scrub, a`ali`i-nama scrub, pohinahina, naupaka dune, strand, drainage-way wetlands, and ruderal (plant species that are first to colonize disturbed areas) vegetation. Kiawe/koa-haole and a`ali`i-nama scrub are the dominant vegetation in the undeveloped portions of PMRF and SNL/KTF. Kiawe/koa-haole is the dominant vegetation type present in the relatively undisturbed areas of the sand dunes, associated with SNL/KTF and Polihale State Park, as well as along the cliff face in a restrictive easement area. Due to off-highway vehicle restrictions, sand dune-related vegetation within the PMRF and SNL/KTF boundary is less disturbed than vegetation in Polihale State Park. A well-developed native strand community exists along the shoreline. Common plants that inhabit the sandy beach habitat on Kauaʻi include beach naupaka, pohinahina, pohuehue, milo, and hau.

The composition of the kiawe/koa-haole vegetation community can vary from pure stands of kiawe to pure stands of koa-haole, or any combination of the two. The kiawe trees often attain a height of 45 feet or more. The understory is commonly koa-haole except where the kiawe trees form a canopy. The height of the koa-haole depends to a large degree on the presence or absence of the kiawe trees. Ground cover varies and may consist of pure stands of Guinea grass (*Panicum maximum*), lantana (*Lantana camara*), or wild basil (*Ocimum gratissimum*). However, the most common ground cover is mixed forbs and grasses.

The majority of SNL/KTF is occupied by an open, woody scrub or ruderal community of plants, which is mowed regularly. The open scrub community is mostly comprised of introduced species, although there are some Hawaiʻian taxa to be found along the roads. These are worthy of mention because, even in such highly disturbed areas as roadways, the native plants can and do persist. Taken together, the open scrub communities occupy most of the land area.

Two wetlands areas exist along parts of the coastline west of SNL/KTF. The U.S. Fish and Wildlife Service has classified these areas as Marine System, Subtidal Subsystem, Reef Class, Coral Subclass, Subtidal. There is also a wetlands area to the south of SNL/KTF along Nohili Ditch, which is classified as Riverine System, Lower Perennial Subsystem, Open Water/Unknown Bottom Class, Permanent, Non-Tidal, Excavated. There is potential for aquatic vegetation types and accompanying waterbird species to be present on or near SNL/KTF property during wet periods. Ditches along the eastern edge of SNL/KTF and several reservoirs on the Mana Plain, including the Mana Base Pond near the entrance to PMRF, serve as waterbird habitats and sanctuaries.

Two federally listed plant species have been observed north of, but not on, PMRF. Ohai (*Sesbania tomentosa*), a spreading shrub, is a federally endangered species that has been observed in the sand dunes to the north of PMRF in Polihale State Park and could potentially occur on the installation, including SNL/KTF. Lau`ehu (*Panicum niihauense*), an endangered species of rare grass, has been observed near Queens Pond, also north of PMRF.

9.2 Wildlife

Numerous birds, mammals, and reptiles have been observed and documented at and near SNL/KTF. Species that are listed as protected, threatened, or endangered are noted.

9.2.1 Birds

Forty species of birds have been identified in the general PMRF area, although not specifically at SNL/KTF. Seven of these species are native to Kauaʻi: Hawaiʻian Coot (*Fulica alai*), Hawaiʻian Stilt (*Himantopus mexicanus knudseni*), Hawaiʻian Gallinule (*Gallinula galleta sanvicensis*), Hawaiʻian Duck (*Anas*

wyvilliana), Hawai'ian Petrel (*Petrodroma sandwichensis*), Newell's Shearwater (*Puffinus auricularis newelli*), and Hawai'ian Short-eared Owl (*Asio flammeus sandwichensis*). The only native terrestrial species that may occur in the area is the Hawai'ian Short-eared Owl. Past wildlife surveys of birds and mammals conducted at SNL/KTF found 20 species of birds throughout the facility.

Bird species protected under the MBTA that have been observed at SNL/KTF include the Hawai'ian Short-eared Owl along with the Black-crowned Night-Heron (*Nycticorax nycticorax haoctli*), Ruddy Turnstone (*Arenaria interpres)*, Brown Noddy (*Anous stolidus*), Great Frigatebird (*Fregata minor*), and Laysan Albatross (*Diomedea immutabilis*). The Laysan Albatross use the lawn-like ruderal vegetation areas for courtship and nesting. Up to six pairs of Laysan Albatross have been observed in the SNL/KTF area. Other species known to exist within or near SNL/KTF are Band-rumped Storm Petrel (*Oceanodroma castro*), Wedge-tailed Shearwater (*Puffinus pacificus chlororyncus*), Pacific Golden-Plover (*Pluvailis fulva*), Wandering Tattler (*Heteroscelus incanus*), Sanderling (*Calidris alba*), and Barn Owl (*Tyto alba*).

Five of the bird species observed at SNL/KTF are federally listed as endangered: Hawai'ian Duck, Hawai'ian Petrel, Hawai'ian Gallinule, Hawai'ian Coot, and Hawai'ian Stilt. Additionally, Newell's Shearwater, observed at PMRF, is federally listed as threatened. These species all have special protections under the Endangered Species Act as administered by the U.S. Fish and Wildlife Service.

The Hawai'ian Duck, Hawai'ian Coot, Hawai'ian Gallinule, and Hawai'ian Stilt use wetlands habitat (such as the Nohili Ditch system, ditch systems along the eastern edge of SNL/KTF, and several reservoirs on the Mana Plain) for breeding, nesting, and feeding.

The Newell's Shearwater is a pelagic (open sea) species that once nested on all the major Hawai'ian Islands. However, it has become extinct on the islands of Hawai'i, Maui, Molokai, and Oahu due to the introduction of the mongoose in the late 1800s. Kaua'i provides the last Hawai'ian habitat for this federally listed threatened species.

Newell's Shearwater nest during the spring and summer months (April to November) in the interior mountains of Kaua'i. Nestlings leave the breeding grounds in October and November, departing by themselves shortly after nightfall and heading for the open ocean, guided by the reflection of moonlight on the water. Being inexperienced and naturally attracted to bright lights, they have a tendency to collide with trees, utility lines, buildings, and automobiles. The most critical period for Shearwaters' flight accidents is one week before and one week after the new moon in October and in November.

The Hawai'ian Petrel may traverse the area from their nesting grounds to the sea. Fledging of the Hawai'ian Petrel occurs in October, slightly earlier than for the Newell's Shearwater.

Mitigation measures that are oriented toward minimizing fallout for the Newell's Shearwater will also benefit Wedge-tailed Shearwater, Hawai'ian Petrel, and Band-rumped Storm Petrel, thus reducing potential adverse effects caused to those species as well (PMRF 2015).

9.2.2 Mammals

Thirteen species of mammals are known to occur on the island of Kaua'i. Eleven of these species are exotic (Tomich 1986). Past surveys found mammal species such as feral dogs (*Canis lupes familiares*) feral cat (*Felsi catus*), and small rodents (*Muroidea spp.*) within SNL/KTF. Feral dogs are known to roam the areas around the SNL/KTF. At least four species of rodents are expected to be present at SNL/KTF: house mouse (*Mus musculus*), Norway rat (*Rattus norvegicus*), roof rat (*Rattus rattus*), and Pacific rat (*Rattus exulans*).

The Hawai'ian hoary bat (*Lasiurus cinereus semotus*) is protected under the Endangered Species Act as endangered. The species is most common in regions between sea level and 4,000 feet that receive 20 to 90 inches of rain per year. This bat species uses trees or, possibly, rock shelters for roosting (Baldwin 1950). The Hawai'ian hoary bat has not been recorded at PMRF, although it is known to feed offshore and to occur at the Polihale State Park north of SNL/KTF.

The humpback whale (*Megaptera novaeangliae*) is protected under the Endangered Species Act as endangered. It is a migratory species that winters in tropical waters near coasts and islands and spends summers in temperate or subtropical waters (Johnson and Wolman 1984).

An *exotic* species, which may be invasive or noninvasive, is not native to the environment.

The Hawai'ian monk seal is protected under the Endangered Species Act as endangered and is Hawai'i's only indigenous mammal. Monk seals use sandy beaches to give birth and use vegetation behind beaches for shelter. Monk seals are only occasionally reported around the main Hawai'ian Islands (USFWS 1984) although they have been observed at PMRF (The Traverse Group 1988).

9.2.3 Reptiles

The Green Sea Turtle (*Chelonia mydas*) is protected under the Endangered Species Act as threatened. The species inhabits pelagic (open sea) habitat as juveniles and benthic (deep sea) habitat around all the Hawai'ian Islands as adults. Adult turtles are known to rest along ledges and in caves and to forage in shallow intertidal and subtidal waters around the main islands. The turtles use sandy beaches for nesting during the summer months. Hatchlings emerge between July and October. Green Sea Turtles occasionally nest at the southern end of PMRF and north of Kokole Point (Balazs, Forsyth, and Kam 1987).

Up to 32 Green Sea Turtles have been observed during surveys of the shoreline at SNL/KTF. Turtles were observed foraging near the mouth of the Nohili Ditch, and at a resting area further offshore at the same point along the coast (Brock 1990).

9.3 Threatened and Endangered Species

Federal- and state-listed threatened or endangered species potentially occurring on Kaua'i can be found in Table 9-1.

Table 9-1. Federal and state list of threatened or endangered species potentially occurring on Kaua'i

Common Name	Scientific Name	Federal Status	State Status
Plants			
Ferns and Allies			
Pendant kihi fern	*Adenophorus periens*	Endangered	Endangered
No common name	*Asplenium diellaciniatum*	Proposed endangered	Proposed endangered
No common name	*Asplenium dielmannii*	Endangered	Endangered
No common name	*Asplenium dielpallidum*	Endangered	Endangered
Pauoa	*Ctenitis squamigera*	Endangered	Endangered
Asplenium-leaved diellia	*Diellia erecta*	Endangered	Endangered
No common name	*Diplazium molokaiense*	Endangered	Endangered
No common name	*Doryopteris angelica*	Endangered	Endangered

Table continued on next page.

Table 9-1. Federally listed threatened or endangered species potentially occurring on Kaua'i (continued)

Common Name	Scientific Name	Federal Status	State Status
Plants (continued)			
Ferns and Allies (continued)			
Palapalai aumakua	*Dryopteris crinalis var. podosorus*	Endangered	Endangered
Kilau	*Dryopteris glabra var. pusilla*	Proposed endangered	Proposed endangered
Wawae'iole	*Huperzia mannii*	Endangered	Endangered
Wawae'iole	*Huperzia nutans*	Endangered	Endangered
Flowering Plants			
Liliwai	*Acaena exigua*	Endangered	Endangered
No common name	*Achyranthes mutica*	Endangered	Endangered
Mahoe	*Alectryon macrococcus*	Endangered	Endangered
Pa'iniu	*Astelia waialealae*	Endangered	Endangered
No common name	*Bonamia menziesii*	Endangered	Endangered
Olulu	*Brighamia insignis*	Endangered	Endangered
'Awikiwiki	*Canavalia napaliensis*	Endangered	Endangered
'Awikiwiki	*Canavalia pubescens*	Endangered	Endangered
Awiwi	*Centaurium sebaeoides*	Endangered	Endangered
Papala	*Charpentiera densiflora*	Endangered	Endangered
Haha	*Cyanea asarifolia*	Endangered	Endangered
Haha	*Cyanea dolichopoda*	Endangered	Endangered
Haha	*Cyanea eleeleensis*	Endangered	Endangered
Haha	*Cyanea kolekoleensis*	Endangered	Endangered
Haha	*Cyanea kuhihewa*	Endangered	Endangered
Haha	*Cyanea recta*	Threatened	Threatened
Haha	*Cyanea remyi*	Endangered	Endangered
Haha	*Cyanea rivularis*	Endangered	Endangered
Haha	*Cyanea undulata*	Endangered	Endangered
No common name	*Cyperus pennatiformis*	Endangered	Endangered
Pu'uka'a	*Cyperus trachysanthos*	Endangered	Endangered
Mapele	*Cyrtandra cyaneoides*	Endangered	Endangered
Ha'iwale	*Cyrtandra limahuliensis*	Threatened	Threatened
Ha'iwale	*Cyrtandra oenobarba*	Endangered	Endangered
Haiwale	*Cyrtandra paliku*	Endangered	Endangered
No common name	*Delissea rhytidosperma*	Endangered	Endangered
No common name	*Delissea undulata*	Endangered	Endangered
Na'ena'e	*Dubautia imbricata imbricata*	Endangered	Endangered
Naenae	*Dubautia kalalauensis*	Endangered	Endangered
Naenae	*Dubautia kenwoodii*	Endangered	Endangered
Koholapehu	*Dubautia latifolia*	Endangered	Endangered
Na'ena'e	*Dubautia pauciflorula*	Endangered	Endangered
Na'ena'e	*Dubautia plantaginea magnifolia*	Endangered	Endangered
Na'ena'e	*Dubautia waialealae*	Endangered	Endangered
'Akoko	*Euphorbia eleanoriae*	Endangered	Endangered
'Akoko	*Euphorbia haeleeleana*	Endangered	Endangered
'Akoko	*Euphorbia halemanui*	Endangered	Endangered
'Akoko	*Euphorbia remyi var. Kaua'iensis*	Endangered	Endangered
'Akoko	*Euphorbia remyi var. remyi*	Endangered	Endangered
Heau	*Exocarpos luteolus*	Endangered	Endangered

Table continued on next page.

Table 9-1. Federally listed threatened or endangered species potentially occurring on Kaua'i (continued)

Common Name	Scientific Name	Federal Status	State Status
Plants (continued)			
Flowering Plants (continued)			
Mehamehame	*Flueggea neowawraea*	Endangered	Endangered
Nanu	*Gardenia remyi*	Proposed endangered	Proposed endangered
Nohoanu	*Geranium Kaua'iense*	Endangered	Endangered
No common name	*Gouania meyenii*	Endangered	Endangered
Honohono	*Haplostachys haplostachya*	Endangered	Endangered
No common name	*Hesperomannia lydgatei*	Endangered	Endangered
Kaua'i hau kuahiwi	*Hibiscadelphus distans*	Endangered	Endangered
Hau kuahiwi	*Hibiscadelphus woodii*	Endangered	Endangered
Clay's hibiscus	*Hibiscus clayi*	Endangered	Endangered
Koki'o ke'oke'o	*Hibiscus waimeae ssp. hannerae*	Endangered	Endangered
Hilo ischaemum	*Ischaemum byrone*	Endangered	Endangered
Aupaka	*Isodendrion laurifolium*	Endangered	Endangered
Aupaka	*Isodendrion longifolium*	Threatened	Threatened
'Ohe	*Joinvillea ascendens ascendens*	Proposed endangered	Proposed endangered
Kampua'a	*Kadua (=Hedyotis) fluviatilis*	Proposed endangered	Proposed endangered
'Awiwi	*Kadua cookiana*	Endangered	Endangered
No common name	*Kadua haupuensis*	Proposed endangered	Proposed endangered
No common name	*Kadua st.-johnii*	Endangered	Endangered
No common name	*Keysseria (=Lagenifera) erici*	Endangered	Endangered
No common name	*Keysseria (=Lagenifera) helenae*	Endangered	Endangered
Koki'o	*Kokia Kaua'iensis*	Endangered	Endangered
Kamakahala	*Labordia helleri*	Endangered	Endangered
Kamakahala	*Labordia lydgatei*	Endangered	Endangered
Kamakahala	*Labordia pumila*	Endangered	Endangered
Kamakahala	*Labordia tinifolia var. wahiawaensis*	Endangered	Endangered
No common name	*Lepidium orbiculare*	Proposed endangered	Proposed endangered
Nehe	*Lipochaeta fauriei*	Endangered	Endangered
Nehe	*Lipochaeta micrantha*	Endangered	Endangered
No common name	*Lobelia niihauensis*	Endangered	Endangered
lehua makanoe	*Lysimachia daphnoides*	Endangered	Endangered
No common name	*Lysimachia filifolia*	Endangered	Endangered
No common name	*Lysimachia iniki*	Endangered	Endangered
No common name	*Lysimachia pendens*	Endangered	Endangered
No common name	*Lysimachia scopulensis*	Endangered	Endangered
No common name	*Lysimachia venosa*	Endangered	Endangered
Alani	*Melicope degeneri*	Endangered	Endangered
Alani	*Melicope haupuensis*	Endangered	Endangered
Alani	*Melicope knudsenii*	Endangered	Endangered
Alani	*Melicope pallida*	Endangered	Endangered
Alani	*Melicope paniculata*	Endangered	Endangered
Alani	*Melicope puberula*	Endangered	Endangered
Alani	*Melicope quadrangularis*	Endangered	Endangered
Uhi uhi	*Mezoneuron kavaiense*	Endangered	Endangered
Kolea	*Myrsine fosbergii*	Proposed endangered	Proposed endangered

Table continued on next page.

Table 9-1. Federally listed threatened or endangered species potentially occurring on Kaua'i (continued)

Common Name	Scientific Name	Federal Status	State Status
Plants (continued)			
Flowering Plants (continued)			
Kolea	*Myrsine knudsenii*	Endangered	Endangered
Kolea	*Myrsine linearifolia*	Threatened	Threatened
Kolea	*Myrsine mezii*	Endangered	Endangered
'Aiea	*Nothocestrum latifolium*	Proposed endangered	Proposed endangered
'Aiea	*Nothocestrum peltatum*	Endangered	Endangered
Lau 'ehu	*Panicum niihauense*	Endangered	Endangered
Makou	*Peucedanum sandwicense*	Threatened	Threatened
No common name	*Phyllostegia helleri*	Proposed endangered	Proposed endangered
No common name	*Phyllostegia knudsenii*	Endangered	Endangered
No common name	*Phyllostegia renovans*	Endangered	Endangered
No common name	*Phyllostegia waimeae*	Endangered	Endangered
No common name	*Phyllostegia wawrana*	Endangered	Endangered
Ho'awa	*Pittosporum napaliense*	Endangered	Endangered
Pilo kea lau li'i	*Platydesma rostrata*	Endangered	Endangered
Mann's bluegrass	*Poa mannii*	Endangered	Endangered
Hawai'ian bluegrass	*Poa sandvicensis*	Endangered	Endangered
No common name	*Poa siphonoglossa*	Endangered	Endangered
No common name	*Polyscias bisattenuata*	Endangered	Endangered
No common name	*Platanthera holochila*	Endangered	Endangered
No common name	*Polyscias flynnii*	Endangered	Endangered
No common name	*Polyscias racemosa*	Endangered	Endangered
Lo'ulu (=Na'ena'e)	*Pritchardia hardyi*	Endangered	Endangered
Lo'ulu	*Pritchardia napaliensis*	Endangered	Endangered
Lo'ulu	*Pritchardia viscosa*	Endangered	Endangered
Kopiko	*Psychotria grandiflora*	Endangered	Endangered
Kopiko	*Psychotria hobdyi*	Endangered	Endangered
Kaulu	*Pteralyxia Kaua'iensis*	Endangered	Endangered
Makou	*Ranunculus mauiensis*	Proposed endangered	Proposed endangered
No common name	*Remya Kaua'iensis*	Endangered	Endangered
No common name	*Remya montgomeryi*	Endangered	Endangered
No common name	*Santalum involutum*	Proposed endangered	Proposed endangered
Dwarf naupaka	*Scaevola coriacea*	Endangered	Endangered
Ma'oli'oli	*Schiedea apokremnos*	Endangered	Endangered
No common name	*Schiedea attenuata*	Endangered	Endangered
No common name	*Schiedea helleri*	Endangered	Endangered
No common name	*Schiedea Kaua'iensis*	Endangered	Endangered
Kuawawaenohu	*Schiedea lychnoides*	Endangered	Endangered
No common name	*Schiedea membranacea*	Endangered	Endangered
No common name	*Schiedea nuttallii*	Endangered	Endangered
No common name	*Schiedea spergulina var. leiopoda*	Endangered	Endangered
No common name	*Schiedea spergulina var. spergulina*	Threatened	Threatened
Laulihilihi	*Schiedea stellarioides*	Endangered	Endangered
No common name	*Schiedea viscosa*	Endangered	Endangered
Ohai	*Sesbania tomentosa*	Endangered	Endangered

Table continued on next page.

Table 9-1. Federally listed threatened or endangered species potentially occurring on Kaua'i (continued)

Common Name	Scientific Name	Federal Status	State Status
Plants (continued)			
Flowering Plants (continued)			
No common name	*Sicyos lanceoloideus*	Proposed endangered	Proposed endangered
No common name	*Silene lanceolata*	Endangered	Endangered
Popolo ku mai	*Solanum incompletum*	Endangered	Endangered
Popolo	*Solanum nelsonii*	Proposed endangered	Proposed endangered
'Aiakeakua, popolo	*Solanum sandwicense*	Endangered	Endangered
No common name	*Spermolepis Hawai'iensis*	Endangered	Endangered
No common name	*Stenogyne campanulata*	Endangered	Endangered
No common name	*Stenogyne kealiae*	Endangered	Endangered
No common name	*Viola helenae*	Endangered	Endangered
Nani wai'ale'ale	*Viola Kaua'iensis var. wahiawaensis*	Endangered	Endangered
No common name	*Wikstroemia skottsbergiana*	Proposed endangered	Proposed endangered
Dwarf iliau	*Wilkesia hobdyi*	Endangered	Endangered
No common name	*Xylosma crenatum*	Endangered	Endangered
A'e	*Zanthoxylum Hawai'iense*	Endangered	Endangered
Animals			
Mammals			
Hawai'ian hoary bat	*Lasiurus cinereus semotus*	Endangered	Endangered
Birds			
Koloa (Hawai'ian Duck)	*Anas wyvilliana*	Endangered	Endangered
Nēnē (Hawi'ian Goose)	*Branta sandvicensis*	Endangered	Endangered
'Alae ke'oke'o (Hawai'ian Coot)	*Fulica alai*	Endangered	Endangered
'Alae 'ula (Hawai'ian Gallinule)	*Gallinula chloropus sandvicensis*	Endangered	Endangered
Nuku pu'u (Honeycreeper)	*Hemignathus lucidus*	Endangered	Endangered
Kaua'i 'Akialoa (Honeycreeper)	*Hemignathus procerus*	Endangered	Endangered
Kaua'i 'amakihi	*Hemignathus kauaiensis*	—	Vulnerable
Lesser 'amakihi	*Hemignathus parvus*	—	Vulnerable
Ae'o (Hawai'ian Stilt)	*Himantopus mexicanus knudseni*	Endangered	Endangered
'Akeke'e (Kaua'i Akepa)	*Loxops caeruleirostris*	Endangered	Endangered
Kaua'i ' o'o (Honeyeater)	*Moho braccatus*	Endangered	Endangered
Kāma'o (Large Kaua'i Thrush)	*Myadestes myadestinus*	Endangered	Endangered
Puaiohi (Small Kaua'i Thrush)	*Myadestes palmeri*	Endangered	Endangered
Band-rumped Storm Petrel	*Oceanodroma castro*	Endangered	Endangered
Short-tailed Albatross	*Phoebastria albatrus*	—	Threatened
Laysan Albatross	*Phoebastria immutabilis*	—	Near threatened
'Akikiki (Kaua'i Creeper)	*Oreomystis bairdi*	Endangered	Endangered
'I'iwi	*Vestiaria coccinea*	Proposed threatened	Vulnerable
'O'u	*Psittirostra psittacea*	Endangered	Endangered
Hawai'ian Petrel	*Pterodroma sandwichensis*	Endangered	Endangered
Newell's Shearwater	*Puffinus newelli*	Threatened	Endangered
Kioea (Bristle-thighed Curlew)	*Numenius tahitiensis*	—	Vulnerable
Reptiles			
Green Sea Turtle	*Chelonia mydas*	Threatened	Threatened
Leatherback Sea Turtle	*Dermochelys coriacea*	Endangered	Endangered
Hawksbill Sea Turtle	*Eretmochelys imbricata*	Endangered	Endangered
Olive Ridley Sea Turtle	*Lepidochelys olivacea*	Threatened	Threatened

Table continued on next page.

Table 9-1. Federally listed threatened or endangered species potentially occurring on Kaua'i (continued)

Common Name	Scientific Name	Federal Status	State Status
Animals (continued)			
Snails			
Newcomb's snail	*Erinna newcombi*	Threatened	Threatened
Arachnids			
Kaua'i cave wolf or pe'e pe'e maka 'ole spider	*Adelocosa anops*	Endangered	Endangered
Insects			
pomace fly (no common name)	*Drosophila musaphilia*	Endangered	Endangered
Hawai'ian picture-wing fly	*Drosophila sharpi*	Endangered	Endangered
Pacific Hawai'ian damselfly	*Megalagrion pacificum*	Endangered	Endangered
Orangeblack Hawai'ian damselfly	*Megalagrion xanthomelas*	Proposed endangered	Proposed endangered
Crustaceans			
Kaua'i cave amphipod	*Spelaeorchestia koloana*	Endangered	Endangered

— = no designation for federal status
ssp. = subspecies
var. = variety

Chapter 10. SNL/KTF Quality Assurance

Hawai'ian Goose (*Branta sandvicensis*)

OVERVIEW ■ Sandia quality assurance teams monitor environmental impacts of the work done at SNL/KTF. Personnel in various programs collect environmental samples and analyze them for nonradiological constituents. Quality control samples are sent to contract laboratories to ensure that the samples meet statistically established control criteria or prescribed acceptance control limits. No findings for SNL/KTF samples were issued in 2017 during quality assurance audits.

Sandia personnel take responsibility and assume accountability for implementing quality assurance for operations as specified in International Organization for Standard 9001 (ISO 2008), the Contractor Requirements Document of the U.S. Department of Energy (DOE) Order 414.1D (DOE O 414.1D Admin Change 1), *Quality Assurance*, and 10 CFR 830, Subpart A, "Quality Assurance," via policy statements, processes, and procedures, and by executing the actions specified in those processes and procedures. Sandia management is responsible for ensuring the quality of the company's products; for assessing its operations, programs, projects, and business systems; and for identifying deficiencies and effecting continuous improvements.

10.1 Environmental Monitoring for Quality Assurance

Environmental monitoring (which includes sampling) is conducted in accordance with program-specific sampling and analysis plans, work plans, or quality assurance plans, which contain applicable quality assurance elements. These documents meet appropriate federal, state, and local requirements for conducting sampling and analysis activities. Personnel in various programs collect environmental samples and submit them for analysis of radiological and nonradiological constituents.

Project sampling and analysis plans (or equivalent) include critical elements, such as procedures for sample collection, sample preservation and handling, sample control, laboratory quality control, required limits of detection, field quality control, health and safety, schedules and frequency of sampling, data review, data acceptability, and reporting, along with references to analytical methods and analyte lists and known potential matrix interference.

10.1.1 Sample Management Office

Sample Management Office personnel, located at SNL/NM, package, ship, and track environmental samples to off-site (contracted) laboratories.

Sample Management Office personnel provide guidance and sample management support for field activities. However, program leads are responsible for each distinct program's overall adherence to and compliance with any sampling and analysis activity performed.

There are instances when samples are shipped directly to off-site laboratories, rather than to the Sample Management Office at SNL/NM. The Terrestrial Surveillance Program soil samples are shipped directly to an off-site laboratory.

10.1.2 Contract Laboratory Selection

All off-site contract laboratories are selected based on performance objectives, licenses and accreditations, and appraisals (pre-award assessments) as described in the *Quality Assurance Project Plan (QAPP) for the Sample Management Office* (SNL/NM 2016c). All laboratories must employ EPA test procedures whenever possible; when these are not available, other suitable and validated test procedures are applied. Laboratory instruments must be calibrated in accordance with established procedures, methods, and the Sample Management Office Statement of Work for Analytical Laboratories (SNL/NM 2013b). All calibrations and detection limits must be verified before analyzing samples and reporting data. Once a laboratory has passed an initial appraisal and has been awarded a contract, Sample Management Office personnel are responsible for continuously monitoring laboratory performance to ensure that the laboratory meets its contractual requirements during annual audits.

Sample Management Office contract laboratories perform work in compliance with the Sample Management Office Statement of Work for Analytical Laboratories. Contract laboratories are required to participate in applicable DOE and EPA programs for blind audit check sampling to monitor the overall accuracy of analyses routinely performed on SNL/KTF samples. Sample Management Office contract laboratories are required to participate in the DOE Mixed Analyte Performance Evaluation Program. Contract laboratories also participate in commercial vendor programs designed to meet the evaluation requirements given in the proficiency testing section (Chapter II) of the National Environmental Laboratory Accreditation Conference Standard.

10.1.3 Quality Control for Samples

Project-specified quality control samples are submitted to contract laboratories in order to meet project data quality objectives and sampling and analysis plan requirements. Various field quality control samples may be collected to assess the data's quality and final usability. Errors, some of which are unavoidable, can be introduced into the sampling process, including potential contamination of samples in the field or during transportation. Additionally, sample results can be affected by the variability present at each sample location.

With each sample batch, laboratory quality control samples are prepared concurrently at defined frequencies and analyzed in accordance with established methods. Contract laboratory personnel determine the analytical accuracy, precision, contamination, and matrix effects associated with each analytical measurement.

Quality control sample results are compared either to statistically established control criteria or to prescribed acceptance control limits. Analytical results generated concurrently with quality control sample results within established limits are considered acceptable. If quality control analytical results exceed control limits, the results are qualified and corrective action is initiated if warranted.

Reanalysis is then performed for samples in the analytical batch as specified in the Statement of Work and laboratory procedures. Quality control sample summaries are included in analytical reports prepared by contract laboratory personnel.

10.1.4 Data Validation and Records Management

Sample collection, analysis request, chain of custody documentation, and measurement data are reviewed and validated for each sample collected. Analytical data reported by contract laboratories are reviewed to assess laboratory and field precision, accuracy, completeness, representativeness, and comparability with respect to the particular program's method of compliance and data quality objectives.

The data are validated at a minimum of three levels:

- The analytical laboratory validates data according to the laboratory's quality assurance plan, standard operating procedures, and client-specific requirements.
- Sample Management Office personnel review the analytical reports, corresponding sample collection, and analysis request and chain of custody documentation for completeness and laboratory contract compliance.
- A program lead reviews program objectives, regulatory compliance, and project-specific data quality requirements, and makes the final decision regarding the data's usability and reporting.

Additionally, Terrestrial Surveillance Program data are validated to detailed method-specific requirements.

Kaua'i Test Facility

10.2 Sample Management Office Activities in 2017

Sample Management Office activities in 2017 included sample packaging, shipping, and tracking to off-site (contracted) laboratories, and reviewing all data deliverables for compliance with contract and data quality requirements.

10.2.1 Sample Handling and Analyses

In 2017, no samples were collected for the Terrestrial Surveillance Program or other environmental programs or projects at SNL/KTF.

10.2.2 Laboratory Quality Assurance Assessments and Validation

In 2017, Sample Management Office personnel continued independent, on-site assessments and validation at the National Environmental Laboratory Accreditation Conference-approved laboratories used by Sandia personnel. Specific checks were made for documentation completeness, proper equipment calibration, proper laboratory practices, and batch quality control data.

10.2.3 Quality Assurance Audits

The DOE Consolidated Audit Program conducted audits in 2017 at the primary Sample Management Office contract laboratories using DOE/DoD *Consolidated Quality Systems Manual* requirements. The audit reports, laboratory responses, and closure letters are all posted and tracked through the DOE Consolidated Audit Program website. Sample Management Office personnel worked closely with the contract laboratories to resolve audit findings expeditiously. Decisions regarding sample distribution to contract laboratories were based on audit information, including outstanding corrective actions.

No findings were issued in 2017 in either the DOE Consolidated Audit Program audit or the Mixed Analyte Performance Evaluation Program audit.

Appendix A. 2017 SNL/TTR Air Monitoring Stations

Joshua tree (*Yucca brevifolia*)

A.1 Introduction

During 2017, DRI maintained five portable environmental monitoring stations at SNL/TTR as part of Project Soils, an environmental restoration activity. The monitoring stations collect data on selected meteorological and environmental parameters (e.g., wind speed and direction, and airborne particulate concentration as a function of particulate size). In addition, airborne particulate samplers are deployed at each location to collect particulate samples for radiological analyses. Five DRI portable monitoring stations were in use at SNL/TTR in 2017. Station 400 is located near the SNL/TTR Range Operations Center. Station 401 is located near Clean Slate 3. Station 402 was located near Clean Slate 1 until April 2017, when it was moved to Clean Slate 3 and renamed Station 403. Stations 404 and 405 were newly installed in 2017 at Clean Slate 2 (see Figure 3-1).

A.2 Air Station Capabilities and Results

The air stations are equipped with multiple monitoring systems. A description of the capabilities and the monitoring results are presented here.

Station 400: Range Operations Center

Station 400 is a portable station with all monitoring and sampling systems mounted on a 7-foot by 14-foot trailer. The station is located approximately 100 yards south–southwest of the Range Operations Center.

Station 400: Capabilities

An air sampler collects airborne dust particles continuously at Station 400. Filters are recovered and new filters deployed every two weeks. Sensors include an anemometer, a wind direction vane, a pyranometer, a tipping rain bucket, a temperature and relative humidity probe, a barometer, a soil moisture probe, a soil temperature probe, a pressurized ion chamber, and an ambient air particulate size profiler. Data from these sensors are stored on a data logger and transmitted through a Geostationary Operational Environmental Satellite transmitter to the Western Regional Climate Center.

Regular quality assurance procedures include checking the pressurized ion chamber response and the calibration of air volume passing through the air sampler on a monthly basis, as well as performing data quality checks on the Western Regional Climate Center database. In addition to the real-time instruments and continuous air sampler, Station 400 is equipped with a manually activated low-volume air sampler that can collect air samples on quartz and Teflon filter media, which allows for different types of chemical and elemental analysis. This air sampler is intended to run in the event of a nearby wildfire or in conditions of extreme dust storms, during which there may be value in distinguishing the relative contribution of organic and inorganic constituents.

The station is also equipped with an ambient air particulate size profiler, which measures the concentration of suspended particulates in real time. Data can be used to determine whether high wind events are always associated with higher concentrations of suspended particulates, and whether there are correlations between particulate concentrations and radionuclide concentration. The station configuration as currently deployed is shown in Figure A-1.

Figure A-1. TTR Station 400 measures radiological and meteorological conditions near the Range Operations Center

Station 400: Air Sampling Results

Station 400 is equipped with a continuous air particulate sampler from which a 4-inch glass-fiber air filter sample is collected every two weeks. Samples are delivered to the Radiological Services Laboratory at the University of Nevada, Las Vegas, on a monthly basis for batch processing. Between December 21, 2016, and December 20, 2017, 25 air particulate filter samples were collected and then analyzed by gamma spectroscopy and for gross alpha and gross beta activity.

Only naturally occurring radionuclides were identified and measured on these samples; beryllium-7 (21 samples) and lead-210 (10 samples) were the most commonly identified radionuclides, with occasional detections of potassium-40 (3 samples), lead-212 (one sample), and bismuth-214 (2 samples). No anthropogenic gamma-emitting radionuclides such as cesium-137, cobalt-60, or americium-241 have been detected. The mean annual gross alpha activity from all samples (Table A-1) was 1.89×10^{-15} µCi/mL, with a maximum of 3.44×10^{-15} µCi/mL, a minimum of 0.52×10^{-15} µCi/mL, and a standard deviation of 0.69×10^{-15} µCi/mL. The mean annual gross beta activity from all samples (Table A-2) was 1.69×10^{-14} µCi/mL, with a maximum of 3.07×10^{-14} µCi/mL, a minimum of 0.56×10^{-14} µCi/mL, and a standard deviation of 0.62×10^{-14} µCi/mL.

Table A-1. Gross alpha results for sampling stations, 2017

Station Location	Number of Samples	Concentration ($\times 10^{-15}$ µCi/mL [3.7×10^{-5} Bq/m^3])			
		Mean	Standard Deviation	Minimum	Maximum
400	25	1.89	0.69	0.52	3.44
401	26	1.68	0.79	0.31	3.67
402	9	1.85	0.58	0.91	2.67
403	17	2.04	0.93	0.52	4.46
404	17	2.85	1.38	1.06	7.06
405	17	2.34	0.89	0.95	3.89

Table A-2. Gross beta results for sampling stations, 2017

Station Location	Number of Samples	Concentration ($\times 10^{-14}$ µCi/mL [3.7×10^{-4} Bq/m^3])			
		Mean	Standard Deviation	Minimum	Maximum
400	25	1.69	0.62	0.56	3.07
401	26	1.39	0.49	0.44	2.63
402	9	1.36	0.49	0.75	2.55
403	17	2.01	0.50	1.32	3.32
404	17	2.18	0.40	1.33	3.04
405	17	2.16	0.47	1.31	3.13

Station 401: Clean Slate 3

Station 401 consists of a solar-powered air sampler (sampler and solar panels) mounted on a 7-foot by 14-foot trailer, and includes a portable meteorological tower. The station is located on the north end of Clean Slate 3.

Station 401: Capabilities

Sensors associated with the meteorological tower include an anemometer, a wind direction vane, a tipping rain bucket, a soil moisture probe, a soil temperature probe, a temperature and relative humidity probe, an ambient air particulate size profiler, a saltation sensor, and a Geostationary Operational Environmental Satellite transmitter. This meteorological tower collects all relevant weather conditions as well as ambient dust concentration and real-time movement of saltation size particles. The ambient air particulate size profiler and saltation sensor instruments measure dust and sand particle movement by aeolian transport close to the ground surface. Saltation is a wind-driven process and is an important mechanism for transport of soil material in desert

environments. DRI monitors for frequency of saltation events as a function of wind speed and wind direction at Station 401.

Adjacent to the meteorological tower is a solar-powered air sampler with solar array, battery pack, and pressurized ion chamber, all mounted on a trailer. Working with Hi-Q Products Inc., DRI constructed this mobile version of a solar-powered air sampler based on a design currently being used by the USAF at NTTR. Internal airflow monitoring and self-adjustment capabilities allow the air sampler to maintain a near-constant flow rate as it collects samples. An internal totalizer computes the volume of air passed through the collection filter and the run time. Data from these sensors are collected and stored on a data logger. Solar panels, with battery assist, provide power for the air sampler and the meteorological station. The configurations of the solar-powered air sampler, saltation sensor, and portable meteorological tower are shown in Figure A-2. Regular quality assurance procedures include checking the pressurized ion chamber response and the calibration of air volume passing through the air sampler on a monthly basis, as well as performing data quality checks on the Western Regional Climate Center database.

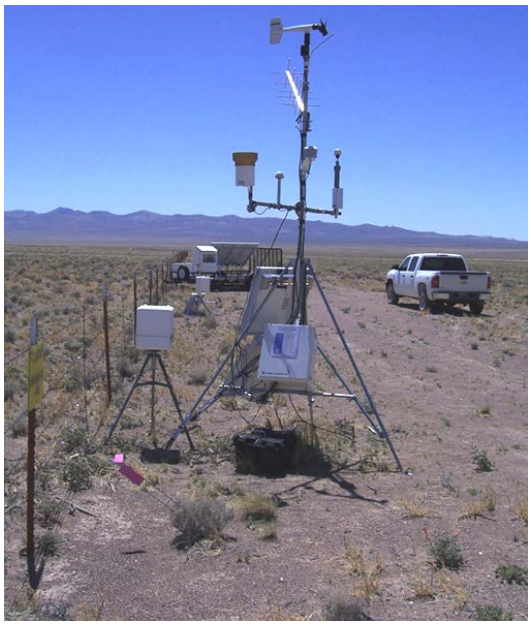


Figure A-2. TTR solar-powered air sampler, saltation sensor, and meteorological tower (background, center, and foreground, respectively) at Station 401, located along the north fence that bounds the Clean Slate 3 contamination area

Station 401: Air Sampling Results

Station 401 is equipped with a continuous air particulate sampler from which a 4-inch glass-fiber air filter sample is collected every two weeks. Samples are delivered to the Radiological Services Laboratory at the University of Nevada, Las Vegas, on a monthly basis for batch processing. Between December 21, 2016, and December 20, 2017, 26 air particulate filter samples were collected and then analyzed by gamma spectroscopy and for gross alpha and gross beta activity. Only naturally occurring radionuclides were identified and measured on these samples; beryllium-7 (22 samples) and lead-210 (9 samples) were the most commonly identified radionuclides, with minor detections of lead-212 (two samples). No anthropogenic gamma-emitting radionuclides such as cesium-137, cobalt-60, or americium-241 have been detected. The mean annual gross alpha activity (Table A-1) from all samples was 1.68×10^{-15} µCi/mL, with a maximum of 3.67×10^{-15} µCi/mL, a minimum of 0.31×10^{-15} µCi/mL, and a standard deviation of 0.79×10^{-15} µCi/mL. The mean annual gross beta activity (Table A-2) from all samples was

1.39 × 10^{-14} µCi/mL, with a maximum of 2.63 × 10^{-14} µCi/mL, a minimum of 0.44 × 10^{-14} µCi/mL, and a standard deviation of 0.49 × 10^{-14} µCi/mL.

Station 402: Clean Slate 1

Station 402 operated at Clean Slate 1 between May 2011 and April 2017, when it was moved to a new location at Clean Slate 3 and renamed Station 403.

Station 402: Capabilities

Prior to its decommissioning, Station 402 included a portable meteorological tower with an anemometer, a pyranometer, a tipping rain bucket, a soil moisture probe, a soil temperature probe, a temperature and relative humidity probe, an ambient air particulate size profiler, a saltation sensor, and a Geostationary Operational Environmental Satellite transmitter.

The station also included a solar-powered air sampler (sampler and solar panels) mounted on a trailer and a pressurized ion chamber. Internal airflow monitoring and self-adjustment capabilities allowed the air sampler to maintain a near-constant flow rate. An internal totalizer computed the volume of air passed through the collection filter and the run time. Data from the sensors was collected and stored on a data logger. Solar panels, with battery assistance, provided power for the air sampler and the meteorological station. The configurations of the solar-powered air sampler, saltation sensor, and portable meteorological tower, prior to the April 25, 2017 move, are shown in Figure A-3.

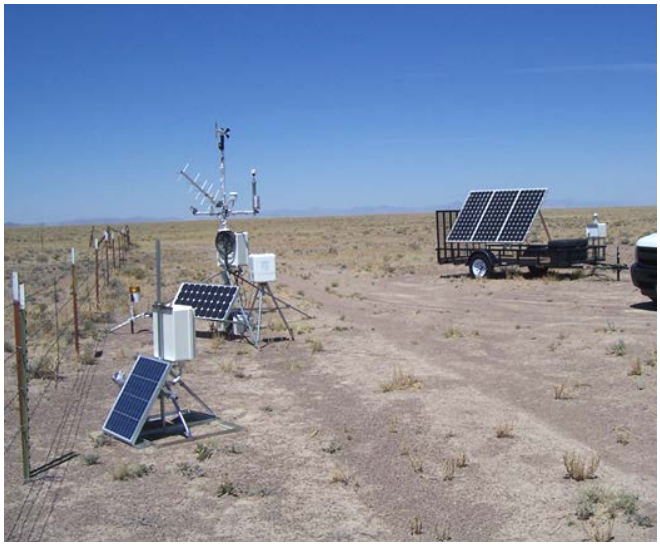


Figure A-3. TTR solar-powered air sampler, saltation sensor, and meteorological tower (right, foreground left, and center left, respectively) at Station 402, located along the north fence that bounds the Clean Slate 1 contamination area, prior to the station being moved in April 2017

Station 402: Air Sampling Results

Station 402 was equipped with a continuous air particulate sampler from which a 4-inch glass-fiber air filter sample was collected every two weeks. Samples were delivered to the Radiological Services Laboratory at the University of Nevada, Las Vegas, on a monthly basis for batch processing. Between December 21, 2016, and April 25, 2017 (date the station was moved), a total of 9 air particulate samples were collected and then analyzed by gamma spectroscopy and for gross alpha and gross beta activity. Only naturally occurring radionuclides were identified and measured on these samples; beryllium-7 (9 samples) and lead-210 (3 samples) were the most commonly identified radionuclides. No anthropogenic gamma-emitting radionuclides such as cesium-137, cobalt-60, or americium-241 were detected. The mean gross alpha activity

(Table A-1) from all samples was 1.85×10^{-15} µCi/mL, with a maximum of 2.67×10^{-15} µCi/mL, a minimum of 0.91×10^{-15} µCi/mL, and a standard deviation of 0.58×10^{-15} µCi/mL. The mean gross beta activity (Table A-2) from all samples was 1.36×10^{-14} µCi/mL, with a maximum of 2.55×10^{-14} µCi/mL, a minimum of 0.75×10^{-14} µCi/mL, and a standard deviation of 0.49×10^{-14} µCi/mL.

Station 403: Clean Slate 3

In April of 2017, DRI established Station 403 at the south end of Clean Slate 3 and installed a portable meteorological tower.

Station 403: Capabilities

This metrological tower collects all relevant weather conditions and is equipped with an anemometer with wind speed and wind direction reading, a pyranometer, a tipping rain bucket, a soil moisture probe, a soil temperature probe, a temperature and relative humidity probe, a barometric pressure sensor, an ambient air particulate size profiler, a saltation sensor, and a Geostationary Operational Environmental Satellite transmitter. The ambient air particulate size profiler and saltation sensor instruments measures real-time dust and sand particle movement by aeolian transport close to the ground surface. Saltation is a wind-driven process and is an important mechanism for transport of soil material in desert environments. DRI monitors for frequency of saltation events as a function of wind speed and wind direction at Station 403.

Adjacent to the meteorological tower, DRI installed a solar-powered air sampler with solar array, battery pack, and pressurized ion chamber, all mounted on a trailer. Internal airflow monitoring and self-adjustment capabilities allow the air sampler to maintain a near-constant airflow rate as it collects samples on filters. An internal totalizer computes the volume of air passed through the collection filter and the run time. Data from the sensors are stored on a data logger. Solar panels, with battery assistance, provide power for the air sampler and the meteorological station. The configurations of the solar-powered air sampler and the portable meteorological tower are shown in Figure A-4.

Figure A-4. TTR solar-powered air sampler and meteorological tower (center right and center left, respectively) at Station 403, located along the south fence that bounds the Clean Slate 3 contamination area

Station 403: Air Sampling Results

Station 403 is equipped with a continuous air particulate sampler from which a 4-inch glass-fiber air filter sample is collected every two weeks. Samples are delivered to the Radiological Services Laboratory at the University of Nevada, Las Vegas, on a monthly basis for batch processing. Between April 25, 2017 (the date the station began operation) and December 20, 2017, a total of 17 air particulate samples were collected and then analyzed by gamma spectroscopy and for gross alpha and gross beta activity. Only naturally occurring radionuclides were identified and measured on these samples; beryllium-7 (17 samples) and lead-210 (9 samples) were the most commonly identified radionuclides, with minor detections of potassium-40 (3 samples) and protactinium-234m (2 samples). No anthropogenic gamma-emitting radionuclides such as cesium-137, cobalt-60, or americium-241 have been detected. The mean gross alpha activity (Table A-1) from all samples was 2.04×10^{-15} µCi/mL, with a maximum of 4.46×10^{-15} µCi/mL, a minimum of 0.52×10^{-15} µCi/mL, and a standard deviation of 0.93×10^{-15} µCi/mL. The mean gross beta activity (Table A-2) from all samples was 2.01×10^{-14} µCi/mL, with a maximum of 3.32×10^{-14} µCi/mL, a minimum of 1.32×10^{-14} µCi/mL, and a standard deviation of 0.50×10^{-14} µCi/mL.

Station 404: Clean Slate 2

In April of 2017, DRI established Station 404 at the north end of Clean Slate 2 and installed a portable meteorological tower.

Station 404: Capabilities

This meteorological tower is equipped with an anemometer with wind speed and wind direction reading, a pyranometer, a tipping rain bucket, a soil moisture probe, a soil temperature probe, a temperature and relative humidity probe, a barometric pressure sensor, an ambient air particulate size profiler, a saltation sensor, and a Geostationary Operational Environmental Satellite transmitter. This metrological tower collects all relevant weather conditions as well as ambient dust concentration and real-time movement of saltation size particles. The ambient air particulate size profiler and saltation sensor instruments measure dust and sand particle movement by aeolian transport close to the ground surface. Saltation is a wind-driven process and is an important mechanism for transport of soil material in desert environments. DRI monitors for frequency of saltation events as a function of wind speed and wind direction at Station 404.

Adjacent to the meteorological tower, DRI installed a solar-powered air sampler with solar array, battery pack, and pressurized ion chamber instrument all mounted on a trailer. Internal airflow monitoring and self-adjustment capabilities allow the air sampler to maintain a near-constant airflow rate as it collects filter samples. An internal totalizer computes the volume of air passed through the collection filter and the run time. Data from the sensors are stored on a data logger. Solar panels, with battery assistance, provide power for the air sampler and the meteorological station. The configurations of the solar-powered air sampler and the portable meteorological tower are shown in Figure A-5.

Figure A-5. TTR solar-powered air sampler and meteorological tower (center right and far right, respectively) at Station 404, located along the north fence that bounds the Clean Slate 2 contamination area

Station 404: Air Sampling Results

Station 404 is equipped with a continuous air particulate sampler from which a 4-inch glass-fiber air filter sample is collected every two weeks. Samples are delivered to the Radiological Services Laboratory at the University of Nevada, Las Vegas, on a monthly basis for batch processing. Between April 25, 2017 (the date the station began operation), and December 20, 2017, a total of 17 air particulate samples were collected and then analyzed by gamma spectroscopy and for gross alpha and gross beta activity. Only naturally occurring radionuclides were identified and measured on these samples; beryllium-7 (17 samples) and lead-210 (6 samples) were the most commonly identified radionuclides, with minor detections of potassium-40 (1 sample) and bismuth-214 (2 samples). No anthropogenic gamma-emitting radionuclides such as cesium-137, cobalt-60, or americium-241 have been detected. The mean gross alpha activity (Table A-1) from all samples was 2.85×10^{-15} µCi/mL, with a maximum of 7.06×10^{-15} µCi/mL, a minimum of 1.06×10^{-15} µCi/mL, and a standard deviation of 1.38×10^{-15} µCi/mL. The mean gross beta activity (Table A-2) from all samples was 2.18×10^{-14} µCi/mL, with a maximum of 3.04×10^{-14} µCi/mL, a minimum of 1.33×10^{-14} µCi/mL, and a standard deviation of 0.40×10^{-14} µCi/mL.

Station 405: Clean Slate 2

In April of 2017, DRI established Station 405 at the south end of Clean Slate 2 and installed a portable meteorological tower.

Station 405: Capabilities

This metrological tower is equipped tower with an anemometer with wind speed and wind direction reading, a pyranometer, a tipping rain bucket, a soil moisture probe, a soil temperature probe, a temperature and relative humidity probe, a barometric pressure sensor, an ambient air particulate size profiler, a saltation sensor, and a Geostationary Operational Environmental Satellite transmitter. The tower collects all relevant weather conditions as well as ambient dust concentration and real-time movement of saltation size particles. The ambient air particulate size profiler and saltation sensor instruments measure dust and sand particle movement by aeolian

transport close to the ground surface. Saltation is a wind-driven process and is an important mechanism for transport of soil material in desert environments. DRI monitors for frequency of saltation events as a function of wind speed and wind direction at Station 405.

Adjacent to the meteorological tower, DRI installed a solar-powered air sampler with solar array, battery pack, and a pressurized ion chamber all mounted on a trailer. Internal airflow monitoring and self-adjustment capabilities allow the air sampler to maintain a near-constant airflow rate as it collects filter samples. An internal totalizer computes the volume of air passed through the collection filter and the run time. Data from the sensors are stored on a data logger. Solar panels, with battery assistance, provide power for the air sampler and the meteorological station. The configurations of the solar-powered air sampler, saltation sensor, and portable meteorological tower are shown in Figure A-6.

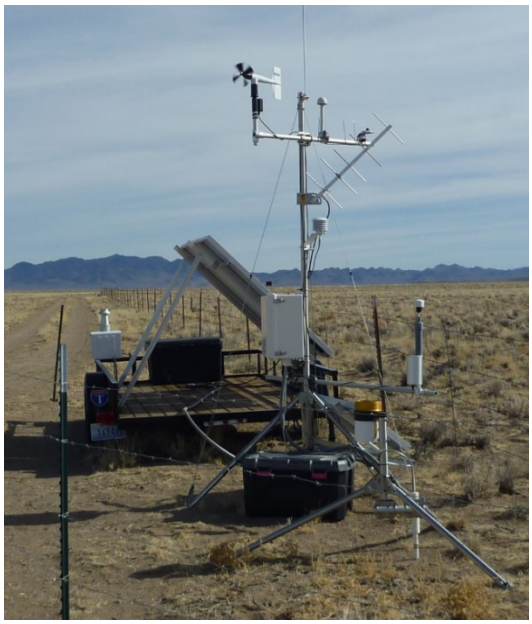


Figure A-6. TTR solar-powered air sampler, meteorological tower, saltation sensor (left, center, and right, respectively) at Station 405, located along the south fence that bounds the Clean Slate 2 contamination area

Station 405: Air Sampling Results

Station 405 is equipped with a continuous air particulate sampler from which a 4-inch glass-fiber air filter sample is collected every two weeks. Samples are delivered to the Radiological Services Laboratory at the University of Nevada, Las Vegas, on a monthly basis for batch processing. Between April 25, 2017 (the date the station began operation), and December 20, 2017, a total of 17 air particulate samples were collected and then analyzed by gamma spectroscopy and for gross alpha and gross beta activity. Only naturally occurring radionuclides were identified and measured on these samples; beryllium-7 (17 samples) and lead-210 (5 samples) were the most commonly identified radionuclides, with minor detections of potassium-40 (2 samples) and lead-212 (two samples). No anthropogenic gamma-emitting radionuclides such as cesium-137, cobalt-60, or americium-241 have been detected. The mean gross alpha activity (Table A-1) from all samples was 2.34×10^{-15} µCi/mL, with a maximum of 3.89×10^{-15} µCi/mL, a minimum of 0.95×10^{-15} µCi/mL, and a standard deviation of 0.89×10^{-15} µCi/mL. The mean gross beta activity (Table A-2) from all samples was 2.16×10^{-14} µCi/mL, with a maximum of 3.13×10^{-14} µCi/mL, a minimum of 1.31×10^{-14} µCi/mL, and a standard deviation of 0.47×10^{-14} µCi/mL.

A.3 Alpha Spectroscopy Results for Stations 400, 401, 402, 403, 404, and 405

Alpha spectroscopy analysis for plutonium (Pu) isotopes was conducted on air filters collected in 2017. Every quarter, two filters from each station are semi-randomly selected and submitted to TestAmerica Laboratories for analysis. These quarterly samples include the sample with the highest gross alpha result plus one random sample from each station. Stations 400 and 401 ran all four quarters of the year and provided eight samples. Four samples were submitted for Station 402 before it was decommissioned. Stations 403, 404, and 405 provided six samples each, representing the final three quarters of the year. Note that previous gamma spectroscopy on the samples selected for alpha spectroscopy did not detect americium-241, which would have automatically flagged the sample to require alpha spectroscopy analysis for plutonium isotopes.

Table A-3 summarizes the results of alpha spectroscopy analyses for Pu-238 and Pu-239/240 for all stations during 2017. Plutonium isotopes were not detected at Station 400, the Range Operations Center. A few detections of Pu-239/240 occurred at Station 401, but Pu-238 was not detected. The mean Pu-239/240 activity at Station 401 was 11.3×10^{-16} µCi/mL, with a maximum of 49.91×10^{-16} µCi/mL, a minimum of 1.15×10^{-16} µCi/mL, and a standard deviation of 21.5×10^{-16} µCi/mL. Station 402 (decommissioned in April of 2017) had a few minor detections Pu-238 and Pu-239/240 (see Table A-3). Station 403 had one detection of Pu-238 at 0.61×10^{-16} µCi/mL. Three detections of Pu-239/240 occurred in the Station 403 samples, with a mean activity of 1.59×10^{-16} µCi/mL, and a maximum of 2.06×10^{-16} µCi/mL, a minimum of 1.04×10^{-16} µCi/mL, and a standard deviation of 0.51×10^{-16} µCi/mL. Station 404 (Clean Slate 2 north) had the largest number of detectable results for plutonium isotopes. Pu-238 was detected in two samples with a mean of 1.15×10^{-16} µCi/mL. Pu-239/240 was detected in all six samples with a mean of 26.36×10^{-16} µCi/mL, a maximum of 110.6×10^{-16} µCi/mL, a minimum of 3.26×10^{-16} µCi/mL, and a standard deviation of 41.73×10^{-16} µCi/mL. Station 405 did not have any detections of Pu-238, but all six samples had detections of Pu-239/240. The mean Pu-239/240 for the Station 405 samples is 4.51×10^{-16} µCi/mL, with a maximum of 9.21×10^{-16} µCi/mL, a minimum of 1.58×10^{-16} µCi/mL, and a standard deviation of 2.42×10^{-16} µCi/mL.

Table A-3. Alpha spectroscopy results for sampling stations 2017

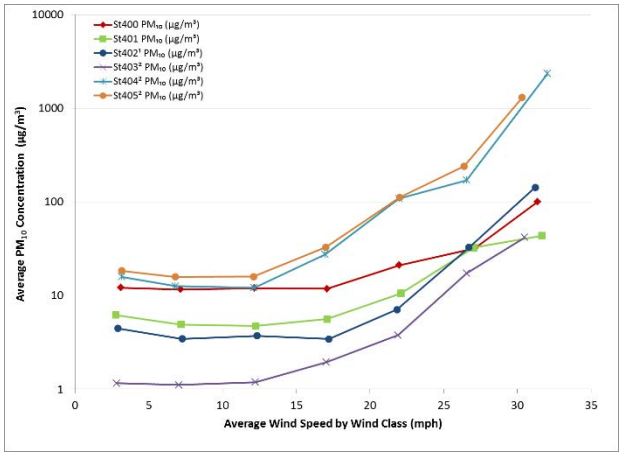
Station Location	Total Number of Samples	Number of Samples > MDC Pu-238	Number of Samples > MDC Pu-239/240	Concentration (×10^{-16} µCi/mL [3.7 × 10^{-6} Bq/m^3])		
				Mean ± Standard Deviation	Minimum	Maximum
400	8	0	0	N/A	N/A	N/A
401	8	0	5	Pu-239/240 11.3 ± 21.5	1.15	49.91
402	4	2	1	Pu-238 0.74 ± 0.13 Pu-239/240 0.72	0.61 N/A	0.86 N/A
403	6	1	3	Pu-238 0.61 Pu-239/240 1.59 ± 0.51	N/A 1.04	N/A 2.06
404	6	2	6	Pu-238 1.15 ± 0.52 Pu-239/240 26.36 ± 41.73	0.63 3.26	1.67 110.60
405	6	0	6	Pu-239/240 4.51 ± 2.42	1.58	9.21

MDC = minimum detectable concentration N/A = not applicable Pu = plutonium

A.4 Station 400, Station 401, Station 402, Station 403, Station 404, and Station 405: Air Particulate Migration

At Station 400 (near the Range Operations Center), wind speeds of 15 mph or less were observed 90.6 percent of the time during 2017; wind speeds exceeded 30 mph for 6 hours and 30 minutes during the year, and there were no sustained winds over 35 mph. Slightly higher wind speeds were observed at Station 401 (Clean Slate 3), where winds of 15 mph or less were observed 89.9 percent of the time, and wind speed exceeded 30 mph for approximately 9 hours during 2017. At Station 402 (Clean Slate 1), which recorded data only between January 1 and April 25 in 2017 before being moved, wind speeds of 15 mph or less were observed approximately 85.4 percent of the time, and the wind speed exceeded 30 mph for approximately 1 hour and 20 minutes. At Station 403 (at the south end of Clean Slate 3), which started operation on April 25, 2017, wind speeds of 15 mph or less were observed 94 percent of the time, and winds over 30 mph were recorded for only 30 minutes. Stations 404 and 405, at the north and south ends of Clean Slate 2, respectively, recorded winds below 15 mph for 94.1 and 94.4 percent of the time, respectively, of the recorded time between April 25, 2017 and year-end. Winds over 30 mph at stations 404 and 405 occurred for a total of 30 and 10 minutes, respectively, during the recorded time.

Figure A-7 shows the average respirable particulate matter (having a diameter equal to or less than 10 μ [PM_{10}]) concentrations for 5 mph wind speed intervals at all six stations operating during the year. The PM_{10} concentrations increased exponentially as wind speed increased at all stations. At high wind speeds, PM_{10} concentrations are highly dependent on nearby dust sources that can result in a significant increase of airborne particulate matter. PM_{10} concentrations at all six stations were less than approximately 15 μg/m³ for wind speeds below 15 mph. At Station 400, PM_{10} concentrations peaked at 100 μg/m³ for wind speeds over 30 mph. At Station 401, PM_{10} concentrations rose to 44 μg/m³ for wind speeds over 30 mph. At Station 402, PM_{10} concentrations peaked at 143 μg/m³ for wind speeds over 30 mph. PM_{10} concentrations at Station 403 peaked at 42 μg/m³ for wind speeds over 30 mph. A significant increase in PM_{10} concentrations for wind speeds over 30 mph was observed at stations 404 and 405 where maximum PM_{10} concentrations were 2,350 and 1,300 μg/m³, respectively.



NOTE: Station 402 data represents the period between January 1, 2017, and April 25, 2017. Station 403, 404, and 405 data represents the period between April 25, 2017, and December 31, 2017.
PM_{10} = having a diameter equal to or less than 10 μ
St = station

Figure A-7. Wind speed and log-normal PM_{10} trends for stations 400, 401, 402, 403, 404, and 405 January 1–December 31, 2017

Appendix B. 2017 SNL/TTR Terrestrial Surveillance Analytical Results

Wild horses (*Equus ferus*)

Table B-1. Radiological results for off-site soil sampling locations at SNL/TTR, 2017

Location	Analyte	Activity	MDA (pCi/g)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
C-20	Americium-241	0.034 ± 0.0508	0.0825	U	BD	HASL 300
	Cesium-137	0.0743 ± 0.0222	0.019		None	HASL 300
	Uranium-235	0.0374 ± 0.122	0.107	U	BD	HASL 300
	Uranium-238	1.53 ± 0.973	0.697		J	HASL 300
C-21	Americium-241	-0.0171 ± 0.0382	0.0707	U	BD	HASL 300
	Cesium-137	0.112 ± 0.0389	0.0275		None	HASL 300
	Uranium-235	0.101 ± 0.138	0.132	U	BD	HASL 300
	Uranium-238	0.379 ± 0.924	0.677	U	BD	HASL 300
C-22	Americium-241	0.00307 ± 0.0141	0.0259	U	BD	HASL 300
	Cesium-137	0.237 ± 0.0247	0.0184		None	HASL 300
	Uranium-235	0.111 ± 0.0838	0.0837		J	HASL 300
	Uranium-238	1.51 ± 0.545	0.26		None	HASL 300
C-23	Americium-241	0.0142 ± 0.0457	0.0778	U	BD	HASL 300
	Cesium-137	0.114 ± 0.0299	0.0264		None	HASL 300
	Uranium-235	-0.00243 ± 0.0924	0.154	U	BD	HASL 300
	Uranium-238	1.37 ± 0.996	0.689		J	HASL 300
C-24	Americium-241	0.0213 ± 0.0255	0.0436	U	BD	HASL 300
	Cesium-137	0.0874 ± 0.0313	0.0314		J	HASL 300
	Uranium-235	0.108 ± 0.141	0.136	U	BD	HASL 300
	Uranium-238	1.92 ± 0.783	0.436		None	HASL 300
C-25	Americium-241	-0.00714 ± 0.0906	0.155	U	BD	HASL 300
	Cesium-137	0.0666 ± 0.0312	0.0267		J	HASL 300
	Uranium-235	0.096 ± 0.164	0.16	U	BD	HASL 300
	Uranium-238	1.18 ± 1.72	1.3	U	BD	HASL 300
C-26	Americium-241	0.0253 ± 0.0329	0.027	U	BD	HASL 300
	Cesium-137	0.386 ± 0.0361	0.0198		None	HASL 300
	Uranium-235	0.147 ± 0.0963	0.0855		J	HASL 300
	Uranium-238	1.42 ± 0.508	0.273		None	HASL 300
C-27	Americium-241	0.0448 ± 0.0561	0.0868	U	BD	HASL 300
	Cesium-137	0.394 ± 0.0456	0.0203		None	HASL 300
	Uranium-235	0.0374 ± 0.0736	0.12	U	BD	HASL 300
	Uranium-238	1.74 ± 1.14	0.725		J	HASL 300
C-28	Americium-241	0.0029 ± 0.0354	0.0578	U	BD	HASL 300
	Cesium-137	0.201 ± 0.0259	0.0177		None	HASL 300
	Uranium-235	0.0139 ± 0.0962	0.0987	U	BD	HASL 300
	Uranium-238	0.716 ± 0.649	0.532		J	HASL 300
C-29	Americium-241	0.0108 ±0 .0892	0.15	U	BD	HASL 300
	Americium-241	0.0552 ± 0.0909	0.146	U	BD	HASL 300
	Cesium-137	0.0739 ± 0.0271	0.0232		None	HASL 300
	Cesium-137	0.109 ± 0.0311	0.0294		None	HASL 300
	Cesium-137	0.0777 ± 0.0275	0.0247		None	HASL 300

Table continued on next page.

Table B-1. Radiological results for off-site soil sampling locations at SNL/TTR, 2017 (continued)

Location	Analyte	Activity	MDA (pCi/g)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
C-29	Uranium-235	0.0866 ± 0.126	0.151	U	BD	HASL 300
	Uranium-235	0.0455 ± 0.143	0.128	U	BD	HASL 300
	Uranium-235	0.0079 ± 0.15	0.158	U	BD	HASL 300
	Uranium-238	1.2 ± 1.46	1.21	U	BD	HASL 300
	Uranium-238	1.14 ± 0.957	0.773		J	HASL 300
	Uranium-238	0.829 ± 1.36	1.17	U	BD	HASL 300
C-30	Americium-241	0.0218 ± 0.0551	0.0978	U	BD	HASL 300
	Cesium-137	0.202 ± 0.0446	0.0265		None	HASL 300
	Uranium-235	0.000441 ± 0.0799	0.139	U	BD	HASL 300
C-31	Americium-241	0.0198 ± 0.0311	0.0514	U	BD	HASL 300
	Cesium-137	0.0662 ± 0.019	0.0192		None	HASL 300
	Uranium-238	1.14 ± 0.727	0.476		J	HASL 300
C-32	Americium-241	-0.0161 ± 0.0502	0.0857	U	BD	HASL 300
	Cesium-137	0.0825 ± 0.027	0.0296		J	HASL 300
	Uranium-235	0.0265 ± 0.101	0.173	U	BD	HASL 300
	Uranium-238	1.76 ± 1.18	0.796		J	HASL 300
C-33	Americium-241	-0.0197 ± 0.0765	0.125	U	BD	HASL 300
	Cesium-137	0.123 ± 0.0247	0.0244		None	HASL 300
	Uranium-235	0.0473 ± 0.138	0.125	U	BD	HASL 300
	Uranium-238	0.734 ± 1.28	1.03	U	BD	HASL 300

See notes at end of appendices.

Table B-2. Radiological results for perimeter soil sampling locations at SNL/TTR, 2017

Location	Analyte	Activity	MDA (pCi/g)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
P-06	Americium-241	-0.0272 ± 0.0552	0.0965	U	BD	HASL 300
	Cesium-137	0.0845 ± 0.0273	0.0275		None	HASL 300
	Uranium-235	0.0576 ± 0.116	0.133	U	BD	HASL 300
	Uranium-238	0.757 ± 0.963	0.859	U	BD	HASL 300
P-08	Americium-241	0.054 ± 0.08	0.128	U	BD	HASL 300
	Cesium-137	0.0774 ± 0.0268	0.0249		None	HASL 300
	Uranium-235	0.0921 ± 0.156	0.131	U	BD	HASL 300
	Uranium-238	0.589 ± 1.57	1.04	U	BD	HASL 300
P-11	Americium-241	-0.0048 ± 0.0166	0.0326	U	BD	HASL 300
	Cesium-137	0.0692 ± 0.0199	0.026		J	HASL 300
	Uranium-235	0.161 ± 0.133	0.107		J	HASL 300
	Uranium-238	1.33 ± 0.57	0.331		None	HASL 300
P-12	Americium-241	-0.0171 ± 0.0602	0.0998	U	BD	HASL 300
	Cesium-137	0.174 ± 0.0248	0.0229		None	HASL 300
	Uranium-235	0.00333 ± 0.128	0.121	U	BD	HASL 300
P-34	Americium-241	0.00777 ± 0.0962	0.169	U	BD	HASL 300
	Cesium-137	0.241 ± 0.0399	0.0281		None	HASL 300
	Uranium-235	0.0528 ± 0.159	0.149	U	BD	HASL 300
	Uranium-238	1.01 ± 1.38	1.33	U	BD	HASL 300
P-35	Americium-241	0.0715 ± 0.048	0.0715	U	BD	HASL 300
	Cesium-137	0.236 ± 0.0396	0.0349		None	HASL 300
	Uranium-235	-0.0368 ± 0.105	0.174	U	BD	HASL 300
	Uranium-238	3.14 ± 1.31	0.201	X	R	HASL 300
P-36	Americium-241	0.00919 ± 0.0224	0.042	U	BD	HASL 300
	Cesium-137	0.122 ± 0.0405	0.0274		None	HASL 300
	Uranium-238	1.03 ±0 .653	0.411		J	HASL 300
P-37	Americium-241	0.0153 ± 0.0581	0.11	U	BD	HASL 300
	Cesium-137	0.0279 ± 0.0212	0.0234		J	HASL 300
	Uranium-235	0.161 ± 0.144	0.113		J	HASL 300
	Uranium-238	0.692 ± 1.58	0.871	U	BD	HASL 300

See notes at end of appendices.

Table B-3. Radiological results for South Plume Area soil sampling locations at SNL/TTR, 2017

Location	Analyte	Activity	MDA (pCi/g)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
S-49	Americium-241	0.278 ± 0.136	0.117		J	HASL 300
	Cesium-137	0.235 ± 0.0333	0.0235		None	HASL 300
	Uranium-235	0.0907 ± 0.14	0.127	U	BD	HASL 300
	Uranium-238	1.94 ± 1.18	0.913		J	HASL 300
S-50	Americium-241	0.0913 ± 0.103	0.163	U	BD	HASL 300
	Cesium-137	0.344 ± 0.0446	0.0272		None	HASL 300
	Uranium-235	0.0431 ± 0.159	0.141	U	BD	HASL 300
	Uranium-238	0.868 ± 1.51	1.24	U	BD	HASL 300
S-51	Americium-241	9.97 ± 0.886	0.236		None	HASL 300
	Cesium-137	0.544 ± 0.0503	0.0284		None	HASL 300
	Plutonium-238	0.239 ± 0.132	0.115			HASL 300
	Plutonium-239/240	16 ± 2.65	0.165			HASL 300
	Uranium-235	0.0137 ± 0.0914	0.157	U	BD	HASL 300
	Uranium-238	1.31 ± 1.59	1.56	U	BD	HASL 300
S-52	Americium-241	0.0731 ± 0.0896	0.15	U	BD	HASL 300
	Cesium-137	0.0704 ± 0.0288	0.0284		J	HASL 300
	Uranium-235	0.0792 ± 0.136	0.145	U	BD	HASL 300
	Uranium-238	0.189 ± 1.6	1.16	U	BD	HASL 300

See notes at end of appendices.

Table B-4. Radiological results for Range Operations Center on-site soil sampling locations at SNL/TTR, 2017

Location	Analyte	Activity	MDA (pCi/g)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
S-40	Americium-241	-0.0189 ± 0.102	0.16	U	BD	HASL 300
	Cesium-137	0.2 ± 0.0392	0.0304		None	HASL 300
	Uranium-235	0.131 ± 0.186	0.168	U	BD	HASL 300
	Uranium-238	0.498 ± 1.5	1.38	U	BD	HASL 300
S-41	Americium-241	0.0531 ± 0.0491	0.0729	U	BD	HASL 300
	Cesium-137	0.0398 ± 0.022	0.022		J	HASL 300
	Uranium-235	0.121 ± 0.143	0.122	U	BD	HASL 300
	Uranium-238	01.17 ± 0.894	0.653		J	HASL 300
S-42	Americium-241	0.00512 ± 0.0455	0.0866	U	BD	HASL 300
	Cesium-137	0.297 ± 0.0409	0.0285		None	HASL 300
	Uranium-235	0.0441 ± 0.0995	0.173	U	BD	HASL 300
	Uranium-238	1.45 ± 1.06	0.757		J	HASL 300
S-43	Americium-241	0.0196 ± 0.0541	0.0938	U	BD	HASL 300
	Cesium-137	0.0229 ± 0.0252	0.0251	U	BD	HASL 300
	Uranium-235	-0.0136 ± 0.0833	0.135	U	BD	HASL 300
	Uranium-238	1.99 ± 1.32	0.825		J	HASL 300
S-44	Americium-241	0.0458 ± 0.121	0.209	U	BD	HASL 300
	Cesium-137	0.0412 ± 0.0266	0.0284		J	HASL 300
S-45	Americium-241	0.0252 ± 0.0642	0.118	U	BD	HASL 300
	Cesium-137	0.0585 ± 0.0256	0.0261		J	HASL 300
	Uranium-235	0.0854 ± 0.121	0.132	U	BD	HASL 300
	Uranium-238	0.942 ± 1.14	0.985	U	BD	HASL 300
S-46	Americium-241	0.0474 ± 0.0684	0.109	U	BD	HASL 300
	Cesium-137	0.0418 ± 0.028	0.0267		J	HASL 300
	Uranium-235	0.0792 ± 0.134	0.141	U	BD	HASL 300
	Uranium-238	1.27 ± 1.24	0.908		J	HASL 300
S-47	Americium-241	0.0832 ± 0.103	0.164	U	BD	HASL 300
	Cesium-137	0.0942 ± 0.0278	0.0265		None	HASL 300
	Uranium-235	0.175 ± 0.156	0.143		J	HASL 300
	Uranium-238	2.48 ± 1.62	1.29		J	HASL 300

See notes at end of appendices.

Table B-5. Radiological results for various on-site soil sampling locations at SNL/TTR, 2017

Location	Analyte	Activity	MDA (pCi/g)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
S-02	Americium-241	0.0149 ± 0.0448	0.074	U	BD	HASL 300
	Cesium-137	0.24 ± 0.0317	0.0222		None	HASL 300
	Uranium-235	0.0695 ± 0.131	0.122	U	BD	HASL 300
	Uranium-238	1.04 ± 0.816	0.655		J	HASL 300
S-03	Americium-241	0.00437 ± 0.0568	0.102	U	BD	HASL 300
	Cesium-137	0.151 ± 0.0291	0.0202		None	HASL 300
S-04	Americium-241	0.0334 ± 0.0404	0.0651	U	BD	HASL 300
	Cesium-137	0.284 ± 0.0385	0.0243		None	HASL 300
	Uranium-235	0.0469 ± 0.146	0.115	U	BD	HASL 300
	Uranium-238	1.78 ± .0834	0.578		None	HASL 300
S-09	Americium-241	1.96 ± 0.177	0.071		None	HASL 300
	Cesium-137	0.206 ± 0.0328	0.0196		None	HASL 300
	Uranium-235	0.0193 ± 0.0686	0.116	U	BD	HASL 300
	Uranium-238	0.948 ± 0.65	0.57		J	HASL 300
S-10	Americium-241	0.0274 ± 0.0617	0.0603	U	BD	HASL 300
	Cesium-137	0.102 ± 0.0234	0.0206		None	HASL 300
	Uranium-235	0.0859 ± 0.121	0.114	U	BD	HASL 300
	Uranium-238	1.33 ± 0.775	0.552		J	HASL 300
S-38	Americium-241	0.0247 ± 0.0855	0.159	U	BD	HASL 300
	Cesium-137	0.293 ± 0.038	0.028		None	HASL 300
	Uranium-235	0.03 ± 0.145	0.142	U	BD	HASL 300
	Uranium-238	1.2 ± 1.56	1.23	U	BD	HASL 300
S-39	Americium-241	0.0529 ± 0.0966	0.169	U	BD	HASL 300
	Cesium-137	0.378 ± 0.0501	0.0298		None	HASL 300
	Uranium-235	0.109 ± 0.165	0.166	U	BD	HASL 300
S-53	Americium-241	-0.00675 ± 0.075	0.128	U	BD	HASL 300
	Cesium-137	0.165 ± 0.0302	0.0208		None	HASL 300
	Uranium-235	0.0594 ± 0.135	0.115	U	BD	HASL 300
	Uranium-238	0.939 ± 1.29	1.03	U	BD	HASL 300

See notes at end of appendices.

Table B-6. Thermoluminescent dosimeter measurements by quarter and location class, FY 2017

Location Class	Location Number	First Quarter (84 Days)		Second Quarter (84 Days)		Third Quarter (111 Days)		Fourth Quarter (91 Days)	
		Exposure (mR)	Error	Exposure (mR)	Error	Exposure (mR)	Error	Exposure (mR)	Error
On-Site	S-01	NC	N/A	48.2	1.0	49.5	2.0	43.9	3.4
	S-02	50.0	2.5	48.3	0.9	NC	N/A	NC	N/A
	S-03	53.0	2.3	49.9	0.9	50.9	2.4	45.5	2.5
	S-04	51.4	1.3	52.4	1.0	53.0	3.5	NC	N/A
	S-09	44.7	1.0	43.2	1.1	46.4	2.9	44.6	4.6
	S-10	NC	N/A	NC	N/A	50.7	2.0	45.7	2.3
	S-13	49.3	1.0	46.0	1.2	49.7	2.7	41.4	2.3
	S-14	43.8	1.1	44.6	1.0	44.5	2.2	38.3	3.2
	S-15	50.0	1.3	47.7	0.8	51.9	4.3	43.1	2.8
	S-16	50.4	2.4	49.6	1.5	46.8	2.1	42.5	3.0
	S-17	49.6	2.1	48.6	1.3	48.6	2.6	43.2	2.3
Perimeter	P-05	48.8	1.1	49.3	1.3	51.1	2.4	45.2	2.5
	P-06	45.2	6.5	44.9	1.3	49.0	3.2	42.0	2.6
	P-07	45.3	1.1	47.8	3.0	45.2	2.3	37.4	2.8
	P-08	44.2	1.2	44.0	0.8	44.2	2.4	40.2	2.3
	P-11	56.4	1.0	50.1	4.1	58.6	2.5	52.5	3.9
	P-12	47.5	1.0	46.5	2.3	51.4	2.8	46.0	2.4
Community	C-19	35.5	1.1	43.2	2.7	36.0	2.3	35.9	2.6
	C-21	46.7	1.1	45.6	0.9	47.3	4.6	46.8	2.9
	C-22	45.5	1.5	44.2	0.8	43.3	2.1	43.2	2.3

See notes at end of appendices.

Table B-7. Nonradiological results for South Plume Area soil sampling locations at SNL/TTR, 2017

Location	Analyte	Result (mg/kg)	MDL (mg/kg)	PQL (mg/kg)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
S-49	Aluminum	13,200	42.3	92.9		J	SW846 3050B/6020
	Antimony	0.918	0.32	0.971	JB	0.97UJ	SW846 3050B/6010B
	Arsenic	3.25	0.314	0.929		None	SW846 3050B/6020
	Beryllium	0.526	0.0186	0.0929		None	SW846 3050B/6020
	Cadmium	0.279	0.0186	0.186		None	SW846 3050B/6020
	Chromium	5.45	0.186	0.558		None	SW846 3050B/6020
	Copper	6.73	0.0613	0.186		None	SW846 3050B/6020
	Iron	9,560	61.3	186		J	SW846 3050B/6020
	Lead	11.1	0.0929	0.372		None	SW846 3050B/6020
	Magnesium	4,360	1.86	5.58		None	SW846 3050B/6020
	Nickel	5.41	0.0929	0.372		None	SW846 3050B/6020
	Selenium	0.916	0.335	0.929	JN	J	SW846 3050B/6020
	Silver	0.0971	0.0971	0.485	U	None	SW846 3050B/6010B
	Thallium	0.159	0.13	0.372	J	None	SW846 3050B/6020
	Uranium	0.892	0.0123	0.0372		None	SW846 3050B/6020
	Zinc	29.2	0.743	1.86	B	None	SW846 3050B/6020
S-50	Aluminum	9,300	4.39	9.65		J	SW846 3050B/6020
	Antimony	0.502	0.322	0.977	JB	0.98UJ	SW846 3050B/6010B
	Arsenic	2.66	0.326	0.965		None	SW846 3050B/6020
	Beryllium	0.397	0.0193	0.0965		None	SW846 3050B/6020
	Cadmium	0.17	0.0193	0.193	J	None	SW846 3050B/6020
	Chromium	4.55	0.193	0.579		None	SW846 3050B/6020
	Copper	5.25	0.0637	0.193		None	SW846 3050B/6020
	Iron	8,770	6.37	19.3		J	SW846 3050B/6020
	Lead	9.36	0.0965	0.386		None	SW846 3050B/6020
	Magnesium	3,510	1.93	5.79		None	SW846 3050B/6020
	Nickel	4.2	0.0965	0.386		None	SW846 3050B/6020
	Selenium	0.808	0.347	0.965	JN	J	SW846 3050B/6020
	Silver	0.0977	0.0977	0.488	U	None	SW846 3050B/6010B
	Thallium	0.135	0.135	0.386	U	None	SW846 3050B/6020

Table continued on next page.

Table B-7. Nonradiological results for South Plume Area soil sampling locations at SNL/TTR, 2017 (continued)

Location	Analyte	Result (mg/kg)	MDL (mg/kg)	PQL (mg/kg)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
S-50	Uranium	0.579	0.0127	0.0386		None	SW846 3050B/6020
	Zinc	35.6	0.772	1.93	B	None	SW846 3050B/6020
S-51	Aluminum	10,500	42.8	94.2		J	SW846 3050B/6020
	Antimony	0.655	0.314	0.951	JB	0.95UJ	SW846 3050B/6010B
	Arsenic	3.36	0.318	0.942		None	SW846 3050B/6020
	Beryllium	0.426	0.0188	0.0942		None	SW846 3050B/6020
	Cadmium	0.177	0.0188	0.188	J	None	SW846 3050B/6020
	Chromium	5.17	0.188	0.565		None	SW846 3050B/6020
	Copper	6.02	0.0621	0.188		None	SW846 3050B/6020
	Iron	8,920	62.1	188		J	SW846 3050B/6020
	Lead	11.3	0.0942	0.377		None	SW846 3050B/6020
	Magnesium	3,620	1.88	5.65		None	SW846 3050B/6020
	Nickel	4.97	0.0942	0.377		None	SW846 3050B/6020
	Selenium	0.76	0.339	0.942	JN	J	SW846 3050B/6020
	Silver	0.0951	0.0951	0.475	U	None	SW846 3050B/6010B
	Thallium	0.132	0.132	0.377	J	None	SW846 3050B/6020
	Uranium	0.79	0.0124	0.0377		None	SW846 3050B/6020
	Zinc	26.7	0.753	1.88	B	None	SW846 3050B/6020
S-52	Aluminum	8,480	4.24	9.31		J	SW846 3050B/6020
	Antimony	1.18	0.32	0.971	B	J	SW846 3050B/6010B
	Arsenic	3.6	0.315	0.931		None	SW846 3050B/6020
	Beryllium	0.423	0.0186	0.0931		None	SW846 3050B/6020
	Cadmium	0.134	0.0186	0.186	J	None	SW846 3050B/6020
	Chromium	3.95	0.186	0.559		None	SW846 3050B/6020
	Copper	4.62	0.0615	0.186		None	SW846 3050B/6020
	Iron	7,410	6.15	18.6		J	SW846 3050B/6020
	Lead	8.1	0.0931	0.372		None	SW846 3050B/6020
	Magnesium	2,520	18.6	55.9		None	SW846 3050B/6020
	Nickel	3.75	0.0931	0.372		None	SW846 3050B/6020
	Selenium	0.787	0.335	0.931	JN	J	SW846 3050B/6020

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Table B-7. Nonradiological results for South Plume Area soil sampling locations at SNL/TTR, 2017 (continued)

Location	Analyte	Result (mg/kg)	MDL (mg/kg)	PQL (mg/kg)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
S-52	Silver	0.0971	0.0971	0.485	U	None	SW846 3050B/6010B
	Thallium	0.13	0.13	0.372	U	None	SW846 3050B/6020
	Uranium	1.05	0.0123	0.0372		None	SW846 3050B/6020
	Zinc	22.9	0.745	1.86	B	None	SW846 3050B/6020

See notes at end of appendices.

Table B-8. Nonradiological results for various on-site soil sampling locations at SNL/TTR, 2017

Location	Analyte	Result (mg/kg)	MDL (mg/kg)	PQL (mg/kg)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
S-02	Aluminum	7,600	4.46	9.8		J	SW846 3050B/6020
	Antimony	0.435	0.315	0.954	JB	0.95UJ	SW846 3050B/6010B
	Arsenic	4.24	0.331	0.98		None	SW846 3050B/6020
	Beryllium	0.414	0.0196	0.098		None	SW846 3050B/6020
	Cadmium	0.0951	0.0196	0.196	J	None	SW846 3050B/6020
	Chromium	3.24	0.196	0.588		None	SW846 3050B/6020
	Copper	3.21	0.0647	0.196		None	SW846 3050B/6020
	Iron	6,300	6.47	19.6		J	SW846 3050B/6020
	Lead	25.7	0.098	0.392		None	SW846 3050B/6020
	Magnesium	2,080	19.6	58.8		None	SW846 3050B/6020
	Nickel	3.14	0.098	0.392		None	SW846 3050B/6020
	Selenium	0.725	0.353	0.98	JN	J	SW846 3050B/6020
	Silver	0.0954	0.0954	0.477	U	None	SW846 3050B/6010B
	Thallium	0.137	0.137	0.392	U	None	SW846 3050B/6020
	Uranium	0.943	0.0129	0.0392		None	SW846 3050B/6020
	Zinc	21.9	0.784	1.96	B	None	SW846 3050B/6020
S-03	Aluminum	7,320	4.41	9.69		J	SW846 3050B/6020
	Antimony	0.858	0.302	0.914	JB	0.91UJ	SW846 3050B/6010B
	Arsenic	3.04	0.328	0.969		None	SW846 3050B/6020
	Beryllium	0.387	0.0194	0.0969		None	SW846 3050B/6020
	Cadmium	0.162	0.0194	0.194	J	None	SW846 3050B/6020
	Chromium	3.79	0.194	0.581		None	SW846 3050B/6020
	Copper	3.82	0.064	0.194		None	SW846 3050B/6020
	Iron	6,400	6.4	19.4		J	SW846 3050B/6020
	Lead	6.48	0.0969	0.388		None	SW846 3050B/6020
	Magnesium	2,490	19.4	58.1		None	SW846 3050B/6020
	Nickel	3.13	0.0969	0.388		None	SW846 3050B/6020
	Selenium	1.06	0.349	0.969	N	J	SW846 3050B/6020
	Silver	0.0914	0.0914	0.457	U	None	SW846 3050B/6010B
	Thallium	0.136	0.136	0.388	U	None	SW846 3050B/6020

Table continued on next page.

Table B-8. Nonradiological results for various on-site soil sampling locations at SNL/TTR, 2017 (continued)

Location	Analyte	Result (mg/kg)	MDL (mg/kg)	PQL (mg/kg)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
S-03	Uranium	1.11	0.0128	0.0388		None	SW846 3050B/6020
	Zinc	20.1	0.775	1.94	B	None	SW846 3050B/6020
S-04	Aluminum	7,200	4.35	9.56		J	SW846 3050B/6020
	Antimony	0.31	0.31	0.94	U	0.94UJ	SW846 3050B/6010B
	Arsenic	2.51	0.323	0.956		None	SW846 3050B/6020
	Beryllium	0.439	0.0191	0.0956		None	SW846 3050B/6020
	Cadmium	0.175	0.0191	0.191	J	None	SW846 3050B/6020
	Chromium	2.71	0.191	0.574		None	SW846 3050B/6020
	Copper	3.7	0.0631	0.191		None	SW846 3050B/6020
	Iron	7,100	6.31	19.1		J	SW846 3050B/6020
	Lead	6.35	0.0956	0.382		None	SW846 3050B/6020
	Magnesium	2,490	19.1	57.4		None	SW846 3050B/6020
	Nickel	2.43	0.0956	0.382		None	SW846 3050B/6020
	Selenium	0.701	0.344	0.956	JN	J	SW846 3050B/6020
	Silver	0.094	0.094	0.47	U	None	SW846 3050B/6010B
	Thallium	0.134	0.134	0.382	U	None	SW846 3050B/6020
	Uranium	1.1	0.0126	0.0382		None	SW846 3050B/6020
	Zinc	21.4	0.765	1.91	B	None	SW846 3050B/6020
S-09	Aluminum	15,400	42.6	93.6		J	SW846 3050B/6020
	Antimony	0.601	0.325	0.984	JB	0.98UJ	SW846 3050B/6010B
	Arsenic	5.73	0.316	0.936		None	SW846 3050B/6020
	Beryllium	0.824	0.0187	0.0936		None	SW846 3050B/6020
	Cadmium	0.124	0.0187	0.187	J	None	SW846 3050B/6020
	Chromium	9.15	0.187	0.562		None	SW846 3050B/6020
	Copper	8.83	0.0618	0.187		None	SW846 3050B/6020
	Iron	15,900	61.8	187		J	SW846 3050B/6020
	Lead	14.1	0.0936	0.375		None	SW846 3050B/6020
	Magnesium	6,470	1.87	5.62		None	SW846 3050B/6020
	Nickel	8.07	0.0936	0.375		None	SW846 3050B/6020
	Selenium	0.852	0.337	0.936	JN	J	SW846 3050B/6020

Table continued on next page.

Table B-8. Nonradiological results for various on-site soil sampling locations at SNL/TTR, 2017 (continued)

Location	Analyte	Result (mg/kg)	MDL (mg/kg)	PQL (mg/kg)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
S-09	Silver	0.0984	0.0984	0.492	U	None	SW846 3050B/6010B
	Thallium	0.222	0.131	0.375	J	None	SW846 3050B/6020
	Uranium	0.761	0.0124	0.0375		None	SW846 3050B/6020
	Zinc	41.8	0.749	1.87	B	None	SW846 3050B/6020
S-10	Aluminum	10,500	44.5	97.8		J	SW846 3050B/6020
	Antimony	1.34	0.326	0.988	B	J	SW846 3050B/6010B
	Arsenic	3.73	0.331	0.978		None	SW846 3050B/6020
	Beryllium	0.655	0.0196	0.0978		None	SW846 3050B/6020
	Cadmium	0.209	0.0196	0.196		None	SW846 3050B/6020
	Chromium	5.45	0.196	0.587		None	SW846 3050B/6020
	Copper	6.51	0.0646	0.196		None	SW846 3050B/6020
	Iron	10,900	64.6	196		J	SW846 3050B/6020
	Lead	8.68	0.0978	0.391		None	SW846 3050B/6020
	Magnesium	3,660	19.6	58.7		None	SW846 3050B/6020
	Nickel	4.88	0.0978	0.391		None	SW846 3050B/6020
	Selenium	0.613	0.352	0.978	JN	J	SW846 3050B/6020
	Silver	0.0988	0.0988	0.494	U	None	SW846 3050B/6010B
	Thallium	0.16	0.137	0.391	J	None	SW846 3050B/6020
	Uranium	0.913	0.0129	0.0391		None	SW846 3050B/6020
	Zinc	31.8	0.783	1.96	B	None	SW846 3050B/6020
S-38	Aluminum	13,200	43.3	95.2		J	SW846 3050B/6020
	Antimony	1.22	0.31	0.938	B	J	SW846 3050B/6010B
	Arsenic	4.78	0.322	0.952		None	SW846 3050B/6020
	Beryllium	0.651	0.019	0.0952		None	SW846 3050B/6020
	Cadmium	0.359	0.019	0.19		None	SW846 3050B/6020
	Chromium	7.68	0.19	0.571		None	SW846 3050B/6020
	Copper	12.8	0.0629	0.19		None	SW846 3050B/6020
	Iron	11,100	62.9	190		J	SW846 3050B/6020
	Lead	12	0.0952	0.381		None	SW846 3050B/6020
	Magnesium	4,790	1.9	5.71		None	SW846 3050B/6020

Table continued on next page.

Table B-8. Nonradiological results for various on-site soil sampling locations at SNL/TTR, 2017 (continued)

Location	Analyte	Result (mg/kg)	MDL (mg/kg)	PQL (mg/kg)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
S-38	Nickel	6.82	0.0952	0.381		None	SW846 3050B/6020
	Selenium	0.631	0.343	0.952	JN	J	SW846 3050B/6020
	Silver	0.0938	0.0938	0.469	U	None	SW846 3050B/6010B
	Thallium	0.191	0.133	0.381	J	None	SW846 3050B/6020
	Uranium	0.821	0.0126	0.0381		None	SW846 3050B/6020
	Zinc	30.8	0.762	1.9	B	None	SW846 3050B/6020
S-39	Aluminum	9,880	43.8	96.3		J	SW846 3050B/6020
	Antimony	1.07	0.319	0.965	B	J	SW846 3050B/6010B
	Arsenic	3.57	0.326	0.963		None	SW846 3050B/6020
	Beryllium	0.489	0.0193	0.0963		None	SW846 3050B/6020
	Cadmium	0.198	0.0193	0.193		None	SW846 3050B/6020
	Chromium	4.89	0.193	0.578		None	SW846 3050B/6020
	Copper	5.39	0.0636	0.193		None	SW846 3050B/6020
	Iron	8,220	63.6	193		J	SW846 3050B/6020
	Lead	9.03	0.0963	0.385		None	SW846 3050B/6020
	Magnesium	3,880	1.93	5.78		None	SW846 3050B/6020
	Nickel	4.71	0.0963	0.385		None	SW846 3050B/6020
	Selenium	0.821	0.347	0.963	JN	J	SW846 3050B/6020
	Silver	0.0965	0.0965	0.483	U	None	SW846 3050B/6010B
	Thallium	0.137	0.135	0.385	J	None	SW846 3050B/6020
	Uranium	1.03	0.0127	0.0385		None	SW846 3050B/6020
	Zinc	26.6	0.771	1.93	B	None	SW846 3050B/6020
S-53	Aluminum	6,030	4.43	9.75		J	SW846 3050B/6020
	Antimony	0.573	0.317	0.962	JB	0.96UJ	SW846 3050B/6010B
	Arsenic	3.05	0.329	0.975		None	SW846 3050B/6020
	Beryllium	0.313	0.0195	0.0975		None	SW846 3050B/6020
	Cadmium	0.115	0.0195	0.195	J	None	SW846 3050B/6020
	Chromium	3.24	0.195	0.585		None	SW846 3050B/6020
	Copper	3.88	0.0643	0.195		None	SW846 3050B/6020
	Iron	5,830	6.43	19.5		J	SW846 3050B/6020

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Table B-8. Nonradiological results for various on-site soil sampling locations at SNL/TTR, 2017 (continued)

Location	Analyte	Result (mg/kg)	MDL (mg/kg)	PQL (mg/kg)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
S-53	Lead	5.6	0.0975	0.39		None	SW846 3050B/6020
	Magnesium	2,700	19.5	58.5		None	SW846 3050B/6020
	Nickel	2.72	0.0975	0.39		None	SW846 3050B/6020
	Selenium	0.67	0.351	0.975	JN	J	SW846 3050B/6020
	Silver	0.0962	0.0962	0.481	U	None	SW846 3050B/6010B
	Thallium	0.136	0.136	0.39	U	None	SW846 3050B/6020
	Uranium	0.659	0.0129	0.039		None	SW846 3050B/6020
	Zinc	16.4	0.78	1.95	B	None	SW846 3050B/6020

See notes at end of appendices.

Appendix C. 2017 SNL/TTR Wastewater Sampling Results

Johnson's fishhook cactus (*Echinomastus johnsonii*)

Table C-1. Sanitary outfalls of inorganic analyses, June 2017

Station	Date Collected	Sample Identifier	Analyte	Result (mg/L)	MDL (mg/L)	Laboratory Data Qualifiers	Analytical Method
TTR	21-Jun-2017	102684-001	Aluminum	0.128	0.0193		EPA 200.8
		102684-001	Arsenic	0.00644	0.002		EPA 200.8
		102684-001	Boron	0.705	0.052		EPA 200.8
		102684-001	Cadmium	0.000326	0.0003	J	EPA 200.8
		102684-001	Chromium		0.003	U	EPA 200.8
		102684-001	Copper	0.152	0.0003		EPA 200.8
		102684-001	Lead	0.00238	0.0005		EPA 200.8
		102684-001	Mercury		0.000067	U	EPA 245.1/245.2
		102684-001	Molybdenum	0.00833	0.0002		EPA 200.8
		102684-001	Nickel	0.00369	0.0006		EPA 200.8
		102684-001	Selenium		0.002	U	EPA 200.8
		102684-001	Silver	0.00217	0.0003		EPA 200.8
		102684-001	Zinc	0.191	0.0033		EPA 200.8
		102684-002	Cyanide, total	0.00648	0.00167		EPA 335.4
		102684-003	Solids, total suspended	128	11.4		SM 2540D
		102684-004	pH	8.21	0.01	H	SM 4500-H B
		102684-007	Phenol	0.0752	0.00333	N	SW846 9066
		102684-008	Grease and oil	17.2	1.2	N	EPA 1664A/1664B
		102684-009	Grease and oil		1.16	NU	EPA 1664A/1664B
		102684-013	Chemical Oxygen Demand	276	8.95		EPA 410.4

See notes at end of appendices.

Table C-2. Summary of sanitary outfalls of radiological analyses, June 2017

Station	Date Collected	Sample Identifier	Analyte	Activity (pCi/L)	MDA (pCi/L)	Laboratory Data Qualifiers	Analytical Method
TTR	21-Jun-2017	102684-010	Actinium-228	5.87 ± 12.3	12.5	U	EPA 901.1
		102684-010	Americium-241	-.387 ± 9.6	14.7	U	EPA 901.1
		102684-010	Beryllium-7	-.727 ± 15.3	26	U	EPA 901.1
		102684-010	Bismuth-212	-14.2 ± 26.5	44.9	U	EPA 901.1
		102684-010	Bismuth-214	5.37 ± 8.85	6.38	U	EPA 901.1
		102684-010	Cesium-137	.163 ± 1.77	3.23	U	EPA 901.1
		102684-010	Cobalt-60	-.965 ± 1.94	3.2	U	EPA 901.1
		102684-010	Lead-212	10.1 ± 7.17	5.36		EPA 901.1
		102684-010	Lead-214	.855 ± 8.94	6.57	U	EPA 901.1
		102684-010	Neptunium-237	-.983 ± 3.53	6.01	U	EPA 901.1
		102684-010	Potassium-40	50.3 ± 50.3	31.5	X	EPA 901.1
		102684-010	Radium-223	22.5 ± 36.7	62.3	U	EPA 901.1
		102684-010	Radium-224	29.7 ± 37.7	57	U	EPA 901.1
		102684-010	Radium-226	8.83 ± 82.6	75.1	U	EPA 901.1
		102684-010	Radium-228	5.87 ± 12.3	12.5	U	EPA 901.1
		102684-010	Sodium-22	-.123 ± 1.7	3.03	U	EPA 901.1
		102684-010	Thorium-227	-7.6 ± 13.7	22.6	U	EPA 901.1
		102684-010	Thorium-231	9.64 ± 23.7	38.6	U	EPA 901.1
		102684-010	Thorium-234	89 ± 156	120	U	EPA 901.1
		102684-010	Uranium-235	6.62 ± 20.9	17.9	U	EPA 901.1
		102684-010	Uranium-238	89 ± 156	120	U	EPA 901.1
		102684-011	Alpha, gross	1.28 ± 3.77	6.49	U	EPA 900.0/SW846 9310
		102684-011	Beta, gross	31.6 ± 5.85	3.17		EPA 900.0/SW846 9310
		102684-012	Tritium	-96.8 ± 128	231	U	EPA 906.0 Modified

See notes at end of appendices.

Table C-3. Summary of sanitary outfalls of semivolatile organic compounds, June 2017

Station	Date Collected	Sample Identifier	Analyte	Result (µg/L)	MDL (µg/L)	Laboratory Data Qualifiers	Analytical Method
TTR	21-Jun-2017	102684-006	Acenaphthene		0.3	*NU	EPA 625
		102684-006	Acenaphthylene		0.3	*NU	EPA 625
		102684-006	Anthracene		0.3	*NU	EPA 625
		102684-006	Benzidine		3.9	NU	EPA 625
		102684-006	Benzo(a)anthracene		0.3	*NU	EPA 625
		102684-006	Benzo(a)pyrene		0.3	*NU	EPA 625
		102684-006	Benzo(b)fluoranthene		0.3	*NU	EPA 625
		102684-006	Benzo(ghi)perylene		0.3	*NU	EPA 625
		102684-006	Benzo(k)fluoranthene		0.3	*NU	EPA 625
		102684-006	Bromophenyl phenyl ether, 4-		3	*NU	EPA 625
		102684-006	Butylbenzyl phthalate		3	*NU	EPA 625
		102684-006	Chloro-3-methylphenol, 4-		3	U	EPA 625
		102684-006	Chloroethoxy)methane, bis(2-		3	*NU	EPA 625
		102684-006	Chloroethyl)ether, bis(2-		3	*NU	EPA 625
		102684-006	Chloroisopropyl ether, bis-		3	*NU	EPA 625
		102684-006	Chloronaphthalene, 2-		0.41	*NU	EPA 625
		102684-006	Chlorophenol, 2-		3	NU	EPA 625
		102684-006	Chlorophenyl phenyl ether, 4-		3	*NU	EPA 625
		102684-006	Chrysene		0.3	*NU	EPA 625
		102684-006	Di-n-butyl phthalate		3	*NU	EPA 625
		102684-006	Di-n-octyl phthalate		3	*NU	EPA 625
		102684-006	Dibenz[a,h]anthracene		0.3	*NU	EPA 625
		102684-006	Dichlorobenzidine, 3,3'-		3	*NU	EPA 625
		102684-006	Dichlorophenol, 2,4-		3	*NU	EPA 625
		102684-006	Diethylphthalate		3	*NU	EPA 625
		102684-006	Dimethylphenol, 2,4-		3	U	EPA 625
		102684-006	Dimethylphthalate		3	*NU	EPA 625
		102684-006	Dinitro-o-cresol		3	*NU	EPA 625
		102684-006	Dinitrophenol, 2,4-		5	*NU	EPA 625

Table continued on next page.

Table C-3. Summary of sanitary outfalls of semivolatile organic compounds, June 2017 (continued)

Station	Date Collected	Sample Identifier	Analyte	Result (µg/L)	MDL (µg/L)	Laboratory Data Qualifiers	Analytical Method
TTR	21-Jun-2017	102684-006	Dinitrotoluene, 2,4-		3	*NU	EPA 625
		102684-006	Dinitrotoluene, 2,6-		3	*NU	EPA 625
		102684-006	Diphenyl amine		3	*NU	EPA 625
		102684-006	Diphenylhydrazine, 1,2-		3	*NU	EPA 625
		102684-006	Ethylhexyl)phthalate, bis(2-		3	*NU	EPA 625
		102684-006	Fluoranthene		0.3	*NU	EPA 625
		102684-006	Fluorene		0.3	*NU	EPA 625
		102684-006	Hexachlorobenzene		3	*NU	EPA 625
		102684-006	Hexachlorobutadiene		3	*NU	EPA 625
		102684-006	Hexachlorocyclopentadiene		3	*NU	EPA 625
		102684-006	Hexachloroethane		3	*NU	EPA 625
		102684-006	Indeno(1,2,3-c,d)pyrene		0.3	*NU	EPA 625
		102684-006	Isophorone		3.5	*NU	EPA 625
		102684-006	Naphthalene		0.3	*NU	EPA 625
		102684-006	Nitro-benzene		3	*NU	EPA 625
		102684-006	Nitrophenol, 2-		3	*NU	EPA 625
		102684-006	Nitrophenol, 4-		3	*U	EPA 625
		102684-006	Nitrosodimethylamine, n-		3	U	EPA 625
		102684-006	Nitrosodipropylamine, n-		3	*NU	EPA 625
		102684-006	Pentachlorophenol		3	*NU	EPA 625
		102684-006	Phenanthrene		0.3	*NU	EPA 625
		102684-006	Phenol		3	U	EPA 625
		102684-006	Pyrene		0.3	*NU	EPA 625
		102684-006	Trichlorobenzene, 1,2,4-		3	*NU	EPA 625
		102684-006	Trichlorophenol, 2,4,6-		3	*NU	EPA 625

See notes at end of appendices.

Table C-4. Summary of sanitary outfalls of volatile organic compounds, June 2017

Station	Date Collected	Sample Identifier	Analyte	Result (µg/L)	MDL (µg/L)	Laboratory Data Qualifiers	Analytical Method
TTR	21-Jun-2017	102684-005	Acrolein		1.67	U	EPA 624
		102684-005	Acrylonitrile		1.67	U	EPA 624
		102684-005	Benzene		0.333	U	EPA 624
		102684-005	Bromodichloromethane		0.333	U	EPA 624
		102684-005	Bromoform		0.333	U	EPA 624
		102684-005	Bromomethane		0.337	U	EPA 624
		102684-005	Carbon tetrachloride		0.333	U	EPA 624
		102684-005	Chlorobenzene		0.333	U	EPA 624
		102684-005	Chloroethane		0.333	U	EPA 624
		102684-005	Chloroethyl vinyl ether, 2-		1.67	NU	EPA 624
		102684-005	Chloroform		0.333	U	EPA 624
		102684-005	Chloromethane		0.333	U	EPA 624
		102684-005	Dibromochloromethane		0.333	U	EPA 624
		102684-005	Dichlorobenzene, 1,2-		0.333	U	EPA 624
		102684-005	Dichlorobenzene, 1,3-		0.333	U	EPA 624
		102684-005	Dichlorobenzene, 1,4-	1.66	0.333		EPA 624
		102684-005	Dichlorodifluoromethane		0.355	U	EPA 624
		102684-005	Dichloroethane, 1,1-		0.333	U	EPA 624
		102684-005	Dichloroethane, 1,2-		0.333	U	EPA 624
		102684-005	Dichloroethene, 1,1-		0.333	U	EPA 624
		102684-005	Dichloroethene, trans-1,2-		0.333	U	EPA 624
		102684-005	Dichloropropane, 1,2-		0.333	U	EPA 624
		102684-005	Dichloropropene, cis-1,3-		0.333	U	EPA 624
		102684-005	Dichloropropene, trans-1,3-		0.333	U	EPA 624
		102684-005	Ethyl benzene		0.333	U	EPA 624
		102684-005	Methylene chloride		1.67	U	EPA 624
		102684-005	Tetrachloroethane, 1,1,2,2-		0.333	U	EPA 624
		102684-005	Tetrachloroethene		0.333	U	EPA 624
		102684-005	Toluene		0.333	U	EPA 624

Table continued on next page.

Table C-4. Summary of sanitary outfalls of volatile organic compounds, June 2017 (continued)

Station	Date Collected	Sample Identifier	Analyte	Result (µg/L)	MDL (µg/L)	Laboratory Data Qualifiers	Analytical Method
TTR	21-Jun-2017	102684-005	Trichloroethane, 1,1,1-		0.333	U	EPA 624
		102684-005	Trichloroethane, 1,1,2-		0.333	U	EPA 624
		102684-005	Trichloroethene	0.6	0.333	J	EPA 624
		102684-005	Trichlorofluoromethane		0.333	U	EPA 624
		102684-005	Vinyl chloride		0.333	U	EPA 624

See notes at end of appendices.

Notes to Appendices

Units

µg/L = micrograms per liter
mg/kg = milligrams per kilogram
mg/L = milligrams per liter
mR = milliroentgen
pCi/g = picocuries per gram
pCi/L – picocuries per liter

Station

TTR = Tonopah Test Range

MDL or MDA

MDA = minimal detectable activity or minimum measured activity in a sample required to ensure a 95% probability that the measured activity is accurately quantified above the critical level
MDL = method detection limit

PQL

PQL = practical quantitation limit; the lowest concentration of analytes in a sample that can be determined reliably within specified limits of precision and accuracy by that indicated method under routine laboratory operating conditions

Results

N/A = not applicable

Laboratory Data Qualifier

B = analyte detected in the blank
H = analytical holding time was exceeded
J = estimated value, the analyte concentration fell above the effective MDL and below the effective PQL
N = Results associated with a spike analysis that was outside control limits
U = the analyte was analyzed for, but not detected; or organic and inorganic analytes the result is less than the effective MDL concentration
X = data rejected due to peak not meeting identification criteria
* = recovery or percent RPD not within acceptance limits and/or spike amount not compatible with the sample or the duplicate RPS's are not applicable where the concentrations falls below the effective PQL

Data Validation Qualifier

BD = below detection limit as used in radiochemistry to identify results that are not statistically different from zero
J = associated value is an estimated quantity
None = no data validation for corrected gross alpha activity
R = The data are unusable
U = The analyte was analyzed for but was not detected. The associated numerical value is the sample quantitation limit
UJ = The analyte was analyzed for but was not detected. The associated value is an estimate and may be inaccurate or imprecise

Exposure

NC = not collected

Analytical Method

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HASL = Health and Safety Laboratory

Glossary

Kaua'i, Hawai'i

A

aboveground storage tank A fixed, stationary, or otherwise permanently installed storage tank that is wholly or partially above the ground surface and used to contain oil of any kind (petroleum, non-petroleum, synthetic, animal and vegetable).

aeolian Relating to or arising from the action of the wind.

ambient air Any unconfined portion of the atmosphere: open air, surrounding air.

audit (1) An examination of records or financial accounts to check their accuracy. (2) An adjustment or correction of accounts. (3) An examined and verified account.

B

background radiation Relatively constant low-level radiation from environmental sources such as building materials, cosmic rays, and ingested radionuclides in the body.

biogeographic province A large region characterized as distinct from other regions, mostly on the basis of different dominant vegetation and wildlife habitat types.

D

dosimeter A device used to measure the dose of ionizing radiation received by an individual.

E

ecology The relationship of living things to one another and their environment, or the study of such relationships.

ecosystem A network of living organisms and nonliving components (e.g., air, water, mineral soil, buildings, and roads) that interact to comprise an overall environment.

environmental release Any spilling, leaking, pouring, emitting, emptying, discharging, injecting, pumping, escaping, leaching, dumping, or disposing into the environment, which may include (but is not limited to) soil, air, and drain systems.

ephemeral spring A spring that flows only briefly in the immediate locality in response to precipitation.

F

fault A fracture in the continuity of a rock formation caused by the earth's crust shifting or dislodging, after which adjacent surfaces are displaced relative to one another and parallel to the plane of fracture.

G

groundwater The water found beneath the earth's surface in pore spaces and in fractures of rock formations.

H

hazardous substance (1) Any material that poses a threat to human health and/or the environment. Typical hazardous substances are toxic, corrosive, ignitable, explosive, or chemically reactive. (2) Any substance the EPA requires to be reported if a designated quantity of the substance is spilled in the waters of the U.S. or is otherwise released into the environment.

I

Integrated Safety Management System (ISMS) A set of guidelines that systematically integrate safety into management and work practices at all levels so missions are accomplished while protecting the worker, the public, and the environment.

L

lagoon (1) A shallow pond where sunlight, bacterial action, and oxygen work to purify wastewater; also used for storing wastewater. (2) A shallow body of water, often separated from the sea by coral reefs or sandbars.

M

mixed waste Radioactive waste that contains both source material, special nuclear material, or by-product material subject to the Atomic Energy Act of 1954, as amended; also a hazardous component subject to RCRA, as amended.

N

nitrate A compound containing nitrogen that can exist in the atmosphere or as a dissolved gas in water and which can have harmful effects on humans and animals. Nitrates in water can cause severe illness in infants and domestic animals. A plant nutrient and inorganic fertilizer, nitrate is found in septic systems, animal feedlots, agricultural fertilizers, manure, industrial wastewaters, sanitary landfills, and garbage dumps.

Q

quality control A system used to determine analytical accuracy, precision, and contamination when samples are collected and to assess the data's quality and usability.

R

radioactive waste Any waste that emits energy as rays, waves, streams, or energetic particles. Radioactive materials are often mixed with hazardous waste from nuclear reactors, research institutions, or hospitals.

S

saltation The movement of hard particles such as sand over an uneven surface in a turbulent flow of air or water.

T

tritium A radioactive hydrogen isotope with an atomic mass of 3 and a half-life of 12.5 years, prepared artificially for use as a tracer and as a constituent of hydrogen bombs.

U

underground storage tank A storage tank installed completely below grade, covered with earth, and used to contain oil of any kind (petroleum, non-petroleum, synthetic, animal, or vegetable). Sandia USTs are double-wall, fiberglass-reinforced plastic construction.

W

wastewater The spent or used water from a home, community, farm, or industry that contains dissolved or suspended matter.

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Note: USC = United States Code.

State of Hawai'i Environmental Regulations

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Hawai'i Administrative Rules, Title 11, Chapter 281, "Underground Storage Tanks."

State of Nevada Environmental Regulations

Nevada regulatory information can be found at the Nevada State Legislature website: *http://www.leg.state.nv.us/*.

A listing of the Nevada Administration Code (NAC) can be found at *http://www.leg.state.nv.us/NAC*.

Sandia
National
Laboratories