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Site Environmental Report for 2021 Sandia National Laboratories, California

Prepared by
Sandia National Laboratories
Livermore, California 94550

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ABSTRACT

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Site Environmental Report for 2021 Sandia National Laboratories, California

Environmental Management Department
Sandia National Laboratories, California
7011 East Avenue
Livermore, CA 94550

Abstract

Sandia National Laboratories, California (SNL/CA) is a U.S. Department of Energy (DOE) facility. The management and operations of the facility are under a contract with the DOE National Nuclear Security Administration (NNSA). On May 1, 2017, the name of the management and operating contractor changed from Sandia Corporation to National Technology & Engineering Solutions of Sandia, LLC (NTESS). The DOE, NNSA, Sandia Field Office administers the contract and oversees contractor operations at the site.

DOE and its management and operating contractor for Sandia National Laboratories (SNL) 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 Site Environmental Report for 2021 was prepared in accordance with DOE Order 231.1B, *Environment, Safety and Health Reporting* (DOE 2012). The report provides a summary of environmental monitoring information and compliance activities that occurred at SNL/CA during calendar year 2021 unless noted otherwise. General site and environmental program information is also included.

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Amy Blumberg
Mark Brynildson
Deanna Dicker
Leslee Gardizi
Pradnya Jadhav
Angelina Hansen
Janet Harris
Carlos Ledesma
Anetha Lue
Trevor Manger
Jeffrey Petraglia
Christina Robinson
Duc Tran

Additional information about this report can be obtained from:

Sandia National Laboratories, California
Public and Media Relations Office
P.O. Box 969
Livermore, CA 94551-0969
Attention: Paul Rhien
Phone: (925) 294-6452
E-mail: prhien@sandia.gov

Or

U.S. Department of Energy
National Nuclear Security Administration
Sandia Field Office
P.O. Box 5400
Albuquerque, NM 87185-5400
Attention: Jeffrey Petraglia
Phone: (505) 284-7668
E-mail: jeffrey.petraglia@nnsa.doe.gov

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PREFACE

Each year, Sandia National Laboratories, California (SNL/CA) staff prepare a report to provide environmental information to the local community, under Department of Energy Order 231.1B, *Environment, Safety and Health Reporting* (DOE 2012). The Site Environmental Report for 2021 summarizes compliance with environmental requirements, presents the results of monitoring and surveillance activities, and provides an update of site environmental program activities for SNL/CA.

The Site Environmental Report for 2021 was prepared for ease in readability. Each chapter focuses on a specific topic or area. Reference to other sections and chapters is made throughout the report to avoid redundancy. Detailed data is provided only when necessary to improve the presentation of information and the quality of the document.

ACRONYMS AND DEFINITIONS

Abbreviation	Definition
ACOE	U.S. Army Corp of Engineers
ALARA	as low as reasonably achievable
ASIP	Arroyo Seco Improvement Program
BAAQMD	Bay Area Air Quality Management District
BMP	best management practice
BOD	biochemical oxygen demand
BTU	British Thermal Unit
CARB	California Air Resources Board Code of Regulations
CCR	California Code of Regulations
CEARP	Comprehensive Environmental Assessment and Response Program
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERS	California Environmental Reporting System
CFR	Code of Federal Regulations
CGP	construction general permit
COD	chemical oxygen demand
CUPA	Certified Unified Programs Agencies
CY	calendar year
DOE	Department of Energy
DTSC	Department of Toxic Substances Control (California)
EISA	Energy Independence and Security Act
EMS	environmental management system
EO	Executive Order
EPA	Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act
ERA	Exceedance Response Action
ESA	Endangered Species Act
ES&H	environment, safety, and health
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FONSI	Finding of No Significant Impact

Abbreviation	Definition
FY	fiscal year
GHG	greenhouse gas
GSF	Gross Square Feet
IGP	Industrial General Permit
ISO	International Organization for Standardization
LAMP	Limited Area Multi-Purpose
LBNL	Lawrence Berkeley National Laboratory
LECS	liquid effluent containment system
LLNL	Lawrence Livermore National Laboratory
MCLs	maximum contaminant levels
M&O Contract	Management and Operating Contract
NA	not applicable
NALs	Numeric Action Levels
ND	non-detectable
NEPA	National Environmental Policy Act
NESHAPs	National Emission Standards for Hazardous Air Pollutants
NFPA	National Fire Protection Association
NNSA	National Nuclear Security Administration
NNSA/SFO	National Nuclear Security Administration, Sandia Field Office
NNSS	Nevada National Security Site
NOV	notice of violation
NPDES	national pollutant discharge elimination system
NTESS	National Technology & Engineering Solutions of Sandia, LLC
PCB	polychlorinated biphenyl
PFAS	per- and polyfluoroalkyl substances
POTW	publicly owned treatment works
PPE	personal protective equipment
QSE	qualifying storm event
RCRA	Resource Conservation and Recovery Act
RPDP	Radiation Protection Dosimetry Program

Abbreviation	Definition
RWQCB	Regional Water Quality Control Board (California)
SA	supplement analysis
SF6	Sulfur Hexafluoride
SFPUC	San Francisco Public Utilities Commission
SHPO	State Historic Preservation Officer
SLAC	Stanford Linear Accelerator Center
SNL	Sandia National Laboratories
SNL/CA	Sandia National Laboratories, California
SNL/NM	Sandia National Laboratories, New Mexico
SOP	standard operating procedure
SPCC	Spill Prevention Control and Countermeasure
SSOs	Sanitary Sewer Overflows
SSP	Site Sustainability Plan
SWEA	site-wide environmental assessment
SWMU	Solid Waste Management Unit
SWPPP	Stormwater Pollution Prevention Plan
TDS	total dissolved solids
TSCA	Toxic Substances Control Act
TSS	total suspended solids
U.S.	United States
USC	United States Code
USFWS	United States Fish and Wildlife Service
Zone 7	Alameda County Flood Control and Water Conservation District

UNITS OF MEASURE

Unit	Definition
cu ft	cubic foot
cu yd	cubic yard
ft	foot
gal	gallon
kg	kilogram
lb	pound
µg/L	micrograms per liter
mg/L	milligrams pe liter
mL	milliliter
mrem	millirem
mrem/year	millirem per year
mSv	millisievert
MW hr	megawatt hour
sf	square foot
yr	year

CHAPTER 1. EXECUTIVE SUMMARY

1.1. Overview

Sandia National Laboratories (SNL) is one of three national laboratories supporting the United States Department of Energy (DOE) National Nuclear Security Administration (NNSA) statutory responsibilities for nuclear weapons research and development. SNL is the most diverse of the three laboratories and includes other missions for development of energy technologies and basic scientific research. SNL facilities are located in New Mexico, California, Nevada, and Hawaii. Sandia National Laboratories, California (SNL/CA) is a multi-program engineering and science laboratory supporting the nuclear weapons stockpile program, energy and environment research, homeland security, micro- and nanotechnologies, and basic science and engineering research.

This Site Environmental Report summarizes the environmental programs and compliance efforts at SNL/CA for calendar year (CY) 2021. It also discusses integration of environmental programs with the broader corporate environmental management system (EMS) and site contributions to corporate sustainability goals.

1.2. Environmental Programs

At SNL/CA, environmental monitoring, surveillance, and compliance are supported by a site-specific Environmental Management Department. The department has seven focused programs: Air Quality, Environmental Monitoring and Ecology, Environmental Planning, Chemical Management, Radiation Protection, Pollution Prevention and Waste Minimization, and Waste Management. Environmental personnel apply their expertise with federal, state, and local environmental requirements, including DOE directives in support of all site operations and activities.

The EMS, SNL/CA's primary corporate management approach to achieving environmental improvement and minimizing impact, is also implemented through the site's environmental programs. The SNL/CA site is certified to the International Organization for Standardization (ISO) 14001:2015 standard (ISO 2015) under the corporate multi-site certification.

1.3. Environmental Performance

SNL/CA personnel measure environmental performance as progress towards achieving site environmental objectives, meeting, or exceeding compliance, and contributing to corporate goals and contract performance objectives. During 2021, SNL/CA participated, through the Corporate EMS, to address impacts from several different significant aspects for Sandia operations (see Section 4.1 for a full list). No non-conformances were identified during the ISO 14001:2015 recertification audit. SNL/CA received one minor finding in 2021 for environmental performance, which is detailed in Section 3.14. Chapter 4 presents additional information about environmental performance at SNL/CA.

1.4. Monitoring and Surveillance

Personnel at SNL/CA monitor stormwater, wastewater, groundwater, and gamma radiation. The results of monitoring during the 2020/2021 wet season show that SNL/CA had an exceedance for the Numeric Action Levels (NALs) in the Industrial General Permit for stormwater for aluminum. During 2021, there was no permit exceedance of the wastewater discharge limit at the site sewer outfall. Monitoring results for groundwater at the closed Navy Landfill and Fuel Oil Spill site were

similar to previous years' results. The average annual gamma radiation dose from all sources at the site perimeter in 2021 was 47 mrem (0.47 mSv), well below the allowable annual exposure dose to the public of 100 mrem established by DOE. Chapter 5 provides additional information about the monitoring and surveillance at SNL/CA.

In addition, during the CY 2021 SNL/CA performed active monitoring of a pair of Swainson's hawk nesting near an active SNL/CA construction site. The nest was monitored, and construction activities were halted as needed. The monitoring was effective, and the hawks utilized their nest until the young fledged. Chapter 2 provides additional information.

CHAPTER 2. INTRODUCTION

2.1. History and Mission

Sandia National Laboratories, California (SNL/CA) was established in 1956 to provide a closer relationship with Lawrence Livermore National Laboratory (LLNL) and their nuclear weapons design work. The SNL/CA facility evolved into an engineering research and development laboratory by the early 1960s and into a multi-program engineering and science laboratory during the 1970s. As international arms control efforts increased in the late 1970s and throughout the 1980s, the United States emphasized treaty monitoring, safety, security, and control of the national nuclear weapons stockpile. With the end of the Cold War in the late 1980s, SNL/CA's role in supporting stockpile stewardship, ensuring nonproliferation and continued safety, security, and reliability, took on greater importance.

SNL/CA personnel have provided distinguished service to the nation for over 60 years through engineering support and systems integration for nuclear weapons and related national security research and development efforts. Our programs support four key areas – the national nuclear deterrence policy and stockpile security, nonproliferation and materials control, energy and critical infrastructure, and emerging threats. SNL/CA personnel are committed to collaborative research and development with industry and universities, resulting in new and enhanced technologies that have both commercial and national security benefits.

Research Activities at SNL/CA

- Science-based performance and reliability testing and computer-based modeling of nuclear weapon components
- Development, design, and testing of nonnuclear components for nuclear weapon systems
- Development and testing of materials and diagnostic equipment in support of defense programs, homeland security, and basic science and engineering
- Energy and environmental research
- Research and development of microelectronics, microsystems, and nanotechnologies

SNL/CA is a Department of Energy (DOE) facility. The government owns the site, the buildings, and the equipment while management and operations are under a contract with the DOE National Nuclear Security Administration (NNSA). On May 1, 2017, the name of the management and operating contractor changed from Sandia Corporation to National Technology & Engineering Solutions of Sandia, LLC (NTESS). The NNSA/Sandia Field Office (NNSA/SFO) administers the contract and oversees the operations at the site.

2.2. Location

SNL/CA is located approximately 40 miles east of San Francisco, within the City of Livermore in eastern Alameda County. The site lies at the western base of the Altamont Hills on relatively flat terrain with low relief sloping gently northwest and north. Figure 2-1 shows the regional location of the site.

SNL/CA is comprised of 410 acres. The main campus (134 acres) is surrounded by the remaining undeveloped land (276 acres) on the east, south, and west as shown on Figure 2-2. To the north of SNL/CA are East Avenue and LLNL. Land use to the east and south of the site is agricultural and low-density residential. A residential development is located along the western boundary of the site.

Figure 2-1 Regional Location Map

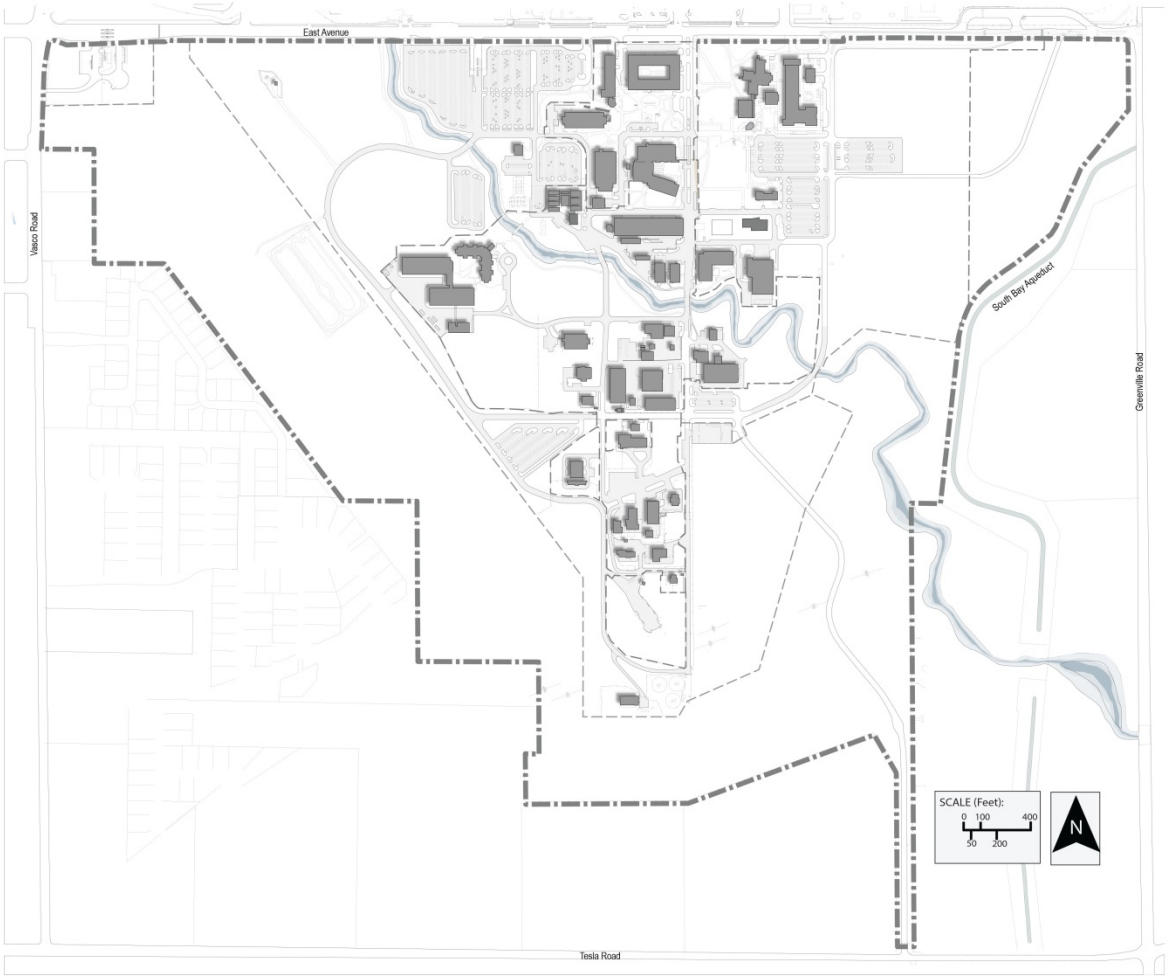


Figure 2-2 SNL/CA Site Map

2.3. Site Population

The SNL/CA workforce is comprised of employees (full and part-time staff, student interns, and post-doctoral appointees) and contracted staff. As of October 2021, there were 1,416 personnel (employees and on-site contractors) working at SNL/CA, a decrease of 163 from 2020.

2.4. Environmental Setting

The following summarizes the environmental setting at SNL/CA. Additional information can be found in the *Final Site-wide Environmental Assessment of the Sandia National Laboratories/California* (DOE 2003a).

2.4.1. Geology and Soils

SNL/CA is located in the California Coast Ranges geologic province in the southeastern portion of the Livermore Valley. The valley forms an irregularly shaped lowland area about 16 miles long, east to west, and 7 to 10 miles wide, north to south. The land at SNL/CA slopes gently to the northwest and north, with steep terrain in the southern portion of the site and along the banks of Arroyo Seco. The site ranges in elevation from 615 feet above mean sea level at the northwest corner of the property to 849 feet at the southern end. Site topography is depicted on Figure 2-3.

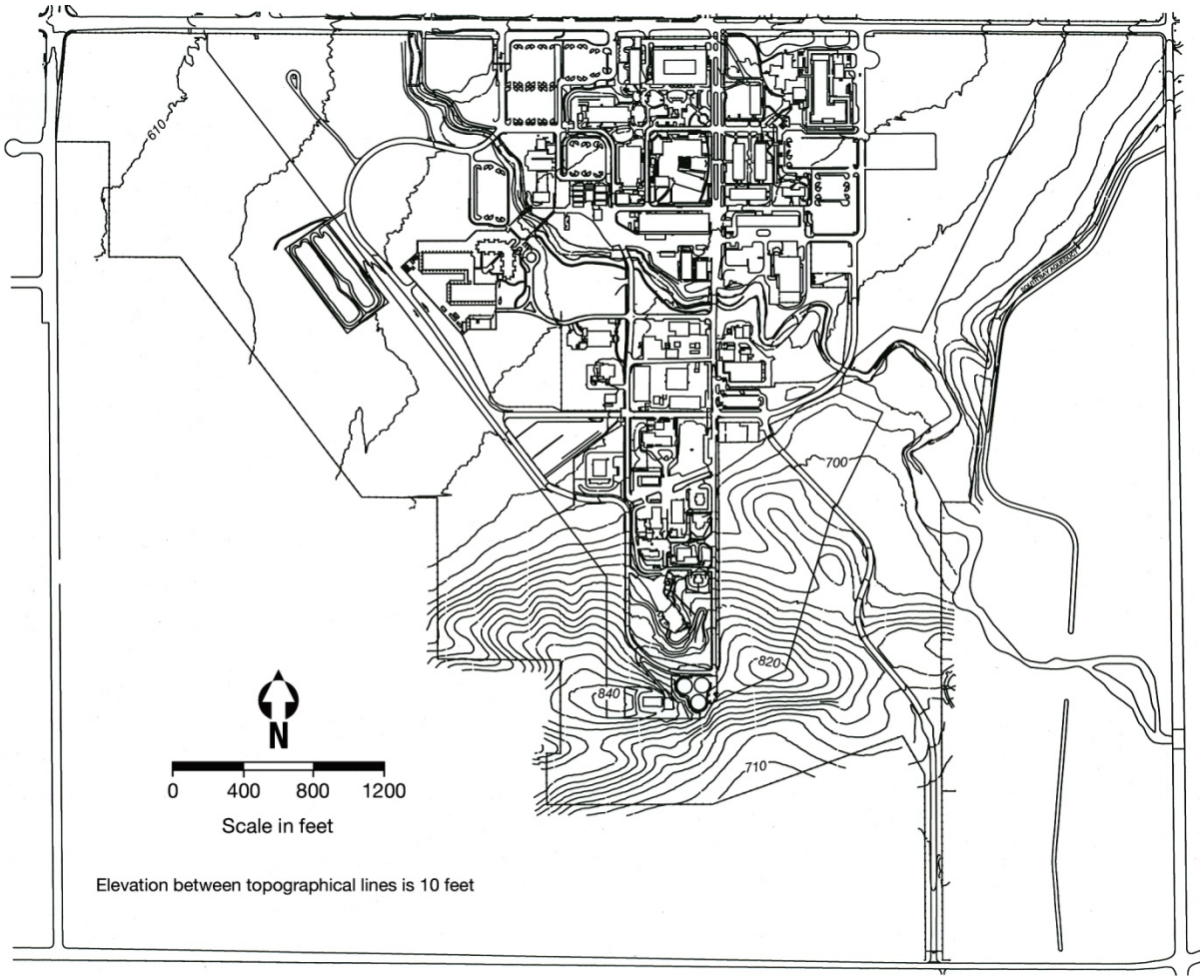


Figure 2-3 SNL/CA Topography

SNL/CA is located in a seismically active region. The major fault systems in the area are the San Andreas fault system and the much older Coast Range thrust fault system. The upper plate of the Coast Range thrust formed the northwest trending Coast Range, including the Altamont Hills. Any seismic activity in the Livermore Valley would probably result from movement on the San Andreas fault, a right-lateral strike-slip fault system trending northwest-southeast, extending from Point Arena to the Gulf of California. The regional faults closest to SNL/CA, the Hayward, Calaveras, Greenville, and Tesla faults follow this trend and have been seismically active in the historic past. A magnitude 5.8 earthquake on the Greenville fault in 1980 caused minor damage at SNL/CA and in the Livermore Valley. The Las Positas fault crossing SNL/CA is a transverse fault, at right angles to the Greenville fault, and was active during this earthquake. The Verona fault is a low-angle thrust fault, dissimilar to the regional faulting, and probably not connecting with either the Calaveras or Las Positas faults. The last significant microseismicity in the vicinity was recorded on the Verona fault in 1980. These faults are shown on Figure 2-4.

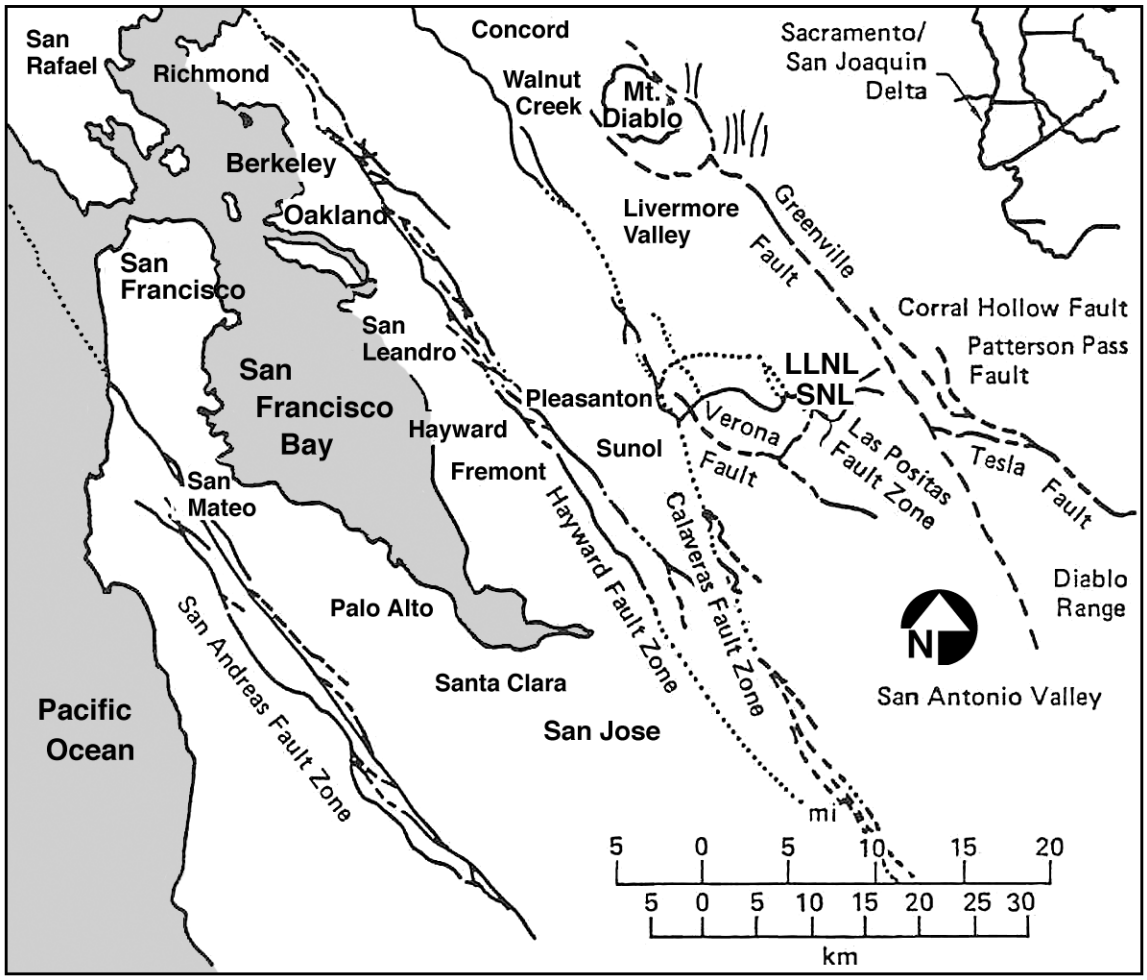


Figure 2-4 Regional Earthquake Faults

Surface soils and arroyo sediments cover the SNL/CA site. Soils at the site are formed primarily upon sediments deposited by local streams. Three soils cover most of SNL/CA: Rincon clay loam, Positas gravelly loam, and Livermore gravelly loam (SNL/CA 2002). There are no known mineral resources or fossil occurrences at the site.

2.4.2. Hydrology and Water Resources

There are no perennial streams or natural surface water bodies at SNL/CA. The Arroyo Seco, an intermittent stream, diagonally traverses the site from southeast to northwest. The arroyo typically flows only in very wet years, and for short periods of time during heavy storms. A seasonal wetland that is wet well into June, and sometimes July, is located in the streambed along the eastern part of the arroyo. Stormwater runoff at SNL/CA is conveyed to the Arroyo Seco through a system of storm drains and channels, that further discharges the stormwater runoff into the Alameda Creek and eventually to the San Francisco Bay. The Arroyo Seco and seasonal wetland are shown on Figure 2-5.

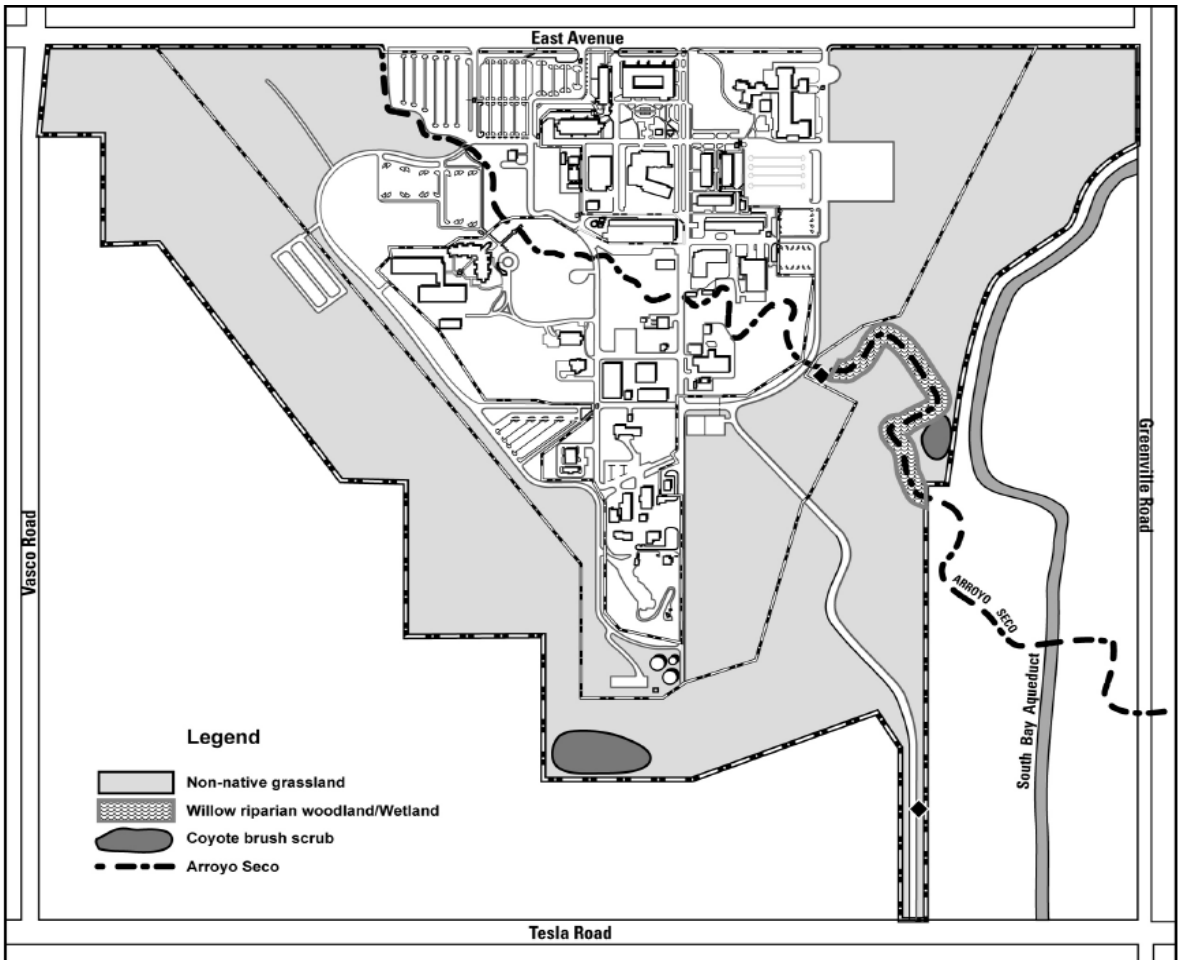


Figure 2-5 Habitat at SNL/CA

Groundwater at SNL/CA occurs within saturated unconsolidated geologic material. Depth to groundwater varies from less than 20 feet on the eastern portion of the site to 126 feet on the west side of the site. Water bearing-units beneath the site are composed of shallow heterogeneous, unconsolidated alluvium and deep fluvial and lacustrine sediments. Groundwater near SNL/CA is generally suitable for use as domestic, municipal, agricultural, and industrial supply. However, some shallower groundwater may be of marginal quality and not suitable for industrial or agricultural purposes. Groundwater less than 300 feet deep is usually unsuitable for domestic use without treatment (LLNL 1990). SNL/CA does not have any active groundwater recharge onsite.

Potable water used at SNL/CA is purchased from LLNL, which is supplied by the San Francisco Public Utilities Commission (SFPUC) but can be supplemented by the Alameda County Flood Control and Water Conservation District (known as Zone 7) as a backup source.

2.4.3. Climate and Meteorology

The climate at SNL/CA is typical of the Mediterranean conditions in the San Francisco Bay region where cool, wet winters and hot, dry summers are normal. In the summer, inland valleys, such as the Livermore Valley, generally experience more sunshine and higher temperatures than the coastal areas. In the winter, temperatures in the valley are usually cooler than at the coast.

Annual meteorological data for 2021 was obtained from a nearby meteorological tower located at LLNL (LLNL 2022). The total precipitation for 2021 was 11.64 inches. Temperatures in 2021 ranged from 26.0 to 111.1° Fahrenheit. Average annual rainfall in the Livermore area over the last five years was 12.88 inches. The windiest months in the area occur in the spring and summer and are dominated by westerly sea breezes. The winds during the fall and winter are typically lighter and more varied in direction.

2.4.4. Ecology

2.4.4.1. Plant Species

The plant community at SNL/CA is typical of the surrounding region, consisting primarily of grassland. Localized areas of coyote brush scrub, willow riparian woodland, and wetland habitat are also present. Areas developed and disturbed by SNL operations constitute an additional habitat type, designated altered habitat. Figure 2-5 depicts the habitat types. No threatened, endangered, proposed, or candidate plant species are present on-site.

2.4.4.2. Wildlife Species

A variety of wildlife species live and forage at SNL/CA. Table 2-1 provides a list of animals seen on site. State and federally protected animals are not included in this list; but discussed separately below.

SNL/CA provides habitat (or potential habitat) for one threatened avian species, the Swainson's hawk, *Buteo swainsoni* is a special status species for the state of California, In April 2021, a pair of Swainson's hawks were confirmed to be nesting near an active SNL/CA construction site. A SNL/CA contracted biologist monitored the nest daily for the duration of the construction activities. Construction activities were halted as needed to allow the hawks to return to an undisturbed state. After the chick had fledged and the nest was determined to be inactive, monitoring of the nest ceased.

SNL/CA provides habitat (or potential habitat) for two threatened wildlife species, the California red-legged frog *(Rana aurora draytonii)* and the California tiger salamander *(Ambystoma californiense).* under the federal and the state law. The red-legged frog is listed as Threatened under the Federal Endangered Species Act (ESA) and a Species of Special Concern under the State of California ESA. The tiger salamander (Central California Distinct Population Segment) is listed as Threatened under the Federal ESA and listed as Threatened under the State ESA. The most recent confirmed observation of a tiger salamander at SNL/CA was on December 13, 2007, when an adult salamander was found within the developed area of the site. The first confirmed observation of California red-legged frogs at SNL/CA occurred in April 2004 when a group of these frogs were found on the eastern portion of the site in shallow water contained within Arroyo Seco. The most recent observation of red-legged frogs at SNL/CA was in 2010. SNL/CA contracted biologists monitor for the California red-legged frog and the California tiger salamander on-site annually, none were observed in 2021.

SNL/CA is located within the range of the mountain lion (*Puma concolor*), a "specially protected mammal" under California law. There were no reports of a mountain lion at SNL/CA in 2021

.

Table 2-1 Animals Seen at SNL/CA

BIRDS			
American crow	*Corvus brachyrhynchos*	Northern mockingbird	*Mimus polyglottos*
American kestrel	*Falco sparverius*	Nuttall's woodpecker	*Picoides nuttallii*
American robin	*Turdus migratorius*	Red-tailed hawk	*Buteo jamaicensis*
Anna's hummingbird	*Calypte anna*	Turkey vulture	*Cathartes aura*
Barn owl	*Tyto alba*	Western kingbird	*Tyrannus verticalis*
Bushtit	*Psaltriparus minimus*	Western meadowlark	*Sturnella neglecta*
California towhee	*Pipilo crissalis*	Western scrub jay	*Aphelocoma californica*
Golden-crowned sparrow	*Zonotrichia atricapilla*	White-crowned sparrow	*Zonotrichia leucophrys*
Killdeer	*Charadrius vociferous*	White-tailed kite	*Elanus leucurus*
Northern flicker	*Colaptes auratus*	Yellow-rumped warbler	*Dendroica coronata*
MAMMALS			
Bobcat	*Lynx rufus*	Fox squirrel	*Sciurus niger*
California ground squirrel	*Spermophylus beecheyii*	Raccoon	*Procyon lotor*
Coyote	*Canis latrans*	Red fox	*Vulpes vulpes*
Desert cottontail	*Sylvilagus audubonii*	Striped skunk	*Mephitis mephitis*
REPTILES AND AMPHIBIANS			
Pacific chorus frog	*Pseudacris regilla*	Western fence lizard	*Sceloporus occidentalis*
Pacific gopher snake	*Pituophis catenifer catenifer*	Western toad	*Bufo boreas*

CHAPTER 3. COMPLIANCE SUMMARY

Sandia National Laboratories, California (SNL/CA) is managed and operated in compliance with the letter and spirit of applicable federal, state, and local environmental laws and regulations. Additionally, as a Department of Energy (DOE) facility, site activities are subject to DOE directives (i.e., Orders, Manuals, Policies, and Notices) and implemented to meet or exceed goals and requirements delineated in applicable presidential executive orders. This chapter summarizes SNL/CA's compliance status with major environmental requirements for calendar year (CY) 2021, unless noted otherwise.

3.1. Environmental Management System and Sustainability

DOE Order 436.1, *Departmental Sustainability* (DOE 2011), was established in 2011 to ensure that an environmental management system (EMS) and site sustainability program are at the forefront of environmental excellence at DOE facilities. DOE Order 436.1 is a requirement of the National Technology & Engineering Solutions of Sandia, LLC (NTESS) Management and Operating Contract (M&O Contract). It requires compliance with the Emergency Planning and Community Right-to-Know Act (EPCRA), establishment and implementation of a site sustainability plan (SSP), and an EMS that is certified to/or conforms with the ISO 14001:2015 standard (ISO 2015).

Sandia (SNL) management employs environmental stewardship as a core operating principle. A robust EMS was established in 2005 as part of this commitment. The EMS ensures a systematic approach to identifying environmental aspects, setting environmental objectives, and monitoring environmental performance. Designated to meet the requirements of the globally recognized ISO 14001:2015 standard, the EMS is ISO 14001:2015 certified. The EMS was recertified in August 2021, and no nonconformances were identified during the recertification audit (see Section 4.3 for additional information). The EMS is Sandia's primary platform for implementing the environmental management programs that help achieve annual site sustainability goals.

The first corporate-wide SSP that addressed energy, water, fuels, and a variety of other environmental concerns for all SNL sites was developed in 2011. The corporate SSP is updated annually and addresses the following DOE reporting requirements:

- DOE's Annual Energy Report, as required by the National Energy Conservation Policy Act (42 USC § 8201 et. seq.), the Energy Policy Act of 2005 (42 USC § 15801), and the Energy Independence and Security Act (EISA) of 2007 (42 USC § 17001);
- Section 432 of EISA 2007 (42 USC § 17001), which requires reporting of energy and water conservation measures that are identified as a result of site audits; and
- Commitments in the DOE Strategic Sustainability Performance Plan (DOE 2016).

In 2021, site personnel provided input to the reports identified above and participated in development of the corporate SSP for fiscal year (FY) 2022.

Section 3.6.1 presents information on compliance with requirements of EPCRA and Chapter 4 presents SNL/CA's environmental performance supporting site and corporate objectives and targets, which result from the EMS.

3.2. National Environmental Policy Act

The National Environmental Policy Act (NEPA) (42 USC § 4321 et. seq.) is the basic national charter for protection of the environment. It requires all federal agencies to evaluate the effects of major federal actions on the human environment, including the physical, socioeconomic, and cultural environments. NEPA review of DOE actions is conducted in accordance with the NEPA Implementing Procedures (10 CFR 1021). The DOE National Nuclear Security Administration/Sandia Field Office (NNSA/SFO) performed a site-wide environmental assessment (SWEA) for continued operations at SNL/CA (DOE 2003a) in 2003 and a Finding of No Significant Impact (FONSI) was issued on March 20, 2003 (DOE 2003b). The SWEA provides an evaluation of the impacts of site operations, and the FONSI concludes that continuation of site operations is not a major federal action significantly affecting the quality of the human environment.

In 2012, NNSA/SFO completed a review of SNL/CA's SWEA through a supplemental analysis. The results of the analysis found that continuing operations at SNL/CA do not constitute substantial changes to the SWEA, FONSI, or result in significant new circumstances or information relevant to environmental concerns.

SNL/CA personnel support compliance with NEPA by reviewing all new projects and programs, or changes to existing projects and programs, to ensure that they fit within the bounds of existing NEPA documentation. When required, a NEPA review of proposed activities is performed by preparation of a NEPA checklist. Once completed, the NEPA checklist is forwarded to DOE for additional review and determination as to whether the proposed project meets a categorical exclusion or requires development of an environmental assessment or environmental impact statement. During CY 2021, 109 SNL/CA projects underwent NEPA review by completion of NEPA checklists. None of these projects required the preparation of an environmental assessment or an environmental impact statement.

3.3. Air Quality

3.3.1. Clean Air Act

The Clean Air Act (42 USC § 7401) is the federal statute that forms the basis for national air pollution control efforts. It authorizes the Environmental Protection Agency (EPA) to promulgate air quality regulations and establishes national ambient air quality standards for criteria pollutants. Authority to implement the requirements of the Clean Air Act is provided to each state that has an EPA-approved State Implementation Plan. The State Implementation Plan for California describes how National Ambient Air Quality Standards will be attained in each air district. Each district establishes and enforces air pollution regulations to attain and maintain state and federal ambient air quality standards. The Bay Area Air Quality Management District (BAAQMD) is the regulating authority for controlling air pollution from stationary sources at SNL/CA. The California Air Resources Board (CARB) is responsible for ensuring that federal and state standards are met for mobile and small "area" sources of air pollution.

There are no major sources of air pollutants (as defined in 40 CFR Part 70.2) present at SNL/CA. SNL/CA personnel work with the BAAQMD and CARB to permit or register all regulated emission sources. There were eight permitted sources and nine registered sources (boilers) for the 2020/2021

and 2021/2022 permitting periods[1]. Table 3-5 (Section 3.15) provides a list of the permitted and registered sources.

3.3.2. Radionuclide Emissions

The *National Emissions Standards for Hazardous Air Pollutants, Subpart H – National Emission Standards for Emissions of Radionuclides Other Than Radon from Department of Energy Facilities (NESHAPs)* (40 CFR Part 61) establishes radiation protection standards, monitoring requirements, and annual reporting of radionuclide air emissions. Additional requirements pertaining to radionuclide emissions are contained in DOE Order 458.1 *Radiation Protection of the Public and the Environment* (DOE 2013a).

There are no radionuclide emission sources at SNL/CA that are subject to the monitoring requirements of 40 CFR Part 61. To comply with national emission standards, individual projects with the potential to release radionuclide emissions are evaluated to determine the worst-case dose to the public. Additionally, dose calculations are compared to the requirements to determine the need for annual monitoring. During 2021, there were no projects using radionuclides above the Annual Possession Quantity; consequently, no NESHAPs evaluations were completed.

3.4. Natural and Cultural Resources

3.4.1. Endangered Species Act

The Endangered Species Act (16 USC § 1531 et. seq.) provides for protection of plant and wildlife species in danger of becoming extinct. In 2002, NNSA/SFO and SNL/CA personnel initiated consultation with the United States (U.S.) Fish and Wildlife Service (USFWS) under Section 7 of the Endangered Species Act for maximum operations of the SNL/CA site. On December 8, 2004, the USFWS issued a biological and conference opinion for continued operations at SNL/CA. The biological opinion concludes that proposed site operations are not likely to jeopardize the continued existence of the California red-legged frog (*Rana aurora draytonii*) and the California tiger salamander (*Ambystoma californiense)*, the two threatened species present on site. The conference opinion concludes that site operations are not likely to destroy or adversely modify proposed critical habitat for the red-legged frog[2].

3.4.2. Interim Protections for California Red-legged Frogs

In October 2006, interim restrictions on pesticide use went into effect to protect the California red-legged frog. The restrictions are the result of a settlement agreement between the EPA and the Center for Biological Diversity outlined in a Stipulated Injunction and Order (US District Court 2006). The agreement requires the EPA to consult with the USFWS under the Endangered Species Act (16 USC § 1531 et. seq.) on the impacts of 66 pesticide ingredients to the California red-legged frog, and it restricts the use of these pesticides in the California red-legged frog aquatic and upland

[1] The BAAQMD permit period is July 1 through June 30 each year. Permit data is presented for the two periods applicable to 2021.

[2] In 2002, when the consultation process began, the Sandia site was within designated critical habitat for the California red-legged frog. In November 2002, the designation was overturned (U.S. District Court 2002), and in April 2004, the USFWS re-issued proposed critical habitat that included the Sandia site (USFWS 2004). However, in November 2005, the USFWS issued a revised designation (USFWS 2005), and a final rule in April 2006 (USFWS 2006). The scientific integrity of the 2006 rule was questioned resulting in another revision to critical habitat. The USFWS issued a new designation in March 2010. The Sandia site is not included in the final determination of critical habitat for the California red-legged frog.

habitat. In response to these interim protections, a review prior to use is conducted of all new pesticides to determine if they are suitable for use at SNL/CA. Any products containing the named pesticide ingredients are restricted from use in and along the Arroyo Seco. In 2021, there were no new pesticides reviewed or approved for use at SNL/CA.

3.4.3. Migratory Bird Treaty Act

The Migratory Bird Treaty Act (16 USC § 703 et. seq.) provides for protection of migratory birds, their nests, and eggs. Most of the bird species observed at SNL/CA are protected under this act. Migratory birds often build nests within the developed campus in locations where they could be disturbed by maintenance activities. To avoid harming birds, nests, or eggs, SNL/CA activities are delayed until the young have fledged, or surveys determine that the nest is abandoned. In 2021, there was no intentional take of migratory birds or disturbance to nests or eggs at the site. Surveys for nesting birds were completed for all projects that had the potential to disturb trees and shrubs. One active nest was identified in 2021 (see Section 2.4.4.2).

3.4.4. Protection of Wetlands

Executive Order 11990, *Protection of Wetlands* (EO 11990), requires federal agencies to minimize the destruction, loss, or degradation of wetlands and preserve and enhance the natural and beneficial values of wetlands. A small wetland area of 0.44 acres is present at SNL/CA. During 2021, wildlife and riparian monitoring activities were conducted in the wetland area in accordance with a permit issued by the U.S. Army Corp of Engineers (see Section 3.4.5).

3.4.5. Floodplain Management

Executive Order 11988, *Floodplain Management*, requires federal agencies to consider impacts associated with the occupancy and modification of floodplains, to reduce the risk of flood loss, to minimize the impact of floods on human safety, health, and welfare, and to restore and preserve the natural and beneficial values served by floodplains. In 2002, a management plan for the Arroyo Seco was completed to identify channel improvements and stream zone management activities that will reduce flood and erosion risk and provide improved habitat for wildlife species that may use the arroyo (Matthews 2002). The plan identifies areas for constructing functional floodplains and for planting of native riparian vegetation. During 2006 and 2007, five improvement tasks were completed under a two-year permit issued by the U.S. Army Corp of Engineers. A new permit request was submitted in 2006 for the remaining improvement actions. In September 2008, a new ten-year permit for SNL/CA was issued by the U.S. Army Corps of Engineers to continue the Arroyo Seco Improvement Program (ASIP). In 2015, the last remaining improvement project was completed under the ten-year permit. Restored areas are monitored annually to determine progress in meeting survival and growth criteria established in the permit. Restored areas are also monitored to ensure channel improvements are functioning as intended and repaired. When needed, shrubs and trees are replanted, or grasses reseeded, and channel improvements are repaired. In 2017, approximately 100 trees were replanted at ASIP Area 17, but did not survive due to inadequate irrigation. There were no projects undertaken in 2021 for the ASIP, however funding has been secured and a schedule is being developed for the sites identified as needing to be replanted to achieve vegetation growth and survivorship criteria. Figure 3-1 and Figure 3-2 depict ASIP Area 8 before and after restoration, respectively.

Figure 3-1 ASIP Area 8 Before Restoration

Figure 3-2 ASIP Area 8 After Restoration

3.4.6. National Historic Preservation Act

The National Historic Preservation Act (16 USC § 470) requires federal agencies to identify, record, and protect cultural resources. In 1990, an assessment of cultural resources at the SNL/CA site was completed. Although no prehistoric resources, Native American resources, or historic archaeological sites were identified during this assessment, there is a possibility that buried resources could be present on site (DOE 2003a). Provisions for cultural resources are included in all construction-related contracts where the potential for buried resources may be unearthed. In 2021, there were no buried archaeological resources unearthed at SNL/CA.

In 2001, SNL/CA personnel completed a historic building survey. None of the buildings on-site are identified as historically significant or eligible for the National Register of Historic Places (SNL 2002). The results of the historic building survey were submitted to NNSA/SFO. In December 2004, NNSA transmitted the survey results to the California State Historic Preservation Officer (SHPO). In April 2005, NNSA/SFO received concurrence from the California SHPO that none of the properties located at SNL/CA are eligible for inclusion in the National Register of Historic Places.

3.5. Environmental Restoration

3.5.1. Comprehensive Environmental Response, Compensation, and Liability Act

Between 1984 and 1986, the DOE investigated the SNL/CA site under their Comprehensive Environmental Assessment and Response Program (CEARP) to identify and assess potential environmental problems (DOE 1986). The CEARP investigation evaluated compliance with major federal environmental laws, including the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (42 USC § 9601).

CERCLA establishes liability compensation, clean-up, and emergency response for hazardous substances released to the environment. During the CEARP investigation, two potential CERCLA sites were identified at SNL/CA, the Fuel Oil Spill Site and the Navy Landfill. A Hazard Ranking System study was performed for each site to determine if either qualified for listing on the National Priorities List. Hazard Ranking System scores for both sites fell below 28.5, the qualifying score for listing. Since completion of the CEARP investigation, there have been no hazardous substance releases or contaminated sites found at SNL/CA that warranted CERCLA investigation or a Hazard Ranking System analysis.

In addition to cleanup and emergency response requirements, CERCLA also establishes a program to report spills of hazardous substances to the National Response Center. CERCLA reporting requirements for spill prevention and spill control activities are incorporated into applicable technical work documents. In 2021, there were no releases of hazardous substances on-site that required notification under CERCLA.

3.5.2. Site Clean-up Orders

Since 1985, environmental restoration and monitoring activities at SNL/CA have been conducted in compliance with site clean-up orders issued by the California Regional Water Quality Control Board (RWQCB), San Francisco Bay Region. The RWQCB issues site clean-up orders under the California Water Code (California RWQCB 1989). Although there are no active remediation sites at SNL/CA, groundwater monitoring is ongoing at two closed locations - the Fuel Oil Spill site and the Navy Landfill. SNL/CA personnel currently sample three groundwater monitoring wells for residual contamination - two at the Fuel Oil Spill site (when there is sufficient water to collect a sample), and one at the Navy Landfill. Chapter 5, Environmental Monitoring presents sampling results.

3.6. Chemical Management

3.6.1. Emergency Planning and Community Right-to Know Act

The Emergency Planning and Community Right-to-Know Act (EPCRA) also known as the Superfund Amendments and Reauthorization Act of 1986, Title III (42 USC § 11001, et. seq.) requires reporting of toxic chemical usage and releases. To meet EPCRA requirements applicable to SNL/CA operations, an annual report is submitted to the Livermore-Pleasanton Fire Department online through the California Environmental Reporting System (CERS). The CERS submittal satisfies EPCRA 302-303 and 311-312 federal, state, and local reporting requirements. To meet Section 313 of EPCRA, an annual report is submitted to EPA, and, if required a Section 304 report is also submitted. Table 3-1 presents applicable EPCRA reporting requirements for 2021.

Table 3-1 Status of EPCRA Reporting for SNL/CA, 2021

EPCRA Section	Description of Reporting	Required in 2021
Sec. 302-303[a]	Planning Notification	Yes (sulfuric acid only)
Sec. 304	Extremely Hazardous Substances Release Notification	No
Sec. 311-312[a]	Safety Data Sheet / Chemical Inventory	Yes
Sec. 313	Toxic Release Inventory Reporting	Yes (lead only)

[a] Reporting accomplished through the annual Hazardous Materials Business Plan, a California Environmental Reporting System (CERS), a California requirement. See Section 3.6.2.

3.6.2. California Hazardous Materials Release Response Plans and Inventory

The California Hazardous Materials Release Response Plans and Inventory (Assembly Bill 2185) addresses the management of hazardous and acutely hazardous materials. The bill is codified in the California Health and Safety Code, Division 20, Chapter 6.95 § 25500, et seq. Specific requirements pertaining to hazardous materials are in Title 19, California Code of Regulations, Division 2, Chapter 4, § 2729-2732. In compliance with California requirements, a Hazardous Material Business Plan is submitted annually for SNL to the Certified Unified Programs Agencies (CUPA) via CERS. The CUPA for SNL/CA is the Livermore-Pleasanton Fire Department.

Annually, the number of hazardous materials containers in inventory are counted and verified at SNL/CA by the Chemical Management Program. The results of the inventory are used to encourage chemical owners to right-size inventories and minimize higher toxicity materials through chemical exchange or reduction. As shown in Figure 3-3, the number of hazardous materials containers peaked in 2003 and has been steadily declining since. Overall, the number of containers for higher toxicity materials (shown as NFPA Health 3&4) has also declined since 2003. These overall declines reduce the risk inherent to personnel and the environment from hazardous materials used and stored on site.

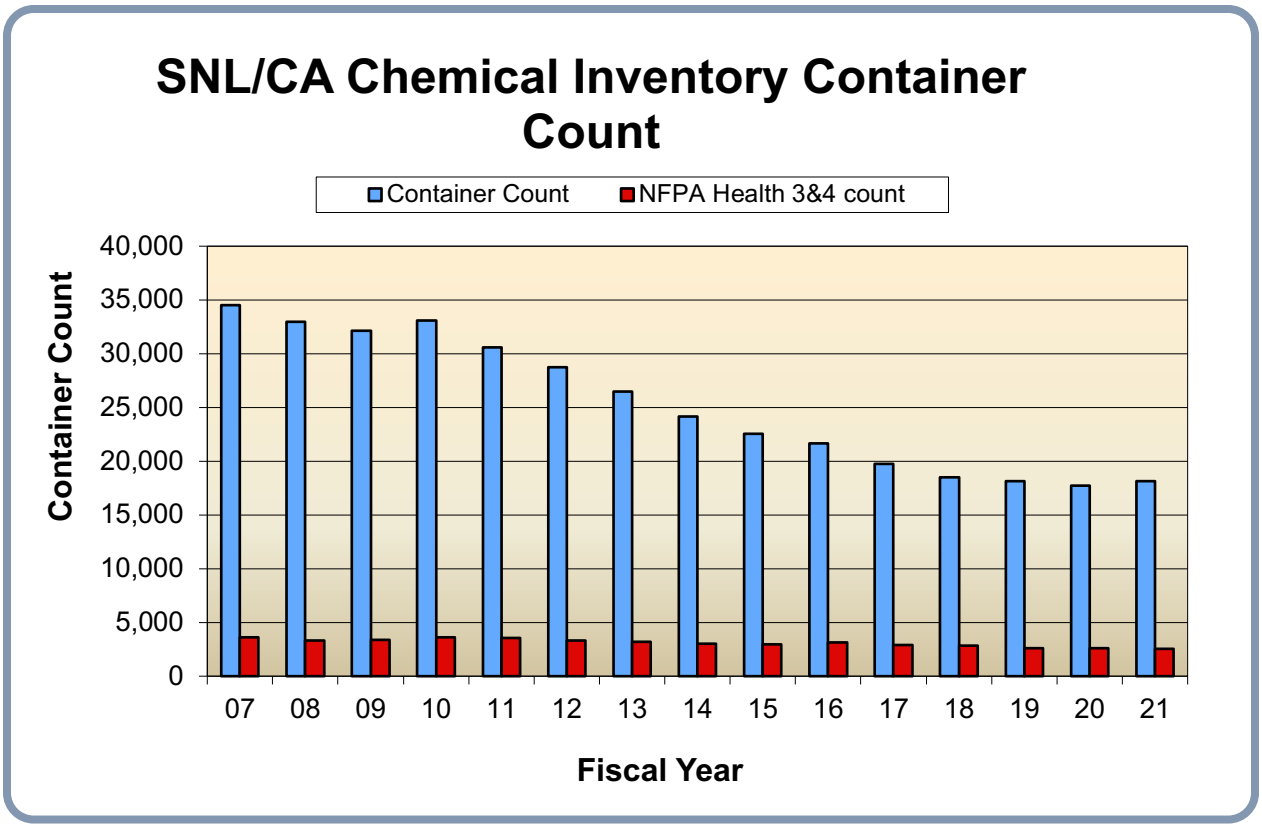


Figure 3-3 SNL/CA Hazardous Material Inventory

3.6.3. Oil Storage Program

Oil storage is regulated under Title 40 Code of Federal Regulations, Part 112 and the California Health and Safety Code Division 20, Chapter 6.67, § 25270-25270.13 and include containers with the capacity to store 55 gallons or more of oil. The federal and California codes require the owners/operators of an aggregate aboveground oil storage capacity greater than 1,320 gallons to prepare a Spill Prevention Control and Countermeasure (SPCC) Plan to define guidelines, practices, and procedures for storing and handling oil and ensure safe, efficient, and timely response in the event of an oil spill or discharge and conduct periodic inspections. SNL/CA has an ongoing SPCC plan that is required to be reviewed every five years and must be updated when a change occurs in the oil storage inventory on-site. The CUPA specifically, the Livermore-Pleasanton Fire Department is the regulating authority for aboveground storage tanks at SNL/CA. Approximately sixty oil storage containers are managed and operated at SNL/CA, ranging in size from 55 to 1000 gallons. Each year, the containers are declared through the Hazardous Material Business Plan described in Section 3.6.2. One aboveground storage tank used as a gasoline dispensing facility is also permitted as an emission source by the BAAQMD. As part of the SPCC Plan, routine inspections are performed as defined in the Plan.

3.6.4. Toxic Substances Control Act

The Toxic Substances Control Act (TSCA) (15 USC § 2601 et. seq.) is the primary federal statute regulating the manufacture, use, distribution, disposal, import, or export of certain chemicals and substances. TSCA requirements that are applicable to SNL/CA operations are incorporated into MN471022, *Environment, Safety, and Health Manual.* At SNL/CA, the only TSCA-regulated chemicals

imported to or exported from the site are for research and development purposes and thus are exempt from general reporting requirements. However, SNL/CA personnel prepare a Notice of Export for Chemical Substances when a regulated chemical is exported out of the customs territory of the United States. In 2021, no TSCA Notice of Export forms were prepared for SNL/CA.

SNL/CA personnel track disposal of TSCA materials generated from SNL/CA operations that are not otherwise captured under the Resource Conservation and Recovery Act (RCRA) (42 USC § 6901 et. seq) or the California Health and Safety Code, Division 20, Chapter 6.5, § 25100 et. seq. These materials include asbestos and polychlorinated biphenyls (PCBs). The majority of TSCA waste generated on-site is asbestos from abatement activities. Only small quantities of PCB wastes are generated at SNL/CA, consisting of light ballasts that are not specifically marked as PCB-free.

3.6.5. Federal Insecticide, Fungicide, and Rodenticide Act

The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) (7 USC § 136) restricts the registration, sale, use, and disposal of pesticides (including herbicides, insecticides, fungicides, and rodenticides). The only activity conducted at SNL/CA that falls under FIFRA is pesticide use. A licensed commercial pesticide applicator conducts this activity under a service contract. SNL/CA's contract requirements include a site-specific environmental specification. The service contractor manages all empty pesticide containers and removes them from the site.

3.7. Pollution Prevention and Waste Minimization

Pollution prevention concepts first appeared in RCRA) (42 USC § 6901 et. seq). An expressed concern was to minimize the generation of hazardous waste through process substitution, materials recovery, recycling, reuse, and treatment. RCRA established hazardous waste reduction and elimination as national policy, and it required that hazardous waste generators and RCRA permit holders have a program in place to minimize waste. Additionally, SNL/CA's Waste Minimization Certificate required by the Hazardous Waste Storage Facility Part B Permit is submitted to the California Department of Toxic Substances Control (DTSC) by February 28 every year.

3.7.1. Pollution Prevention Goals of Site Sustainability Plan

The corporate SSP establishes a commitment to meet pollution prevention goals identified in DOE's Strategic Sustainability Performance Plan and Executive Order 13834. In 2021, personnel continued to implement SNL/CA site-specific activities to support these goals through:

- recycling of 27 solid waste streams;
- recycling of construction debris;
- chemical exchange;
- chemical acquisition program that encourages purchasing only the quantity needed;
- management of batteries and lamps as universal waste; and
- reapplication of equipment and supplies.

P2 Goals

- ❒ Divert solid waste and demolition / construction debris from landfill disposal
- ❒ Strive for net zero waste from operations in existing facilities
- ❒ Promote sustainable acquisition
- ❒ Purchase EPEAT registered products
- ❒ Recycle and reuse, whenever feasible

Pollution prevention and waste minimization data for SNL/CA is reported to the corporate SSP team annually. Chapter 4 provides additional information about pollution prevention activities.

3.7.2. Hazardous Waste Source Reduction and Management Review Act

The California Hazardous Waste Source Reduction and Management Review Act of 1989, (Senate Bill 14), requires hazardous waste generators to consider source reduction as the preferred method of managing hazardous waste. Under this act, facilities that generate more than 12,000 kilograms (kg) of hazardous waste or 12 kg of extremely hazardous waste annually are required to conduct source reduction planning.

Under an agreement between the DOE and DTSC, all of DOE's California sites are considered one waste generator, rather than individual DOE facilities. Every four years, SNL/CA personnel complete a Source Reduction and Evaluation Review and Plan in cooperation with the other three DOE sites in California: Lawrence Livermore National Laboratory (LLNL); Lawrence Berkeley National Laboratory (LBNL); and Stanford Linear Accelerator Center (SLAC). As of 2015, DTSC no longer requires the plan to be submitted; however, each site is to retain a copy on file that will be reviewed during routine annual audits.

The most recent plan was completed on September 1, 2019 and provided information for calendar year 2018. The plan also identifies waste reduction opportunities for any waste stream that is over five percent of a site's total routine regulated waste. The next plan, which will include information from calendar year 2022, will be prepared in 2023.

3.7.3. Pollution Prevention Act

The Pollution Prevention Act of 1990 (42 USC § 13101 et. seq.) declares, as national policy, that pollution should be prevented or reduced at the source. Facilities that meet the reporting requirements under EPCRA, Section 313 are also required to file a toxic chemical source reduction and recycling report. The Section 313 report for CY 2021 (for lead only) includes source reduction and recycling information to meet this requirement. The report is due annually on July 1. See Section 3.6.1 for additional information on EPCRA reporting requirements.

3.8. Hazardous Waste

3.8.1. Federal Facility Compliance Act

The Federal Facility Compliance Act (42 USC § 6961) waives sovereign immunity with respect to RCRA for federal facilities. The act gives EPA and authorized states, authority to conduct annual inspections of federal facilities and establishes requirements for management of hazardous/mixed waste.

Activities at SNL/CA are not subject to a site-specific federal facility compliance agreement for mixed waste, as no possession or storage of legacy mixed waste occurs at the SNL/CA site. All mixed waste generated at SNL/CA during 2021 was appropriately managed under the site's RCRA Hazardous Waste Facility Permit.

3.8.2. Resource Conservation and Recovery Act

RCRA (42 USC § 6901 et. seq) regulates the generation, transportation, treatment, storage, and disposal of hazardous and non-hazardous solid waste. The State of California has authority from EPA to implement RCRA. The California DTSC administers most aspects of RCRA in the state and

is the regulating authority for hazardous waste operations at SNL/CA, including the hazardous component of radioactive mixed waste.

A Waste Management Facility is managed and operated at SNL/CA under a RCRA Hazardous Waste Facility Permit issued by DTSC on March 30, 2004. The permit was effective through March 2014 and allowed for storage, consolidation, commingling, and packaging of hazardous waste. A permit renewal application for another ten-year period was submitted to DTSC on June 28, 2013. DTSC held a public meeting and hearing on July 10, 2018, and a new ten-year permit was issued in September 2018 with an effective date of October 25, 2018.

The SNL/CA facility is a large quantity generator of RCRA waste. As such, SNL/CA is required under RCRA standards and implementing regulations (40 CFR 262.41) to submit a biennial report to DTSC on even numbered years.

DTSC conducts a Compliance Evaluation Inspection audit of the Waste Management Facility annually. The last audit was in September 2021 and there were no concerns or issues noted by the inspectors.

3.8.3. California Hazardous Waste Control Law

The Hazardous Waste Control Law (California Health and Safety Code, Division 20, Chapter 6.5, § 25100 et. seq.) provides a separate regulatory framework for hazardous waste management in California. The state law incorporates all RCRA requirements and imposes additional requirements that are broader and more comprehensive than the federal system. Under the California law, additional waste materials (e.g., oils, metals, asbestos) or activities (e.g., treatment) are regulated as hazardous. State standards are incorporated into the Waste Management Program at SNL/CA so that California regulated waste is managed as hazardous waste in compliance with state requirements.

The California Environmental Health Standards for Management of Hazardous Waste (22 CCR, Division 4.5) require all permitted hazardous waste facilities to submit an annual facility report to DTSC.

Annual facility reports provide information about the quantity of RCRA- and California-designated hazardous waste that is generated and stored at SNL/CA, and the quantity of waste shipped from the site. An annual facility report is submitted to DTSC either in the form of the federal Biennial Report or the California Annual Facility Report.

The California Environmental Health Standards for Management of Hazardous Waste (22 CCR, Division 4.5) also requires the management of hazardous waste at the generator site. The regulating authority for the SNL/CA hazardous waste generator program is the CUPA and specifically, the Livermore-Pleasanton Fire Department. The CUPA regulates the hazardous waste generator program, hazardous materials business plan and aboveground storage tanks program at SNL/CA. The CUPA also conducts a comprehensive inspection annually. The last inspection was in October 2021; one minor finding was noted as detailed in Section 3.14.

3.8.4. Medical Waste Management Act

The California Medical Waste Management Act (California Health and Safety Code, Division 104, Part 14, § 117600-118360) provides for regulation of medical waste generators, transporters, and treatment facilities. The Alameda County Department of Environmental Health is the regulating authority for medical waste generated at SNL/CA. There are two medical waste facilities at SNL/CA. One is identified as small quantity generator (without onsite treatment), and the other is a large quantity generator (with on-site treatment). An annual audit is conducted by the Alameda County Department of Environmental Health. The last audit was performed in November 2021, and there were no findings or concerns.

3.9. Radiation Protection

3.9.1. Atomic Energy Act

The purpose of the Atomic Energy Act (42 USC § 2011 et. seq.) is to assure the proper management of source, special nuclear, and byproduct materials. The DOE sets radiation protection standards and retains authority for radionuclides through department directives. Operations at SNL/CA are subject to the requirements established in DOE Order 435.1*, Radioactive Waste Management* (DOE 2001) and DOE Order 458.1*, Radiation Protection of the Public and the Environment* (DOE 2013a).

3.9.2. DOE Order 435.1, Radioactive Waste Management

DOE Order 435.1 establishes requirements to manage radioactive waste in a manner that protects the environment, and worker and public health and safety. Under this order, DOE contractor operated facilities are required to plan, document, execute, and evaluate the management of radioactive waste. Requirements of DOE Order 435.1 are incorporated into the radioactive waste management element of the SNL/CA site Waste Management Program. The program includes certification and characterization of waste; provisions for inspections and audits; training requirements; and operating procedures for handling, storing, packaging, shipping, and off-site disposal of radioactive waste.

SNL/CA operations typically generate low-level radioactive waste and low-level mixed waste. No high-level radioactive waste is generated by SNL/CA operations. Low-level radioactive wastes are stored prior to shipment in the Low-Level Radioactive and Mixed Waste Building. The Sandia National Laboratories, New Mexico (SNL/NM) Waste Management program oversees the management of the low-level radioactive waste at the SNL/CA site. This waste is shipped off-site to SNL/NM with final disposal at the Nevada National Security Site (NNSS).

Mixed waste is managed under federal (RCRA) and state waste regulations (22 CCR, Division 4.5) and well below the total effective dose of 100 mrem and shipped off-site for treatment and disposal via commercial disposal facilities. See Section 3.8.2 for more information regarding RCRA permitting and compliance. Figure 3-4 shows the quantity of total radioactive waste shipped from SNL/CA since 2011. Radioactive waste shipped increased over the past two years due to a large project removing a contaminated building exhaust system which was initiated in 2020 and completed in 2021.

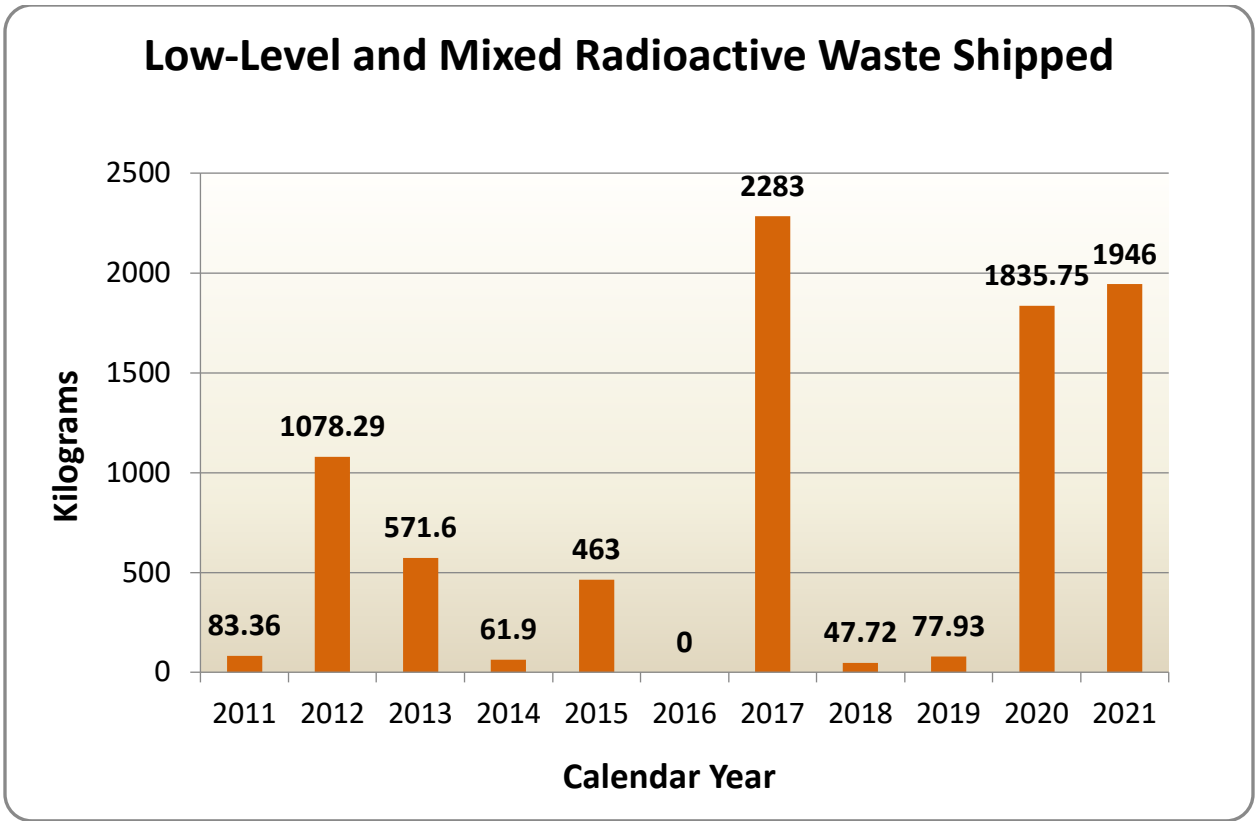


Figure 3-4 Radioactive Waste Shipped from SNL/CA

3.9.3. DOE Order 458.1, Radiation Protection of the Public and the Environment

DOE Order 458.1 *Radiation Protection of the Public and the Environment* (DOE 2013a) sets radiation protection standards for DOE operations so that radiation exposures to members of the public and the environment are as low as reasonably achievable (ALARA) and maintained within established limits of the order. Table 3-2 provides a summary of related compliance activities conducted at SNL/CA in 2021.

Table 3-2 Order 458.1 Compliance Summary, 2021

Order 458.1 Requirement	SNL/CA 2021 Summary
Develop and implement an environmental radiological protection program.	An environmental radiological protection program has been in place at SNL/CA for more than 30 years.
Control exposure to the public such that annual exposure will not exceed a total effective dose of 100 mrem, an equivalent dose to the lens of the eye of 1500 mrem, or an equivalent dose to the skin or extremities of 5000 mrem.	There were no radionuclide emissions in FY 2021. The average annual gamma radiation measurement at the site perimeter in FY 2021 was 46 mrem and well below the total effective dose of 100 mrem.
Request authorization for temporary dose limits.	There were no special circumstances in 2021 requiring temporary dose limits.
Adopt ALARA exposures.	ALARA is incorporated into environment, safety, and health (ES&H) policy, processes, and operating procedures.

Order 458.1 Requirement	SNL/CA 2021 Summary
Demonstrate compliance with public dose limits from the air pathway.	NESHAPs dose calculations are completed as needed. There were no airborne radionuclide emission sources in 2021; therefore, there is no monitoring data available for dose evaluations.
Control airborne radioactive effluents.	ES&H policy, processes, operating procedures, and management systems are incorporated into site operations to ensure that projects are reviewed for potential airborne effluents. Dose calculations are performed as needed.
Control release of liquid radioactive discharges.	No intentional discharges of liquid radioactive wastes to the environment occur on-site. No accidental releases of liquid radioactive waste occurred in 2021. Radioactive releases to the sanitary sewer above DOE Order 458.1 guidelines are not allowed at SNL/CA. ES&H policy, processes, operating procedures, and management systems are incorporated into site operations to ensure proper handling and disposal of radioactive materials.
Control radioactive waste.	SNL/CA typically generates low-level radioactive waste only. ES&H policy, processes, procedures, and management systems are incorporated into site operations to ensure proper handling and disposal of radioactive waste.
Protect drinking water and groundwater.	ES&H policy, processes, operating procedures, and management systems are incorporated into site operations to ensure proper handling and disposal of radioactive materials offsite at approved facilities. Routine analyses of groundwater and stormwater samples include radioactive constituents.
Protect biota.	ES&H policy, processes, operating procedures, and management systems are incorporated into site operations to ensure proper handling and disposal of radioactive materials offsite at approved facilities. SNL/CA has no operations requiring biota monitoring.
Control the release of property with residual radioactivity.	There is no release of property to the public (e.g., vehicles, equipment, or other materials) with residual radioactivity above the limits specified in DOE Order 458.1. Under written procedures, items that are potentially contaminated or activated are either surveyed prior to the release to the public, or a process knowledge evaluation is conducted to verify that the material 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 2021, no required equipment clearance surveys were processed by SNL/CA's Radiation Protection personnel. SNL/CA personnel track property with an acquisition cost greater than $10,000 and routinely release items without residual radioactivity to the public. SNL/CA personnel complete process knowledge evaluations for all property items to verify that they had not been exposed to radioactive material or to energy capable of inducing radioactivity. DOE issued a moratorium in January 2000 prohibiting the release of volume-contaminated metals and subsequently suspended the release of metals for recycling purposes from

Order 458.1 Requirement	SNL/CA 2021 Summary
	DOE radiological areas in July 2000. No metals subject to the moratorium or suspension were released from SNL/CA in 2021. Excess property with residual radioactivity above the limits in DOE Order 458.1 is either transferred to other DOE facilities for reuse or transferred to SNL/NM for offsite shipment and disposal to the Nevada National Security Site as radioactive waste. There were no releases of real property to the public in 2021 with residual radioactivity above the limits in DOE Order 458.1.
Retain records.	ES&H policy, processes, and operating procedures are in place to manage records.

3.10. Water Quality and Protection

SNL/CA operations are subject to the requirements of the Clean Water Act and equivalent California statutes. There is no public water system at the SNL/CA facility, and no environmental restoration activities for which Safe Drinking Water Act standards are being applied.

Potable water for SNL/CA is purchased through LLNL and obtained from the San Francisco Public Utilities Commission (SFPUC) but can be supplemented by the Alameda County Flood Control and Water Conservation District (known as Zone 7) as a backup source. The SFPUC and Zone 7 are responsible for monitoring the quality of the incoming water. There is no requirement to treat or sample the drinking water at SNL/CA. LLNL maintains the primary drinking water distribution system that feeds to SNL/CA and screens for water quality (SNL/CA 2002).

LLNL meters the water use at SNL/CA as the water enters the site. In calendar year 2021, 36.6 million gallons of water were used at SNL/CA, a decrease of 18.1 percent (8 million gallons) from water used in calendar year 2020. (See discussion in Section 4.2.2). The site discharged approximately 5.9 million gallons of wastewater during the calendar year 2021. Water loss, or the difference between water use and wastewater discharge, is attributed to irrigation, cooling towers, water tank releases, evaporative losses, eyewash and safety shower testing, and fire system testing.

3.10.1. Clean Water Act

The Clean Water Act (33 USC § 1251) regulates all direct discharges into navigable waters of the United States. Direct discharges require permits issued under the National Pollutant Discharge Elimination System (NPDES). In California, the State Water Resources Control Board has authority from EPA to implement the Clean Water Act. Federal permitting requirements are included in Waste Discharge Requirements issued by Regional Water Quality Control Boards.

3.10.1.1. Wastewater Discharge

Wastewater generated at SNL/CA is discharged to the City of Livermore Water Reclamation Plant, a publicly owned treatment works (POTW). The Livermore POTW maintains an NPDES permit, and then regulates industry discharges into their sewer system. A Wastewater Discharge Permit[3] issued by the Livermore POTW regulates SNL/CA's wastewater discharges. The permit is updated

[3] Refer Table 3-5 SNL/CA Environmental Permits and Orders for permit/registration number.

annually and includes discharge limits for the site sanitary sewer outfall and for processes subject to EPA's pretreatment standards. SNL/CA is responsible for monitoring and sampling the wastewater generated to ensure permit compliance. For routine wastewater monitoring information, see Section 5.2.1.

There are three categorical processes at the SNL/CA site that are subject to EPA's pretreatment standards: one metal finishing operation, a robotic spray-paint booth, and a semiconductor manufacturing operation. The metal finishing operation is a closed-loop process and does not discharge any effluents. The spray-paint booth is not connected to the sanitary sewer and does not discharge effluents. Wastewater generated from the semiconductor manufacturing process is sampled and monitored as part of the Environmental Monitoring Program.

3.10.1.2. Stormwater Discharge

On July 1, 2015, a new industrial general permit[3] for stormwater discharges at SNL/CA became effective. The *State of California NPDES General Permit for Stormwater Discharge Associated with Industrial Activities* (2014 Industrial General Permit) (California Water Resources Control Board 2014) contains Numeric Action Levels (NALs) and a requirement to implement a Stormwater Pollution Prevention Plan (SWPPP). During 2018, SNL/CA installed stormwater detention basins near the scrap yard as a Best Management Practice to address exceedances of the NALs. The basins were upgraded during 2019 to address continued exceedances. During 2020-2021 reporting year, one storm event was able to be sampled. The results showed an exceedance of the NAL for aluminum. Additional sampling will need to be performed to determine if further Best Management Practice (BMP) modifications and/or actions are needed. Currently SNL/CA is in Level 2 status for exceedances in pH, aluminum, and iron, which are discussed in the Exceedance Response Action (ERA) Level 2 Technical Report that was submitted to the State Waterboard. The report also discusses the strategies and BMP implementations to lower these parameter values so that SNL/CA can pursue baseline status. Results from the stormwater reporting year 2020–2021 can be found in Table 5-1.

Under Section 438 of the Energy Independence and Security Act of 2007, federal agencies are required to reduce stormwater runoff from development and redevelopment projects. In 2019, construction on a replacement data center was initiated and was completed in 2021. In 2020, a Type-1 Linear Underground/Overhead Project was initiated to construct a new water pipeline and continued through 2021. Construction of the Limited Area Multi-Purpose (LAMP) Facility Building Project began in 2021 and continued through the year. Each of the construction projects met the requirements laid out in the Construction General Permit, including a Stormwater Pollution Prevention Plan.

3.11. Emergent Contaminants

Per- and polyfluoroalkyl substances (collectively known as "PFAS") are a group of human-made fluorinated chemicals that include PFOA, PFOS, GenX, and other related chemicals. PFAS have been widely produced and used in the United States since the 1940s for many applications such as product surface coating and fire-fighting foam. Both the EPA and California State Water Quality Control Board are investigating PFAS as a constituent of emerging concern. In 2021, Both the EPA and California State Water Quality Control Board's investigations focused on drinking water suppliers and active facilities that may have PFAS groundwater contamination properties such as airports, landfills, chrome plating facilities and POTW. As none of these are ongoing activities at SNL/CA, the RWQCB has not made any indication nor determination that the SNL/CA site needs

to perform PFAS investigations, testing or monitoring. There are current internal discussions on incorporating PFAS monitoring in the future, and SNL/CA will continue to look to the RWQCB's evaluation and decision to implement appropriate regulatory actions.

3.12. Resilience and Climate Change

In FY 2017, Sandia National Laboratories (SNL) personnel conducted a Vulnerability Assessment to assess the potential impact to SNL's current and planned facilities and mission within the context of a changing physical environment. Table 3-3 lists SNL/CA's climate stressors as identified in the assessment. An updated assessment was completed in FY 2020 that addressed anticipated changes in climate by the year 2050 as well as potential vulnerabilities to these changes at SNL sites focusing on resource areas such as energy, water, space and infrastructure, and personnel. In FY 2021, SNL personnel participated in the Technical Resilience Navigator DOE cohort along with seven other DOE sites. The cohort was established to provide participating personnel an overview of this tool which helps users assess risk for a sites' critical functions following energy and water utility disruption and then prioritize solutions. Additionally, in FY 2021, SNL personnel invested resources in development of several cross disciplinary teams with expertise on climate and resiliency such as a Resilient Energy Working Group, with the purpose of bringing together R&D, ES&H and Facilities with an attempt to make the SNL sites more energy resilient and sustainable while simultaneously showcasing SNL research.

Table 3-3 SNL/CA Climate Stressors, 2017

Area/Site/Program	Climate Stressors	Climate Stressor Likelihood	Impact on Mission Objective	Effect on Area/Site/Program
Main Campus	Extreme Heat (Electricity Usage)	Low	Medium	Programs may be affected if there are electricity shortages due to high heat.
Main Campus	Drought	Very High	Medium	If California experiences water shortages due to extended drought, SNL/CA's ability to perform programs or accept new programs may be affected.
Main Campus	Extreme Heat Wave	Very High	High	Extended high temperatures limit the amount of time personnel can work outdoors, especially in personal protective equipment (PPE). Heat waves also stress the electric grid.
Outdoor Projects	Heat Waves	Very High	Very High	Any personnel working outdoors during extended heat waves, especially those in PPE, will have reduced productivity due to necessary health safety breaks.
Outdoor Projects	Wildfire	Medium	High	Wildfires would interrupt program operation and keep personnel from job sites.

In addition to internal assessment and planning to manage climate related impacts, SNL/CA operations are also required to comply with the state's efforts to mitigate climate impacts. California

measures stem from the state's Assembly Bill 32 (AB32) titled the 'Global Warming Solutions Act of 2006'. The bill requires a reduction in greenhouse gas emissions across all sectors of society, ranging from large electric power generating facilities to vehicles to appliances. Various regulations resulting from the AB32 legislation currently require the reporting of greenhouse gasses from mobile sources and refrigerants from SNL/CA's operation; and the avoidance/reduction of greenhouse gas emissions from these sources. During 2021 the state adopted, the "Small Off-Road Engine Regulations: Transition to Zero Emissions", for new equipment below 25 horsepower, manufactured after 2024, as part of the state's plan to reduce greenhouse gas emissions. The rule is expected to be made final in 2022 and include new standards on SNL/CA's purchases of lawn mowers, leaf blowers, chainsaws, pressure washers, air compressors, and portable generators, etc. (which generally have spark-ignition engines) for equipment with model-year 2024 and future years.

State requirements of AB32 will add to the DOE's Vulnerability Assessment and Resilience Planning Guidance in planning responses to climate related impacts.

3.13. Audits, Assessments, and Inspections

Table 3-4 provides a list of environmental audits, assessments, and/or inspections conducted at SNL/CA during calendar year 2021.

Table 3-4 SNL/CA Audits, Assessments, and Inspections, 2021

Title	Area of Focus	Date Conducted	Results
Livermore-Pleasanton Fire Department (CUPA)	Hazardous Waste Accumulation Area	October 26-28, 2021	One minor finding
Department of Toxic Substances Control (DTSC)	Hazardous Waste Facilities	September 29, 2021	No findings
Alameda County Department of Environmental Health	Medical Waste Management	November 16, 2021	No findings
City of Livermore, Water Resources Division Inspections	Wastewater discharges and categorical process laboratories	October 20-21, 2021	No findings
Alameda County Department of Environmental Health	Inspection of Navy Landfill site	November 03, 2021	No findings, one minor observation
Orion Registrar, Inc.	Environmental Management System (EMS) ISO 14001 Surveillance Audit	August 9-11, 2021	No findings, three observations

3.14. Environmental Occurrences

An environmental occurrence is an event that meets the occurrence criteria established in DOE Order 232.2, Admin Change 1 (2017). In 2021, there was one environmental occurrence from SNL/CA operations as a result of a violation during an annual audit.

An annual Certified Unified Program Agency (CUPA) inspection was carried out from October 26-28, by the Livermore-Pleasanton Fire Department. During the walk through performed on October 26, an inspector observed multiple gas cylinders that were not secured in a storage location.

SNL/CA personnel secured the gas cylinders immediately and notified the inspector. The observation was documented in the inspection report as a Minor Finding.

3.15. Permits

Table 3-5 lists active environmental permits and clean-up orders held for SNL/CA operations. Additional information is provided in previous sections under the related program or regulation.

Table 3-5 SNL/CA Environmental Permits and Orders, 2021

Type	Description	Permit/Registration Number	Effective Date	Statute / Regulation	Issuing Agency
Environmental restoration	Site Clean-up Order No. 89-184	Order No. 89-184	December 1989 (no expiration date)	California Water Code	Regional Water Quality Control Board, San Francisco Bay
Hazardous materials	Hazardous Materials Business Plan	CERS ID # 10135531	March 1–February 28, annually	California Health and Safety Code	Livermore-Pleasanton Fire Department
Hazardous waste	Hazardous Waste Transporter Permit	3060	January 31-January 30 annually	California Health and Safety Code, California Code of Regulations, Tittle 22	California Department of Toxic Substances Control, Transportation Unit
Hazardous waste	RCRA Hazardous Waste Facility Permit	EPA ID # CA2890012923	October 2018–October 2028[a]	RCRA	California Department of Toxic Substances Control
Hazardous waste	Permit by Rule	943PBR1 943PBR2	March 1-March 1, annually	California Health and Safety Code	Livermore-Pleasanton Fire Department
Hazardous waste	Conditionally Authorized Permit to Operate	SS1, B968	March 2-March 1, annually	California Health and Safety Code	Livermore-Pleasanton Fire Department
Medical waste	Large Quantity Generator with On-site Treatment	PT0322429	July 10 – July 9, annually	California Health and Safety Code	Alameda County Dept. of Environmental Health
Medical waste	Small Quantity Generator without On-site Treatment	PT0304629	March 26-March 25, annually	California Health and Safety Code	Alameda County Dept. of Environmental Health

Type	Description	Permit/Registration Number	Effective Date	Statute / Regulation	Issuing Agency
Solid Waste	Tire Program Identification Number	128975-01	N/A (no expiration date)	California Tire Recycling Act	CalRecycle
Wastewater	Wastewater Discharge Permit	1251	August 4, 2021 – August 3, 2026	Clean Water Act	City of Livermore Water Reclamation Plant
Stormwater	State of California Industrial General Permit	NPDES NO. CAS000001 & Order 2014-0057-DWQ, Site WDID 2 01I002598	July 1, 2015-indefinite	Clean Water Act	California Water Resources Control Board
Stormwater	State of California Construction General Permit	Construction General Permit Order 2009-0009-DWQ/WDID 201C396034 "Limited Area, Multi-Purpose (LAMP) High Bay Laboratory Building C931"	December 23, 2021	Clean Water Act	California Water Resources Control Board
Stormwater	State of California Construction General Permit	Construction General Permit Order 2009-0009-DWQ/WDID 201C391679 "Water Line Project"	September 28, 2020	Clean Water Act	California Water Resources Control Board
Stormwater	State of California Construction General Permit	Construction General Permit Order 2009-0009-DWQ/WDID 201C394642 "LAMP Secure Office Building C930"	August 2, 2021	Clean Water Act	California Water Resources Control Board
Aboveground storage tanks	Storage statement	1211-12142017	December 14, 2017 – indefinite (will reissue if change occurs) Required in CERS	Aboveground Petroleum Storage Act	Livermore-Pleasanton Fire Department
Air	Permit to Operate-non-retail Gasoline Dispensing Facility	Plant 290 Source 32	July 1 – June 30, annually	Clean Air Act	Bay Area Air Quality Management District

Type	Description	Permit/Registration Number	Effective Date	Statute / Regulation	Issuing Agency
Air	Permit to Operate-Maintenance and Facilities Adhesive Usage	Plant 290 Source 93	July 1 – June 30, annually	Clean Air Act	Bay Area Air Quality Management District
Air	Permit to Operate-Site-wide wipe cleaning	Plant 290 Source 95	July 1 – June 30, annually	Clean Air Act	Bay Area Air Quality Management District
Air	Permit to Operate-Spray Paint Booth	Plant 290 Source 110	July 1 – June 30, annually	Clean Air Act	Bay Area Air Quality Management District
Air	Permit to Operate-Standby generator	Plant 290 Source 104	July 1 – June 30, annually	Clean Air Act	Bay Area Air Quality Management District
Air	Permit to Operate-Standby generator	Plant 290 Source 108	July 1 – June 30, annually	Clean Air Act	Bay Area Air Quality Management District
Air	Permit to Operate-Standby generator	Plant 290 Source 109	July 1 – June 30, annually	Clean Air Act	Bay Area Air Quality Management District
Air	Registered emission sources-boilers 9	Plant 290 Sources 81, 82, 121, 122, 123, 124, 125, 126, 127	July 1 – June 30, annually	Clean Air Act	Bay Area Air Quality Management District
Air	Permit to Operate-Standby generator	Plant 290 Source 128	July 1-June 30, annually	Clean Air Act	Bay Area Air Quality Management District
Universal waste	Generator statement	Business ID # 516 Facility ID # 396	February 1, 2006-indefinite (will amend if change occurs)	California Electronic Waste Recycling Act	California Department of Toxic Substances Control

[a] A permit renewal application for another ten-year period was submitted to DTSC on June 28, 2013. A public meeting and hearing were held by DTSC on July 10, 2018, and a new permit was issued in September 2018 with an effective date of October 25, 2018.

CHAPTER 4. ENVIRONMENTAL PROGRAMS INFORMATION

Sandia National Laboratories, California (SNL/CA) personnel take the responsibility of protecting the environment seriously, preventing pollution and conserving natural resources. Environmental program activities meet or exceed federal, state, and local environmental requirements. In addition, all activities adhere to the corporate Environment, Safety & Health (ES&H) policy. The environmental management system (EMS) is the primary management approach for addressing environmental aspects and impacts of operations and activities. Sustainability strategies and goals are presented in the annual Site Sustainability Plan (SSP). At SNL/CA, the site's Environmental Management Organization supports both the corporate EMS and SSP goals. Additionally, SNL/CA management maintains seven site-specific environmental programs to monitor environmental aspects of site operations and provide compliance assistance for all site activities. SNL/CA's environmental programs are:

- Air Quality;
- Chemical Management;
- Environmental Monitoring and Ecology;
- Environmental Planning;
- Pollution Prevention and Waste Minimization;
- Radiation Protection; and
- Waste Management

4.1. SNL/CA EMS Implementation

The Environmental Management System (EMS) is a continuing cycle of planning, implementing, evaluating, and improving processes to achieve environmental goals. The EMS facilitates identification of the environmental aspects and impacts of Sandia National Laboratories' (SNL) activities, products, and services; identification of risks and opportunities that could impact the environment; evaluation of applicable compliance obligations; establishment of environmental objectives; and creation of plans to achieve and monitor those objectives and their progress.

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.

DOE O 436.1, *Departmental Sustainability*, (DOE 2011) provides requirements for EMS and sustainability. SNL personnel implement this order through an ISO 14001-certified EMS (ISO 14001:2015). SNL/CA received initial ISO 14001:2004 certification in 2005. In 2015, the SNL/NM and SNL/CA site-specific certifications were integrated into a multi-site ISO 14001:2004 certification. In 2021, the EMS was recertified under ISO 14001:2015. To maintain this certification, audits by a third-party registrar are required annually to ensure continued conformance to the standard. Additional information can be found at the following external EMS website:

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

The EMS provides the following benefits:

- Improved environmental performance
- Enhanced compliance with environmental regulations

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

For fiscal year (FY) 2021, the significant aspects for SNL operations were: air emissions- greenhouse gasses and hazardous air pollutants (asbestos); hazardous materials; hazardous, mixed, and radiologic waste; release of petroleum to soil, surface, and groundwater. Positive aspects for FY 2021 SNL operations were a reduction in water usage and air emissions- greenhouse gasses. When significant aspects and negative impacts have been identified, environmental objectives—at all operating levels—are established to guide efforts toward minimizing those aspects and impacts.

4.2. SSP Contributions

An annual Strategic Sustainability Performance Plan (SSP) articulates the corporation's performance status and planned actions for meeting DOE's Strategic Sustainability Performance Plan goals and DOE's broader sustainability program initiatives. SNL/CA contributes to many of the corporate SSP goals.

4.2.1. Energy Use

Figure 4-1 depicts the energy use intensity data for SNL/CA. Starting in 2016, the corporate target is to reduce energy intensity by 25 percent in goal-subject buildings by the end of FY 2025 from an FY 2015 baseline. Energy intensity is the amount of energy used annually per square foot of building space presented as British Thermal Unit/Gross Square Feet (BTU/GSF). The energy reduction target is 156,844 BTU/GSF illustrated by the dashed red line in Figure 4-1. As shown, energy intensity decreased from FY 2020 to FY 2021 from 204,414 to 199,801 BTU/GSF. Personnel will continue to identify energy reduction opportunities at SNL/CA to support this target in future years.

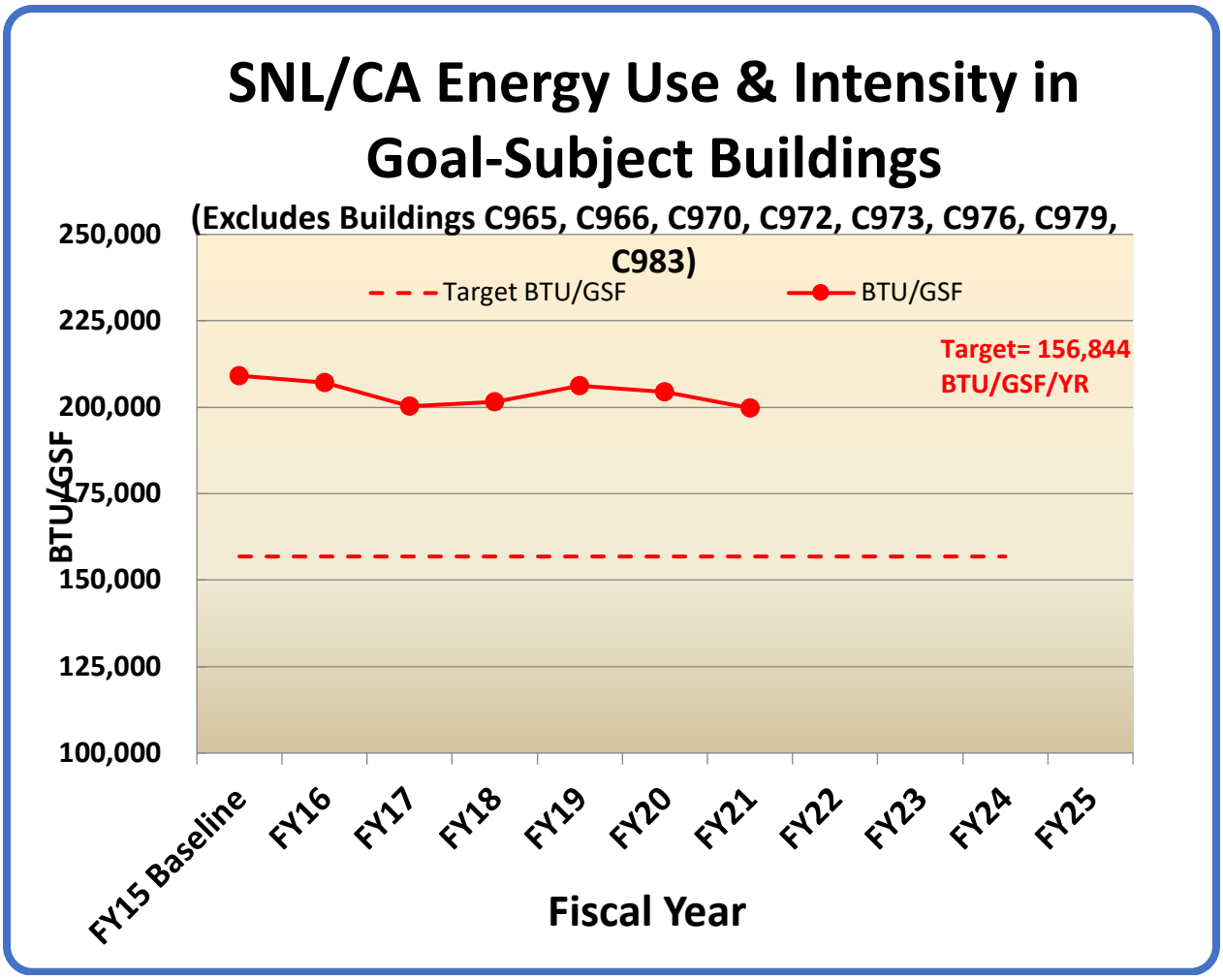


Figure 4-1 SNL/CA Energy Use Intensity

4.2.2. Water Use

Figure 4-2 presents fiscal year water use data for SNL/CA since 2007. The corporate target for water use intensity as established in 2017 was a 36 percent reduction by FY 2025, using FY 2007 data as a baseline. The 36 percent reduction goal was met in 2015 and maintained for six years.

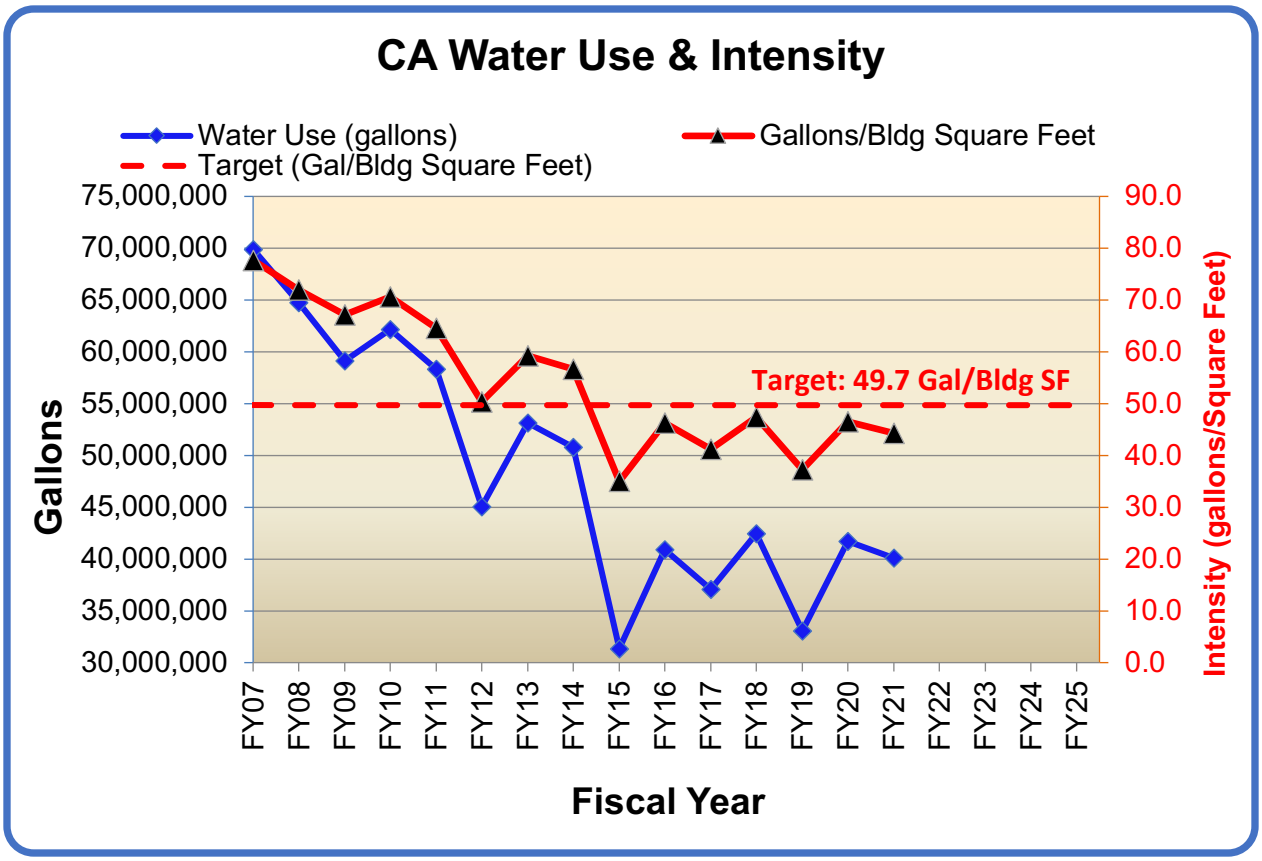


Figure 4-2 SNL/CA Water Use Intensity

4.2.3. Greenhouse Gas Reduction

Targets for air emissions in effect for 2021 include reducing Scope 1 and 2 greenhouse gas (GHG) emissions by 50 percent and reducing Scope 3 GHG emissions by 25 percent by FY 2025 from an FY 2008 baseline. Table 4-1 identifies the components of each emissions category.

Table 4-1 Greenhouse Gas Emissions by Category

Scope 1	Scope 2	Scope 3
Natural gas consumption	Purchased electricity	Employee commuting
Stationary combustion		Business ground and air travel
Fleet fuel consumption		Transmission and distribution losses
Process gases and fugitive emissions		Contracted (off-site) wastewater treatment
		Contracted (off-site) municipal waste disposal

Reductions in GHG emissions are measured collectively for SNL/CA and SNL/NM. Overall, there has been a reduction of Scope 1 and 2 GHG emissions by 58.9 percent relative to the 2008 baseline. Scope 3 GHG emissions have decreased from the 2008 baseline by 29.3 percent.

In 2021, SNL/CA personnel completed the following activities to support the corporate targets:

- continued design and replacement of heating/air conditioning control systems in site buildings to allow for automatic shutdown and set-back during nonstandard work hours;
- continued to divert solid waste from landfill disposal; and
- continued a Workplace Charging Program that allows SNL/CA personnel to utilize fleet vehicle charging stations for personal electric vehicles.

The State of California has many regulations addressing the reduction of GHG emissions. The regulations that are applicable to SNL/CA operations are:

- Sulfur Hexafluoride (SF6) Emission Reductions from Gas Insulated Switchgear
- SF6 Reductions from Non-Electric and Non-Semiconductor Applications (e.g., research applications)
- Refrigerant Management Program: Regulation for Non-Residential Refrigeration Systems

SNL/CA's Air Quality staff track GHG usage and emissions, advise on repair of GHG leaks and equipment, and report data to either the California Air Resources Board or the BAAQMD as required by these regulations. Table 4-2 provides a summary of GHG reporting.

Table 4-2 Summary of GHG Reporting, 2021

Greenhouse Gas	Emissions
Greenhouse Gas Emissions from Gas Insulated Equipment	0.0 MTCO2[a]
SF6 for Research Operations	4.79 kg of SF6
Refrigerants	0 lb of R-123 68 lb of R-22 59lb of R-410A 0 lb of R-502 0 lb of R-134a 0 lb of 404A 0 lb of 407C

[a] Leak rate and lb of SF6 emitted are calculated per CCR Title 17 Article 4 Sub article 3.1.

4.3. General Environmental Compliance Metrics

SNL/CA personnel track noncompliance with environmental requirements as a measure of our environmental management performance at SNL/CA. Figure 4-3 shows the number of findings from third-party audits (including those from DOE), notices of violation, and other environmental occurrences in the last ten years. The corporate goal is zero findings and zero violations. An EMS ISO 1400:2015 recertification audit was carried out from August 9 to the 11 by the Orion Registrar, Inc. During the audit, one initial finding was identified but was later voided and an additional three opportunities of improvement were documented. A CUPA audit was performed from October 26 to the 28 by the CUPA specifically Livermore Pleasanton Fire Department. During this audit, one minor finding was identified for 6 cylinders that were not properly restrained, this was fixed during the inspection. There were no self-reported non-compliances during CY 2021.

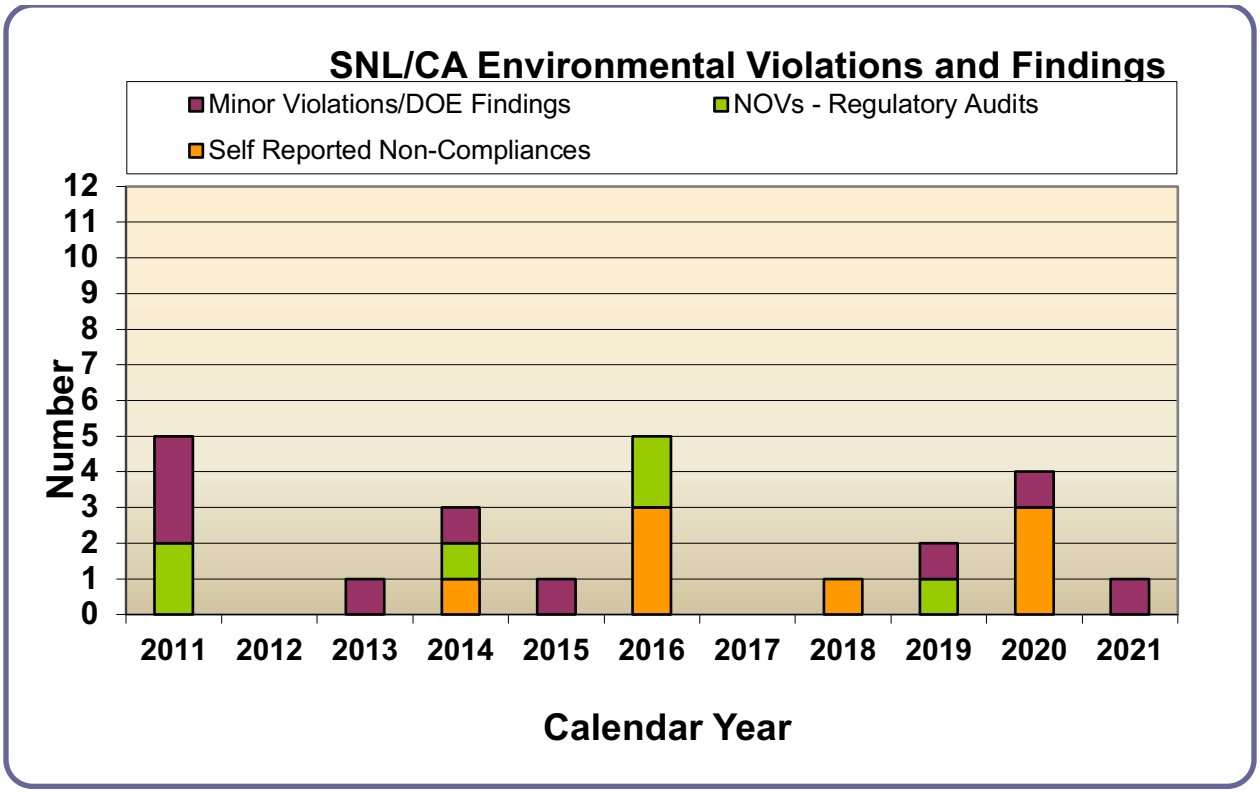


Figure 4-3 Measurement of Excellence in Environmental Management

4.4. Air Quality Program

In Alameda County, California, the Bay Area Air Quality Management District (BAAQMD) is the local regulatory authority that implements the air quality regulations and standards established by the EPA and the CA Air Resources Board (CARB).

The Air Quality program provides compliance assistance for all non-radiological air emission sources at SNL/CA. Air Quality staff review all directives, laws, and regulations relevant to air emissions for applicability to the site. Program staff manage the air permitting process, from the initial steps of preparing permit applications through implementing permit conditions and annual renewals. Air Quality staff are responsible for evaluating proposed projects, assessing chemical use, and assessing emissions of all criteria pollutants and toxic air contaminants.

Federal, state, and local agencies continue to develop measures to reduce exposure to toxic air contaminants and criteria pollutants. In addition, the State of California is well underway in implementing many new regulations aimed at reducing emissions from diesel engines and greenhouse gases, such as refrigerants, SF6 and other fluorinated gases. SNL/CA's Air Quality staff track GHG usage and emissions, monitor GHG containing equipment, advice on repair of leaks and develop strategies to minimize the GHG emissions. Many of the Air Quality Program efforts undertaken in 2021 support the state's endeavors through monitoring, compliance activities, and annual reporting. The Air Quality Program's additional highlights for 2021 are listed below.

- Prepared notification for the BAAQMD to discontinue two air permits for the emergency generators.

- Completed and submitted the BAAQMD Annual Update Package (supporting documentation and data for renewal of BAAQMD Permit-To-Operate).
- Tracked and report the SNL/CA leak rate for SF6 emissions from gas insulated switchgear for the year; which was 0% thereby meeting the required 2021 Air Resources Board Maximum Annual allowable SF6 Emission Rate of one percent or less.
- Met all regulatory report deadlines in 2021, submitting seven reports on schedule.
- Obtained an Authority to Construct for the Robotic Paint booth from the Bay Area Air Quality Management District.
- Obtained the Permit-to-Operate an emergency diesel generator from the Bay Area Air Quality Management District.

4.5. Environmental Monitoring and Ecology Program

The Environmental Monitoring and Ecology staff routinely monitor wastewater, stormwater, and groundwater systems at SNL/CA to assess the effect of site operations on the public and local environment (see Chapter 5). This program also monitors ecological resources and external radiation at the site perimeter (see Section 5.4 for radiation). This section presents general monitoring data for the Environmental Monitoring and Ecology Program. Chapter 5 presents detailed monitoring activities and sample results.

4.5.1. Ecological Resources

In June 2006, an Arroyo Seco Improvement Program (ASIP) was initiated to address erosion and stormwater control within the arroyo. In 2015, SNL/CA personnel completed the Arroyo Seco improvements under a U.S. Army Corp of Engineers (ACOE) permit authorizing specific activities within jurisdictional waters of the United States such as removing riprap and bank stabilizing projects. The initial ten-year period for this permit ended in July 2018, but a permit extension was received in 2018 that was valid until December 2020. The extension was required because SNL/CA personnel identified areas within the Arroyo Seco that had experienced significant erosion after heavy rainfall in the 2016/2017 storm season. Repairs to two different locations within the arroyo were completed in 2019. SNL/CA personnel do not anticipate further construction activities within the jurisdictional waters of the U.S. and as such has allowed the U.S. ACOE permit to expire.

In coordination with the ACOE streambed alteration permit, the Regional Water Quality Control Board (RWQCB) issued a requirement for restoration plantings at various locations along the Arroyo Seco. The permit outlines the locations, planting requirements, and growth and survivorship criteria. Monitoring is required for a minimum of 10 years from completion of plantings, or until the criteria identified in the permit have been met. Restoration plantings were carried out at thirteen different locations along the arroyo, some plantings occurred as early as 2007 with the most recent replating occurring in 2017. Annual surveys are performed by a contractor and an ASIP monitoring report is submitted to RWQCB by January 30 each year outlining the status and monitoring phase of each location. As of the 2021 monitoring season, seven sites met the 10-year growth and survivorship criteria, three sites are expected to meet criteria next monitoring season, and three sites may require additional plantings to meet criteria. Monitoring will continue until each site reaches the criteria outline by RWQCB. SNL/CA personnel have secured funding and a schedule is being developed to plant additional plants at the 3 locations not currently meeting growth and survivorship criteria.

4.5.2. Wastewater Discharges

The volume of sanitary sewer discharged in calendar year 2021 was approximately 5.9 million gallons, representing a 34.9 percent decrease from 2020. Wastewater discharges typically fluctuate year-to-year in response to changes in site operations and different influent water sources. Potential efforts that may have led to reduced wastewater include addition of closed loop systems (i.e. cooling water systems), improvements to irrigation systems, site wide potable water line replacement, and reduced onsite work presence in response to continued COVID-19 telework efforts.

4.5.3. Pollutants Released to the Ground or Groundwater

SNL/CA personnel track chemical spills that occur throughout the year. Figure 4-4 shows the number of spills and total gallons spilled each year since 2009. Typical materials spilled include motor oil, hydraulic oil, and coolants. Small releases to the ground surface are cleaned up within a few hours by the SNL/CA spill response team. There was one spill resulting from a small excavator that resulted in approximately one and one half (1.5) gallons of hydraulic oil to the soil. This spill did not reach groundwater or a storm drain and was promptly cleaned up by SNL/CA personnel.

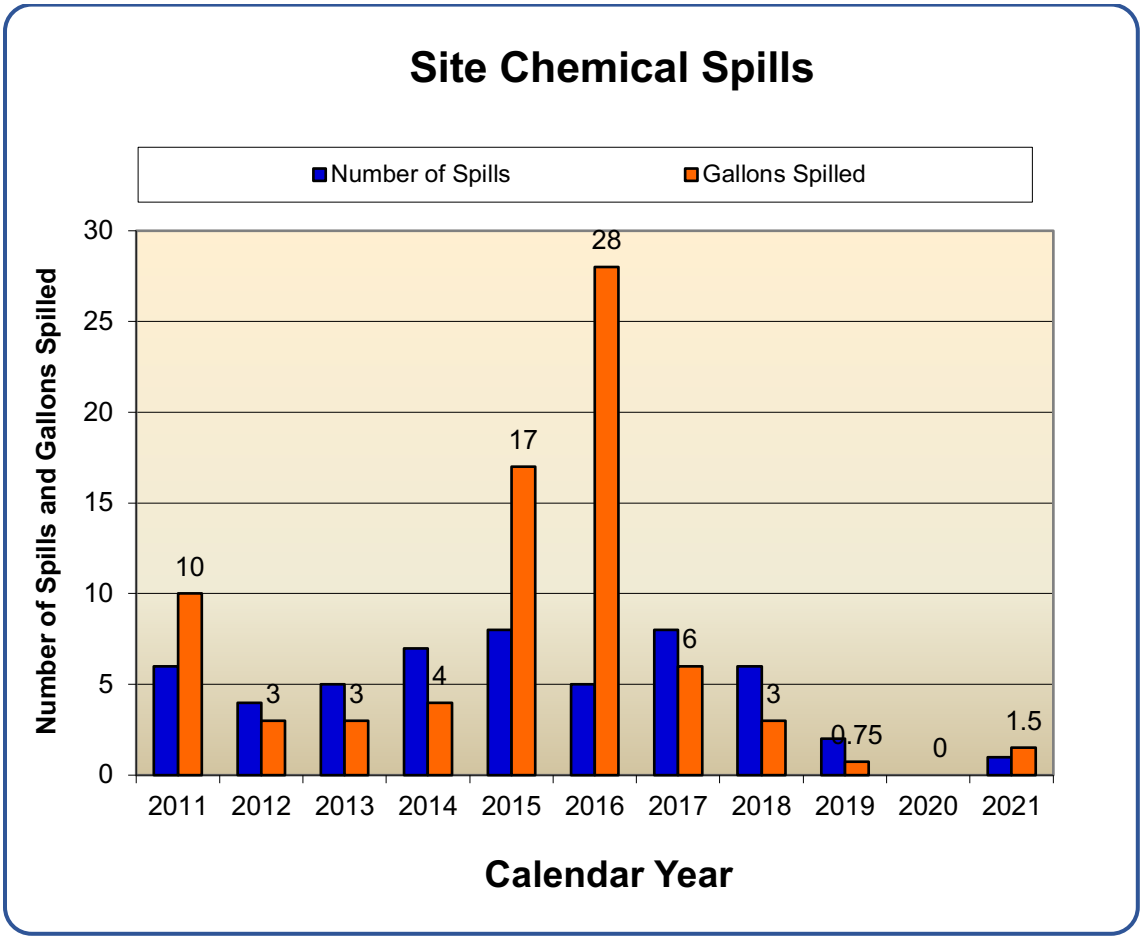


Figure 4-4 SNL/CA Chemical Spills

SNL/CA personnel are also required to report sanitary sewer overflows (SSOs) to the California State Water Resources Control Board. There were no sanitary sewer overflows at SNL/CA during the 2021 reporting year.

In 2019, SNL/CA personnel completed upgrading its sanitary sewer discharge network. As new sewer lines were installed or flow was rerouted to other existing lines, several sections of the sewer system were discontinued and abandoned-in-place by capping. Due to the SNL/CA's network of sanitary sewer lines being identified as Solid Waste Management Unit (SWMU) #16 under a Resource Conservation and Recovery Act (RCRA) Permit, the abandoned-in-place sections must be reviewed and formally closed by the RWQCB. In order to achieve a formal closure, the RWQCB required that SNL/CA personnel perform a soil investigation by collecting soil samples from around the abandoned sewer lines and have them analyzed for any potentially released contaminants. Currently to the date of this report, the RWQCB has not yet responded to the investigation results. If it is determined there is soil contamination around the sewer lines, SNL/CA personnel will address the contamination at the instruction of the agencies.

4.6. Environmental Planning Program

The Environmental Planning Program focuses on integrating environmental considerations and initiatives into site planning and development. Program activities include site-wide environmental analyses and reporting and NEPA reviews. Each year, Environmental Planning staff compare actual site operations to the maximum operations scenario presented in DOE's Site-Wide Environmental Assessment (SWEA) from 2003, and a supplement analysis (SA) completed in 2012, to determine whether SNL/CA operations remain within the bounding impact analysis. Table 4-3 presents a summary of the 2021 comparison and an evaluation of results.

Table 4-3 Comparison of 2021 Operations with SWEA / SA Envelope

Activity / Unit	SWEA / SA Envelope (maximum operations)	Calendar Year 2021	Site Operations Remain Within Impact Analysis of SWEA/SA
Action			
Site mission	Supports DOE, NNSA, DHS	No change	Yes
Arroyo Seco improvements	20 tasks	20 tasks – improvements completed	Yes
Increase operations	Increase to 2 shifts	1 shift	Yes
New facilities	5,000 sf badge office; new 16,000 sf laboratory; 84,000 sf laboratory replacement for Building 916; 8,400 sf computational facility	9,117 GSF added in 2021. (Data Center was completed in February 2021)	No- Data Center was reviewed and determined to be Categorically Excluded by DOE/SFO through checklist process.
Demolition- Real Property	100,000 sf	60,377 sf as of December 31, 2021	Yes
Land Use			
Construction area	93 acres	7.2 acres have been developed as of December 2021	Yes
Wildlife reserve	30 acres minimum	106 acres	Yes
Geology / Soil			
Solid waste management units	23 units total	22 units[a]	Yes
Soil removed	5000 cu yd/yr	<500 cu yd	Yes
Soil managed on site	5000 cu yd/yr	<5000 cu yd	Yes

Activity / Unit	SWEA / SA Envelope (maximum operations)	Calendar Year 2021	Site Operations Remain Within Impact Analysis of SWEA/SA
Backfill material brought on site	6000 cu yd/yr	<500 cu yd	Yes
Infrastructure			
Water use	91.8 million gal/yr	40 million gal	Yes
Sanitary sewer discharge	29.1 million gal/yr	5.9 million gal	Yes
Natural gas use	94 million cu ft/yr	57.2 million cu ft	Yes
Electricity use	48,800 MW hr/yr	34,430 MW hrs	Yes
Biological and Ecological Resources			
Construct flood plains in Arroyo Seco	1800 linear feet	612 linear feet as of December 31, 2018	Yes
Create riparian habitat	0.2 acres	5.64 acres as of December 31, 2021[b]	No, Positive impact
Ground disturbance in / along Arroyo	10 acres	< 6 acres as of December 31, 2018	Yes
Cultural Resources	None known on site	No change	Yes
Water Resources			
Impervious surface area	95.35 acres total	100.9 acres as of December 2021[c]	No
Irrigation water use	17 million gal/yr	No data[d]	- - -
Waste Generation			
Radioactive waste	8,811 kg/yr	0 kg	Yes
Hazardous waste	133,820 kg/yr	1946 kg	Yes
Solid waste (non-hazardous, excludes construction debris)	378.7 metric tons/yr	112 metric tons/yr[e,f]	Yes
Transportation			
Hazardous / radioactive waste shipments	116 shipments/yr	44 shipments/yr	Yes
Nonhazardous solid waste shipments to landfill	80 shipments/yr	48 routine trash/yr and 97 construction debris shipments/yr; 145 total/yr	No
Air Emissions			
Total criteria pollutants	8,212 kg/yr	4100.95 kg/yr[g]	Yes
Total air toxics	2,880.16 kg/yr	321.2kg/yr[g]	Yes
Radioactive	0 emissions annually	0 emissions annually	Yes
Permits	57 permits annually	9 permits annually[h]	Yes
Human Health			
Recordable accidents / injuries	78 accidents / injuries annually	12 accident / injuries annually[i]	Yes
Lost work-day cases	19 cases annually[i]	1 case annually[i]	Yes
Socioeconomics			
Employment	Up to 1931 persons annually	1416 persons annually[j]	Yes

[a] One SWMU was removed from site.
[b] Increase in riparian acreage is in response to ASIP.

[c] Increase in impervious surface is a result of continued site development.
[d] Water meters were not read in 2021 no data available for irrigation water use.
[e] Fiscal year data (October 1–September 30).
[f] Routine waste sent to the landfill.
[g] Annual emissions were calculated by multiplying the daily emissions reported in the BAAQMD Permit to Operate by 365. 2021 emissions are based on 2020 data.
[h] Data provided for the 2020/2021 (9 permitted sources) and 2021/2022 (8 permitted sources) permit periods. See Section 3.3.1 for more information.
[i] Extrapolated from historical average.
[j] SNL/CA employees (U.S. citizens and foreign nationals) and on-site contractors. Data from October 2021.

4.7. Pollution Prevention and Waste Minimization Program

The Pollution Prevention and Waste Minimization Program promotes the elimination or reduction of all waste types generated at SNL/CA. Staff work closely with other SNL/CA organizations to establish routine and project-specific recycling programs. Pollution Prevention and Waste Minimization staff provide guidance for resource and energy conservation and assist in identifying recycled-content products for use throughout the site.

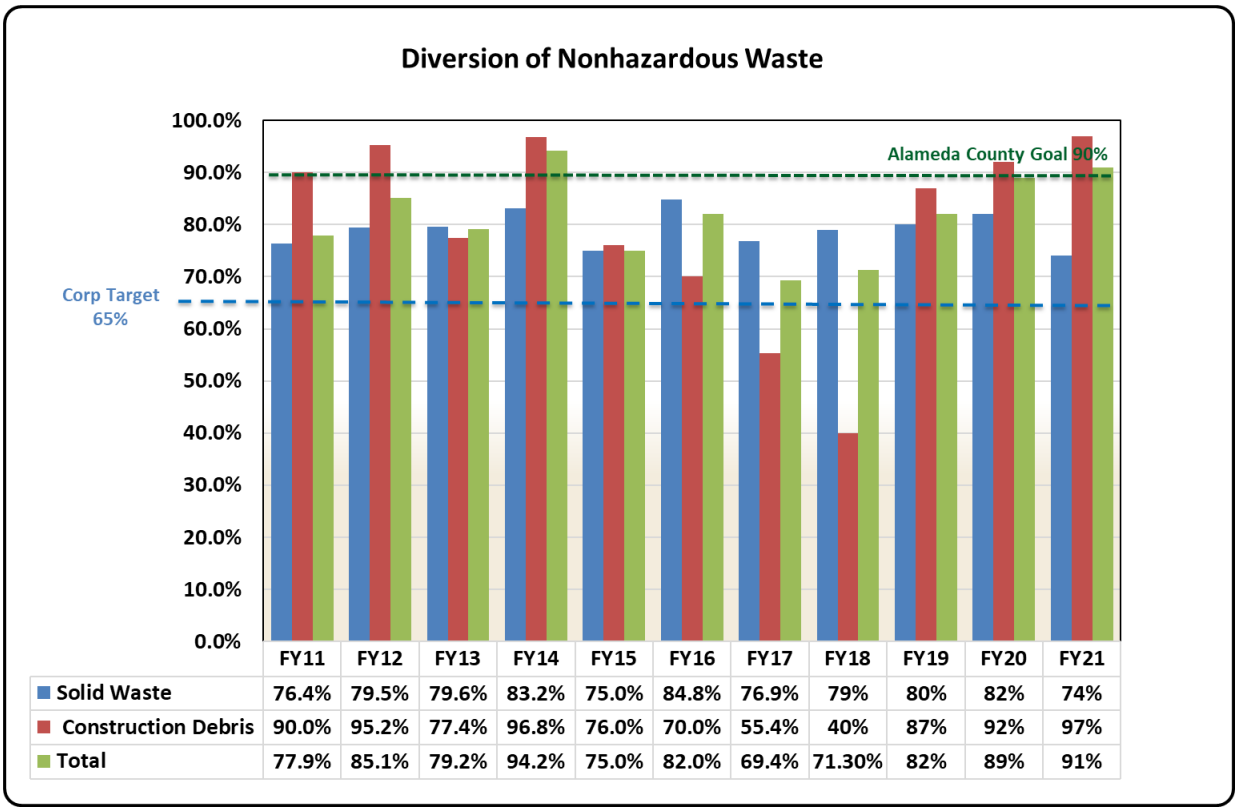
In 2021, Pollution Prevention staff conducted or supported the activities below.

- Hosted a virtual Earth Day celebration due to COVID 19. SNL/CA participants had an opportunity to attend virtual presentations by local environmental experts on topics such as backyard birding, highlighting adventures in nature, health benefits from being outdoors and minimizing food waste.
- Implemented the new Solid Waste Management Improvement Plan for the SNL/CA site. The implementation included deploying new signage, containers, and lids; educating the SNL/CA site on what materials should go in which waste container through California Daily Announcements. Inspections were conducted at 20 percent of the solid waste collection locations at the SNL/CA site to confirm communication efforts are being effective. The results of the assessment indicated that additional communications efforts are still needed, and a campaign to educate the site will continue in FY 2022.

4.7.1. Solid Waste

Consistent with an Alameda County ordinance, SNL/CA's goal for solid waste was to divert 90 percent of non-hazardous solid waste from landfill disposal by 2020. Figure 4-5 presents diversion results since FY 2017. During FY 2021, SNL/CA met Alameda County's 90 percent diversion goal when looking at the solid waste and construction debris combined waste streams. The total diverted waste increased from 89 percent in FY 2020 to 91 percent in FY 2021. However, the solid waste diversion (excluding construction debris) decreased from FY 2020 to FY 2021 from 82 percent to 74 percent, respectively. SNL/CA personnel will continue efforts to increase the diversion rate through recycling, composting, and reuse. The number of shipments of non-hazardous waste from the SNL/CA site was 145. This exceeded the maximum operation number of shipments identified in the SWEA of 80. The increase in shipments was due to an increase in construction and site operations. However, the increase in shipments did not result in the need for additional capacity at the local landfill.

Figure 4-6 presents routine municipal solid waste sent to the landfill for fiscal years 2017 to 2021. The quantity of non-hazardous solid waste sent to the landfill in 2021 increased by 52 metric tons from 2020. The increase in waste at SNL/CA is due to a change in the recycling facility's practices.



	FY11	FY12	FY13	FY14	FY15	FY16	FY17	FY18	FY19	FY20	FY21
Solid Waste	76.4%	79.5%	79.6%	83.2%	75.0%	84.8%	76.9%	79%	80%	82%	74%
Construction Debris	90.0%	95.2%	77.4%	96.8%	76.0%	70.0%	55.4%	40%	87%	92%	97%
Total	77.9%	85.1%	79.2%	94.2%	75.0%	82.0%	69.4%	71.30%	82%	89%	91%

Figure 4-5 Solid Waste and Construction Debris Diverted from Landfill Disposal

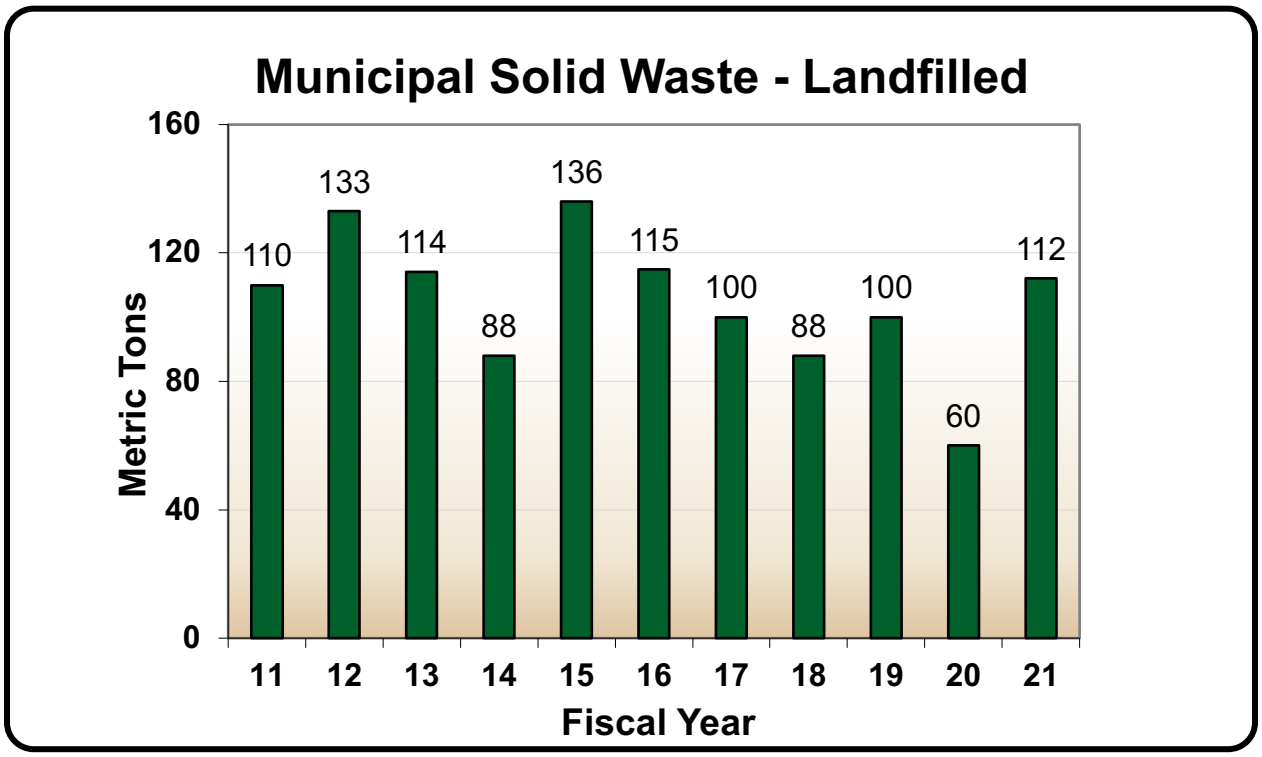


Figure 4-6 SNL/CA Landfill Waste

4.8. Waste Management

The Waste Management Program is responsible for managing hazardous, radioactive, and mixed wastes generated by SNL/CA operations. Waste Management personnel collect waste from the point of generation and transfer waste to on-site waste storage facilities for storage, consolidation, commingling, and packaging. Program personnel establish and maintain contracts for off-site recycling, treatment, and disposal of wastes. They provide regulatory oversight in accordance with federal, state, and local regulations, manage the Resource Conservation and Recovery Act (RCRA) and tiered permit process, and implement RCRA and tiered permit conditions. Waste Management personnel conduct process knowledge evaluations to characterize waste types generated from specific operations and provide waste generator training to the workforce at SNL/CA.

In 2021, Waste Management personnel conducted and/or supported the activities below.

- Coordinated with Environmental Management, Facilities, Occupational Health and Safety and research personnel to dispose of equipment and hazardous materials no longer needed for SNL/CA activities. All waste streams generated from this effort were processed and disposed as hazardous waste.
- Continued ongoing work with SNL/NM personnel to roll out a new database for tracking the generation and management (cradle to grave) of hazardous waste.
- Coordinated disposition of multiple roll-off bins of California Toxic/asbestos/PCB contaminated materials from building retrofits.
- Coordinated disposal of legacy export-controlled waste type material.
- Coordinated disposal of various energetic/ explosive materials
- Supported mixed/ non-mixed radioactive waste shipments
- Assist with coordination of decontamination services to support onsite lab expansion and building retrofits.
- Coordinated and performed decontamination services to support COVID-19 locations due to positive cases.

4.8.1. Hazardous and Radioactive Waste

SNL/CA personnel strive to minimize generation of hazardous and radioactive wastes through process controls, recycling, and reapplication of chemicals from one activity to another. Figure 4-7 and Figure 4-8 show hazardous and radioactive waste generated, respectively, over the last ten years. As shown, waste generation in both categories fluctuates from year to year depending on the nature and scope of projects conducted. The radioactive waste generated in 2021 was from routine research projects. Figure 3-4 depicts the radioactive waste shipped for the calendar year.

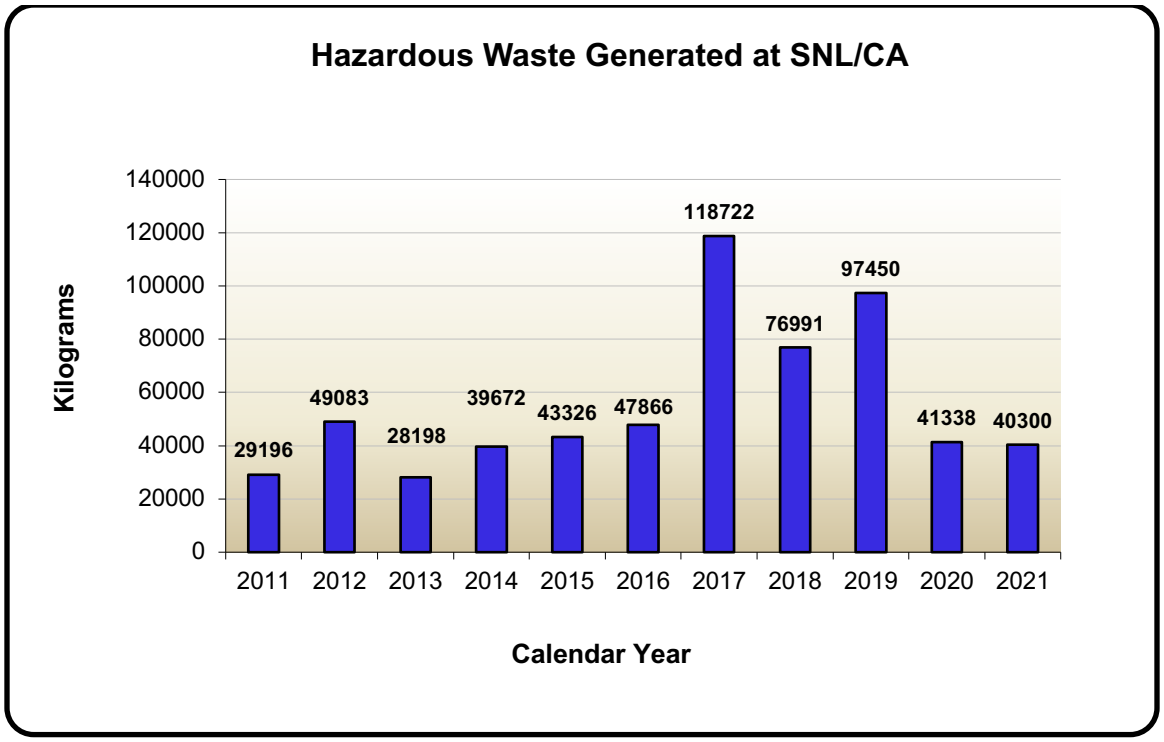


Figure 4-7 Hazardous Waste Generated at SNL/CA

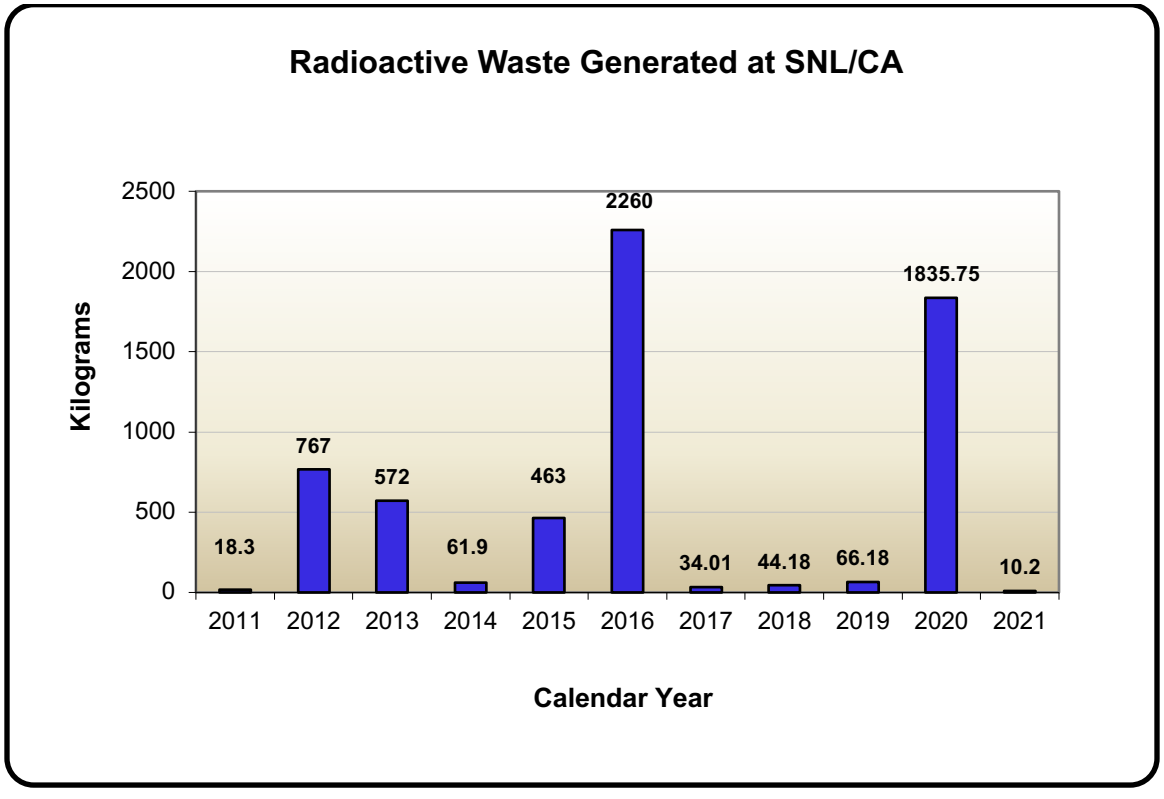


Figure 4-8 Radioactive Waste Generated at SNL/CA

CHAPTER 5. ENVIRONMENTAL MONITORING

Personnel at SNL/CA monitor stormwater, wastewater, groundwater, and gamma radiation. This chapter summarizes monitoring activities and results for each of these media. Both radiological and non-radiological data are presented.

SNL/CA personnel do not directly monitor airborne effluents. Non-radiological (chemical) emission sources do not require routine or continuous monitoring of ambient air quality concentrations. However, SNL/CA personnel do maintain equipment and process usage records (e.g., hours of operation or quantity of solvents used). Similarly, there are no radionuclide emission sources that require routine monitoring. SNL/CA personnel maintain an inventory of radioactive isotopes (small quantity sealed and unsealed sources) and operate several radiation generating devices. Emission monitoring is not required for these materials and devices.

Typically, radiological emission data that would be obtained from radionuclide effluent monitoring is used to evaluate the potential effect that a particular site's operations may have on local populations and the environment. Because there are no radionuclide emission sources and no monitoring data for site operations, calculations for maximum individual dose or collective population dose are not possible. SNL/CA personnel monitor ambient radiation. The results are presented in Section 5.4.

In the past, SNL/CA personnel conducted a biological dose assessment using the graded approach presented in DOE Standard 1153-2002, *A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota* (DOE 2002). The biological dose assessment was discontinued in 2017 since SNL/CA has not had a routine source of tritium emissions since 1995.

5.1. Stormwater

All industrial stormwater runoff from SNL/CA is conveyed to the Arroyo Seco that discharges into Alameda Creek and eventually to the San Francisco Bay. Stormwater that flows off buildings, material-handling areas, parking lots, and other impervious surfaces, may pick up pollutants, such as oil and grease, soil, litter, pesticides, and fertilizers. During heavy or continuing storms, runoff may transport pollutants to Arroyo Seco before the stormwater has time to evaporate or infiltrate into the ground.

Analytical Parameters – Stormwater

- ❒ pH
- ❒ Total suspended solids
- ❒ Oil and grease
- ❒ Metals – iron, lead, zinc, aluminum
- ❒ Chemical oxygen demand
- ❒ Nitrite + nitrate
- ❒ Phosphorus

To assess the impact of site operations to stormwater discharges, three sampling locations and 20 outfall locations were identified that provide the best representation of drainage areas and activities on site. Stormwater sampling locations are shown on Figure 5-1. Representative locations are required to be sampled four times during the year, twice during each half of the year. However, storm events may not produce enough runoff to collect samples at all three locations during the period or during any one storm.

During the 2020/2021 reporting year (July 1 through June 30), SNL/CA personnel performed sampling at one location. The sample was collected at Location 11 (ST-11), but none were collected at Location 13-2 due to the lack of discharge during the qualifying storm event (QSE). Location 13-2 is designed to contain flow up to the 95th percentile storm, so it is only sampled

during heavy rain events. The Industrial General Permit (IGP) requires SNL/CA to sample four (4) QSEs in a reporting year. However, due to lower-than-normal rainfall and timing of storms only one (1) QSE occurred for the SNL/CA site. Analytical results of stormwater sampling for the 2020/2021 reporting year are presented in Table 5-1. This sample was collected under the provisions of the IGP.

To minimize pollution in the runoff, SNL/CA personnel inspect and clean debris from the stormwater drainage system at least once per year before the rainy season begins. In addition, street sweeping is implemented as another best management practice to minimize stormwater pollution.

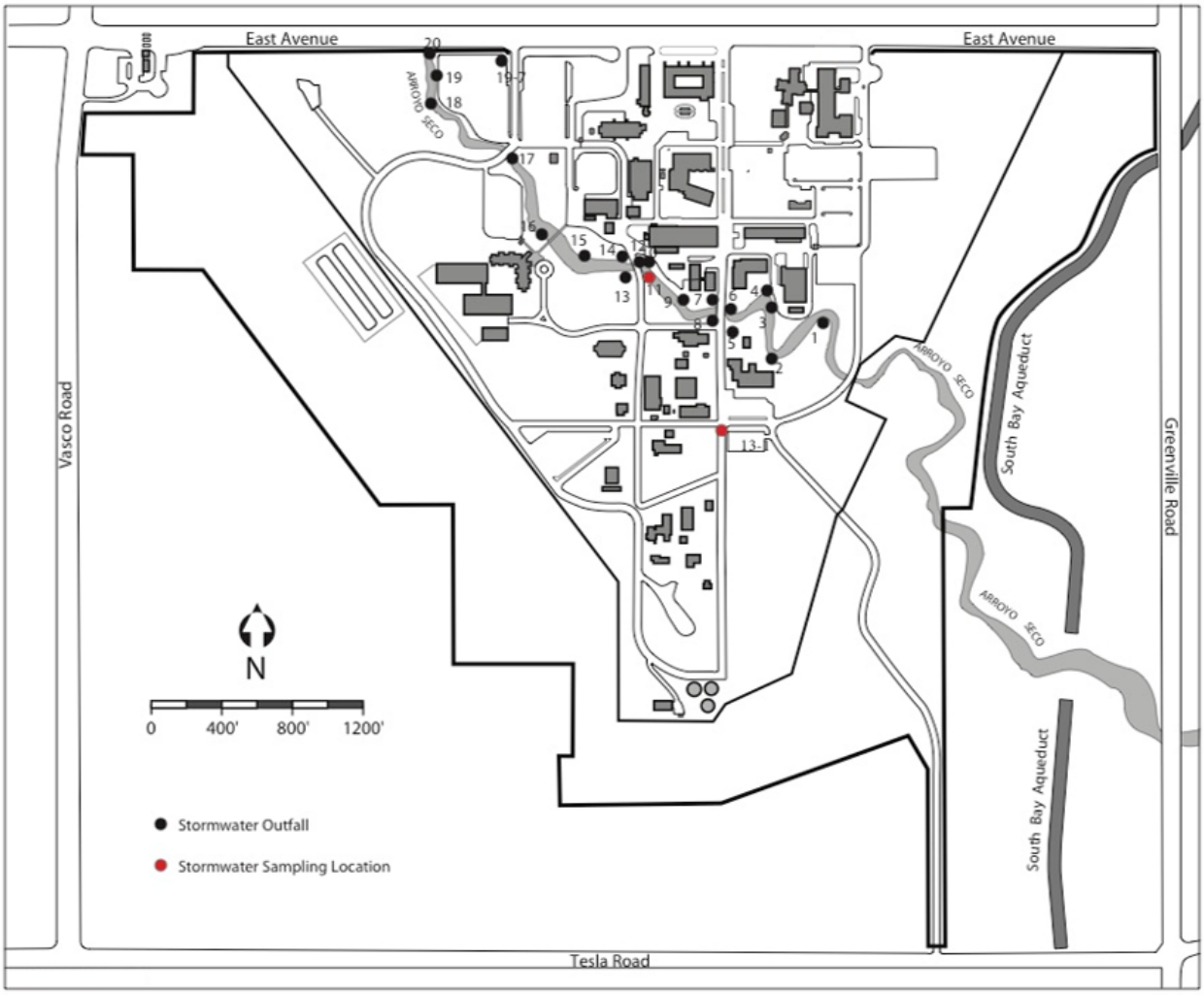


Figure 5-1 Stormwater Sampling Locations

Table 5-1 Summary of Analytical Results for Stormwater, 2020/2021 Reporting Year

Parameter	Number of Samples Analyzed	Number Found Below Detection Limit	Method Detection Limit	Numeric Action Level	Results Annual Average Concentration
Total suspended solids	1	0	0.3 mg/L	100 mg/L	6.9 mg/L
pH	1	NA	None	<6 or >9	7.25[a]
Oil and grease	1	0	1.4 mg/L	15 mg/L	1.6 mg/L[b]
Chemical oxygen demand	1	0	9 mg/L	120 mg/L	77 mg/L
Aluminum	1	0	0.02 mg/L	0.75 mg/L	0.92 mg/L
Iron	1	0	0.05 mg/L	1.0 mg/L	0.91 mg/L
Lead	1	0	0.0024 mg/L	0.262 mg/L	0.0052 mg/L
Zinc	1	0	0.016 mg/L	0.26 mg/L	0.091 mg/L
Nitrite + nitrate	1	0	0.04 mg/L	0.68 mg/L	0.39 mg/L
Total Phosphorus	1	0	0.02 mg/L	2.0 mg/L	0.18 mg/L

Tritium analyses were discontinued because SNL/CA has not had active tritium emissions since 1995.
[a] pH from stormwater readings are determined from instantaneous NALs.
[b] One or more results are below the reporting limit but above detection limit.

As under the 2014 IGP (amended version effective July 1, 2020), one (1) stormwater sample was collected by SNL/CA personnel for the 2020/2021 reporting year (July 1, 2020 through June 30, 2021), the sample was compared to the NALs to determine the site's compliance status. For SNL/CA to lower out of its current Level 2 status for iron and aluminum, the IGP requires SNL/CA to submit stormwater samples that are within the NALs for iron and aluminum from four (4) subsequent consecutive QSEs. Due to California's drought and limited rainfall, SNL/CA was unable to collect enough samples to meet this permit requirement for the 2020/2021 reporting year. To meet the permit's reporting requirements for Level 2 status, SNL/CA personnel submitted a Level 2 ERA Technical Report in June 2021 that outlined the actions to address the continued Level 2 status for iron and aluminum. These included actions such as adding a new type of metal-absorbing media socks (wattles), improving sampling techniques through pooling, performing investigating sampling, and finding ways to eliminating dirt introduction from the drainage channels and sampling locations. Per the IGP, SNL/CA personnel also submitted an Exceedance Response Action (ERA) Level 1 Report and ERA Level 2 Action Plan in June 2021 to described additional actions to be taken to address the NAL exceedances for pH in stormwater for the 2018/2019 and 2019/2020 reporting years. These actions included revising the pH calibration and operation procedures, performing investigative sampling upstream (if pH exceedance is observed), and confirmation testing with pH paper (if pH exceedance is observed).

Construction activities that are subject to the Construction General Permit (CGP) follow the compliance of the permit's requirements and implement a Stormwater Pollution Prevention Plan (SWPPP). All other construction activities onsite that do not fall under the CGP follow the compliance requirements under the IGP and SNL/CA's SWPPP. Stormwater runoff from these activities are properly contained onsite.

5.2. Wastewater

Wastewater effluent generated at SNL/CA consists of sanitary and laboratory discharges. Sanitary effluent is discharged directly to the sewer system. Sewer discharges exit the site through a sewer outfall located at the northern boundary and join with the Lawrence Livermore National Laboratory (LLNL) sewer system. Laboratory discharges are generated from general research activities and from operations that qualify as categorical processes subject to Federal pretreatment standards. Laboratory effluent from most laboratory areas is diverted to liquid effluent containment system (LECS) holding tanks prior to discharge to the sanitary sewer. SNL/CA personnel monitor wastewater at the sewer outfall, LECS tanks, and at categorical process point sources. SNL/CA met all the City of Livermore's wastewater permit requirements and discharge pollutant limits for the year as discussed in the following sections.

5.2.1. Sewer Outfall

A sewer outfall and monitoring station is operated at the northern SNL/CA boundary to continuously monitor wastewater for flow and pH. SNL/CA personnel also collect samples at the outfall to monitor compliance with wastewater discharge limits established in the Wastewater Discharge Permit for SNL/CA. Table 5-2 details the outfall sampling schedule and analytical parameters which were followed in 2021. Consistent with permit requirements, wastewater samples collected at the sewer outfall are not monitored for radioactive constituents.

Table 5-2 Sewer Outfall Sampling Schedule

Frequency	Sample Type	Analytical Parameter
Daily	Composite	Archive sample; analyzed only when weekly composite sample shows concentration greater than or equal to 50% of discharge limit for metals.
Weekly	Composite	Metals
Monthly	Composite	Total dissolved solids
		Total suspended solids
		Biochemical oxygen demand
		Chemical oxygen demand[a]
		Oil and grease
Monthly	Grab	Cyanide
		EPA priority organic pollutants

[a] Chemical oxygen demand analyses are not required by the Wastewater Discharge Permit.

Table 5-3 provides a summary of analytical results for physical parameters and metals from the SNL/CA sanitary sewer outfall. In 2021, all liquid effluent from the outfall complied with the site outfall discharge limits for all parameters. Sewer outfall samples are also analyzed for priority pollutants that are listed by the U.S. EPA as toxic organics. SNL/CA personnel report positively identified organic constituents. In 2021, sewer outfall samples showed sporadic concentrations of Dibromochloromethane (up to 1.3 μg/L), Toluene (up to 2.2 μg/L), Bromoform (up to 1.4 μg/L), Chloroform (up to 5.6 μg/L), Bromodichloromethane (up to 0.51 μg/L), Di-n-butylphthalate, (up to 1.6 μg/L), Phenol (at 10.0 μg/L) and Total Trihalomethanes (up to 5.6 μg/L). All other constituents on the EPA toxic organic list were below minimum detection limits. The toxic organic

discharge limit for the site is 1,000 µg/L. In 2021, SNL/CA operations did not exceed this discharge limit. Detailed sewer analysis results are provided in Appendix A.

Table 5-3 Composite Sewer Outfall Monitoring Results – Physical Parameters and Metals, 2021

Parameter	Number of Samples Analyzed	Quantity Found Below Detection Limit	Detection Limit (mg/L)	Sewer Discharge Limit (mg/L)	Minimum Concentration (mg/L)	Maximum Concentration (mg/L)
Total suspended solids	12	0	0.30	None	200	710
Total dissolved solids	12	0	10	None	150	1500
Biochemical oxygen demand	12	0	2.0	None	160	970
Chemical oxygen demand[a]	12	0	9	None	360	670
Oil & Grease – Mineral	12	0	1.4	100	3.6	16
Oil & Grease – Animal / Veg.	12	8	1.4	300	1.6	3.8
Cyanide	12	7	0.0020	0.04	0.0022	0.021
Arsenic	52	25	0.00040	0.06	0.00091	0.013
Cadmium	52	26	0.000060	0.14	0.000077	0.00042
Chromium	52	29	0.0005	0.62	0.00055	0.0082
Copper	52	0	0.00040	1.0	0.00042	0.34
Lead	52	32	0.00060	0.2	0.0012	0.0095
Mercury	52	51	0.00006	0.01	<0.000060	0.000061
Nickel	52	5	0.00030	0.61	0.002	0.010
Silver	52	34	0.000050	0.20	0.000053	0.00087
Zinc	52	0	0.0010	3.00	0.069	0.73

[a] Chemical oxygen demand analyses are not required by the Wastewater Discharge Permit.

5.2.2. Liquid Effluent Containment System

Effluent from major laboratory facilities is diverted to LECS holding tanks where wastewater can be sampled and analyzed prior to release to the sewer system. Five LECS tanks were operated at SNL/CA during 2021. Wastewater from LECS tanks is typically analyzed for metals. Analyses for other parameters associated with the process that generates the wastewater may also be done. Four of the five LECS tanks are also continuously monitored for pH. One LECS tank located at the Radioactive Waste Management Facility is used infrequently and monitored prior to discharge for tritium and uranium.

Wastewater captured in LECS tanks that does not meet wastewater discharge permit limits at the sewer outfall is evaluated on a case-by-case basis to ensure appropriate disposal requirements are met. Depending on the constituents of the wastewater, it may be released to the sanitary sewer (the standard process), disposed off-site as non-hazardous waste, or disposed off-site as hazardous waste. Through this routine sampling process, SNL/CA personnel identified one (1) instance where

wastewater contained in a LECS system did not meet the discharge requirements, and as such, that batch was collected and shipped off-site for disposal as non-hazardous waste.

5.2.3. Categorical Processes

Three research operations at SNL/CA are defined as federal categorical processes subject to the EPA's pretreatment standards for point sources (40 CFR Part 403, 40 CFR Part 433). These categorical processes include one metal finishing operation, a semiconductor manufacturing operation, and a spray paint booth. Wastewater from the semiconductor manufacturing operation is sampled semiannually. The metal finishing operations and the spray paint booth are closed-loop systems that do not discharge effluent to the sanitary sewer, and, therefore, wastewater monitoring is not required. There is an additional laboratory that has the ability to infrequently use metal cyanide complexes for electroplating, but this is done on a very small scale (less than 50 mL), and all liquid waste is collected and handled as hazardous waste. There is no discharge to the sanitary sewer system from this process.

Samples collected from the semiconductor manufacturing operation are analyzed for pH, arsenic, and toxic organic pollutants. Table 5-4 presents a summary of semiannual monitoring results for the semiconductor manufacturing operation. In 2021, all wastewater from this operation met the pretreatment standards.

Table 5-4 Monitoring for Semiconductor Manufacturing Categorical Process, 2021

Parameter	Number of Samples Analyzed	Number Found Below Detection Limit	Detection Limit	Minimum Concentration	Maximum Concentration	Permit Limit[a]
pH	2	--	None	6.34	6.76	5-10
Arsenic	2	2	0.0040 mg/L	<0.0040 mg/L	0.0040 mg/L	2.09 mg/L
Total toxic organics	2	2	Range[b]	All below detection limit	<0.010 mg/L	1.37 mg/L[c]

[a] Permit limit for site outfall.
[b] Detection limits for the various organics included in this value range from 0.005 to 0.130 mg/L.
[c] The limit for total organics is a daily maximum concentration.

5.3. Groundwater

There are seven (7) groundwater monitoring wells at SNL/CA. SNL/CA personnel monitor groundwater at two (2) former restoration areas and along Arroyo Seco. Three (3) groundwater monitoring wells are used to monitor residual contamination at former restoration areas under a 1989 site clean-up order issued by the RWQCB, San Francisco Bay Region. Two (2) of these wells are located at the Fuel Oil Spill site, and one (1) is at the Navy Landfill. Four (4) monitoring wells are located along Arroyo Seco to monitor the effect of site operations on groundwater quality. Well AS-4 is located up gradient of the developed area of the site and provides background data about local groundwater quality. Figure 5-2 displays groundwater monitoring well locations. Also shown in Figure 5-2 is groundwater monitoring well MW-406 which is monitored by LLNL. Table 5-5 provides the sampling schedule for each well location.

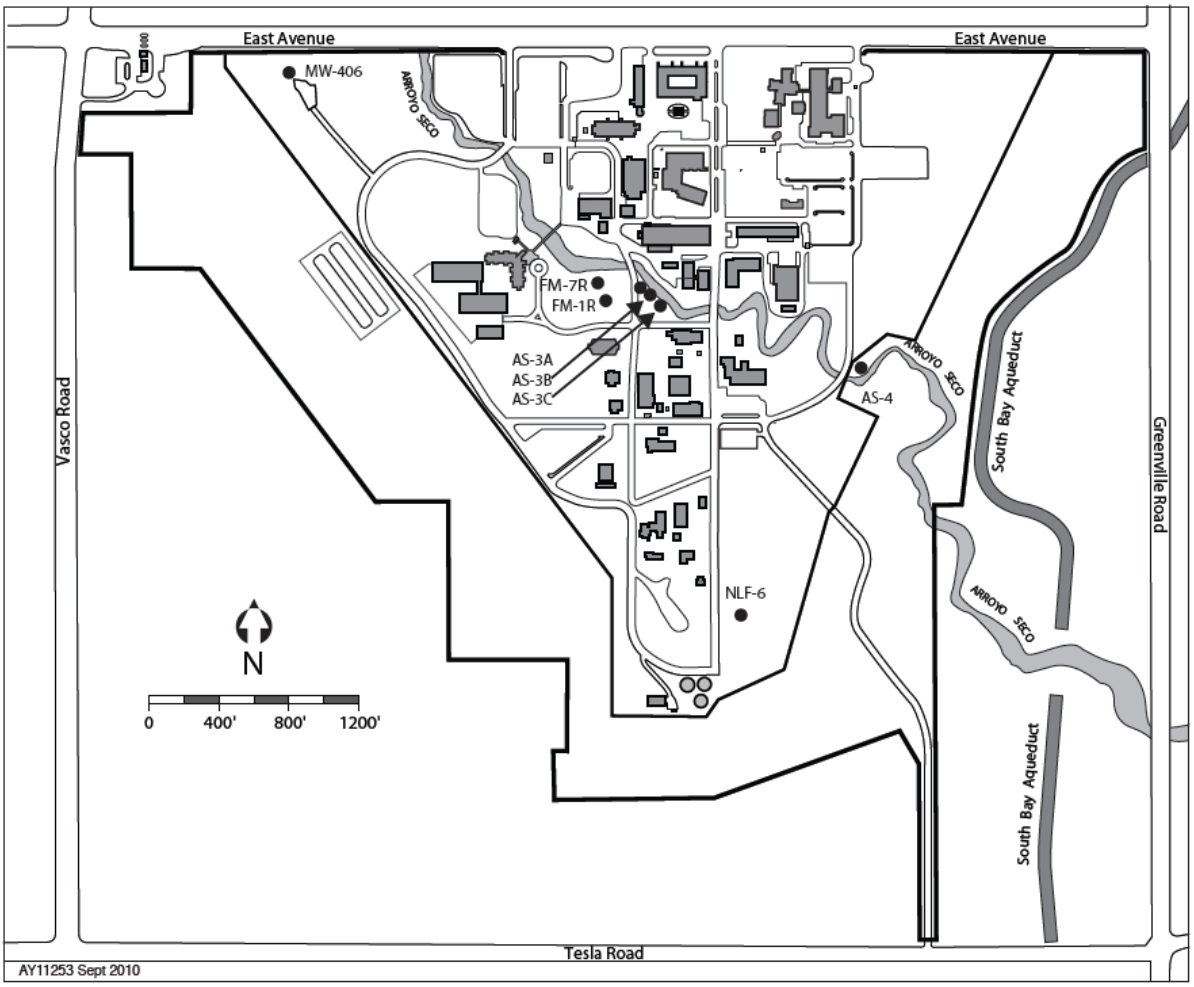


Figure 5-2 Groundwater Monitoring Well Locations

Table 5-5 Groundwater Sampling Schedule

Well location	Sampling frequency	Analytical parameter
Fuel Oil Spill site (Wells FM-1R, FM-7R)	Semi-annually	Total petroleum hydrocarbons diesel-methane; Benzene, Ethylbenzene, Toluene, Xylenes; Napthalene; water elevation
Navy Landfill (Well NLF-6)	Annually	Volatile halogenated organics; water elevation
Arroyo Seco (Wells AS-3A, AS-3B, AS-3C, and AS-4)	Annually	Metals, volatile halogenated organics, total petroleum hydrocarbons-diesel, water elevation
Arroyo Seco (Wells AS-3A, AS-3B, AS-3C, and AS-4)	Every two years	General minerals

Table 5-6 presents a summary of groundwater analytical results for the Navy Landfill. Table 5-7 presents a summary of groundwater analytical results for the Fuel Oil Spill wells. Table 5-8 summarizes groundwater analytical results for Arroyo Seco wells. Analyses for general minerals in

Arroyo Seco samples are completed every two years and are required for 2021. Appendix A provides complete groundwater analytical results. As a point of reference, analytical results are compared to federal and state maximum contaminant levels (MCLs), which are applicable for drinking water sources. No wells at SNL/CA are used as a source for drinking water, and MCLs are not standards applied to groundwater at the site.

As in past years, sample results continued to show carbon tetrachloride at the Navy Landfill well (NLF-6) in 2021. The concentration was above the state MCL of 0.5 µg/L, but below the federal MCL of 5.0 µg/L. The result is similar to that detected in past years. The presence of carbon tetrachloride in this well has been noted since well completion. The State Water Resources Control Board requires SNL/CA personnel to continue monitoring this well for carbon tetrachloride, though the Navy Landfill is considered a closed site. It should be noted that well NLF-6 does not draw water from a drinking water or irrigation aquifer. The MCLs are shown for comparison only. A further comparison would be to EPA's Suggested No-Adverse Response Level— that of 200 µg/L for a 10-day exposure.

In 2021, there was no detection of diesel at the Fuel Oil Spill site during the first quarter and third quarter sampling. Table 5-7 summarizes ground water analyses for the Fuel Oil Spill site. Figure 5-3 shows the levels of diesel at Fuel Oil Spill site and the associated depth to ground water and uses the method detection limit figure if a result read "Non-Detect" from the analytical report.

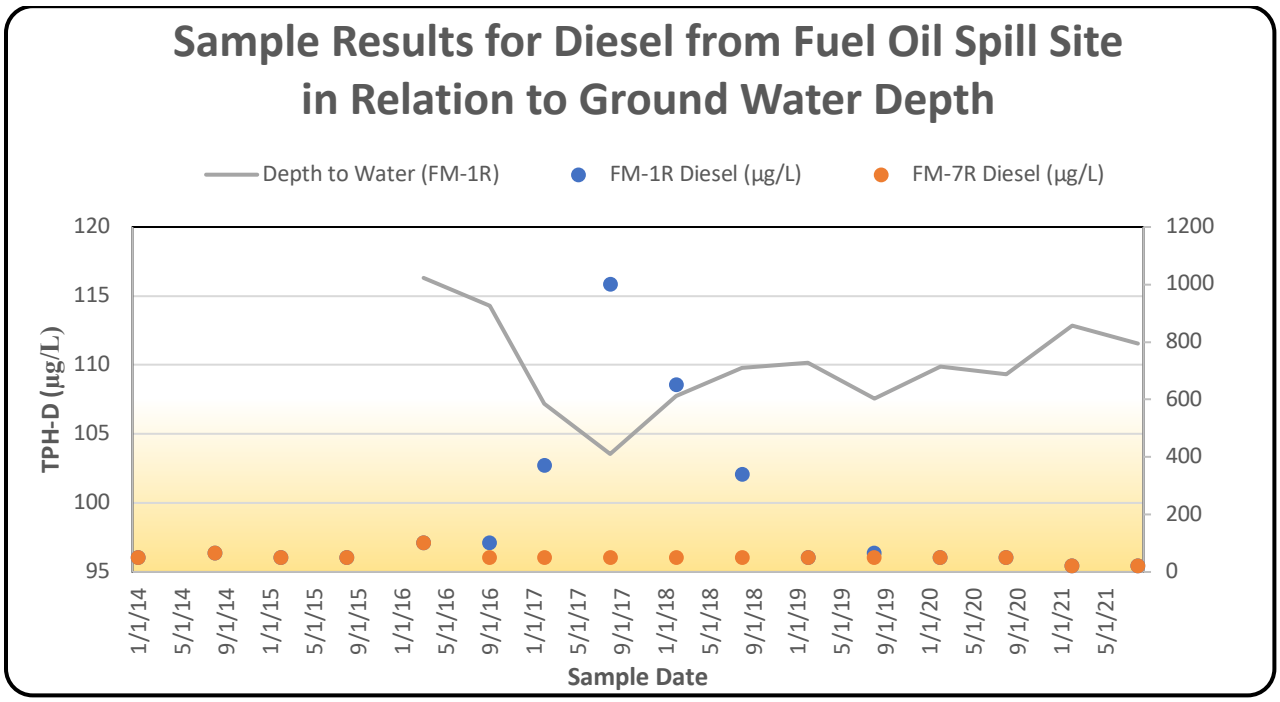


Figure 5-3 Sample Results for Diesel from Fuel Oil Spill Site in Relation to Ground Water Depth

Table 5-6 Summary of Groundwater Analyses – Navy Landfill, 2021

	Date	Trichloromethane[a] (chloroform) µg/L	Carbon Tetrachloride[a] µg/L	Tetrachloroethene[a] µg/L	Dibromofluoromethane µg/L	Toluene-d8[b] µg/L
Detection limit	N/A	0.2	0.2	0.2	1.0	1.0
MCL – California	N/A	N/A	0.5	5	N/A	150
MCL – Federal	N/A	100	5	5	N/A	1000
Navy Landfill						
NLF-6	5/19/21	0.58	1.4	ND	20.6	19.9

[a] All other EPA 8260B parameters were non-detectable.
[b] Limits for Toluene used as a substitute due to Toluene-d8 does not have limits listed.
MCL – Maximum contaminant levels.
N/A- Not Applicable

Table 5-7 Summary of Groundwater Analyses – Fuel Oil Spill, 2021

	Date	TPH-D µg/L	Benzene µg/L	Toluene µg/L	Ethylbenzene µg/L	Xylenes µg/L
Detection limit	N/A	50	0.3	0.3	0.4	0.5
MCL – California	N/A	-	1	150	300	1750
MCL – Federal	N/A	-	5	1000	700	10000
Fuel Oil Spill						
FM-1R	2/18/21	ND	ND	ND	ND	ND
FM-7R	2/18/21	ND	ND	ND	ND	ND
FM-1R	8/18/21	ND	ND	ND	ND	ND
FM-7R	8/18/21	ND	ND	ND	ND	ND

MCL – Maximum contaminant levels.
N/A- Not Applicable

Table 5-8 Summary of Groundwater Analyses at Arroyo Seco Wells - Metals, 2021

				CCR Metals										
	Date	EPA 8260b	Diesel (8015) µg/L	Arsenic mg/L	Barium mg/L	Cadmium mg/L	Chromium mg/L	Mercury µg/L	Copper mg/L	Molybdenum mg/L	Nickel mg/L	Selenium mg/L	Vanadium mg/L	Thallium mg/L
Detection limit	N/A	-	50	0.0040	0.003	0.001	0.004	0.060	0.014	0.003	0.003	0.008	0.0030	0.003
MCL - California	N/A	-	-	0.01	1	0.01	0.05	2.0	1	-	-	0.01	-	-
MCL – Federal	N/A	-	-	0.01	2	0.005	0.1	2.0	1	-	0.1	0.05	-	0.002
AS-3A[a]	5/19/21	-	-	-	-	-	-	-	-	-	-	-	-	-
AS-3B	5/19/21	19.1[b], 19.9[c], 21[d]	ND	ND	0.12	ND	0.011	ND	ND	ND	ND	ND	0.0041	ND
AS-3C	5/19/21	18[b], 19.8[c], 19.9[d]	ND	ND	0.15	ND	0.0082	ND	ND	0.0061	ND	ND	ND	ND
AS-4	5/19/21	19.7[b], 20.7[c], 22.2[d]	ND	ND	0.079	ND	0.0041	ND	ND	ND	ND	ND	0.0065	ND

[a] Water level in well too low (dry) to sample
[b] Bromofluorobenzene (ug/L)
[c] Toluene-d8 (ug/L)
[d] Dibromofluoromethane (ug/L)
MCL – Maximum contaminant levels.
ND – Non-detectable.
N/A- Not Applicable

5.4. Radiation Monitoring

SNL/CA personnel monitor gamma radiation to ensure that site operations are not significantly contributing to the ambient radiation dose in the surrounding environment. On-site sources that could contribute to gamma radiation include small, unsealed radioactive isotopes, sealed sources, and several radiation-generating devices. Ten perimeter monitoring stations, two background monitoring stations, and one onsite monitoring station are equipped with optically stimulated luminescent dosimeters and maintained at SNL/CA. Monitoring stations are shown in Table 5-9. The dosimeters are collected and evaluated quarterly.

The annual average background dose in 2021 was measured to be 44.1 mrem (0.44.1 mSv). The average annual perimeter dose was measured to be 46 mrem (0.46 mSv). The average annual dose for the San Francisco Area is estimated to be 43.8 mrem (Mauro and Briggs 2005). Figure 5-4 shows the dosimeter locations at SNL/CA.

Table 5-9 Environmental Radiation Monitoring Data, 2021

Location Classification	Number of Observations	Average (mrem/year)	Median (mrem/year)	Standard Deviation (mrem/year)	Minimum (mrem/year)	Maximum (mrem/year)
On Site	1	25	n/a	n/a	n/a	n/a
Perimeter	10	46.0	46.1	3.0	40.9	50.2
Off-Site	2	44.1	44.1	15.8	32.9	55.9

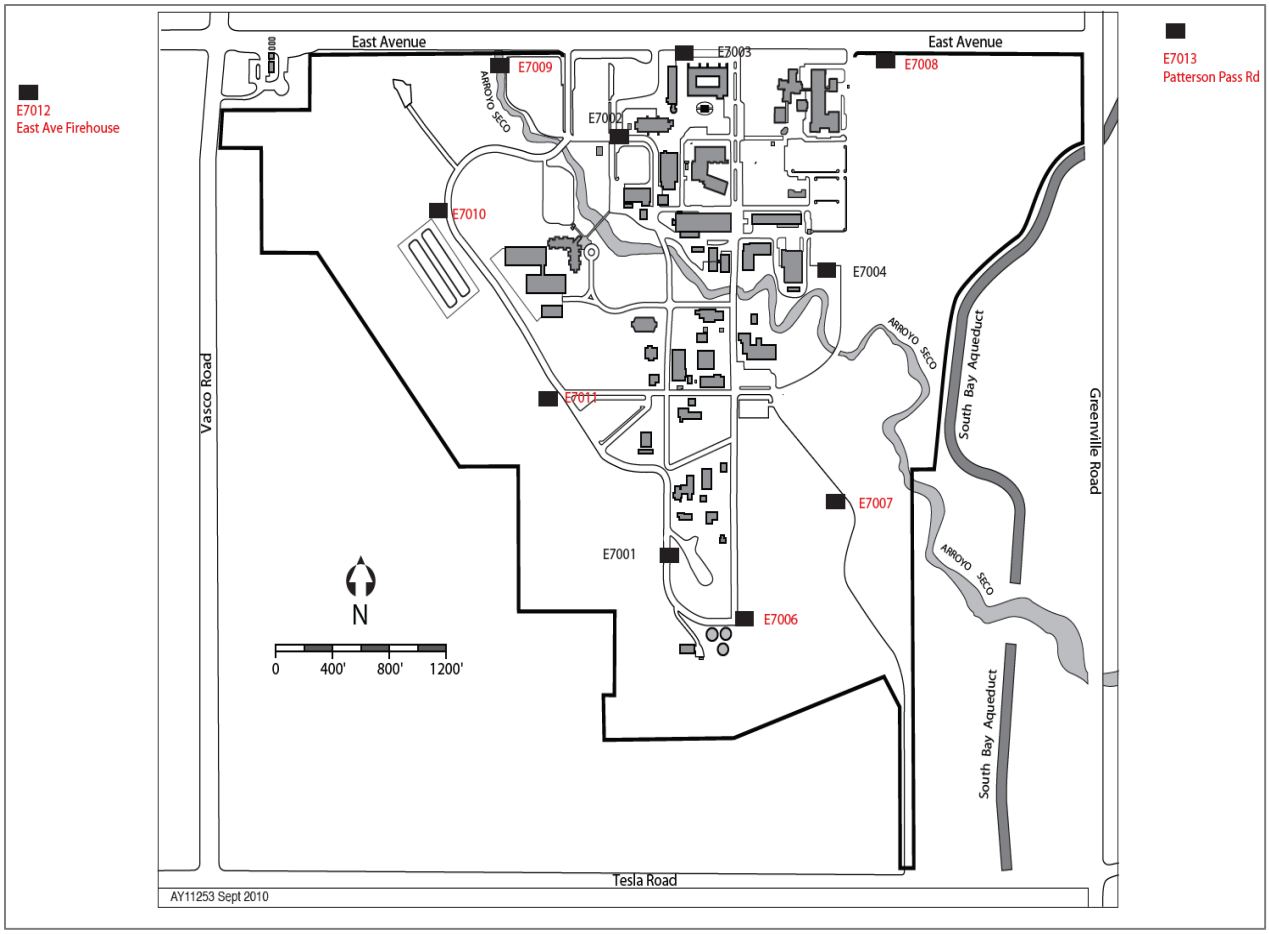


Figure 5-4 Dosimeter Locations at SNL/CA and Around Site Perimeter

CHAPTER 6. QUALITY ASSURANCE

Sandia National Laboratories, California (SNL/CA) personnel follow the Laboratory Policy for quality assurance, QA001, *Quality Assurance Policy* (SNL 2022). The Policy further indicates that the Quality Assurance Program is described in the *Quality Assurance Program Description* and satisfies the requirements established in the DOE 10 CFR (Code of Federal Regulations) 830, *Nuclear Safety Management*, Subpart A, *Quality Assurance Requirements*, and *DOE Order 414.1D, Quality Assurance* (DOE 2013b). The Environmental Management Department implements each functional area quality requirements by executing the actions specified in those policies and operating procedures.

DOE Order 414.1D identifies ten criteria that are integral to a quality program:

1) Quality assurance program
2) Personnel training and qualification
3) Quality improvement process
4) Documents and records
5) Established work processes
6) Established standards for design and verification
7) Established procurement requirements
8) Inspection and acceptance testing
9) Management assessment
10) Independent assessment

6.1. Environmental Monitoring Quality Assurance

The Environmental Monitoring and Ecology Program ensures quality in its activities through implementation of quality assurance plans and procedures. An Environmental Management Department-specific quality assurance project plan addresses each of the 10 criteria listed above, and documents quality assurance activities performed for the function (SNL/CA 2020a). Additional operating procedures specify training requirements, establish work processes, define data verification and validation processes, and identify reporting and records management requirements. The operating procedures are reviewed by subject matter experts and approved by the Environmental Management Department Manager every 3 years.

6.2. Environmental Sampling

Protocols for environmental sampling at SNL/CA are contained in activity-specific standard operating procedures (SOPs). Each SOP is controlled by the program lead and the frequency at which the procedure is reviewed and updated is self-identified by the program lead when the documents are created, which can vary from 1 to 3 years. Elements of these protocols include appropriate sampling methods and equipment; sampling frequency; sampling locations; and sample handling, storage, and packaging. Implementation of established protocols ensures that samples are representative of the environmental medium monitored and that monitoring requirements outlined in permits, DOE directives, and regulations are met. Chain-of-custody protocols are also used to ensure quality control through proper transfer of samples from the point of collection to the analytical laboratory.

6.3. Sample Analyses

Analyses of samples collected at SNL/CA are performed using one of two avenues, depending on the sample medium or constituent analyzed. The two avenues are: a state accredited laboratory, or the SNL/NM Radiation Protection Dosimetry Program (RPDP).

6.3.1. Accredited Laboratory

A state of California accredited laboratory performs analyses of non-radiological samples collected at SNL/CA. To receive accreditation, a laboratory must implement all applicable requirements identified in the Environmental Laboratory Accreditation Program certification process. These laboratories are periodically inspected by the California Environmental Protection Agency to ensure that they are operating within quality assurance requirements. Consistent with industry standards, non-radiological samples are processed according to federal Environmental Protection Agency methods.

6.3.2. SNL/NM Radiation Protection Dosimetry Program

The RPDP at SNL/NM issues optically stimulated luminescent dosimeters to measure gamma and neutron radiation. The environmental dosimetry program utilizes dosimeters provided and read by Landauer Corporation. Dosimeters are issued and processed quarterly.

6.4. Data Verification and Validation

SNL/CA personnel conduct data verification and validation to ensure that environmental data is precise, accurate, representative, comparable, and complete. The data verification is performed to ensure that environmental data used is accurately reported and transmitted whereas the data validation is performed to ensure that environmental data used meets the quality objectives. Verification and validation are accomplished through analyses of quality control samples and by conducting statistical analyses.

6.4.1. Quality Control Samples

Types of quality control samples prepared for the Environmental Monitoring Program include duplicate, spiked, and blank samples. A definition of each sample type follows:

- *Duplicate samples* are collected at the same time and location, and follow the same method, as a routine sample. These samples are used to assess the precision of sample collection and analytical processes.
- *Spiked samples* resemble a routine sample but contain a known amount of one or more of the constituents of interest. These samples are obtained from an independent laboratory that certifies the concentration of the constituents.
- *Blank samples resemble a routine sample matrix* (e.g., deionized water is used for blank water samples) but lack the constituents of interest. These samples are used to assess background levels of constituents and possible contamination of the samples in the laboratory or in the field.

The goal for number of quality control samples at SNL/CA is 20 percent of the total sample load, where feasible. This includes quality control samples initiated at the laboratory. In 2021, SNL/CA personnel collected 26 wastewater quality control samples and submitted two blind spike sample, representing 28 percent of the sample load. Three groundwater quality control samples were collected representing 27 percent of the sample load. One stormwater quality control sample was collected during the 2020/2021 wet season, representing 25 percent of the sample load.

6.4.2. Statistical Analyses

Statistical analyses are used to determine completeness, precision, and accuracy of monitoring and surveillance data. Prior to performing statistical analyses, the data is normalized to ensure that valid results are obtained. Descriptions of the statistical tests follow:

- Completeness is evaluated by determining the ratio between the number of samples collected and the number of samples scheduled for collection. The data quality objective for completeness is 85 percent.
- Precision is evaluated using three methods: determining the ratio between routine and duplicate samples, tests of significant difference, and calculating the 95 percent confidence interval. Data quality objectives vary for precision depending on the results of laboratory analyses and number of samples.
- Accuracy is also evaluated using three methods: determining the ratio between sample results and known values of spiked samples, tests of significant difference, and calculating the 95 percent confidence interval. Data quality objectives vary for accuracy depending on the results of laboratory analyses and number of samples.

Table 6-1 summarizes the results of statistical analyses conducted in 2021. There was one (1) observed outlier (greater than three (3) standard deviations) in November 2021 for Total Dissolved Solids (TDS) and was removed from the statistical analyses. The three (3) failed wastewater accuracy tests were silver (one sample), Biochemical Oxygen Demand (BOD) (one sample), and Total Suspended Solids (TSS) (one sample). Silver failed due to laboratory oversight when the silver analysis was not diluted and redigested. This was discussed with SNL/CA personnel. With the exception of the one (1) silver sample, these failed tests and all other accuracy tests parameters met the manufacture's Certificate of Analysis: Performance Acceptance Limits. Stormwater sampling is reported by the California State Waterboard Industrial General Permit's reporting calendar of July (2020) through June (2021). Due to limited precipitation and Qualifying Storm Events (QSEs) during the 2020/2021 reporting year, only one (1) stormwater sample was collected. With the lower sample volume from the QSE, a duplicate sample could not be collected, and a precision test was not performed. However, a blank sample was collected and did not display any reportable limits.

Table 6-1 Summary of Statistical Analyses, 2021

Sample Medium	Completeness Test	Precision Test		Accuracy Test	
	Results	# of Tests	Results	# of Tests	Results
Wastewater (sanitary sewer)	100%	6	6 passed[a]	28	25 passed
Stormwater [b, c]	100%	-	-	-	-
Groundwater	100%	2	2 passed	-	-

[a] Outlier data point found and removed for Total Dissolved Solids.
[b] Stormwater samples used were from the July 2020-June 2021 reporting year.
[c] Stormwater samples are scheduled when a QSE occurs during operating hours and when conditions are safe.

APPENDIX A. GROUNDWATER ANALYTICAL RESULTS, WELL COMPLETION DATA, AND SANITARY SEWER ANALYTICAL RESULTS

Groundwater analysis results for 2021 are presented in Table A-1. Well depth and screen period intervals are presented in Table A-2. Routine monitoring results for sanitary sewer outfall are presented in Table A-3, Table A-4, and Table A-5.

Table A-1 Results of Groundwater Analyses at SNL/CA, 2021

	Date	Chloromethane µg/L	Vinyl Chloride µg/L	Bromomethane µg/L	Chloroethane µg/L	Methylene Chloride µg/L	Trans-1,2-Dichloroethene µg/L	1,1 Dichloroethane µg/L	Trichloromethane (chloroform) µg/L	1,1,1-Trichloroethane µg/L	Carbon Tetrachloride µg/L	1,2 Dichloroethane µg/L	Trichloroethene µg/L	1,2-Dichloropropane µg/L
Detection limit		0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
MCL - California			0.5			5	10	5		200	0.5	0.5		5
MCL - Federal			2			5	100			200	5	5		5
Well ID														
NLF-6	5/19/21	ND	ND	ND	ND	ND	ND	ND	0.58	ND	1.4	ND	ND	ND
Field Dup	5/19/21	ND	ND	ND	ND	ND	ND	ND	0.59	ND	1.2	ND	ND	ND
Field Blank	5/19/21	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Trip Blank	5/19/21	ND	ND	ND	ND	0.29	ND	ND	ND	ND	ND	ND	ND	ND
AS-3A [a]	5/19/21	-	-	-	-	-	-	-	-	-	-	-	-	-
AS-3B	5/19/21	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
AS-3C	5/19/21	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
AS-4	5/19/21	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
FM-1R	-	-	-	-	-	-	-	-	-	-	-	-	-	-
FM-1R	-	-	-	-	-	-	-	-	-	-	-	-	-	-
FM-7R	-	-	-	-	-	-	-	-	-	-	-	-	-	-
FM-7R	-	-	-	-	-	-	-	-	-	-	-	-	-	-

MCL – Maximum contaminant level.
ND – Non-detectable.
[a] Well was dry.
- Not required to analyze or sample not collected.

Table A-1 Results of Groundwater Analyses at SNL/CA, 2021 (continued)

	Date	Bromodichloromethane µg/L	Cis-1,3-Dichloropropene µg/L	Trans-1,3-Dichloropropene µg/L	1,1,2-Trichloroethane µg/L	Tetrachloroethene µg/L	Dibromochloromethane µg/L	Chlorobenzene µg/L	Bromoform µg/L	1,1,2,2-Tetrachloroethane µg/L	1,3-Dichlorobenzene µg/L	1,4-Dichlorobenzene µg/L	1,2-Dichlorobenzene µg/L	8015-Diesel (w/silica gel clean-up) µg/L
Detection limit		0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	20
MCL - California			0.5	0.5	5					1		5	600	
MCL - Federal					5					100		75	600	
Well ID														
NLF-6	5/19/21	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Field dup	5/19/21	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Field blank	5/19/21	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Trip Blank	5/19/21	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
AS-3A	5/19/21	-	-	-	-	-	-	-	-	-	-	-	-	-
AS-3B	5/19/21	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
AS-3C	5/19/21	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
AS-4	5/19/21	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
FM-1R	2/18/21	-	-	-	-	-	-	-	-	-	-	-	-	ND
FM-1R	8/18/21	-	-	-	-	-	-	-	-	-	-	-	-	ND
FM-7 R	2/18/21	-	-	-	-	-	-	-	-	-	-	-	-	ND
FM-7R	8/18/21	-	-	-	-	-	-	-	-	-	-	-	-	ND

MCL – Maximum contaminant level.
ND – Non-detectable. - Not required to analyze or sample not collected.

Table A-1 Results of Groundwater Analyses at SNL/CA, 2021 (continued)

	Date	Antimony mg/L	Arsenic mg/L	Barium mg/L	Beryllium mg/L	Cadmium mg/L	Chromium mg/L	Cobalt mg/L	Copper mg/L	Lead mg/L	Mercury mg/L	Molybdenum mg/L	Nickel mg/L	Selenium mg/L	Silver mg/L	Thallium mg/L	Vanadium mg/L	Zinc mg/L
Detection limit		0.0060	0.0040	0.020	0.0050	0.0010	0.0040	0.0020	0.014	0.010	0.060	0.0030	0.0030	0.010	0.0040	0.0030	0.0030	0.050
MCL - California		0.006	0.010	1	0.004	0.005	0.05		1.3	0.015	0.002		0.1	0.05		0.002		
MCL - Federal		0.006	0.010	2	0.004	0.005	0.1		1.3	0.015	0.002			0.05		0.002		
Well ID																		
NLF-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Field dup	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Field blank	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AS-3A	5/19/21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AS-3B	5/19/21	ND	ND	0.12	ND	ND	0.011	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.0041	ND
AS-3C	5/19/21	0.0098	ND	0.15	ND	ND	0.0082	ND	ND	ND	ND	0.0061	ND	ND	ND	ND	ND	ND	ND
AS-4	5/19/21	ND	ND	0.079	ND	ND	0.0041	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.0065	ND
FM-1R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
FM-1R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
FM-7 R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
FM-7R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

MCL – Maximum contaminant level. ND – Non-detectable. - Not required to analyze or sample not collected

Table A-1 Results of Groundwater Analyses at SNL/CA, 2021 (continued)

Date	Benzene µg/L	Toluene µg/L	Ethylbenzene µg/L	Xylenes (total) µg/L
Detection limit	0.3	0.3	0.4	0.5
MCL - California	1	150	300	1750
MCL - Federal	5	1000	700	10000
Well ID				
NLF-6 5/19/21	ND	ND	ND	ND
Field dup 5/19/21	ND	ND	ND	ND
Field blank 5/19/21	ND	ND	ND	ND
AS-3A 5/19/21	-	-	-	-
AS-3B 5/19/21	ND	ND	ND	ND
AS-3C 5/19/21	ND	ND	ND	ND
AS-4 5/19/21	ND	ND	ND	ND
FM-1R 2/18/21	ND	ND	ND	ND
FM-1R 8/18/21	ND	ND	ND	ND
FM-7R 2/18/21	ND	ND	ND	ND
FM-7R 8/18/21	ND	ND	ND	ND

MCL – Maximum contaminant level.
ND – Non-detectable.
- Not required to analyze or sample not collected

Table A-2 Well Depth and Screen Period Interval

Area	Well ID	Well Depth (ft)	Screen Period Interval (ft)
Fuel Oil Spill Site	FM-1R	129	99 – 129
	FM-7R	129	99 - 129
Arroyo Seco	AS-3A	112.58	100 – 110
	AS-3B	124.97	118 – 123
	AS-3C	157	150 – 155
	AS-4	28.57	15 – 25
Trudell Auto Repair Shop	MW-406	94	87[a]
Navy Landfill	NLF-6	110	87 – 102

[a] Start of screen interval. Length of screen interval is unknown.

Table A-3 Routine Monitoring Results for SNL/CA Sanitary Sewer Outfall, 2021

Date	Laboratory ID #[a]	BOD[b] SM5210B	COD[b] E410.4	TDS[b] SM2540C	TSS[b] SM2540D	Oil & Grease – Mineral[c]	Oil and Grease-Animal/ Veg[c]	Cyanide[c] Kelada-01
		All results reported in mg/L						
January								
January 5	21A0626	510	390	150	200	3.6	<1.4	<0.0050
February								
February 2	21B0656	450	600	370	430	15	<1.4	<0.0050
March								
March 2	21C0459	200	440	670	310	4.8	<1.4	<0.0050
April								
April 6	21D0782	200	460	910	340	11	2.6 J	<0.0050
May								
May 4	21E0501	370	670	330	290	16	1.6 J	<0.0050
June								
June 1	21F0203	170	510	740	200	4.4	<1.4	0.021
July								
July 6	21G0479	190	360	290	220	7.4	<1.4	<0.0020
August								
August 3	21H0492	160	410	370	210	8.9	3.8	<0.0050
September								
September 7	21I0747	230	530	310	200	6.7	<1.4	<0.0050
October								
October 5	21J0632	160	350	400	200	5.0	<1.4	<0.0050
November								
November 2	21K0502	970	610	1500	710	16	2.0	<0.0050
December[d]								
December 7	21L0922	480	620	780	460	13	<1.4	<0.0050
Discharge Limit[e]		N/A[f]	N/A[f]	N/A[f]	N/A[f]	100	300	0.04

[a] Analyses performed by an offsite, state certified laboratory.
[b] Weekly composite sample. The dates indicate the day the sample was collected. The sample represents a representative composite for the previous week.
[c] Grab sample.
[d] Site shutdown from December 25, 2021, through January 3, 2022.
[e] Discharge concentration limits, City of Livermore Municipal Code 13.32.
[f] N/A indicates not applicable (i.e., there is no specific discharge limit for this parameter).

Table A-4 Routine Monitoring Results for SNL/CA Sanitary Sewer Outfall, Method E200.8, 2021

		As	Cd	Cr	Cu	Pb	Hg	Ni	Ag	Zn
Date[a]	**Laboratory ID #[b]**	**All results reported in mg/L**								
January										
01/05/2021	21A0602	<0.0040	<0.0010	<0.0050	0.098	<0.0070	<0.000060	<0.0100	<0.0040	0.730
01/12/2021	21A1675	<0.0040	<0.0010	<0.0050	0.090	<0.0070	<0.000060	<0.0100	<0.0040	0.550
01/19/2021	21A2448	<0.0040	<0.0010	<0.0050	0.085	<0.0070	<0.000060	<0.0100	<0.0040	0.420
01/26/2021	21A3158	<0.0040	<0.0010	<0.0050	0.088	<0.0070	<0.000060	<0.0100	<0.0040	0.310
February										
02/02/2021	21B0650	0.0072	<0.0010	<0.0050	0.100	<0.0070	<0.000060	<0.0100	<0.0040	0.340
02/09/2021	21B1851	0.0057	<0.0010	<0.0050	0.096	<0.0070	<0.000060	<0.0100	<0.0040	0.270
02/16/2021	21B2623	0.0065	<0.0010	<0.0050	0.110	<0.0070	<0.000060	<0.0100	<0.0040	0.260
02/23/2021	21B3396	<0.0040	<0.0010	<0.0050	0.078	<0.0070	<0.000060	<0.0100	<0.0040	0.160
March										
03/02/2021	21C0479	0.0066	<0.0010	<0.0050	0.065	<0.0070	<0.000060	<0.0100	<0.0040	0.200
03/09/2021	21C1587	<0.0040	<0.0010	0.0082	0.340	0.0095	<0.000060	<0.0100	<0.0040	0.460
03/16/2021	21C2656	<0.0040	<0.0010	<0.0050	0.200	<0.0070	0.000061	<0.0100	<0.0040	0.420
03/23/2021	21C3536	<0.0040	<0.0010	<0.0050	0.140	<0.0070	<0.000060	<0.0100	<0.0040	0.410
03/30/2021	21C4126	<0.0040	<0.0010	<0.0050	0.100	<0.0070	<0.000060	<0.0100	<0.0040	0.290
April										
04/06/2021	21D0785	<0.0040	<0.0010	<0.0050	0.073	<0.0070	<0.000060	<0.0100	<0.0040	0.200
04/13/2021	21D1671	<0.0040	<0.0010	<0.0050	0.042	<0.0070	<0.000060	<0.0100	<0.0040	0.100
04/20/2021	21D0782	<0.0040	<0.0010	<0.0050	0.061	<0.0070	<0.000060	<0.0100	<0.0040	0.150
04/27/2021	21D3159	<0.0040	<0.0010	<0.0050	0.074	<0.0070	<0.000060	<0.0100	<0.0040	0.180
Discharge Limit[c]		0.06	0.14	0.62	1.0	0.20	0.01	0.61	0.20	3.0

*Site shutdown from December 25, 2021 through January 3, 2022.
"J" Indicates detection above Method Detection Limit (MDL) but below the Reporting Limit (RL).
[a] Samples are collected as a weekly composite.
[b] Analyses performed by an off-site, independent laboratory.
[c] Discharge concentration limits, City of Livermore Municipal Code 13.32.

Table A-4 Routine Monitoring Results for SNL/CA Sanitary Sewer Outfall, Method E200.8, 2021 (continued)

Date[a]	Laboratory ID #[b]	As	Cd	Cr	Cu	Pb	Hg	Ni	Ag	Zn
		All results reported in mg/L								
May										
05/04/2021	21E0498	<0.0040	<0.0010	<0.0050	0.130	<0.0070	<0.000060	<0.0100	<0.0040	0.260
05/11/2021	21E1431	<0.0040	<0.0010	0.0059	0.330	<0.0070	<0.000060	<0.0100	<0.0040	0.340
05/18/2021	21E2225	<0.0040	<0.0010	<0.0050	0.230	<0.0070	<0.000060	0.010	<0.0040	0.350
05/25/2021	21E2972	<0.0040	<0.0010	<0.0050	0.160	<0.0070	<0.000060	<0.0100	<0.0040	0.320
June										
06/01/2021	21F0206	<0.0040	<0.0010	<0.0050	0.12	<0.0070	<0.000060	<0.0100	<0.0040	0.33
06/08/2021	21F1295	<0.0040	<0.0010	<0.0050	0.099	<0.0070	<0.000060	<0.0100	<0.0040	0.33
06/15/2021	21F2143	<0.0040	<0.0010	<0.0050	0.15	<0.0070	<0.000060	<0.0100	<0.0040	0.27
06/22/2021	21F2872	<0.0040	<0.0010	<0.0050	0.17	<0.0070	<0.000060	<0.0100	<0.0040	0.25
06/29/2021	21F3566	<0.0040	<0.0010	<0.0050	0.079	<0.0070	<0.000060	<0.0100	<0.0040	0.25
July										
07/06/2021	21G0481	<0.0040	<0.0010	<0.0050	0.044	<0.0070	<0.000060	<0.0100	<0.0040	0.10
07/13/2021	21G1676	<0.0040	<0.0010	<0.0050	0.051	<0.0070	<0.000060	<0.0100	<0.0040	0.11
07/20/2021	21G2649	<0.0040	<0.0010	<0.0050	0.041	<0.0070	<0.000060	<0.0100	<0.0040	0.092
07/27/2021	21G3468	<0.0040	<0.0010	<0.0050	0.068	<0.0070	<0.000060	<0.0100	<0.0040	0.11
August										
08/03/2021	21H0489	<0.0040	<0.0010	<0.0050	0.083	<0.0070	<0.000060	<0.0100	<0.0040	0.13
08/10/2021	21H1539	<0.0040	<0.0010	<0.0050	0.057	<0.0070	<0.000060	<0.0100	<0.0040	0.099
08/17/2021	21H2419	<0.0040	<0.0010	<0.0050	0.087	<0.0070	<0.000060	<0.0100	<0.0040	0.140
08/24/2021	21H3176	<0.0040	<0.0010	<0.0050	0.054	<0.0070	<0.000060	<0.0100	<0.0040	0.11
08/31/2021	21I0023	<0.0040	<0.0010	<0.0050	0.069	<0.0070	<0.000060	<0.0100	<0.0040	0.12
Discharge Limit[c]		0.06	0.14	0.62	1.0	0.20	0.01	0.61	0.20	3.0

*Site shutdown from December 25, 2021 through January 3, 2022.
"J" Indicates detection above Method Detection Limit (MDL) but below the Reporting Limit (RL).
[a] Samples are collected as a weekly composite.
[b] Analyses performed by an off-site, independent laboratory.
[c] Discharge concentration limits, City of Livermore Municipal Code 13.32.

Table A-4 Routine Monitoring Results for SNL/CA Sanitary Sewer Outfall, Method E200.8, 2021 (continued)

Date[a]	Laboratory ID #[b]	As	Cd	Cr	Cu	Pb	Hg	Ni	Ag	Zn
		All results reported in mg/L								
September										
09/07/2021	21I0732	<0.0040	<0.0010	<0.0040	0.041	<0.0070	<0.000060	<0.0100	<0.0040	0.096
09/14/2021	21I1817	<0.0040	<0.0010	<0.0040	0.085	<0.0070	<0.000060	<0.0100	<0.0040	0.18
09/21/2021	21I2742	<0.0040	<0.0010	<0.0040	0.10	<0.0070	<0.000060	<0.0100	<0.0040	0.26
09/28/2021	21I3572	<0.0040	<0.0010	<0.0040	0.11	<0.0070	<0.000060	<0.0100	<0.0040	0.34
October										
10/05/2021	21J0631	<0.0040	<0.0010	<0.0040	0.069	<0.0070	<0.000060	<0.0100	<0.0040	0.24
10/12/2021	21J1695	<0.0040	<0.0010	<0.0040	0.12	<0.0070	<0.000060	<0.0100	<0.0040	0.26
10/19/2021	21J2652	<0.0040	<0.0010	<0.0040	0.15	<0.0070	<0.000060	<0.0100	<0.0040	0.30
10/26/2021	21J3485	<0.0040	<0.0010	0.0045	0.15	<0.0070	<0.000060	<0.0100	<0.0040	0.35
November										
11/2/2021	21K0493	<0.0040	<0.0010	<0.0040	0.13	<0.0070	<0.000060	<0.0100	<0.0040	0.30
11/9/2021	21K1513	<0.0040	<0.0010	<0.0040	0.15	<0.0070	<0.000060	<0.0100	<0.0040	0.31
11/16/2021	21K2493	<0.0040	<0.0010	<0.0040	0.15	<0.0070	<0.000060	<0.0100	<0.0040	0.31
11/23/2021	21K3258	<0.0040	<0.0010	<0.0040	0.14	<0.0070	<0.000060	<0.0100	<0.0040	0.34
11/30/2021	21L0021	<0.0040	<0.0010	<0.0040	0.059	<0.0070	<0.000060	<0.0100	<0.0040	0.13
December										
12/07/2021	21L0918	<0.0040	<0.0010	<0.0040	0.20	<0.0070	<0.000060	<0.0100	<0.0040	0.41
12/14/2021	21L2030	<0.0040	<0.0010	0.004	0.11	<0.0070	<0.000060	<0.0100	<0.0040	0.27
12/21/2021	21L3354	<0.0040	<0.0010	<0.0040	0.090	<0.0070	<0.000060	<0.0100	<0.0040	0.17
12/28/2021*	22A0560	<0.0040	<0.0010	<0.0040	0.031	<0.0070	<0.000060	<0.0100	<0.0040	0.069
Discharge Limit[c]		0.06	.14	0.62	1.0	0.20	0.01	0.61	0.20	3.0

*Site shutdown from December 25, 2021 through January 3, 2022.
"J" Indicates detection above Method Detection Limit (MDL) but below the Reporting Limit (RL).
[a] Samples are collected as a weekly composite.
[b] Analyses performed by an off-site, independent laboratory.
[c] Discharge concentration limits, City of Livermore Municipal Code 13.32.

Table A-5 Routine Monitoring Results for SNL/CA Sanitary Sewer Outfall, Methods 624, 625 and 608, 2021

Date	EPA Test Method 624 Purgeable Priority Pollutants (µg/L)	EPA Test Method 625 Extractable Priority Pollutants (µg/L)	EPA Test Method 608 Organochlorine Pesticides (µg/L)
January 5	Toluene, 0.53	Di-n-butyl phthalate, 1.6	Not Detected
February 2	Chloroform, 0.69 Toluene, 1.2 Trihalomethanes(total), 0.69	Not Detected	Not Detected
March 2	Bromoform, 1.4 Dibromochloromethane, 1.3 Bromodichloromethane, 0.51 Trihalomethanes (total), 3.2	Not Detected	Not Detected
April 6	Bromoform, 0.48J Dibromochloromethane, 0.47J Chloroform, 0.40J Toluene, 0.86 Trihalomethanes (total), 1.4	Not Detected	Not Detected

This table reports all positively identified organic constituents identified by EPA Methods 624, 625, and 608. All other compounds comprising the EPA toxic organic list were below minimum detection limits, and therefore were not listed. The toxic organic discharge limit for Sandia National Laboratories, California is 1000µg/L. The total toxic organic number is arrived at by summing up all organic constituents greater than 10 µg/L. Please note that trihalomethanes are reported in this table although they are common constituents of chlorinated water. Analyses were performed by an off-site, state certified laboratory. "J" Indicates detection above Method Detection Limit (MDL) but below the Reporting Limit (RL).

GLOSSARY

Ambient air	The surrounding atmosphere, usually the outside air, as it exists around people, plants, and structures. It does not include the air next to emission sources.
Biochemical oxygen demand	A measure of the amount of dissolved oxygen that microorganisms need to break down organic matter in water. Used as an indicator of water quality.
Categorical process	An industrial process that discharges wastewater and is regulated under 40 CFR, Part 403.
Chemical oxygen demand	The amount of oxygen required to degrade the organic compounds of wastewater. Used to measure the overall level of organic contamination in wastewater.
Criteria pollutants	The Clean Air Act requires EPA to set National Ambient Air Quality Standards for six common air pollutants, also known as Criteria Pollutants.
Dose	A term denoting the quantity of radiation energy absorbed.
Dosimeter	A portable detection device for measuring the total accumulated exposure to ionizing radiation.
Effluent	A liquid or gaseous waste discharged to the environment.
Emission	A gaseous or liquid stream containing one or more contaminants.
Environmental aspect	An organization's activities, products, or services that can interact with the environment.
Environmental impact	Any change to the environment, whether adverse or beneficial, wholly or partially, resulting from an organization's activities, products, or services.
Ephemeral stream	A stream that flows only for a short duration during and following rainfall.
External radiation	Radiation originating from a source outside the body.
Fluvial sediments	A sedimentary deposit consisting of material transported by, suspended in, or laid down by a river or stream.
Lacustrine sediments	Sediments formed in, or relating to, a lake.
Mixed waste	Waste that contains both radioactive and hazardous constituents.

pH	A measure of hydrogen ion concentration in an aqueous solution. Acidic solutions have a pH less than 7, basic solutions have a pH greater than 7, and neutral solutions have a pH of 7.
Riparian	Pertaining to, situated in, or adapted to living on the banks of rivers and streams.
Specific conductivity	Measure of the ability of a material to conduct electricity.
Strike-slip fault	A fault with horizontal movement along the break where slipping is parallel with the strike of the fault.
Total dissolved solids	Solids in water that pass through a filter; a measure of the amount of material dissolved in water.
Total suspended solids	Solids in water that can be trapped in a filter. Solids can include silt, decaying plant and animal matter, industrial wastes, and sewage.
Transverse fault	A fault that strikes obliquely or perpendicular to the general structural trend of the region.

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22 CCR, Division 4.5, *Environmental Health Standard for Management of Hazardous Waste*.

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40 CFR Part 403, Environmental Protection Agency, *General Pretreatment Regulations for Existing and New Sources of Pollution*.

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Sandia National Laboratories

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