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2019 Annual Yearbook for the LLNL SW/SPEIS

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2019 Annual Yearbook for the SW/SPEIS

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Annual Yearbook for the SW/SPEIS

1.0 INTRODUCTION

1.1 Publication of the Site-Wide Environmental Impact Statement

In 2005, the U.S. Department of Energy's (DOE's) National Nuclear Security Administration (NNSA) published the final *Site-wide Environmental Impact Statement for Continued Operation of Lawrence Livermore National Laboratory (LLNL) and Supplemental Stockpile Stewardship and Management Programmatic Environmental Impact Statement* (SW/SPEIS) (DOE 2005a). The SW/SPEIS described the purpose and need for agency action for the continued operation of LLNL and analyzed the environmental impacts of these operations at the two LLNL sites: the 821-acre Livermore Site and the 7,000-acre Experimental Test Site (Site 300). It updated the information contained in the 1992 LLNL Environmental Impact Statement/Environmental Impact Report (EIS/EIR) (U.S. Department of Energy and University of California 1992), including the proposed plans for modifications to existing projects or new programs.

The SW/SPEIS provided the DOE/NNSA with an assessment of potential environmental impacts in terms of ongoing and reasonably foreseeable activities at LLNL. Of the three alternatives considered in the SW/SPEIS, the DOE/NNSA chose to implement the Preferred Alternative (identified in the Final SW/SPEIS as the Proposed Action). The Proposed Action in the SW/SPEIS selected the types and levels of operations. As described in Section 3.7 of the SW/SPEIS, DOE/NNSA believes that this alternative would fulfill its statutory missions and responsibilities with consideration for economic, environmental, technical, and other factors (DOE 2005a).

In November 2005, the DOE/NNSA issued its Record of Decision (ROD) on this SW/SPEIS (i.e., *Record of Decision of the Final Site-wide Environmental Impact Statement for Continued Operation of Lawrence Livermore National Laboratory and Supplemental Stockpile Stewardship and Management Programmatic Environmental Impact Statement*). In the ROD, the DOE/NNSA identified its major decisions on the types and the levels of operation for LLNL for the foreseeable future and the potential environmental impacts associated with those operations (DOE 2005b) (see Section 1.5 of the SW/SPEIS). The DOE/NNSA based its decision on the information, evaluations, analyses, and alternatives proposed in the SW/SPEIS and other information, including programmatic mission needs and cost. The DOE/NNSA's selection of the Preferred Alternative (with the exception of the High Explosives Development Center [HEDC] Project and the Energetic Material Processing Center Facility [EMPC]) will expand operations at LLNL that are critical to the DOE/NNSA's Stockpile Stewardship Program.

1.2 Publication of the 2011 Supplement Analysis

In 2011, LLNL completed a Supplement Analysis (SA) for the five-year review of the 2005 SW/SPEIS. The 2011 SA examined proposed new and modified plans, projects, facilities, and continued operations through 2015. In August 2011, the DOE/NNSA determined that a supplement to the 2005 SW/SPEIS or a new SW/SPEIS was not needed, and therefore, the proposed new and modified projects and modifications in site operations were consistent with the impacts analyzed in the 2005 SW/SPEIS. Brief descriptions of the proposed projects and their current status are listed in Table 2.

1.3 Publication of the 2019 Supplement Analysis

In 2019, LLNL completed a SA for decontamination and decommissioning (D&D) projects. The 2019 SA was prepared to evaluate the 2005 SW/SPEIS, considering the increased waste estimates from D&D projects that could have bearing on the potential environmental impacts previously analyzed. In December 2019, the DOE/NNSA determined that a supplement to the 2005 SW/SPEIS or a new SW/SPEIS was not needed, and therefore, the proposed D&D projects were consistent with the impacts analyzed in the 2005 SW/SPEIS.

1.4 Purpose of the Annual Yearbook for the SW/SPEIS

This SW/SPEIS Yearbook provides a yearly status update on specific activities that were projected in the SW/SPEIS (Table 1) and in the 2011 SA (Table 2), as well as prior year data that can be compared against SW/SPEIS impacts analyses and projections. It also anticipates the need for future environmental impact analyses and compiles baseline data for use in other environmental documents. The focus of this Yearbook is on:

- Facility or process modifications and the status of projected activities for which the SW/SPEIS provided coverage required under the National Environmental Policy Act (NEPA).
- Certain other activities for which the SW/SPEIS did not provide NEPA coverage. For these activities, the Yearbook also identifies the additional NEPA documentation (i.e., Categorical Exclusions [CX] and Environmental Assessments [EA]) that were prepared for the activity and referenced in the SW/SPEIS (Table 1). New activities not referenced in the SW/SPEIS, and their additional NEPA documentation, are identified in Table 2.

- Site-wide environmental data for the year, including the number of workers, radiation doses, utility usage, air emissions, liquid effluents, and solid wastes. These data also include changes in other resources for which the DOE/NNSA has long-term stewardship responsibilities (Section 3).
- Presentation of SW/SPEIS mitigation measures and updates of mitigation measures in force from the 1992 LLNL EIS/EIR (Appendix A).

Since the publication of the SW/SPEIS, LLNL has received accreditation for its Environmental Management System (EMS; ISO-14001), Occupational Health and Safety Management System (OHSMS; OHSAS-18001) and Quality Management System (QMS; ISO-9001).

2.0 STATUS OF LLNL PROJECTS

The major projects considered in the 2005 SW/SPEIS (including the no-action alternative) are listed in Table 1 as well as the type of NEPA documentation providing NEPA compliance. The current status of the new and modified projects and modifications in Site Operations evaluated in the 2011 SA are noted in Table 2. If further NEPA review has been performed in relation to the 2011 SA proposed projects, it is also noted in Table 2. New activities not referenced in the 2005 SW/SPEIS and the type of NEPA documentation prepared are shown in Table 3. These new activities are also shown in Figure 1.

Table 1. Status of Projects Identified in the 2005 SW/SPEIS.

Project Identified in SW/SPEIS	Status as of 2019	NEPA Documentation
National Ignition Facility (NIF)	Facility complete	SSM PEIS, Supplement Analyses (SA) to SSM PEIS, and NIF Supplemental EIS
Biosafety Level 3 (BSL-3) Facility	Completed	EA, FONSI
Terascale Simulation Facility (TSF)	Completed	EA, FONSI
Superblock Stockpile Stewardship Program Operations	Completed	SSM PEIS, 2005 SW/SPEIS ROD, 2008 Complex Transformation PEIS
Container Security Testing Facility	Cancelled	Categorical Exclusion
East Avenue Security Upgrade	Completed	EA, FONSI
Central Cafeteria Replacement	Completed	Categorical Exclusion
International Security Research Facility	Completed	Categorical Exclusion
Waste Isolation Pilot Plan Mobile Vendor	Completed	Categorical Exclusion
Engineering Technology Complex Upgrade	Completed	Categorical Exclusion
Tritium Facility Modernization	Completed	Categorical Exclusion

Project Identified in SW/SPEIS	Status as of 2019	NEPA Documentation
Biosafety Laboratories	Completed	2005 SW/SPEIS ROD[1]
Reclassify Building 446 as BSL-2 Facility	Cancelled – Not Feasible	Categorical Exclusion
Remove and Replace Offices	In progress	2005 SW/SPEIS ROD[1]
Westgate Drive Improvements	Completed	2005 SW/SPEIS ROD[1]
Extend Fifth Street	Completed	Categorical Exclusion
Superblock Security Upgrade	Completed	Categorical Exclusion
Site Utilities Upgrade	In progress	2005 SW/SPEIS ROD[1]
Protection of Real Property (roofs)	In progress	2005 SW/SPEIS ROD[1]
Building 298 Roof Replacement	In progress	2005 SW/SPEIS ROD[1]
Plutonium Facility ductwork replacement	Completed	Categorical Exclusion
Special Nuclear Material (SNM) tests with Optical Science Laser	In progress; facility operational in 2009	2005 SW/SPEIS ROD[1]
Use of Proposed Materials on the NIF	Completed	2005 SW/SPEIS ROD[1]
Increased Administrative Limits for Plutonium in the Superblock	Completed – Now reduced due to de-inventory of Security Category I and II SNM	2005 SW/SPEIS ROD[1] 2008 Complex Transformation PEIS
Increased Material-At-Risk Limits for the Plutonium Facility	Completed	2005 SW/SPEIS ROD[1] 2008 Complex Transformation PEIS 2011 SA
Increase of Tritium Facility Material Limits	Completed	2005 SW/SPEIS ROD[1]
NIF Neutron Spectrometer	TBD	2005 SW/SPEIS ROD[1]
High Explosives Development Center Project (HEDC)	Project excepted from Proposed Action	2005 SW/SPEIS ROD[1]
Energetic Material Processing Facility (EMPC)	Project excepted from Proposed Action	2005 SW/SPEIS ROD[1]
Material Science Modernization	TBD	2005 SW/SPEIS ROD[1]
Chemical and Biological Nonproliferation Program Expansion	In progress	2005 SW/SPEIS ROD[1]
Petawatt Laser Prototype	Completed	2005 SW/SPEIS ROD[1]
Consolidated Security Facility	TBD	2005 SW/SPEIS ROD[1]
Waste Management	Completed	2005 SW/SPEIS ROD[1]
Building 625 Waste Storage	Completed	2005 SW/SPEIS ROD[1]
Direct Shipment of Transuranic Wastes from the Plutonium Facility	TBD	2005 SW/SPEIS ROD[1]
Lawrence Berkeley Waste Drums	Completed	2005 SW/SPEIS ROD[1]
Building Utilities Upgrade	In progress	2005 SW/SPEIS ROD[1]
Building Seismic Upgrades	In progress	2005 SW/SPEIS ROD[1]
Deactivation and D&D Projects	In progress	2005 SW/SPEIS ROD[1]

Project Identified in SW/SPEIS	Status as of 2019	NEPA Documentation
Increased Administrative Limit for Highly Enriched Uranium for Building 239	Completed	2005 SW/SPEIS ROD[1] 2008 Complex Transformation PEIS

[1](U.S. Department of Energy National Nuclear Security Administration 2005b)
D&D = Decontamination & decommissioning
SA = Supplement Analysis
EA = Environmental Assessment
SSM PEIS = Stockpile Stewardship and Management Programmatic Environmental Impact Statement
FONSI = Finding of no significant impact
FY = Fiscal Year
TBD = To be determined

Table 2. Status of Projects Identified in the 2011 Supplement Analysis for Continued Operations.

Project Identified in 2011 SA for Continued Operations	Status as of 2019	NEPA Documentation
D&D of TRU legacy work stations; temporary increase in TRU waste generation	In Progress	2011 SA
MegaRay accelerator with primary beam energies up to 750 MeV and average beam powers less than 450 Watts	Completed	2005 SW/SPEIS, 2011 SA
Modification of NIF Operational Parameters: tritium inventory 8,000 Ci; routine tritium release limit of 80 Ci/yr; maximum credible single shot yield at 120 MJ; and beryllium inventory as particulate at 1 k	Completed	2011 SA
De-inventory of Security Category I and II SNM	Completed	2008 PEIS, 2011 SA
Revision of radiological curie-limit per container in Radioactive and Hazardous Waste Management facility to be consistent with current documented safety analysis	Completed	2011 SA
Modification of fence lines and security access requirements in the northwest corner and eastside of the Livermore Site	Completed and In Progress, Respectively	2011 SA
Applied Energy Simulation Center, a new approximately 132,000 sf computational and office facility	TBD	2011 SA
High-Energy Density Science Center, a new approximately 42,000 sf office and laboratory facility	TBD	2011 SA
Commons/Visitor/Collaboration Center, a new approximately 25,000 sf facility to provide office and conference space, and a new cafeteria	In Progress	2011 SA
Livermore Site and Site 300 environmental restoration activities	In Progress	2011 SA
Size-reduction and repackaging of TRU waste boxes	In Progress	2011 SA
Facility beryllium decontamination	In Progress	2011 SA
Livermore Site and Site 300 Programmatic Biological Assessments with a Conservation Set Aside at Site 300	Cancelled	NA
Space Consolidation Initiative to accelerate footprint reduction identified in the DOE/NNSA Complex Transformation PEIS	In Progress	2011 SA
Revision of controlled burning practices at Site 300	Completed	2011 SA
Next phase Site 300 erosion control of several areas	TBD	2011 SA

Table 3. New Project Data.

Project	NEPA Documentation
Construction and Operation of an Administrative and Technical Support Facility, Building 264	2004 Categorical Exclusion
Superblock Security Barriers	2004 Categorical Exclusion
Building 412 Deactivation, Decontamination, Decommissioning & Demolition	2004 Categorical Exclusion
Arroyo Mocho Road Improvement and Anadromous Fish Passage Project	2004 Categorical Exclusion
Demolition of Trailers 4181, 5928 and Building 232	2004 Categorical Exclusion
Use of a 6 MeV Portable Linatron at Various Location at Site 300	2004 Categorical Exclusion
Development of a Room-Scale Aerosol Test Facility in Building 281	2004 Categorical Exclusion
Closure of the Building 233 Container Storage Unit	2004 Categorical Exclusion
Increase to the Single Container Limit at Decontamination and Waste Treatment Facility (DWTF) from 8 Plutonium Equivalent Curies (PE-Ci) to 12 PE-Ci	2004 Categorical Exclusion
Chemical and Physical Microbial Forensics in Buildings 151, 154, 235, and 446	2004 Categorical Exclusion
Erosion Control Activities at Site 300, LLNL	2004 Categorical Exclusion
Closure of the Surface Impoundment Ponds at Site 300, LLNL	2004 Categorical Exclusion
Decommissioning, Decontamination and Demolition of Buildings 854B, 854C, 854D, 854E, 854F, 854G, and 854J at Site 300	2004 Categorical Exclusion
Construction and Operation of Building 583	2004 Categorical Exclusion
Water System Upgrades at Site 300	2004 Categorical Exclusion
Construction and Operation of Building 161A	2004 Categorical Exclusion
SATRN Short Air Optic Link at California Water Service Property, Livermore, CA	2005 Categorical Exclusion
Decommissioning, Decontamination and Demolition of Building 326	2005 Categorical Exclusion
Interim Action Request for the Demolition of Trailer 3629	2005 Categorical Exclusion
Soil Removal Project at Building 855, Site 300	2005 Categorical Exclusion
Tiger Salamander Mitigation Pond at Lower Ambrosino Pond, Site 300	2005 Categorical Exclusion
Pond at Round Valley, Site 300	2005 Categorical Exclusion
Demolition of the Lab Pool	2005 Categorical Exclusion
High-Throughput Mobile Laboratory	2005 Categorical Exclusion
Forensic Evidence Curatorial Facility	2005 Categorical Exclusion
Offsite Well Modification	2005 Categorical Exclusion
Special-status Species Protection in the Drainage Retention Basin	2005 Categorical Exclusion
SATRN Short Air Optic Link Project at Doolan Canyon Road, Livermore, CA	2005 Categorical Exclusion
Construction and Operation of Evidence Receiving and Temporary Storage Facilities in Support of the Forensic Science Center's Analyses Programs	2005 SA
Temporary Siting and Erecting of a Sun Collector	2006 Categorical Exclusion

Project	NEPA Documentation
Decommissioning, Decontamination, and Demolition of Building 811 and 830 at Site 300	2006 Categorical Exclusion
Installation of E85 Fueling Station North of Building 611	2006 Categorical Exclusion
Construction and Operation of Treatment Facility B812-SCR at Site 300	2006 Categorical Exclusion
Construction and Operation of Building 178	2006 Categorical Exclusion
Characterization of Biological Materials in Building 282	2006 Categorical Exclusion
Decommissioning, Decontamination, and Demolition of Building 377	2006 Categorical Exclusion
Proposed Environmental Remediation at the Site 300 Pit 7 Complex	2006 EA
Long-Range Detection of Radiation Sources at Offsite Locations	2007 Categorical Exclusion
Beryllium Coating Operations in Building 153	2007 Categorical Exclusion
Offsite Emergency Response Training and Equipment Storage	2007 Categorical Exclusion
Removal of Boulders from Arroyo Mocho	2007 Categorical Exclusion
Outdoor Short-Pulse Laser Propagation Experiment	2007 Categorical Exclusion
Erosion Control Maintenance Activities at Arroyo Mocho	2008 Categorical Exclusion
B850 Soil Remediation Project, Site 300	2008 SA
2008 Site 300 Sediment Control Project	2008 Categorical Exclusion
Offsite Compact Proton Therapy Accelerator Development	2009 Categorical Exclusion
Lead Removal for Recycling at the Small Firearms Training Facility Pistol Ranges A and B, S300	2009 Categorical Exclusion
Cooling Tower Cell Addition for Building 453	2009 Categorical Exclusion
Mobile Hydrogen-Fueling Station and use of Hydrogen Buses	2010 Categorical Exclusion
Building 850 Mitigation Pond (Pool BC), Site 300	2011 Categorical Exclusion
High-Pressure Cryogenic Pump and Hydrogen Filling Station	2012 Categorical Exclusion
Radiography of Explosive Samples	2012 Categorical Exclusion
M1 a and b Habitat Enhancement Project, Site 300, LLNL	2013 Categorical Exclusion
Expansion of the LLNL Mobile Analytical Laboratory (MAL) Support Operations	2013 Categorical Exclusion
Experimental Detector Construction and Operation	2013 Categorical Exclusion
M2 Pool Habitat Enhancement Project, Site 300, LLNL	2013 Categorical Exclusion
Relocation of the Central General Services Area Operating Unit Misting Towers	2013 Categorical Exclusion
Vessel Burst Test, Site 300, LLNL	2014 Categorical Exclusion
Livermore Site Solar Photovoltaic (PV) Farm	2014 Categorical Exclusion
LLNL Unmanned Aircraft Systems (UAS) Testing and Operations	2015 Categorical Exclusion
Amsinckia grandiflora Recovery Efforts	2015 Categorical Exclusion
Lease for Monopole Communication Cell Tower Installation and Operation	2015 Categorical Exclusion
Ground-based Laser Field Experiments	2015 Categorical Exclusion
East Gate and Vasco Gate Kiosk Modifications	2015 Categorical Exclusion
Vessel Burst Test, Site 300	2015 Categorical Exclusion

Project	NEPA Documentation
Livermore Site Heating, Ventilation and Air Conditioning Modernization	2016 Categorical Exclusion
Construction and Operations of B276, Security Fitness and Training Center Replacement Facility	2016 Categorical Exclusion
Cellular Phone Service at Site 300	2016 Categorical Exclusion
Supplement Analysis for Lawrence Livermore National Laboratory, Superblock Facilities	2017 SA
Building 231 Applied Materials and Engineering Facility	2017 Categorical Exclusion
Electric Vehicle Charging Station Installation and Operation	2017 Categorical Exclusion
Roof Replacements at LLNL	2017 Categorical Exclusion
Proposal to Extend Special Use Lease Agreement No. 1717	2017 Categorical Exclusion
Greenhouse Installation and Operation	2017 Categorical Exclusion
Security Surveillance Project	2017 Categorical Exclusion
Lease Office 490, L'Enfant Plaza SW Suite 2202 Washington DC	2017 Categorical Exclusion
Wood to Fuel for California's Transportation Sector Using Autothermal Pyrolysis	2017 Categorical Exclusion
Supplement Analysis for Exascale Computing Facility Modernization (ECFM) Project	2017 SA
Site 300 Granulated Activated Carbon (GAC) Filtration System	2017 Categorical Exclusion
Building 363 Deconstruction, Demolition, and Site Restoration	2017 Categorical Exclusion
Trailer Facilities Deconstruction, Demolition and Site Restoration	2017 Categorical Exclusion
Proposed Increase in the Weight of Explosives Detonated at Lawrence Livermore National Laboratory Experimental Test Site (Site 300)	2018 EA
Security Kiosk Canopy Installation	2018 Categorical Exclusion
Proposed Construction and Operation of a Water Disinfection Facility at Lawrence Livermore National Laboratory	2018 EA
Remote Firing Facilities Office (T8021)	2018 Categorical Exclusion
Small Firearms Training Facility Project	2018 Categorical Exclusion
Building 292 Complex Deconstruction, Demolition, and Site Restoration	2019 Categorical Exclusion
B341 BSL-2 Laboratory Conversion	2019 Categorical Exclusion
Tritium Air Monitoring Stations	2019 Categorical Exclusion
Supplement Analysis of the 2005 Site-wide Environmental Impact Statement for D&D Projects	2019 SA
Building 173 (B173) Demolition & Jupiter Laser Facility (JLF) Power Conditioning Systems (PCS) Upgrades	2019 Categorical Exclusion

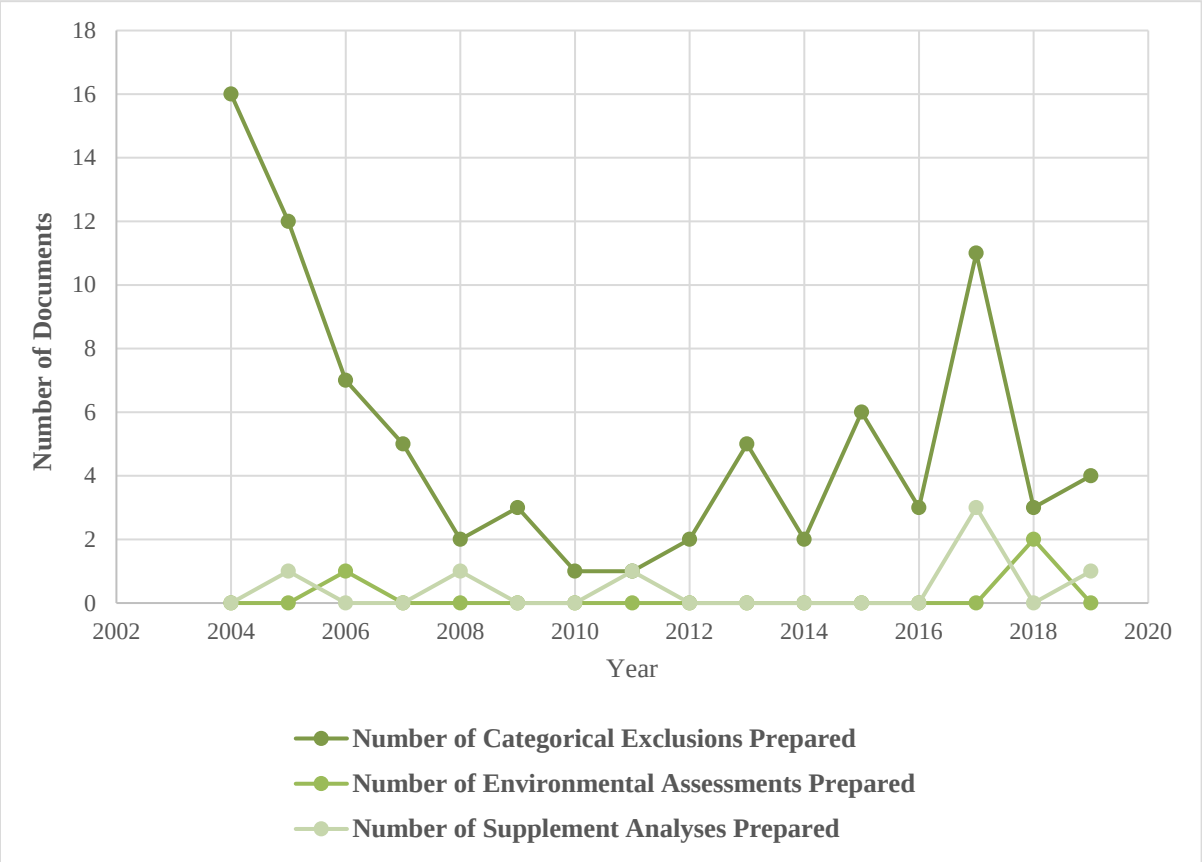

Figure 1. Summary of NEPA Documents Prepared.

3.0 SITE-WIDE OPERATIONS DATA

Section 3 of this Yearbook compares actual operating data to projected levels as discussed in the SW/SPEIS for land resources, socioeconomics, community services, prehistoric and historic cultural resources, aesthetics and scenic resources, geology and soils, biological resources, air quality, water, noise, traffic and transportation, utilities and energy, materials and waste management, human health and safety, site contamination, and bounding accident scenarios. In most instances, the base year for the operating data in the SW/SPEIS was 2002. As applicable, relating information from the 2011 SA is also included.

3.1 Land Resources/Agricultural

This section discusses impacts on land use from the continued operation of LLNL. LLNL considers local land-use planning policies in its land-use decisions, although, as a federal facility, LLNL is exempt from local plans, policies, and zoning regulations. The SW/SPEIS projected 370,000 square feet (sf) of new facilities would be constructed under the Proposed Action Alternative. As of the end of fiscal year 2018, LLNL had added 166,741 sf of new facilities, with no new facilities added in 2019 (see Table 4).

Table 4. New LLNL Facilities in Square Feet (SF) 2003-2019.

Fiscal Year	New SF	Cumulative SF
2003	2,280	2,280
2004	41,335	43,615
2005	43,843	87,458
2006	21,978	109,436
2007	1,750	111,186
2008	0	111,186
2009	0	111,186
2010	1,045	112,231
2011	12,070	124,301
2012	0	124,301
2013	200	124,501
2014	0	124,501
2015	2,800	127,301
2016	15,876	143,177
2017	0	143,177
2018	23,564	166,741
2019	0	166,741
SW/SPEIS Projection	n/a	370,000

Source: Beall 2008-2010, Johnson 2011-2013, Lechner-Strand 2014-2020.

The SW/SPEIS projected 820,000 sf would be decontaminated and demolished (or approximately 82,000 sf a year). However, only 659,755 sf were actually demolished through 2019 (see Table 5).

Table 5. Decontamination and Demolition Projects at LLNL 2003-2019.

Fiscal Year	Demolished SF	Cumulative SF
2003	25,982	25,982
2004	79,045	105,027
2005	73,562	178,589
2006	58,976	237,565
2007	150,164	387,729
2008	58,128	445,857
2009	84,416	530,273
2010	26,916	557,189
2011	11,216	568,405
2012	0	568,405
2013	0	568,405
2014	0	568,405
2015	0	568,405
2016	1,954	570,359
2017	14,375	584,734
2018	12,248	596,982
2019	62,773	659,755
SW/SPEIS Projection	n/a	820,000

Source: Beall 2008-2010, Johnson 2011-2013, Lechner-Strand 2014-2020.

3.1.1 Livermore Site

The SW/SPEIS projected that there would be only a small increase in the developed space at the Livermore Site with no changes in land uses, or future land uses, adjacent to the Site. As a result, the SW/SPEIS projected a small land-use impact for continued operation at the Livermore Site.

Alameda County is experiencing a cumulative loss of agricultural land and open space because of the continuing development, including in the immediate vicinity of the Livermore Site. The projects identified in the SW/SPEIS were not considered as contributing to the overall loss of agricultural land because LLNL's Research and Development (R&D) facility activities are compatible with the industrial park zoning designation in Alameda County and the new Community Facilities-Research and

Development designations in the City of Livermore. Further, DOE determined in the 2011 SA that LLNL's proposed activities at the Livermore Site continue to be compatible with those designations. Projects and activities enacted since the 2011 SA (See Table 3) continue to be consistent with DOE's determination.

3.1.2 Site 300

The SW/SPEIS projected that the primary impact on land uses at Site 300 would occur from the development of additional square-footage associated with certain projects but saw no major alteration occurring in the types of land uses and no changes in land ownership. Land uses adjacent to Site 300 include other explosives testing facilities, undeveloped open space, agricultural land, and an off-road vehicle recreation area. The land uses at Site 300 were identified as compatible with the existing land uses, approved land-use designations surrounding the site, and open space policies applicable to areas near the site. Therefore, the SW/SPEIS did not identify additional impacts to land resources/agricultural land for Site 300. As of 2019, no alterations in land use or changes in land ownership occurred at Site 300.

3.2 Socioeconomics

Socioeconomic analysis in the SW/SPEIS measured the incremental effects from changes in expenditures, population, income, and employment associated with the proposed alternatives. This section describes the socioeconomic characteristics of LLNL, and the population and housing impacts of its continued operation on the four California counties that supply most of the LLNL workforce (see Tables 6 and 7). Employment projections were conservatively high for evaluating reasonably foreseeable socioeconomic impacts associated with employment growth.

3.2.1 Population/Housing

The SW/SPEIS reported approximately 10,650 workers across both LLNL sites at the end of September 2002 and projected that under the Proposed Action there would be 11,400 workers at LLNL (DOE 2005a). At the end of fiscal year 2019, the actual LLNL-affiliated workforce, including subcontractors, was 7,378 people (see Table 6), 35% fewer people than the SW/SPEIS projection.

Table 6. LLNL Affiliated Workforce 2003-2019.

Fiscal Year	Workforce	Difference in Actual Workforce from Projection
SW/SPEIS Projection	11,400	n/a
2003	9,603	1,797
2004	9,693	1, 077
2005	9,411	1, 989
2006	8,938	2,462
2007	8,558	2,842
2008	6,921	4,479
2009	6,916	4, 484
2010	7,263	4,137
2011	7,544	3,856
2012	7,306	4,094
2013	6,458	4,942
2014	6,329	5,071
2015	6,482	4,918
2016	6,360	5,040
2017	6,586	4,814
2018	6,856	4,544
2019	7,378	4,022

Source: Field 2006-2016, Anderson 2015-2020.

Alameda, San Joaquin, Contra Costa, and Stanislaus Counties were considered impacted by LLNL operations because most of the workforce resided in those counties (see Table 7). The SW/SPEIS projected increases in population and housing in those four counties. To determine the maximum expected impact, the SW/SPEIS conservatively projected large increases in population and in housing demand; the geographic distribution of future workforce was assumed to be similar to the 2002 distribution.

DOE determined in the 2011 SA that, consistent with the analysis in the SW/SPEIS, the possible variations in LLNL employees and payroll are anticipated to still have small impacts on the region as a whole; therefore, supplementation of the 2005 SW/SPEIS for socioeconomics was not needed. From 2013 through 2018, the workforce population was relatively stable. However, in 2019 the workforce population increased and is comparable to 2012 workforce population data.

Table 7. County of Residence of the LLNL Workforce 2003-2019.

Fiscal Year	Geographic Distribution of LLNL Workforce (%)					
	Alameda	San Joaquin	Contra Costa	Stanislaus	Other	Total
SW/SPEIS Projection	55.5	18.5	12.8	6.1	7.2	99.9
2003	53.2	18.3	11.8	6.7	10	100
2004	52.2	18.6	11.6	6.7	10.9	100
2005	53.2	18.7	11.6	6.9	9.6	100
2006	54.2	19	11	7.3	8.5	100
2007	50.2	19	13.6	7.1	10.1	100
2008	50.5	19	14.2	6.7	9.6	100
2009	50	20	14	5	11	100
2010	50	20	14	5	11	100
2011	53.5	20.2	10.3	5	11	100
2012	54	20	10	5	11	100
2013	51	20	13	5	11	100
2014	51.9	20.3	14.3	5.2	8.3	100
2015	51	20.6	14.3	5.2	8.9	100
2016	51.4	20.2	13.9	4.9	9.6	100
2017	51.3	20.3	14.0	4.7	9.7	100
2018	51.1	20.3	13.6	4.7	10.2	100
2019	50.9	20.0	13.6	4.8	10.8	100.1

Source: Field 2006-2016, Anderson 2015-2020.

3.3 Community Services

The community services category includes fire protection and emergency services, police protection and security services, school services, and nonhazardous solid waste disposal from the operation of LLNL. LLNL has mutual assistance agreements with neighboring jurisdictions for fire protection and emergency services, and police and security services. In 2019, no agreement changes were made for these services.

Within the range of community services considered in the SW/SPEIS, the most notable impact of LLNL's continued operations would be the generation and disposal of nonhazardous solid waste. During the 2002 baseline year, the Livermore Site generated 13,879.9 mt (15,300 tons) of nonhazardous waste and Site 300 approximately 181.4 mt (200 tons). Approximately 60 percent of that waste was diverted for recycling and reuse.

The SW/SPEIS projected that the Livermore Site would generate approximately 4,900 mt (5,401.3 tons) per year of nonhazardous solid waste (DOE 2005a). The SW/SPEIS projected that Site 300 nonhazardous waste generation would increase to 208 mt (229 tons) per year (DOE 2005a). The SW/SPEIS projected minimal impacts due to the potential additional solid waste to be generated by LLNL. DOE determined that supplementation of the 2005 SW/SPEIS for community services was not needed.

No facilities were demolished at LLNL in fiscal year 2012, 2013, 2014, or 2015 (see Table 5) because funding was not available for those activities. Demolition of trailer facilities accounted for the increases in 2016, 2017, 2018, and 2019 (see Table 5). D&D of dilapidated buildings, and facilities that have reached the end of their useful life, is expected to continue at LLNL in the future. D&D projects would contribute to nonhazardous solid waste generation, as would waste materials from new facility construction (that cannot be recycled).

There were no plans to expand the Livermore Site nonhazardous solid waste storage facilities or to modify nonhazardous waste disposal methods. See Figure 10 of this Yearbook for solid sanitary wastes data including both LLNL sites through 2019. The sharp rise in solid sanitary waste in 2007 included several large demolition projects that generated 11,223 mt. In 2019, 71% of municipal wastes and 78% of non-routine construction/demolition wastes were diverted for recycling and reuse.

3.4 Prehistoric and Historic Cultural Resources

This section summarizes prehistoric and historic resources at LLNL, the impact of continued operation on those resources, and on-going management and treatment strategies. DOE/NNSA determined in the 2011 SA that supplementation of the 2005 SW/SPEIS for prehistoric and historic cultural resources was not needed.

3.4.1 Traditional Cultural Resources

Federal agencies are required to consult with recognized Native American tribes regarding the potential effects of the project on Native American resources or on Traditional Cultural Properties (TCPs). DOE/NNSA conferred with the California Native American Heritage Commission to define a list of appropriate Native American representatives to contact and subsequently consulted with 11 representatives of the Ohlone/Costanoan groups concerning the continued operation of the Livermore Site and Site 300. To date, no federally-recognized American Indian tribes have claimed jurisdiction over lands operated by LLNL, nor are there any tribes with strong cultural affiliations to the land.

3.4.2 Prehistoric Resources

The Proposed Action, as described in the SW/SPEIS, would have the potential to affect prehistoric archaeological resources on both the Livermore Site and Site 300 through Site development activities involving ground-disturbance.

3.4.2.1 Livermore Site

The likelihood of finding unrecorded and undisturbed prehistoric sites at the Livermore Site is considered to be low because most of that Site is developed. However, the possibility still exists that previously unknown sites lay buried beneath the modern landscaping.

3.4.2.2 Site 300

Archaeological surveys undertaken at Site 300 over the past 40 years have resulted in the recordation of 31 prehistoric and historic archaeological sites and isolated artifacts (LLNL 2005b). The eight prehistoric archaeological sites indicate that the area was used by early populations for hunting, and for collecting and processing seasonal plant foods. This use is evidenced by small lithic scatters, and rockshelters that contain bedrock mortars and possible small midden deposits.

Of the eight prehistoric archaeological resources recorded at Site 300, the DOE/NNSA, as the federal agency responsible for historic properties at LLNL, concluded that two qualify for listing in the National Register of Historic Places (NRHP) because of their ability to yield information important in prehistory. The California State Historic Preservation Officer (SHPO) concurred with this determination (OHP 2005).

3.4.3 Historic Resources

The Proposed Action would have the potential to affect important historic buildings and structures on the LLNL Site through decontamination, decommissioning, deactivation, and/or demolishing (D&D), rehabilitation, and renovation of existing facilities. As described in the SW/SPEIS, any potential impacts to cultural resources at LLNL were to be mitigated through implementation of a Draft Programmatic Agreement (PA), however, in 2014 the SHPO requested project-specific compliance with Section 106 of the National Historic Preservation Act (NHPA) in which case a Memorandum of Agreement would be negotiated between DOE/NNSA, the Advisory Council on Historic Preservation (ACHP), and the SHPO.

3.4.3.1 Livermore Site

Historic Archaeological Resources
As with prehistoric sites, the likelihood of finding unrecorded historic archaeological resources at the Livermore Site is considered to be low. Prior to the opening of the

Livermore Naval Air Station in 1942, the land occupied by the Livermore Site had been undeveloped and utilized primarily for ranching activities.

Historic Buildings, Structures and Objects
An assessment of LLNL's built environment for potential historic significance was undertaken in 2004 (Ulrich and Sullivan 2007). As a result of the assessment, DOE/NNSA, in consultation with the SHPO, determined that four individual buildings and selected objects within another building at the Livermore Site are eligible for listing in the National Register because of their association with important research and development that was undertaken within the context of the Cold War (OHP 2005).

3.4.3.2 Site 300

Historic Archaeological Resources
Archaeological surveys undertaken at Site 300 over the past 40 years have resulted in the recordation of 31 prehistoric and historic archaeological sites and isolated artifacts (LLNL 2005b). Twenty-three of the 31 archaeological sites are historic archeological sites (including one that is multi-component, i.e. prehistoric and historic). These sites provide evidence that homesteading, ranching, and mining were the predominant activities in the area during the historic period (circa 1846-1930). The historic archaeological sites include an early 20th century homestead site, a sheepherder's shack (since burned down), possible remnants of a small bridge, two small trash dumps, a power-telegraph line, and a mine adit and associated features. Site 300 also contains the archaeological remains of the residential section of the former town of Carnegie. At the turn of the 20th century, Carnegie hosted a population of approximately 2,500 inhabitants and supported churches, schools, company stores, a hotel, saloons, pool halls, laundries, ice cream parlors, barber and beauty shops, bunkhouses for the single men and company housing for the married men and their families who worked at the Carnegie Brick and Pottery Plant.

Of the 23 historic archaeological resources recorded at Site 300, DOE/NNSA recommended that three are eligible for listing in the NRHP because of their potential to yield information important to history. SHPO concurred with this determination (OHP 2005).

Historic Buildings, Structures and Objects
An assessment of LLNL's built environment for potential historic significance was undertaken in 2004 (Ulrich and Sullivan 2007). As a result of the assessment, DOE/NNSA, in consultation with the SHPO, determined that one building and two historic districts (encompassing a total of thirteen buildings that are contributing elements to the districts) at Site 300 are eligible for listing in the National Register

because of their association with important research and development that was undertaken within the context of the Cold War (OHP 2005).

3.4.4 Management and Treatment of Cultural Resources at LLNL

3.4.4.1 Programmatic Agreement

As described in the SW/SPEIS, in 2005, DOE/NNSA, University of California (UC), and the SHPO initiated discussions toward the development of a new PA that would govern how these National Register-eligible properties would be managed. However, in 2014, the SHPO requested project-specific compliance with Section 106 of the NHPA in which case Memorandum of Agreements would be negotiated between DOE/NNSA, the ACHP, and the SHPO. Consultations were initiated in 2014 and 2015 to address mitigations for potential adverse effects. As of 2019, mitigation was completed for each eligible facility, and these facilities were determined to no longer be eligible properties.

3.4.4.2 Archaeologically Sensitive Areas

Archaeological sensitivity maps have been created for the Livermore Site and Site 300. When projects involving ground-disturbing activities are proposed, the LLNL Subject Matter Expert (SME) or designee consults these maps and provides guidance to the Maintenance and Utilities Services Department prior to permit approval.

Post-Review Discoveries

Inadvertent discoveries and unanticipated effects to resources can occur when previously unknown resources (e.g., subsurface archaeological or paleontological remains) are discovered during ground-disturbing activities. Subsurface remains are unlikely to be present at the Livermore Site due to the highly disturbed nature of the area. Site 300, however, has a greater potential for subsurface remains because of its largely undisturbed nature.

If such remains are encountered during ground-disturbing activities, work within the immediate vicinity of the discovery would cease and the LLNL SME would be notified. If the LLNL SME determines that the find is potentially significant, the DOE/NNSA and SHPO would be notified and consultation would be initiated pursuant to 36 CFR 800.13. Through that consultation, a determination would be made of the resource's significance, the extent of any adverse effect, and the appropriate actions required to avoid, reduce, or mitigate further adverse effects. The inadvertent discovery of Native American human remains or funerary objects (associated or unassociated) at LLNL would require adherence to 43 CFR 10.4 of the implementing regulations of the *Native American Graves Protection and Repatriation Act* (Office of the Secretary of the Interior 2013).

3.5 Aesthetics and Scenic Resources

The SW/SPEIS addressed the impact of LLNL's continued operations on the scenic quality of the landscape but was limited to the construction of buildings and infrastructure located in areas visible to public viewing. Activities that were proposed in the SW/SPEIS and that would change the built environment at the Livermore Site and at Site 300 include improvements to existing buildings and infrastructure, D&D of existing buildings, and construction of new facilities with developments and modifications occurring within the developed portion of the Site.

Although many specifics of proposed future developments were unknown, the SW/SPEIS assumed that future developments would be consistent with previous LLNL landscaping and development practices with the existing character of the Site. Therefore, no additional impacts to visual resources were identified in the SW/SPEIS (DOE 2005a).

The offsite views of the Livermore Site have changed since the 2005 SW/SPEIS with the completion of the East Avenue security upgrade project, the International Security Research Facility, and the NIF. DOE/NNSA determined in the 2011 SA that these facilities and modifications in operations would be consistent with the existing character of LLNL onsite office and laboratory facilities and would also be similar to the Patterson Pass office park to the north and Sandia National Laboratories to the south. Supplementation of the 2005 SW/SPEIS for aesthetics impacts was not needed.

Since completion of the 2011 SA, other new facilities were completed that are visible from offsite. At the Livermore Site, a ten-acre solar photovoltaic array in the north west buffer zone and construction of a computing center. Other new facilities including one and two-story office facilities, a BSL-3 laboratory, and a central cafeteria replacement cannot be seen offsite. The offsite views of Site 300 have changed slightly with completion of utility upgrades, environmental remediation projects, and erosion control efforts.

3.6 Geology and Soils

The geology and the soils analyses in the SW/SPEIS examined the effects of the construction and the operation of facilities and other activities on the land occupied by and immediately adjacent to the Livermore Site and Site 300. The analyses evaluated the amount of disturbance that might affect the geology and/or soils of areas at the Livermore Site and Site 300. Impacts could include erosion and effects to potential geologic economic resources, such as mineral and construction material resources and fossil locations. In general, the SW/SPEIS defined impacts on soils as taking areas with soils that support agriculture out of production.

The SW/SPEIS quantified impacts on soils as the amount of area disturbed by construction activities. According to the SW/SPEIS, 462,000 sf would be disturbed by construction activities in undeveloped zones in the Livermore Site, and 40,000 sf at Site 300 (DOE 2005a). The SW/SPEIS evaluated the impacts and determined their severity. Possible mitigations were identified for adverse impacts. Because the EMPC and HEDC were excepted from the Proposed Action, the 40,000 sf disturbance by construction activities at Site 300 would not take place.

Since publication of the SW/SPEIS, LLNL has completed construction of the Terascale Simulation Facility and the NIF as proposed in the SW/SPEIS in previously undeveloped zones in the Livermore Site. Additionally, three new 20,000 sf office facilities were constructed in previously developed locations.

In 2019, soil-disturbing activities included removal of 62,773 sf of existing facilities and drilling for Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) groundwater remediation requirements. LLNL requires implementation of Best Management Practices (BMPs) including storm water pollution prevention plans (SWPPPs) to reduce adverse impacts of erosion on soils. Soil disturbing activities performed in 2019 did not adversely affect any known aggregate, clay, coal, or mineral resources.

3.7 Biological Resources

This section describes changes related to listed and special status species that have occurred since the 2005 SW/SPEIS was completed. A detailed description of biological resources, habitat types, and complete species lists are described in the 2005 SW/SPEIS. The 2005 SW/SPEIS addressed the impacts of activities on biological resources, including vegetation, wildlife, protected species, and wetlands that occur at both LLNL sites through a qualitative analysis. The potential sources of impacts considered included noise, outdoor tests, erosion, construction, demolition, and prescribed burns. The impact analysis determined that the effect of the Proposed Action on biological resources would occur primarily in areas that have been previously disturbed at the Livermore Site and Site 300 by construction, maintenance, wildfire prevention and security activities.

Land-use with respect to habitat availability and development has not changed substantially at either Site since the 2005 SW/SPEIS was completed. Surveys and monitoring activities through 2019 show no indications of substantial changes in general Site conditions, ecology, and species compositions at the Livermore Site and Site 300 since the 2005 SW/SPEIS was completed. As of 2019, LLNL continues to monitor tritium in vegetation in the Livermore Valley; the results of this monitoring program and LLNL impacts on vegetation are provided in the *LLNL Site Annual Environmental Reports*.

Most of the bird species found at the Livermore Site and Site 300 are protected under the Migratory Bird Treaty Act (MBTA). As of 2019, LLNL reviews projects and completes surveys for migratory birds as needed to ensure compliance with the MBTA. In accordance with implementing Executive Order 13186 ("Responsibilities of Federal Agencies to Protect Migratory Birds"), issued on January 10, 2001, the DOE and U.S. Fish and Wildlife Service (USFWS) entered into a federal Memorandum of Understanding (MOU) in 2006 that was revised in 2013 and is currently in the renewal process. This MOU identifies specific areas in which cooperation between the DOE and USFWS would substantially contribute to the conservation and management of migratory birds and their habitats.

Detailed surveys for federally listed species were conducted at the Livermore Site and Site 300 to provide background information for the 2005 SW/SPEIS. In compliance with DOE guidelines, a biological assessment was prepared in conjunction with the SW/SPEIS and can be found in Appendix E of the SW/SPEIS along with LLNL's previous consultation history. The status of threatened, endangered, and protected species at both LLNL sites as of 2019 is detailed in Section 3.7.1 of this Yearbook. Critical habitat designations have changed multiple times since completion of the 2005 SW/SPEIS, as indicated in Section 3.7.2 of this Yearbook. Due to the potential for impacts on protected species and their habitats at both LLNL sites from various projects since completion of the 2005 SW/SPEIS, LLNL DOE/NNSA has completed multiple consultations with the USFWS pursuant to Section 7(c) of the Endangered Species Act as described in Section 3.7.3 of this Yearbook.

3.7.1 Threatened, Endangered and Protected Species Status

3.7.1.1 Livermore Site

No threatened or endangered plants, invertebrates, reptiles, or mammals have been observed at the Livermore Site. The loggerhead shrike (a federal bird of conservation concern and a state species of special concern) is known to occur in the vicinity of the Arroyo Las Positas. Additionally, the white-tailed kite, a California fully protected species, nests throughout the Livermore Site. Over 60 species of migratory birds have been observed during surveys at the Livermore Site.

Amphibians

The California red-legged frog (threatened) was the only federally listed species identified at the Livermore Site in the 2005 SW/SPEIS. Although the California tiger salamander (threatened) has not been observed at the Livermore Site, this species is considered during consultation with the USFWS regarding Livermore Site activities because of the proximity of observations of this species to the Site.

The California red-legged frog occurs in the Arroyo Las Positas, Lake Haussmann, and other drainage channels. As of 2019, the American bullfrog (an invasive species in California) is a significant threat to the California red-legged frog at the Livermore Site. LLNL has continued to implement the USFWS-approved annual management practices to control bullfrog populations at the Livermore Site in Lake Haussmann and Arroyo Las Positas since 2002. Large-mouth bass, an invasive species that was a significant threat to the California red-legged frog, was eliminated from Lake Haussmann in 2006 and the Lake continues to be free of the species in 2019.

3.7.1.2 Site 300

Five species protected under the federal Endangered Species Act occur at Site 300: the large-flowered fiddleneck (endangered), valley elderberry longhorn beetle (threatened), California tiger salamander (threatened), California red-legged frog (threatened), and Alameda whipsnake (threatened). Three additional species that are protected under the California Endangered Species Act but not the federal Endangered Species Act occur at Site 300. Tricolored blackbirds (California threatened) and Swainson's hawks (California threatened) regularly occur at Site 300, and the willow flycatcher (California endangered) has been infrequently observed at Site 300. The USFWS recently reviewed the conservation status of the tricolored blackbird in response to a petition to list the species under the Endangered Species Act (USFWS 2015), and in the August of 2019 the USFWS determined that it is not warranted to list the tricolored blackbird at this time. Protected natural resources at Site 300 are shown on Figure 2.

Plants

The large-flowered fiddleneck continues to be the only federally protected plant species known to occur at Site 300. Large-flowered fiddleneck is known to exist naturally at Site 300 and on a nearby mitigation property owned by the Contra Costa Water District. Two native Site 300 large-flowered fiddleneck populations are found at Site 300. LLNL continues to maintain and monitor an experimental population of large-flowered fiddleneck in the *Amsinckia grandiflora* Reserve at Site 300 and participates in the USFWS large-flowered fiddleneck Recovery Team. LLNL is working with the USFWS on continued monitoring of native and experimental large-flowered fiddleneck populations and further development of habitat restoration and maintenance techniques.

Including the federally endangered large-flowered fiddleneck, four rare plant species and three uncommon plant species are known to occur at Site 300. Three of these rare plant species—the large-flowered fiddleneck, the big tarplant, and the diamond-petaled California poppy—were known to occur at Site 300 at the time of the 2005 SW/SPEIS. A fourth species, shining navarretia was found to occur at Site 300 in 2014. All four species have a California Rare Plant Rank of 1B (CNPS 2020) and are

considered rare and endangered throughout their range. The round-leaved filaree was included as a rare plant species in the 2005 SW/SPEIS. In 2017, the California Native Plant Society revised the rank of this species to “considered but rejected” (CBR) because this species has recently been found to be too common statewide to be considered rare (CNPS 2019).

The three uncommon plant species, California androsace, stinkbells, and hogwallow starfish, occur in isolated locations at Site 300. These plants have a California Rare Plant Rank of 4 (CNPS 2018) that includes plants of limited distribution that are not considered rare or endangered. The gypsum-loving larkspur, a spring flowering perennial that also occurs in isolated areas throughout Site 300, was previously included on List 4. In 2012, the gypsum-loving larkspur was removed from List 4 because it is now considered too common for inclusion on this list (CNPS 2019).

Invertebrates

As described in the 2005 SW/SPEIS, the valley elderberry longhorn beetle was found to occur at Site 300 in 2002. In 2012, the USFWS proposed to remove the valley elderberry longhorn beetle from the Federal List of Endangered and Threatened Wildlife (USFWS 2012), but later withdrew the proposed rule in 2014 (USFWS 2014b). LLNL has not conducted sitewide surveys for the beetle since 2002 but expects the beetle to still be present. Protective measures as described in the 2005 SW/SPEIS continue to be implemented on all projects at Site 300 through 2019, therefore avoiding impacts on the species (DOE 2005a).

In March of 2018, valley elderberry longhorn beetle monitoring was conducted in the Corral Hollow Ecological Reserve adjacent to the eastern perimeter of Site 300 as part of a vegetation pruning project. Although no individual valley elderberry longhorn beetles, eggs, larvae, or pupae were observed during vegetation pruning conducted in 2018, eleven pruned elderberry stem segments were observed that had exit holes that were potentially created by valley elderberry longhorn beetles or their close relative the California elderberry longhorn beetle (Garcia and Associates, 2018). No federally protected branchiopods have been identified at Site 300 as of 2016, based on surveys during 2001-2002, 2002-2003, 2009, 2010 and 2016 (LLNL 2004, 2005a, 2010, ESA 2016). No new surveys for branchiopods were completed in 2019.

Amphibians

The 2005 SW/SPEIS reported eight California red-legged frog known breeding sites (Ambrosino Pool [Pool A], Rimrock Spring [Pool J], Oasis Wetland [Pool O], Song Pond [Pool S], Overflow Pond [Pool OS] and three pools in Upper Elk Ravine [Upper Elk Ravine Pools and Pool SG]) (DOE 2005a). During the past decade, several breeding pools have been deserted and habitat enhancement projects have been implemented. In addition, the naming scheme of pools has been modified since 2005. Of these eight pools, seven no longer support California red-legged frog breeding.

Pool J received sediment from a landslide. Pool O has been wallowed and filled by feral pigs. Pool SG has reduced spring water production. Two Upper Elk Ravine Pools were created from an artificial water source. This artificial water source was terminated, and as mitigation, two new California red-legged frog breeding sites were created (Pool M1a and Pool M1b). Pool S only fills on years with well above average rainfall, and California red-legged frog breeding has not been observed at this location for the last ten years. Pool OS has generally received insufficient rainfall input to support California red-legged frog breeding (Paterson et al. 2019).

As of 2019, there are five known breeding locations for California red-legged frogs at Site 300 (Pools A, CP, M1a, M1b, and CR) and only four locations (Pool A, CR, M1a, and M1b) provide population recruitment on average rainfall years (Figure 1). Both Pool CR and Pool CP were discovered after the completion of the 2005 SW/SPEIS. Pools M1a, M1b, and CR are within a 1.86-acre Conservation Set Aside (that includes aquatic breeding and non-breeding areas) established as compensation for terminating artificial cooling tower water releases to ground.

Five California tiger salamander known breeding sites were reported in the 2005 SW/SPEIS: Ambrosino Pool [Pool A], Harrier Pool [Pool H], Danger Pond [Pool D], Song Pond [Pool S], and Overflow Pond [Pool OS] (DOE 2005a). As of 2019, California tiger salamanders continue to utilize these five seasonal pools for breeding. Habitat enhancement projects that have occurred since 2005 have created potential California tiger salamander breeding habitat at three additional locations: Pool HC1, Pool M2 and Pool M3.

The Western spadefoot toad is a federal species of concern and state species of special concern. During wet years, this amphibian has been observed at the Pool OS and M3 located in the General Services Area of Site 300 and Pool S along the southern boundary of the Site.

Reptiles

As described in the 2005 SW/SPEIS, an effort to evaluate the effects of prescribed burning on the Alameda whipsnake at Site 300 was initiated in 2002. Despite unintentional burning of the study area during the 2005 Tesla Wildfire, the effort continued through 2009. The effort was canceled and as of 2019 no conclusions have been made about the effects of prescribed fire on the Alameda whipsnake and the area continues to recover from the wildfire.

The coast horned lizard (state species of special concern) has regularly been observed since the time of the 2005 SW/SPEIS through 2019. The San Joaquin coachwhip (state species of special concern) has been incidentally observed in grassland and shrub land habitats at Site 300 since 2005. Both the coast horned lizard and the San

Joaquin coachwhip were listed as federal species of concern at the time of the 2005 SW/SPEIS but are no longer considered federal species of concern.

Birds

The golden eagle (federally protected under the Bald and Golden Eagle Protection Act and California fully protected species) was briefly described in the 2005 SW/SPEIS. In 2014, a bald and golden eagle territory use and occupancy assessment identified 42 occupied golden eagle territories and one bald eagle territory within 10 miles of Site 300 (Garcia and Associates 2014). In 2015, utilization and distribution surveys refined the understanding of the boundary and use of the occupied golden eagle territory that overlapped with Site 300 (Garcia and Associates 2015). These assessments determined that a territorial pair of golden eagles nest off-site to the west of Site 300 and use Site 300 primarily for hunting (Garcia and Associates 2015). Additionally, it was determined that non-territorial adult golden eagles were not regularly present at Site 300 (Garcia and Associates 2015).

The 2005 SW/SPEIS did not anticipate breeding Swainson's hawk (California threatened), would occur at Site 300. However, in 2009, a pair attempted to nest in an oak tree within an area that was routinely included in the Site 300 annual prescribed burn. Burning was not done in the area surrounding the nest tree to prevent potential impacts on the nest. Since that time in most years a deterrent has been placed in the tree to discourage the hawks from selecting that tree for nesting, as there is other appropriate habitat in proximity to Site 300, thus preventing impacts on the species from annual prescribed burns. Since 2009, Swainson's hawks have been regularly observed foraging near the northern perimeter of Site 300, but no nesting Swainson's hawks were observed at Site 300. Burrowing owls (federal species of concern and state species of special concern) were historically a relatively common nesting species at Site 300 (DOE 2005a). Observations through 2019 have confirmed that this species is still nesting at Site 300. The size of breeding burrowing owl populations at Site 300 has varied since 2005 in response to natural fluctuations in the abundance of burrowing owl prey species (LLNL 2015, Paterson et al. 2019). Since 2005, three willow flycatchers (California endangered) have been observed at Site 300 during surveys of Elk Ravine.

A population of tricolored blackbirds (federal species of concern, state species of special concern, and a candidate for listing as endangered under the California Endangered Species Act) has continued to nest in part of Elk Ravine since 2005.

Mammals

As described in the 2005 SW/SPEIS, site-wide surveys in 1980, 1986, 1991, 2002 and 2018 resulted in zero detection of the San Joaquin kit fox (DOE 2005a). San Joaquin kit fox surveys were conducted at Site 300 using scat detection dogs in

November of 2018. Approximately 33 km of transect legs were searched covering 810 acres at Site 300 and the adjacent Corral Hollow Ecological Reserve. Site 300 surveys included the areas most likely to support San Joaquin kit fox (along the perimeter of the northern half of Site 300). Results of the scat detection dog surveys, and subsequent DNA analysis do not support the presence of kit foxes on Site 300 or the Corral Hollow Ecological Reserve (Woollett 2019). Although Site 300 contains potential habitat and occurs within the northern range of the San Joaquin kit fox, the species is not considered a resident species as of 2019.

The American badger (California species of special concern) continues to be observed at Site 300 through 2019. During sitewide surveys conducted in 2002, three bat species protected at the state level as California species of special concern were detected: the pallid bat, the long-legged myotis, and the western red bat. Passive acoustic monitoring for bats at one location at the Site 300 from 2015-2016 did not identify any species of bats protected at the State or Federal levels. The 2015-2016 surveys are much more limited in scope than the 2002 surveys and therefore cannot be used to make any conclusions about the occurrence of special status bat species at Site 300. Surveys for bats were not performed in 2019.

3.7.2 Critical Habitat Designations

Critical habitat designations for the Alameda whipsnake, California red-legged frog, and California tiger salamander have been the subject of litigations and have gone through many revisions since their original designations. The current critical habitat final rule for the Alameda whipsnake encompasses 2,492 acres of Site 300 and all areas surrounding the Arroyo Mocho pump station (USFWS 2006). Approximately 385 acres of federally designated Alameda whipsnake critical habitat are within the Site 300 prescribed burn zones. The current California red-legged frog critical habitat designation does not include any portion of the Livermore Site, but does include all of Site 300 and the land surrounding the Arroyo Mocho pump station (USFWS 2010). All the Site 300 prescribed burn areas occur in California red-legged frog critical habitat. The current critical habitat designation for the California tiger salamander (as final rule issued in 2011 and amended in 2014) does not include the Livermore Site or Site 300 (USFWS 2011, 2014a). Critical habitat for the large-flowered fiddleneck occurs at Site 300, and has not been revised since it was designated in 1985 (USFWS 1985). No critical habitat is designated at the Livermore Site as of 2019.

3.7.3 Endangered Species Act Consultations 2005-2019

In compliance with DOE guidelines, a biological assessment was prepared in conjunction with the SW/SPEIS and can be found in Appendix E of the SW/SPEIS along with LLNL’s previous consultation history. Due to the potential for impacts on protected species and their habitats at both LLNL sites from various projects since

completion of the 2005 SW/SPEIS, LLNL DOE/NNSA has completed multiple consultations with the USFWS pursuant to Section 7(c) of the Endangered Species Act. This section of the Yearbook updates the LLNL consultation history since 2002.

3.7.3.1 Site 300

The 2002 Routine Maintenance and Operations Projects at the LLNL Site 300 Experimental Test Site Biological Opinion (BO) (Service File Number 1-1-02-F-0062) was amended several times, and several projects have been completed under this BO since 2002.

In accordance with the 2002 BO, a Conservation Set Aside and habitat enhancement project was undertaken at Site 300 in August 2005 to compensate for wetland values lost due to termination of potable water surface discharges to the artificial wetlands near Buildings 801, 827, 851, and 865. Pools M1a and M1b, in the Mid-Elk Ravine, were enlarged and deepened for the purpose of protecting 0.012 acres of open water habitat and 1.86 acres of wetland and upland habitat. In 2006, 26 adult and subadult California red-legged frogs were relocated from Buildings 865 and 801 (where potable water discharges had been occurring) to Pools M1a and M1b. Since that time numerous egg masses and the successful metamorphosis of California red-legged frogs has been observed at the Elk Ravine pools annually.

The Oasis Culvert Replacement Project was completed in the fall of 2006. This project was included in the 2002 BO. The Round Valley Culvert Replacement Project was also completed in the fall of 2006. A large pool designed as breeding habitat for the California tiger salamander and California red-legged frog was constructed upstream of the Round Valley culvert as part of the project. This pool, named HC1, was in part mitigation for impacts on wetlands during the Oasis Culvert Replacement Project. Rainfall from 2007 to 2013 was inadequate to fill the pool to sufficient levels to support amphibian breeding. In the fall of 2012, under a USFWS-issued amendment (08ESMF00-2012-F-0591-1) to the 2002 BO (1-1-02-F-0062, 1-1-05-1-0117, and 1-1-07-F-0224), clay was added to the pool bottom in an attempt to limit draining of water through the pool bottom.

A July 2007 amendment (1-1-07-F-0224) to the 2002 BO addressed impacts of ongoing operations on California tiger salamanders at Site 300. This consultation and amendment were necessary as the species was not listed at the time of the 2002 BO, and Site 300 projects that were not evaluated in the 2002 BO had potential for impacts.

An April 2009 amendment (81420-2009-F-0235) to the 2002 BO addressed impacts from the Building 850 Polychlorinated Biphenyls-Bearing Soil Removal Project. To compensate for impacts on the California tiger salamander and California red-legged

frog habitat, a poorly performing breeding pool (Pool M3) was proposed for enhancement. In 2013, DOE/NNSA requested re-initiation of formal consultation for the mitigation, monitoring, and reporting plan (MMRP) for this project. In 2014, DOE/NNSA received an amendment (2014-F-0194) to the 2002 BO from the USFWS authorizing LLNL to start construction of Pool M3 and, within 6 months after completion, to submit the MMRP according to the USFWS "Long Term Management Plan" format. The pool and surrounding 48.5 acres have been formally established as a conservation set-aside area with the USFWS, and therefore has restrictions for use. Construction of Pool M3 was completed in 2014 and the management plan has been submitted to the USFWS within the required time frame.

A California tiger salamander habitat enhancement project was initiated at Site 300 in August 2005, as described in the BO Formal Endangered Species Consultation for the Closure of Class II Explosives Wastewater Surface Impoundments, (1-1-05-F-0107) issued the same year. Two man-made, explosives rinse water ponds, occasionally used by, but of limited value to, California tiger salamanders, were retired from use in the Chemistry Process Area. A depression in the northwest corner, named M2, was deepened and expanded in size. In 2006, 2010, and 2011, California tiger salamanders successfully bred and metamorphosed from Pool M2. From 2007 through 2009 and 2012 to 2014, water evaporated from the pool before the larvae could mature to terrestrial form and leave the pool. In 2013, DOE/NNSA re-initiated formal consultation with the USFWS for the Pool M2 improvements and maintenance and the USFWS issued an amendment (08ESMF00-2014-F0046) to the 2005 BO. Under the amendment, a clay liner was added to the pool in 2014, and in 2015 and 2018 the pool held water but did not fill sufficiently for breeding amphibians due to low rainfall.

DOE/NNSA requested formal consultation in 2011 for a soil characterization project in the area surrounding Building 812 at Site 300 that will be completed as part of the CERCLA process. The USFWS did not amend the 2002 BO, but instead issued a BO and Incidental Take Statement for this project in 2011 (08ESMF00-2011-F-0883-1).

In 2011, LLNL submitted a Programmatic Biological Assessment (PBA) for Continued Operations of the LLNL Experimental Test Site, (Site 300) to the USFWS. This consultation was canceled by LLNL.

In 2017, LLNL submitted a BA for Continued Operations and Maintenance to the USFWS. On August 9, 2018, the USFWS issued a biological opinion (Service File No. 08ESMF00-2018-F-0733) for the Continued Operations and Maintenance of the LLNL Experimental Test Site, Site 300 (2018 Site 300 biological opinion) to DOE/NNSA. Two projects were completed under the 2018 biological opinion in the fall and winter of 2018: the Tank 4 Road project and the Eastern General Service

Areas (EGSA) well decommissioning project. Three projects, the Eastern General Services Area Well Decommissioning Project, construction of the Remote Firing Facility Office Building (Building 8021), and the U815 access road and erosion repair project, were completed under this biological opinion in 2019. In 2019, two new projects were also approved for completion under the 2018 Site 300 biological opinion: the Building 855 fence line relocation, and maintenance of the Building 850 corrective action management unit (CAMU).

3.7.3.2 Livermore Site

In 2005, the USFWS issued a BO for the Arroyo Seco Management Plan (1-1-05-F-0150) that considered potential impacts on California red-legged frog and California tiger salamander from erosion repair and channel restoration activities.

The 1997 Arroyo Maintenance Project on Arroyo Las Positas BO (1-1-97-F-0173) was amended several times since completion of the 2005 SW/SPEIS to expand the project scope. Projects that expanded the 1997 BO scope prior to 2005 are described in the 2005 SW/SPEIS. A 2006 amendment (1-1-007-F-0003) to the 1997 BO was issued in the same year that management actions successfully eliminated large-mouth bass from Lake Haussmann. In 2007, USFWS issued an amendment (1-1-07-F-0109) to the 1997 BO to include potential impacts on California red-legged frogs in drainages throughout the Livermore Site and also included potential impacts on California tiger salamander. Additional measures for the protection of California red-legged frogs during site-wide maintenance were included in a 2010 amendment (81420-2010-F-0240-1) to the 1997 BO. Maintenance on the Arroyo Las Positas and other drainages at the Livermore Site continued in accordance with the BO and amendments in 2019.

The East Campus Site Improvements project and the installation of an access road to a new well at Treatment Facility B posed potential for impacts on protected species resulting in a 2011 BO (81420-2011-F-0738-1). As of 2019, work under this BO has progressed and no amendments have been issued.

A 2012 BO (08ESMF00-2012-F-0500-2) addressed potential impacts from construction of a photovoltaic system and site-wide electrical infrastructure upgrades at the Livermore Site. As of 2015, the photovoltaic array was constructed. Construction of the Electrical Expansion Distribution System (EEDS) project was initiated in 2018 and is ongoing. No amendments have been issued for this BO.

In 2013, USFWS issued a BO for Infill Construction and Redevelopment at the Livermore Site (08ESMF00-2013-F-0461-1). Work under this BO continued through 2019 and no amendments have been issued.

3.7.3.3 Arroyo Mocho Pump Station

The 2004 BO (1-1-04-F-0086) for the proposed Arroyo Mocho road improvement and anadromous fish passage project was amended in 2007 and 2009. In accordance with the BO and amendments, LLNL removed boulders from the channel of Arroyo Mocho in the area directly below the pump station and maintains the area for erosion control. As of 2019 no further amendments have been issued for the 2004 BO.

3.7.4 Wetlands

An assessment of floodplains and wetlands was completed for both LLNL sites to provide background for the 2005 SW/SPEIS. See Appendix F of the SW/SPEIS for a detailed analysis of wetlands and their locations at LLNL.

3.7.4.1 Livermore Site

As of 2019, no new wetland delineations had been performed at the Livermore Site since the 2005 SW/SPEIS. Although very limited in the developed areas of the Livermore Site, wetlands were found to occur in 1.96 acres along Arroyo Las Positas at the northern perimeter of the Site and in 0.04 acres of Arroyo Seco in the southwestern corner of the Site in previous delineations (DOE 2005a).

3.7.4.2 Site 300

Appendix F of the SW/SPEIS includes additional discussion on the wetlands present at Site 300 at the time of preparation of the SW/SPEIS. Six wetland delineations have been completed at Site 300 since completion of the 2005 SW/SPEIS as part of the compliance process for characterization or restoration projects at these sites:

- A total of 0.17 acres of non-wetland jurisdictional waters were identified at Pool M3 in 2010. This area was not studied as part of the 1992 or 2002 site-wide wetland delineations.
- A delineation was completed in the Building 812 canyon in 2011 in preparation for soil characterization and potential future restoration activities. This area was found to contain 0.12 acres of jurisdictional wetlands. An additional 0.04 acres downstream of these wetland communities is considered non-wetland jurisdictional areas (Other Waters). The Building 812 canyon was not studied as part of the 1992 or 2002 wetland delineations.
- The Round Valley Jurisdictional Determination was completed in 2012, resulting in the identification of 0.16 acres of wetlands.
- A total of 0.044 acres of potential jurisdictional wetlands and 0.074 acres of non-wetland jurisdictional waters were identified at Pool M2 in 2013. Wetlands were also identified at this location in 2002. In 2013, the pool was enhanced with a clay liner to repair feral-pig and age-related damages.

- A delineation was completed at Pools M1a and M1b in 2013 in preparation for dredging and maintenance work that was completed in 2014. A total of 0.20 acres of potential jurisdictional wetlands were found at Pools M1a and M1b in 2013, an increase from the 0.06 acres found in 2002. This increase in area is a result of the successful 2005 habitat enhancement project.
- Wetlands located within the right of way of Corral Hollow Road at the Site 300 entrance were delineated in 2019. This delineation was completed to facilitate planning for potential traffic safety improvements to Corral Hollow Road at the Site 300 entrance. Three small wetlands (totaling 2,131 square feet) and two roadside drainage ditches were delineated. The jurisdictional status of these wetlands has not been determined.

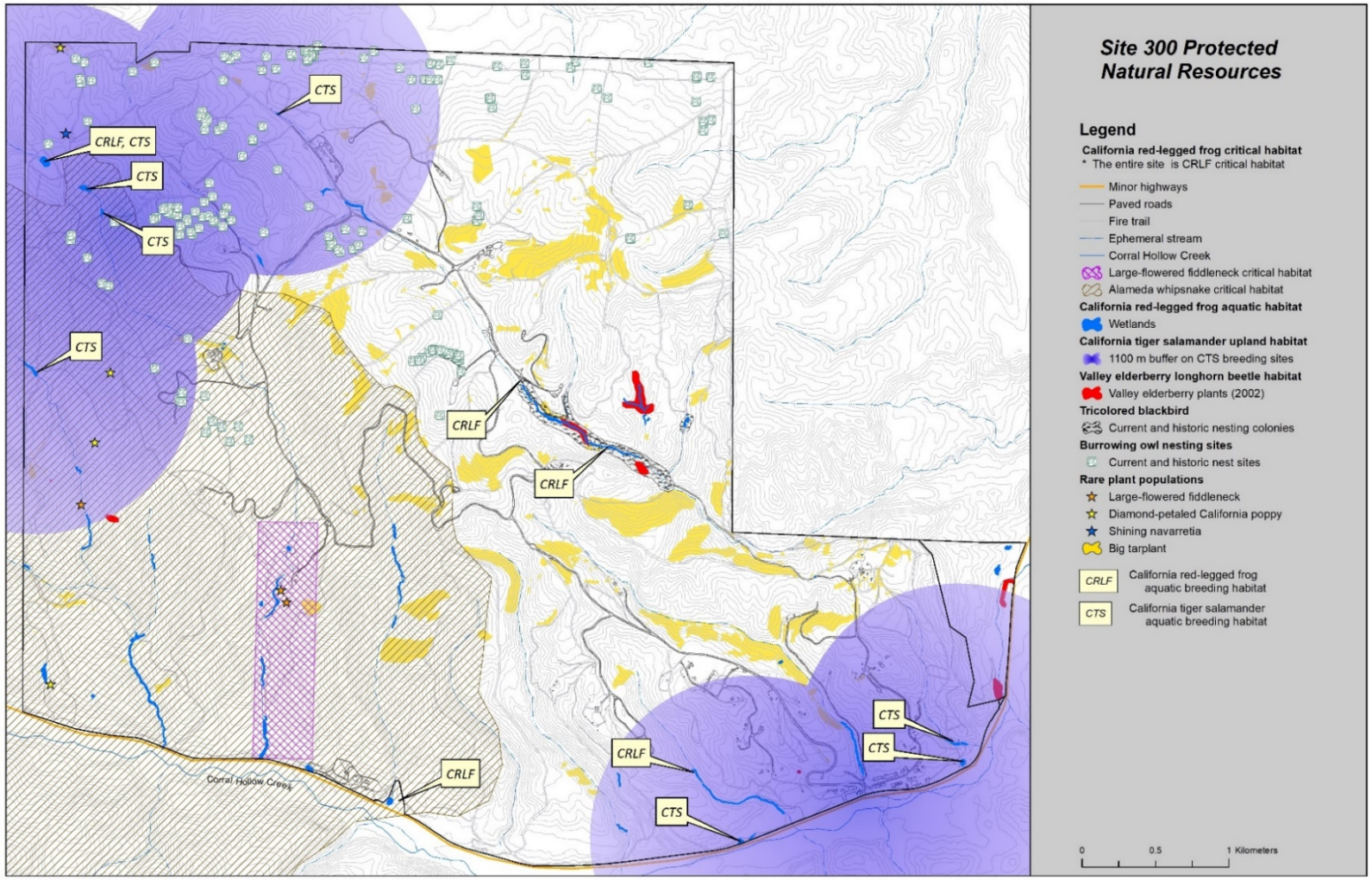

Figure 2. Protected Natural Resources at Site 300. The entire Site is critical habitat for California red-legged frog (CRLF). CRLF and California Tiger Salamander (CTS) aquatic breeding locations are called out along with aquatic non-breeding habitat. All areas within one mile of aquatic habitat are upland habitat for the CRLF; this includes the entire site. CTS upland habitat is symbolized on the map.

3.8 Air Quality

All LLNL activities with the potential to produce air pollutant emissions were evaluated in the SW/SPEIS to determine the need for permits and assessed for continued compliance. The areas of major concern for air quality at LLNL are criteria air pollutants, toxic and hazardous air pollutants, and radiological emissions. This section reviews the changes affecting potential air quality impacts.

3.8.1 Radioactive Air Emissions

The SW/SPEIS evaluated routine radiological emissions from LLNL facility operations on the basis of dose to the site-wide maximally exposed individual (SW-MEI) and collective dose to the general population within 50 miles of the Site (population dose). The SW/SPEIS used radiological emission data from 2002 as the baseline year.

3.8.1.1 Livermore Site

For the 2019 reporting period, radioactive air emissions at the Livermore Site remain low and within bounds of the conservative projections for an individual standing at the SW-MEI of 0.142 mrem per year (mrem/y) as stated in the 2011 SA. The population dose also remains low and within bounds of the 2011 SA, which stated population doses of 1.91 person-rem/yr. It should be noted that the population dose in the 2011 SA used the census data from year 2000.

3.8.1.2 Site 300

The SW/SPEIS estimated that the dose at Site 300 would be 0.055 mrem/y with the SW-MEI located west-southwest of Firing Table 851, the only outdoor firing facility that could use depleted uranium. The population dose was estimated to be 9.8 person-rem per year. The 2003 through 2019 LLNL Environmental Report reported that both radioactive air emissions and the dose to the SW-MEI for Site 300 were much lower than projected by the SW/SPEIS.

3.8.2 Nonradioactive Air Emissions

The SW/SPEIS estimated that, under the proposed action in the worst-case year for the regulated pollutants, LLNL's Livermore Site would emit a total of approximately 60 tons/year (147 kg/day, average daily emission rate is calculated for the purposes of comparison in this Yearbook and is not a regulatory requirement). The Livermore Site's nonradioactive air emissions under the proposed action were projected to be 20 tons a year (49.7 kg/day) of carbon monoxide, 22 tons a year (54.7 kg/day) of nitrogen oxides, 12 tons a year (29.8 kg/day) of particulate matter, 2.1 tons a year (5.2 kg/day) of sulfur oxides, and 3.8 tons a year (9.4 kg/day) of precursor organic compounds (POCs), respectively (see Table 8 for average kg/day calculated from actual yearly quantities).

The largest sources of criteria pollutants from the Livermore Site are surface-coating operations, internal combustion engines, solvent operations and boilers (oil and natural gas-fired) when grouped together. Pollution prevention efforts, a smaller workforce, and changes in work type attribute to the lower quantities through 2019.

Table 8. Nonradioactive Air Emissions Livermore Site 2005-2019.
Average kg/day at the Livermore Site (calculated from actual yearly data) listed by calendar year for comparison with the SW/SPEIS calculated projections.

Calendar Year	Average Emissions (kg/day)					
	Carbon Monoxide	Nitrogen Oxides	Particulate Matter	Sulfur Oxides	Precursor Organic Compounds	Total
SW/SPEIS Projection	49.7	54.7	29.8	5.2	9.8	147
2005	49.9	68.6	5.6	1.7	24.9	150.7
2006	50.3	67.2	5.4	1.6	16.1	140.6
2007	52.3	65.7	6.0	1.5	17.3	142.8
2008	49.0	63.0	5.8	1.7	13.3	132.8
2009	46.8	59.3	5.21	1.48	9.91	122.75
2010	43.1	52.5	4.4	1.4	9.8	111.2
2011	43.3	48.1	4.8	1.5	10.8	108.5
2012	39.9	45.0	4.5	1.7	11.3	102.4
2013	40.5	42.7	4.5	1.2	11.3	100.2
2014	38.4	37.9	4.6	0.7	12.6	94.2
2015	40.9	35.5	4.5	1.6	13.6	96.1
2016	42.6	36.7	4.6	1.8	16.0	101.7
2017	42.7	37.4	4.7	1.9	13.5	100.2
2018	43.3	37.5	4.7	1.7	15.7	102.9
2019	40.5	35.3	4.4	1.7	17.1	99.0

Source: LLNL 2006-2020.

Air pollutants were projected in the SW/SPEIS to be much lower at Site 300 with an estimated total of 12 tons/year (30 kg/day). The Site 300's nonradioactive air emissions were projected to be 1.5 tons/year (3.7 kg/day) of carbon monoxide, 5.0 tons/year (12.4 kg/day) of nitrogen oxides, 4.5 tons/year (11.2 kg/day) of particulate matter, 0.52 tons/year (0.4 kg/day) of sulfur oxides, and 0.77 tons/year (1.9 kg/day) of precursor organic compounds, respectively (see Table 9 for average kg/day calculated from actual yearly quantities data).

Certain operations at Site 300 require air permits from the San Joaquin Valley Air Pollution Control District (SJVAPCD). The stationary emission sources that release

the greatest amounts of regulated air pollutants at Site 300 include internal combustion engines (such as diesel generators) and a gasoline-dispensing facility.

Table 9. Nonradioactive Air Emissions Site 300 2005-2019.
Average kg/day emitted at Site 300 (calculated from actual yearly data) listed by calendar year for comparison with the SW/SPEIS projections.

Calendar Year	Average Emissions (kg/day)					
	Carbon Monoxide	Nitrogen Oxides	Particulate Matter	Sulfur Oxides	Precursor Organic Compounds	Total
SW/SPEIS Projection	3.7	12.4	11.2	0.4	1.9	29.6
2005	0.19	0.52	0.28	0.03	0.41	1.35
2006	0.27	1.2	0.32	0.15	0.44	2.48
2007	0.51	2.32	0.39	0.21	0.48	3.91
2008	0.51	2.32	0.49	0.21	0.42	3.95
2009	0.46	2.14	0.32	0.17	0.42	3.51
2010	0.29	1.35	0.34	0.11	0.34	2.43
2011	0.71	2.7	0.56	0.17	0.33	4.47
2012	0.53	1.72	0.59	0.12	0.21	3.17
2013	0.67	2.88	0.39	0.17	0.26	4.37
2014	0.19	0.61	0.22	0.04	0.24	1.3
2015	0.84	3.59	0.62	0.2	0.32	5.57
2016	0.44	1.88	0.33	0.10	0.31	3.06
2017	0.73	3.17	0.41	0.19	0.30	4.81
2018	0.43	1.72	0.34	0.08	0.17	2.74
2019	0.25	0.79	0.29	0.04	0.15	1.52

Source: LLNL 2006-2020.

Under the authority of California Assembly Bill 32 (AB32), the State of California has adopted several new regulations regarding emissions of greenhouse gases. Initially, California required the mandatory reporting of stationary emission sources from combustion of natural gas that exceeded 25,000 metric tons per year of CO_2 equivalent emissions. For the mandatory reporting years of calendar years 2009, 2010, and 2011, the Livermore Site was slightly below the reporting threshold. Beginning in 2012, California lowered the mandatory reporting threshold to 10,000 metric tons per year of CO_2 equivalent emissions, and consequently LLNL started reporting emissions for 2012 and continued reporting such emissions through 2019. LLNL continues to implement controls that should reduce CO_2 emissions in future years.

LLNL Site 300 emissions of CO_2 are much smaller than Livermore Site emissions, and there is no natural gas service at Site 300. California also has special regulations pertaining to sulfur hexafluoride (SF_6), because of its high greenhouse gas potential. Research facilities, including LLNL, must submit an annual report describing the research uses of SF_6 and the measures taken to control the SF_6 emissions. LLNL must also report the amount of SF_6 contained in electrical switchgear and the amount of SF_6 that leaks from that switchgear. The reporting of SF_6 emissions from research and switchgear commenced in calendar year 2011. The federal Environmental Protection Agency (EPA) also has a mandatory reporting regulation for stationary emission sources, similar to California's regulation. LLNL is currently below the reporting threshold of 25,000 metric tons of CO_2 equivalent emissions for EPA mandatory reporting.

Because the emissions of regulated and hazardous pollutants remain comparable with the analyses in the SW/SPEIS and below regulatory thresholds, the DOE/NNSA determined in 2011 that supplementation of the 2005 SW/SPEIS for air quality was not needed.

Major sources of regulated air pollutants at LLNL would continue to be from combustion of natural gas for comfort heating and environment control, and fuel used for reciprocating engines, such as emergency standby generators. In general, emissions of regulated air pollutants from other sources are declining, due to implementation of pollution prevention measures, including the increased use of products that are manufactured with less content of precursor organic compounds.

3.8.3 Air Quality Conformity

Emissions estimates are well below the applicable conformity thresholds for air quality therefore the SW/SPEIS projected air emissions are still in conformance with Clean Air Act requirements. Refer to Tables 5.1-2 and 5.3.8.1-3 in the SW/SPEIS for conformity threshold limits.

3.9 Water

This section discusses the SW/SPEIS projected impacts on surface water, ground water, water use, and floodplains.

3.9.1 Ground Water

No impacts on ground water from leaking underground storage tanks were identified in the SW/SPEIS because LLNL complies with all underground storage tank regulations. Ground water quality was projected to improve because of ongoing remediation at treatment facilities. No negative impacts to ground water were expected from operations because LLNL does not discharge to ground water.

Impacts on ground water quality from surface water recharge were also projected to be minimal because LLNL continues to comply with National Pollutant Discharge Elimination System (NPDES) requirements.

Under the ROD, developed space at Site 300 would remain the same. Because Site 300 is largely undeveloped and contains permeable soils, it had no noticeable impact to ground water recharge.

No impacts on floodplains were expected in the SW/SPEIS because no activities under the ROD occur within the 100-year floodplain. No projects were anticipated to contribute significant amounts of surface water runoff to cause substantial flooding because the 100-year base flood event would be contained within all channels. Due to the high infiltration rates and lack of appreciable floodplains at Site 300, hydrologic impacts from the Proposed Action were projected to be minimal, but because of the steep slopes, high run-off velocities within the channels could occur during a storm. However, because no facilities are located in these areas, the SW/SPEIS did not project any impact from flooding.

3.9.2 Surface Water Use/Quality

The affected environment discussion in the SW/SPEIS includes a description of local surface water resources at the Livermore Site and Site 300, flow characteristics and relationships, and existing water quality. Data used for impact assessments included rates of water consumption and wastewater discharge. The existing water supply was evaluated to determine if sufficient quantities were available to support an increased demand by comparing projected increases with the capacity of the supplier.

Prior to July 2015, storm water was sampled at both LLNL sites in accordance with the issued storm water permits. At the Livermore Site, storm water was sampled in accordance with the requirements of Waste Discharge Requirement Order No. 95-174; NPDES No. CA0030023. At Site 300, storm water was sampled in accordance with the requirements of the 1997 Industrial General Storm Water Permit Order 97-03-DWQ.

In 2014, the State Water Resources Control Board issued a new General Permit for Storm Water Discharges Associated with Industrial Activities (Industrial General Permit) Order No. 2014-0057-DWQ NPDES No. CAS000001. The industrial storm water pollution prevention programs at Livermore Site and Site 300 were modified in July 2015 to follow the requirements of the new Industrial General Permit based on standard industrial codes. LLNL continues to follow prevention and mitigation steps for spill response, comply with NPDES requirements, follow SWPPP requirements, and follow all applicable requirements to protect site hydrology.

The new and modified projects and modifications in site operations at both LLNL sites, such as new buildings and associated infrastructure improvements, are not anticipated to change the impact to water resources from those analyzed in the SW/SPEIS. Through 2019, LLNL continued to follow all applicable regulations for preventing impacts to surface and groundwater, to the maximum extent feasible.

3.10 Noise

According to the SW/SPEIS, activities associated with the continued operation of LLNL would contribute to noise generation, either directly or indirectly. The general parameters that were used to characterize community noise levels under the Proposed Action were listed in Table 5.3.10.1-1 of the SW/SPEIS (DOE 2005a).

Noise generated during construction activities related to facility and infrastructure renovations at the Livermore Site and Site 300 would generally not be noticeable in nearby communities because of the relatively large spatial area, perimeter buffer zones, and intervening roadways. No additional noise impacts were identified in the SW/SPEIS.

The SW/SPEIS projected a slight increase in heavy-duty vehicle activity at both the Livermore Site and Site 300, and a corresponding increase in the frequency of associated peak noise levels. Vehicles serving LLNL would be required to be properly muffled to reduce noise impacts, and activities would be limited to those times that noise would be less noticeable and less objectionable. Also, continuing operations were projected to require a workforce increase, and a corresponding increase in vehicular activity and ambient noise levels. However, because the 2019 workforce was smaller than the SW/SPEIS projection, vehicular activity and ambient noise levels have not increased.

LLNL continues explosives research testing at both the Livermore Site (in the Building 191 High Explosives Application Facility) and at Site 300 (within the Contained Firing Facility and on an open firing table). LLNL uses blast forecasting as a tool to determine if explosives testing would adversely affect the surrounding community and to restrict operations when peak-impulse noise levels are predicted to exceed the 126-dB (A) level in populated areas. LLNL also continues to perform meteorological monitoring to provide necessary input data for blast forecasting. No additional noise impacts were identified in 2019.

The removal of 820,000 gross sf of excess and legacy facilities over a 10-year period was identified as new activity in the SW/SPEIS (DOE 2005a). However, through 2019 only 659,755 sf had been demolished (see Table 5). The lower than projected rate of demolition combined with relatively large spatial area and perimeter buffer

zone has prevented noise from D&D activities from having additional impacts on offsite areas.

Even though the new and modified projects and modifications in site operations, such as new construction activities and a small increase in workforce traffic may contribute to noise generation, impacts are consistent with those analyzed in the SW/SPEIS.

3.11 Traffic and Transportation

Commuting workers and deliveries of materials needed for the operation of facilities continue to comprise most of LLNL-generated traffic in 2019. Traffic volume at the Livermore Site was projected to increase by approximately 500 workers under the SW/SPEIS Proposed Action, which was a small fraction of the current traffic level in the heavily congested Tri-Valley area (DOE 2005a). However, due to the decrease in the size of the LLNL-affiliated workforce, traffic volume from LLNL commuting workers has decreased.

The SW/SPEIS projected minor changes in the workforce at Site 300 and therefore negligible impacts on traffic. Site 300 does not engage in any significant transport of radioactive materials although explosives are often transported. As projected, the number of explosives shipments has not significantly increased, and very small incremental impacts are expected in future.

The SW/SPEIS projected an increase in waste generation for both routine wastes and nonroutine wastes primarily due to differences in the operation of the NIF. Routine waste is generated from the normal operations of LLNL. Nonroutine waste is generated from construction, D&D, and environmental restoration.

The SW/SPEIS identified that transportation of radioactive materials offsite would increase under the Proposed Action, primarily because of programmatic agreements. The SW/SPEIS modeling of offsite radioactive shipments yielded a collective dose to the public of 9.0 person-rem per year. New modeling for transportation of offsite radioactive shipments has not been conducted during calendar years 2003 through 2019. The potential cancer risk from shipments of radioactive materials from the Livermore Site was projected to be low with the calculated potential latent cancer fatalities (LCFs) to be 5×10^{-3} in the SW/SPEIS. The amount of explosives materials transported to Site 300 was also projected to increase slightly.

Overall shipments of sanitary waste, hazardous/radiological wastes, and regulated materials have been consistent with SW/SPEIS projections for most years. There was an increase in sanitary waste trips beginning in 2006, that has been attributed to the inclusion of nonroutine sanitary waste trips and recycled materials trips (used as cover at landfills) (see Figure 3).

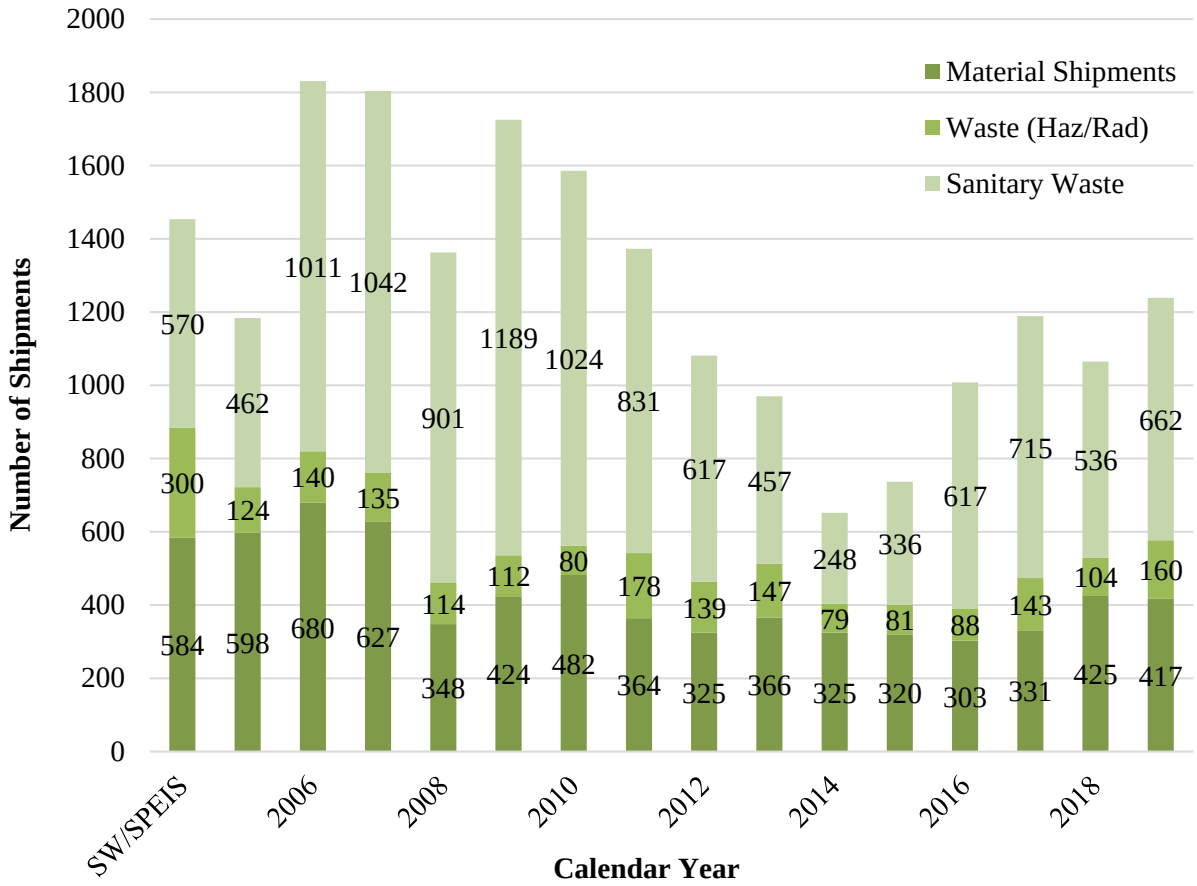

Figure 3. Traffic and Transportation Data.
Number of shipments of sanitary waste, hazardous/radiological wastes, and regulated materials by fiscal year for comparison with SW/SPEIS projections. Source: Byrnes 2006-2015, Doman 2008-2014, Stephens 2006-2011, Ottaway 2015-2020, Garrett 2015-2020, Schneider 2012-2015, Fugmann 2018-2020.

There was a temporary increase in 2011 of hazardous/radiological wastes trips due to the Building 419, 391, and 321C D&D activities. Similarly, there was an increase in low-level waste (LLW) volumes, and therefore trips generated, beginning in 2011 which are expected to continue in the future. It was determined in the 2011 SA that the trips were consistent with those analyzed in the SW/SPEIS and that supplementation for traffic and transportation was not needed. Since 2011, LLNL has not shipped any legacy mixed low-level waste (MLLW), LLW, or transuranic (TRU) wastes, as shown in Table 10.

Table 10. Traffic and Transportation Data - Shipments of Legacy Wastes.
Shipments of legacy TRU, LLW, and MLLW are provided for comparison with the SW/SPEIS projections.

Fiscal Year	Number of Shipments of Legacy Wastes		
	TRU	LLW	MLLW
SW/SPEIS Projection	24	64	80
2005	16	42	17
2006	0	10	3
2007	0	0	0
2008	0	0	0
2009	0	0	0
2010	7	0	0
2011	0	0	0
2012	0	0	0
2013	0	0	0
2014	0	0	0
2015	0	0	0
2016	0	0	0
2017	0	0	0
2018	0	0	0
2019	0	0	0

Source: Stephens 2006-2011, Byrnes 2006-2015, Doman 2008-2014, Schneider 2012-2017, Ottaway 2015-2017, Fugmann 2018-2020.

3.12 Utilities and Energy

The utilities and energy analysis in the SW/SPEIS was based on projected square-footage requirements and available system capacities at LLNL. The total facility space at the Livermore Site was projected to decrease by approximately one percent, and the total facility space at Site 300 was projected to remain the same. Additionally, because several facilities and utility system upgrades have been implemented and with plans to continue similar energy-saving upgrades, LLNL's total utilities and energy uses were projected to decrease by one percent. The SW/SPEIS projected fuel oil use for both the Livermore Site and Site 300. However, fuel oil is no longer used at the Livermore Site or Site 300 and is not reported in this Yearbook.

As shown in Figure 4, electricity usage was trending up in 2013, 2018, and 2019 due to unprecedented mission growth, activities, and population increase. However, for all years since the SW/SPEIS publication, consumption has remained within the SW/SPEIS projections.

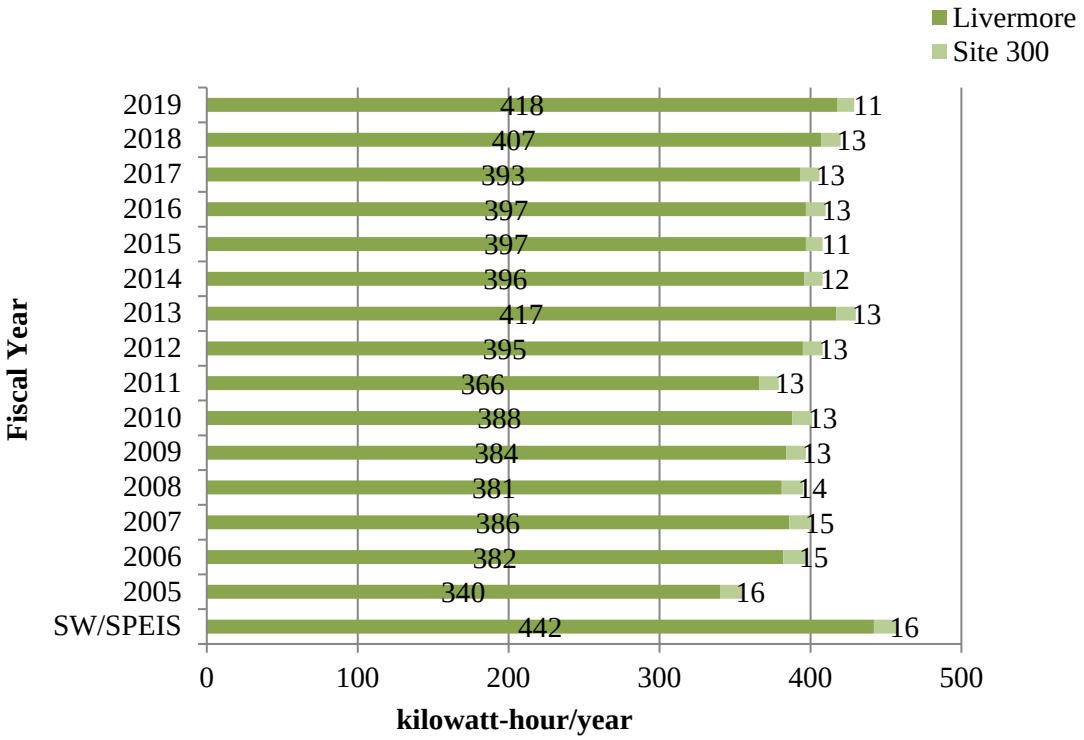

Figure 4. Electricity Consumption 2005-2019.
Kilowatt-hours consumed per fiscal year at the Livermore Site and Site 300 for comparison with SW/SPEIS projections. Source: Horst 2006-2008, Howing 2009-2020.

As shown in Figure 5, water use started to trend up in 2016 due to the shift in water source from Hetch Hetchy to Zone 7. However, for all years since the SW/SPEIS publication, consumption has remained within the SW/SPEIS projections.

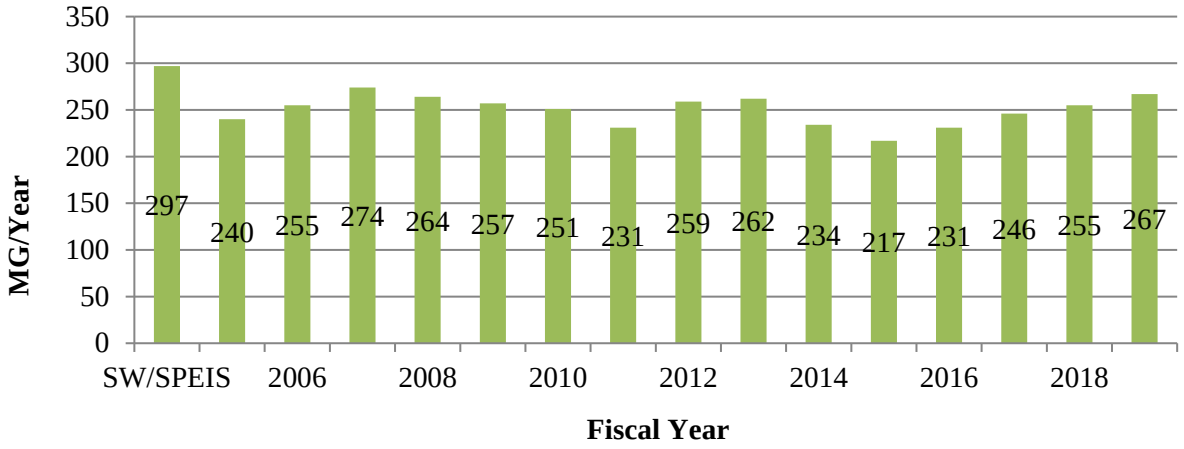

Figure 5. LLNL Water Consumption 2005-2019.
Actual gallons consumed per fiscal year at LLNL for comparison with the SW/SPEIS projection. (Source: Horst 2006-2008, Howing 2009-2020.

As shown in Figure 6, natural gas consumption in 2019 was consistent with the relatively stable trend in recent years. For all years since the SW/SPEIS publication, consumption has remained within the SW/SPEIS projections.

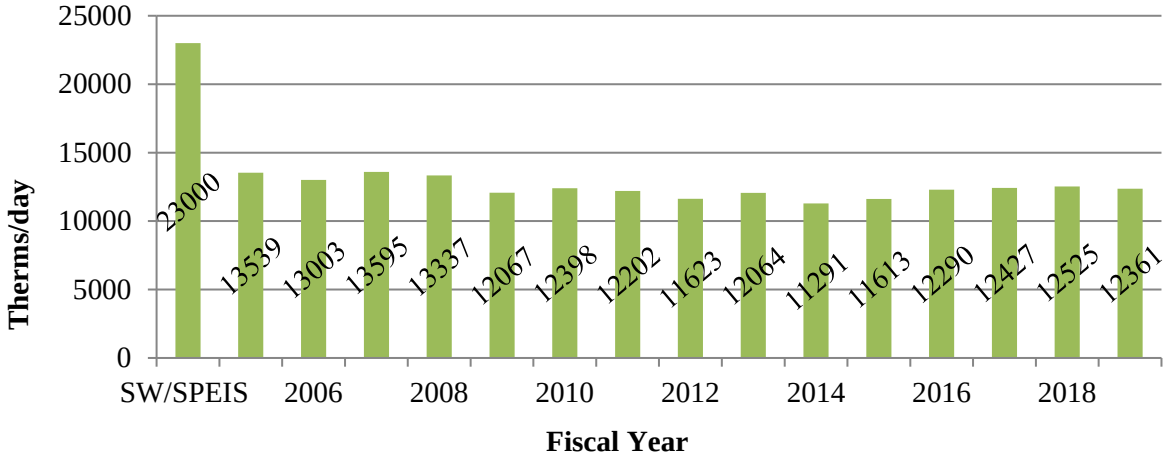

Figure 6. LLNL Natural Gas Consumption 2005-2019.
Average therms consumed per day per fiscal year for comparison with the SW/SPEIS projection. Source: Horst 2006-2008, Howing 2009-2020.

3.13 Materials and Waste Management

The SW/SPEIS projected an increase in waste generation for routine wastes (generated during normal LLNL operations) and nonroutine wastes (generated from construction, D&D, and environmental restoration). However, hazardous waste generation has remained within the SW/SPEIS projections, as shown in Figure 7. Sanitary solid waste generation has also remained within the SW/SPEIS projections, as shown in Figure 8, except for 2007 when there was an increase from cleanup and decommissioning projects at the Livermore Site. Radioactive waste generation rates are shown in Figures 9 and 10.

Beginning in 2011, there was an increase in routine LLW volumes due to wipe cleaning wastes and personal protective equipment disposal; an increase in Site 300 shot activities in 2012 generated additional routine LLW. NIF implemented numerous program improvements that resulted in a 65% reduction of LLW between fiscal year (FY) 2012 and FY2013; the downward trend continued through 2016 (see Figure 7). There was a temporary increase in 2011 of nonroutine MLLW generation due to the Building 419, 391, and 321C D&D activities. There was also a temporary increase in nonroutine LLW generation in 2012 from the Building 801 reroofing project, a campaign to dispose of several tons of gravel from Site 300, and the 2200 Block project.

The 2011 SA projected that routine LLW generation would increase from 330 m^3 to 850 m^3 annually, but because these waste generation increases are not expected to exceed existing capacities, DOE/NNSA determined that the impacts of an increase in MLLW and LLW would remain consistent with the SW/SPEIS projections and that supplementation of the SW/SPEIS in 2011 was not needed.

As shown in Figure 11, wastewater generation has increased in recent years since the switch to Zone 7 water supply in mid-2016. During 2018, the overall sewer flow exceeded SW/SPEIS projections. As described above in Section 3.12 Utilities and Energy, the Livermore Site drew from Zone 7 water supply for 39 weeks in 2018. Water supplied from Zone 7 has substantially higher dissolved solids than Hetch Hetchy water, and cooling tower consumption and blow down had increased substantially due to this switch in supply. Subsequently, the sanitary sewer flow had also increased, as 6 to 20 percent of sanitary sewer flow is from cooling tower blow down. For all years since the SW/SPEIS publication, except for 2018, sanitary sewer flow has remained within the SW/SPEIS projections.

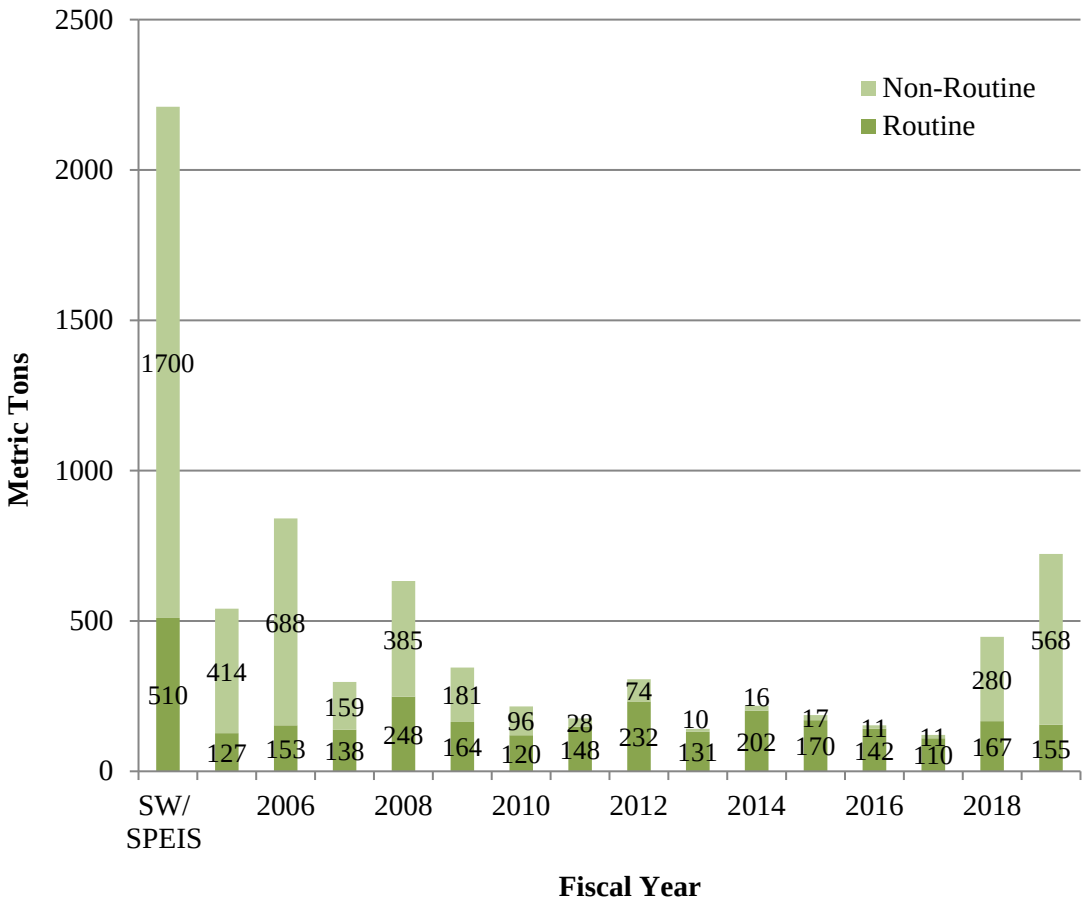

Figure 7. LLNL Hazardous Waste Generation 2005-2019.
Actual amounts of hazardous waste generated by fiscal year for comparison with the SW/SPEIS projections. Source: DOE 2006-2008, Doman 2008-2014, Ottaway 2015-2020.

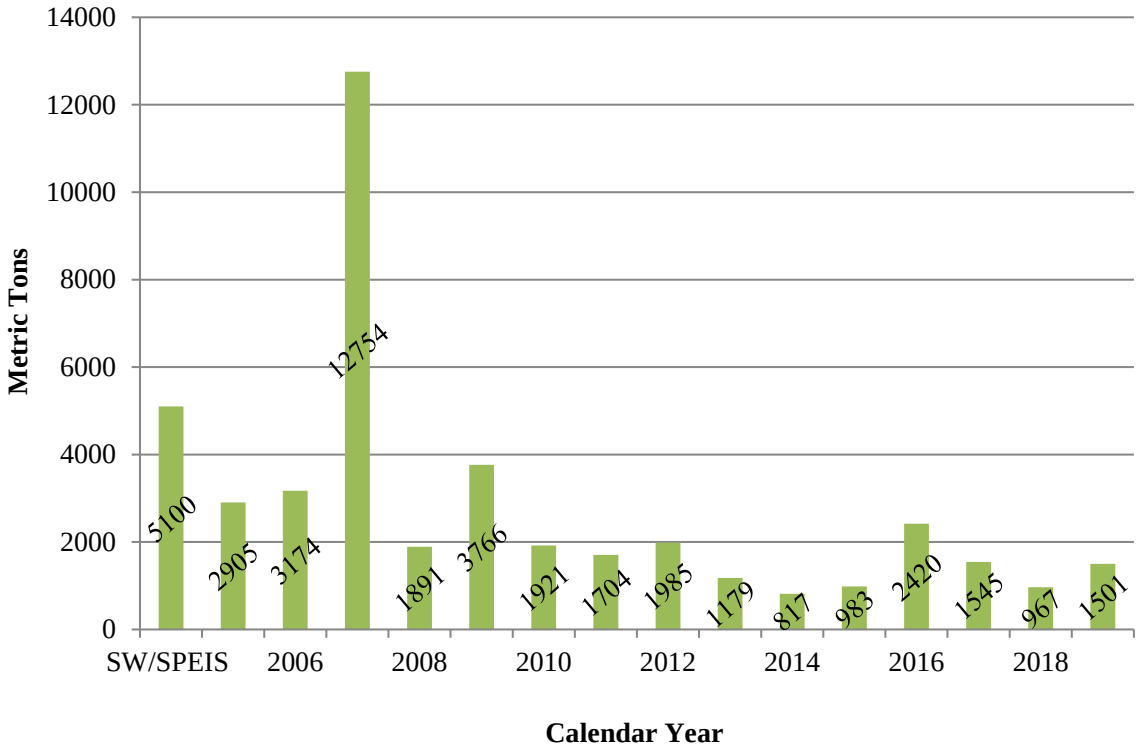

Figure 8. Sanitary Solid Waste Generation 2005-2019.
Actual amounts of sanitary solid waste generated by fiscal year for comparison with SW/SPEIS projection. Source: DOE 2006-2008, Doman 2008-2014, Ottaway 2015-2020.

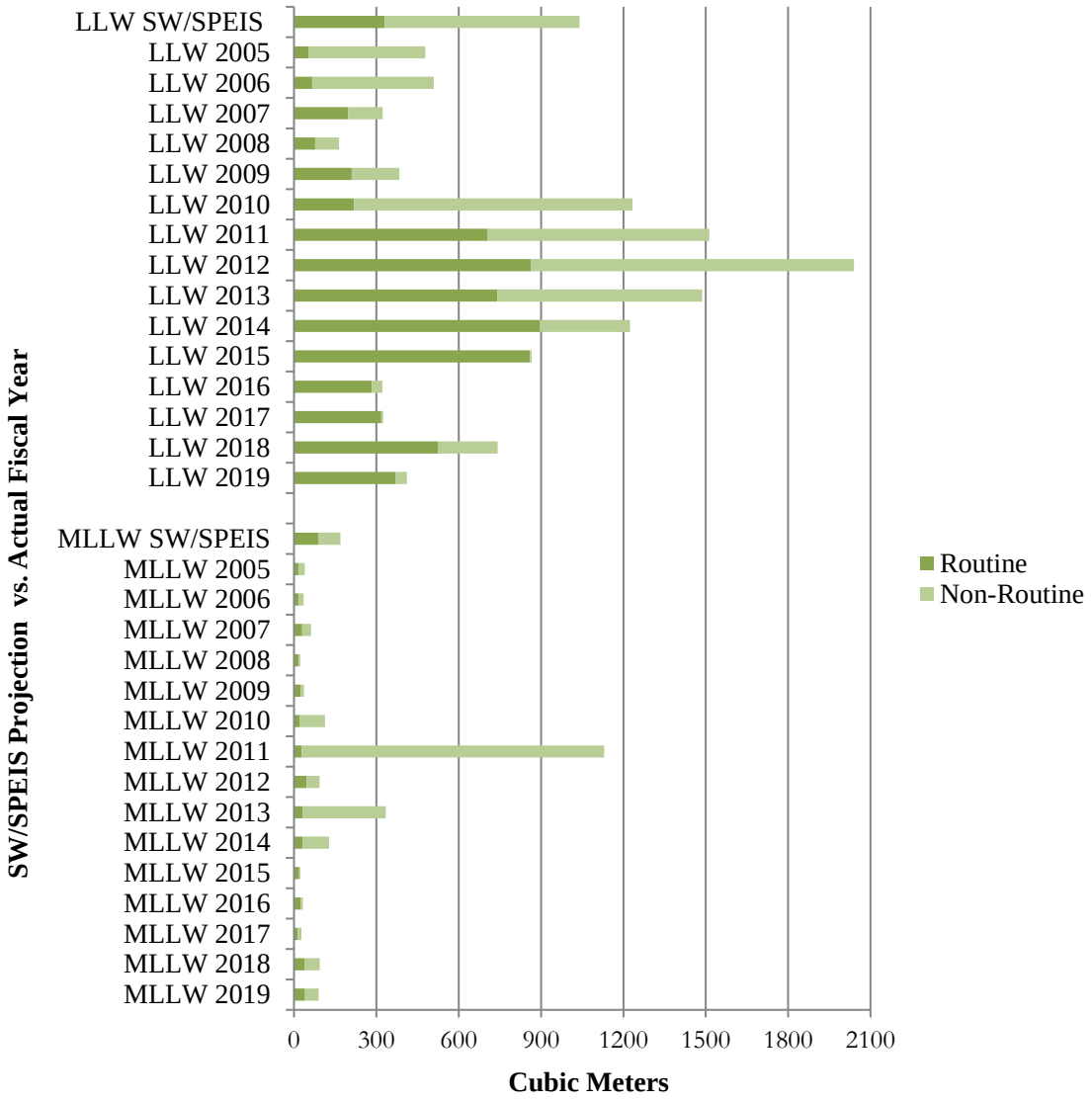

Figure 9. Radioactive Waste Generation – LLW and MLLW 2005-2019.
Actual amounts of routine and non-routine wastes generated by fiscal year for comparison with the SW/SPEIS projections. Source: DOE 2006-2008, Doman 2008-2014, Ottaway 2015-2020. *Please note that waste generation amounts for 2018 reflect corrected data.

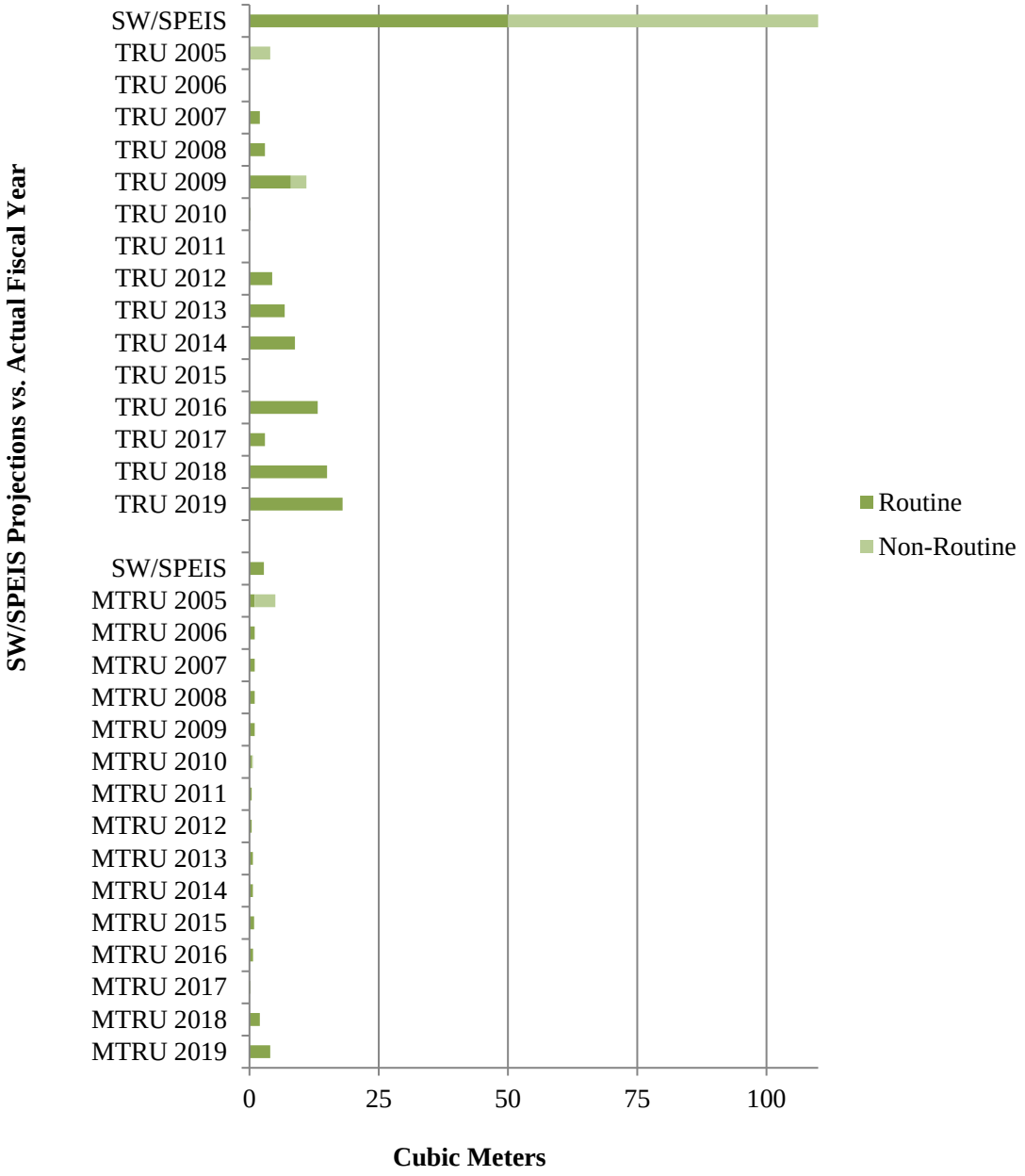

Figure 10. Radioactive Waste Generation 2005-2019.
Actual amounts of transuranic (TRU) and mixed transuranic (MTRU) waste generated by fiscal year for comparison with the SW/SPEIS projections. Source: DOE 2006-2008, Doman 2008-2014, Ottaway 2015-2020.

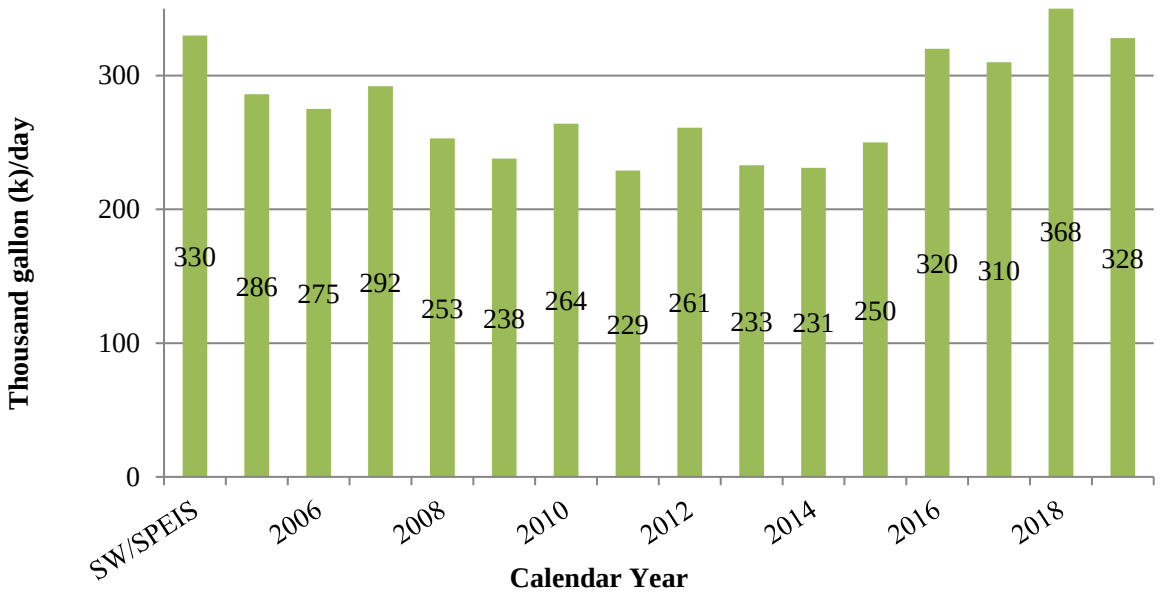

Figure 11. **Wastewater Generation 2005-2019.**
Average daily amount of wastewater generated per calendar year for comparison with the SW/SPEIS projection. Source: LLNL 2006-2017, Jones 2018-2019, Stephens 2020.

3.14 Human Health and Safety

The SW/SPEIS projected that overall site usage of toxic substances would increase and that physical hazards would also increase from rising activity levels at existing facilities and new facilities beginning operation. The uses of additional quantities of chemicals were also expected to result in a slight increase in worker exposures.

Section 5.3.14 of the SW/SPEIS evaluated occupational protection issues and considered existing ES&H programs that specifically addressed worker and general population protection measures implemented to control, reduce, or eliminate operational hazards (DOE 2005a). Working conditions at LLNL have remained essentially the same as those identified in the SW/SPEIS, and more than half of the workforce remains routinely engaged in activities that are typical of office and computing industries. Much of the remainder of the workforce is engaged in light industrial and bench-scale research activities. The population dose and occupational worker dose for ionizing radiation in 2019 were below SW/SPEIS projected values.

DOE/NNSA determined that the implementation of new and modified projects and modifications in site operations represent only a slight variation to the individual and population doses and would remain comparable to the SW/SPEIS projections. DOE/NNSA determined that the impacts on human health and safety remain consistent with the impacts projected in the SW/SPEIS and that supplementation for human health and safety was not needed. The doses to workers would remain as low as reasonably achievable (ALARA), and public doses would be less than 0.4 percent of the DOE standard of 100 mrem/year, and well below the National Emission Standards for Hazardous Air Pollutants (NESHAPs) standard of 10-mrem/year dose to the site-wide MEI member of the public.

3.15 Site Contamination

The SW/SPEIS projected activities that included the continued operations of investigation, cleanup, and long-term stewardship (including treatment system modifications and reporting). A general increase in mission activity levels across LLNL was projected; consequently, an increase in hazardous material management and waste management activities would increase, and an associated spill or release could occur. In the event of a spill or release, LLNL would conduct immediate cleanup actions and perform periodic site surveys to ensure environmental impacts would be minimized. This proactive approach would result in minimal deposition of contaminants to soil from LLNL's continued operations, and the removal of known contaminants under the cleanup effort would continue. No adverse impacts to future land use were expected. No adverse effects on ground water were expected.

In 2007, an EA was prepared to analyze the potential environmental consequences of environmental remediation to reduce contaminant concentrations in soil and ground water at the Pit 7 Complex at Site 300. A subsequent Finding of No Significant Impact was issued by NNSA in 2007.

In 2008, a SA was prepared for the proposed cleanup of contaminated soil at the Building 850 Firing Table at Site 300. DOE/NNSA determined that no further NEPA documentation was required and made the determination and the SA available to the public in April 2009.

3.16 Bounding Accident Scenarios

The LLNL SW/SPEIS discussed accidents for all major facilities. Appendix D of the SW/SPEIS has detailed information regarding potential accidents at LLNL facilities. Additionally, see Chapter 5.5 of the SW/SPEIS for complete analysis. Refer to Section 3.9 of the 2011 SA for the five-year review of bounding radiological and biological accident scenarios. DOE/NNSA determined in the 2011 SA that the

consequences from the accident analyses remained below the consequences of accidents analyzed in the SW/SPEIS; supplementation was not needed.

4.0 CUMULATIVE

Cumulative impacts are identified and analyzed in Chapter 5.3 of the SW/SPEIS. Potential cumulative impacts were identified as demand for housing, school services, solid waste disposal service, loss of cultural resources, noise, traffic and transportation, water consumption, sewer discharge, electrical consumption, fuel consumption, materials management, waste management, and radiological health impacts.

DOE/NNSA reviewed cumulative impacts of new and modified projects and modifications to ongoing operations in the 2011 SA for the following resource areas: land use, biological resources and wetlands, air quality, utilities and energy, materials and waste management, and health and safety. For each of the resource areas, DOE/NNSA determined that the impact projections in the 2005 SW/SPEIS remained adequate and supplementation was not needed.

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ACRONYMS AND ABBREVIATIONS

ACHP	Advisory Council on Historic Preservation
ALARA	as low as reasonably achievable
BO	Biological Opinion
BAAQMD	Bay Area Air Quality Management District
BSL	Biosafety Level (facility)
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CNPS	California Native Plant Society
CX	Categorical Exclusions
D&D	decontamination, deactivation, and/or demolishing
dB (A)	A-weighted decibel
DOE	U.S. Department of Energy
DTSC	Department of Toxic Substances Control
DWTF	Decontamination and Waste Treatment Facility
EA	Environmental Assessments
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
EMPC	Energetic Material Processing Center
EMS	Environmental Management System
ES&H	Environment, Safety and Health
FONSI	Finding of No Significant Impact
ft	feet
FY	fiscal year

HEDC	High Explosives Development Center
HVAC	heating, ventilation, and air conditioning
ISMS	Integrated Safety Management System
kg/day	kilograms per day
LCF	latent cancer fatalities
LLNL	Lawrence Livermore National Laboratory
LLW	low-level waste
MBTA	Migratory Bird Treaty Act
MEI	maximally exposed individual
MG/year	million gallons per year
MTRU	Mixed transuranic waste
MLLW	mixed low-level waste
MOU	Memorandum of Understanding
mrem/y	millirems per year
mt	metric ton
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NHPA	National Historic Preservation Act
NIF	National Ignition Facility
NNSA	National Nuclear Security Administration
NPDES	National Pollutant Discharge Elimination System
NRHP	National Registry of Historic Places
PA	Programmatic Agreement
PBA	Programmatic Biological Assessment

PEIS	Programmatic Environmental Impact Statement
POC	precursor organic compounds
R&D	research and development
rem/y	rems per year
ROD	Record of Decision
SA	Supplement Analysis
SATRN	Secure Air Optics Transport and Routing Network
sf	square feet
SHPO	State Historic Preservation Officer
SJVAPCD	San Joaquin Valley Air Pollution Control District
SME	Subject Matter Expert
SNM	special nuclear material
SSM PEIS	Stockpile Stewardship and Management PEIS
SW/SPEIS	*Site-Wide Environmental Impact Statement for Continued Operation of Lawrence Livermore National Laboratory and Supplemental Stockpile Stewardship and Management Programmatic Environmental Impact Statement*
SWPPP	Storm Water Pollution Prevention Plan
TCP	Traditional Cultural Property
TBD	to be determined
TRU	transuranic waste
TSF	Terascale Simulation Facility
UC	University of California
U.S.C.	United States Code
USFWS	United States Fish and Wildlife Service

APPENDIX A. MITIGATION DISCUSSION

A.1 SW/SPEIS Mitigation Measures

In the 2005 SW/SPEIS, the DOE/NNSA and LLNL acknowledged that the Laboratory operates under existing laws, programs, and controls, including regulations, policies, and contractual requirements. LLNL has numerous existing procedures that provide controls to mitigate potential impacts. Examples include the Environment, Safety and Health (ES&H) Manual, emergency plans, the Integrated Safety Management System (ISMS), several protected species programs, and energy conservation and water reduction programs. In general, these procedures and controls effectively reduce the need for additional mitigation measures for resource areas evaluated in the LLNL SW/SPEIS.

This appendix contains sections that have been excerpted from the SW/SPEIS stating that no additional mitigation measures were required for all resource areas, except for prehistoric and historic cultural resources that are specific to each circumstance. Because DOE/NNSA has determined that no new mitigation measures were required, a Mitigation Action Plan (MAP) for the 2005 SW/SPEIS was not prepared.

A.1.1 Land Uses and Applicable Plans

LLNL does not plan to buy, sell, or transfer any property. All new construction would occur within the existing Livermore Site and Site 300, and the new facilities would be used for office space or R&D, as are all facilities at LLNL. Because no changes in land use at LLNL and no conflict with existing and approved future land uses adjacent to the site were projected, no additional mitigation measures were required.

A.1.2 Socioeconomic Characteristics and Environmental Justice

The SW/SPEIS identified an increase of approximately 5 percent in employment at LLNL. Projected commensurate changes in LLNL direct expenditures, employee expenditures, and housing demand result primarily within Alameda, San Joaquin, Contra Costa, and Stanislaus counties. Because of the large regional economy and the relatively small changes in LLNL employment, the SW/SPEIS projected minimal socioeconomic impacts from implementation of any alternative, and no mitigation measures were required.

LLNL operations that were analyzed in the SW/SPEIS were projected to have minimal impact in the resource areas analyzed, including human health effects to offsite residents and onsite workers. Therefore, no disproportionately high and adverse impacts to minority or low-income populations were anticipated, and no mitigation measures were required.

A.1.3 Community Services

LLNL operations were projected to have minimal impact on the ability of nearby communities to provide fire protection, emergency services, police protection, school services, and nonhazardous solid waste disposal. No mitigation measures were required.

A.1.4 Prehistoric and Historical Cultural Resources

Mitigation measures to address impacts to prehistoric and historic cultural resources resulting from proposed LLNL activities are specific to each circumstance. The draft Programmatic Agreement (see Appendix G of the SW/SPEIS) describes the process to be followed to determine if specific proposed activities conducted would have an effect on important prehistoric or historic cultural resources. If it were determined that a resource would be adversely affected, the process described in the Programmatic Agreement would be followed; and specific actions would be taken, if necessary, to avoid, reduce, or mitigate the adverse effect.

However, because of its undisturbed nature, Site 300 has a greater potential for subsurface remains. If such remains are encountered during ground-disturbing activities, work within the immediate vicinity of the discovery would cease until consultation between the DOE/NNSA and the SHPO regarding the discovery is completed. Through that consultation, a determination would be made of the resource's importance, the extent of the effect, and appropriate actions required to avoid, reduce, or mitigate further adverse effects. The inadvertent discovery of Native American human remains or funerary objects (associated or unassociated) on LLNL property would require adherence to the *Native American Graves Protection and Repatriation Act* (25 U.S.C. §3001).

No traditional cultural properties or Native American sacred sites have been identified on the Livermore Site or Site 300. If any were identified in the future, access to these properties or sites would be restricted. If access were needed, the DOE/NNSA would consult with the appropriate Native American tribe to develop an agreement or procedures for access to the particular site.

A.1.5 Aesthetics and Scenic Resources

No impacts to aesthetics or scenic resources were projected to occur in the SW/SPEIS. Therefore, no additional mitigation measures were required.

A.1.6 Geology and Soils

No known aggregate, clay, coal, or mineral resources were projected to be adversely affected at either the Livermore Site or Site 300. No mitigation measures were required.

The SW/SPEIS anticipated that LLNL would use best management practices to control runoff and soil loss during construction projects, including the wetlands enhancement and the 40,000-sq-ft EMPC; therefore, no additional mitigation measures were required.

A.1.7 Biological Resources

At the Livermore Site, measures would be taken to protect the California red-legged frog during Arroyo Las Positas Maintenance Project activities, as described in a previously approved USFWS BO. A Bullfrog Management Program at the Livermore Site would continue to minimize the adverse impact of this known predator species of the California red-legged frog. These measures are summarized in Appendix E of the SW/SPEIS. No additional mitigation measures were required in the ROD.

For Site 300, LLNL proposed to mitigate the removal of a 0.62-acre artificial wetlands by enhancing selected areas and increasing breeding opportunities for the California red-legged frog. A minimum of 1.86 acres (i.e., 3:1 replacement ratio) of wetlands habitat would be enhanced and managed for this species. Mitigation sites for enhancement include the wetlands at Mid Elk Ravine and the seep at the Super High Altitude Research Project (SHARP) Facility. This mitigation measure has been previously addressed in a BA and related BO. See Appendix E, Section E.2.1.9, of the SW/SPEIS, for more information.

Measures to minimize impacts to the Alameda whipsnake at Site 300 are contained within a recent BA and BO. Mitigation measures to minimize impacts to the California tiger salamander are provided in Appendix E of the SW/SPEIS. Continuing or proposed new activities at Site 300 are not anticipated to adversely affect the large-flowered fiddleneck, San Joaquin kit fox (which has not been observed since at least 1986), or the Valley elderberry longhorn beetle. Therefore, no additional mitigation measures were required in the ROD.

The following mitigation activities are also practiced routinely at both the Livermore Site and Site 300:

- Occupied nests of avian species listed under the Migratory Bird Treaty Act will receive protective exclusion zones up to 250 meters in radius.
- California red-legged frog, California tiger salamander and Alameda whipsnake will receive protective exclusion zones up to 200 meters from the occupied habitat.
- Wetlands features (i.e., seeps, springs) will receive protective exclusion zones up to 20 meters from the resource.

- Power poles or associated structures with potential to cause raptor fatalities (i.e., perches, nest sites with possible phase-to-phase contacts) will be examined for potential protective structures and modified as feasible.
- Invader species that negatively affect protected species and habitats onsite will be considered a pest species and controlled/eradicated in a manner approved by the State or Federal agency staff.

A.1.8 Air Quality

Both the Bay Area and San Joaquin air basins are designated as non-attainment areas for ozone and respirable-sized particulates (PM_{10}). Because of this designation, emissions of particulate matter and ozone precursors, such as oxides of nitrogen and precursor organic compounds, are strictly regulated. Both the Bay Area Air Quality Management District (BAAQMD) and San Joaquin Valley Air Pollution Control District (SJVAPCD) have enacted "no net increase" programs and are required to implement all feasible measures to reduce emissions of these pollutants. Site 300 is rated as a small source and is not subject to offset the requirements that are generally placed on larger emitting sources. The Livermore Site is a mid-sized facility eligible for participation in BAAQMD's offset management program.

LLNL requires stringent mitigation measures to minimize fugitive dust from construction activities. These measures include water spraying of disturbed areas and covering exposed piles of excavated material; and the use of engineering controls, devices, and work practices during work with asbestos to isolate the source of asbestos and prevent fiber migration.

LLNL has enacted standard measures to mitigate emissions from fuel combustion sources. These include the following:

- Fuels must meet the requirements of the *Clean Air Act Power Plant and Industrial Fuels Use Act* and applicable DOE Orders, and would continue to require that construction equipment and vehicles be inspected daily for leaks of fuel, engine coolant, and hydraulic fluid.
- Contract specifications for boilers require adherence to the standards of the American Society of Heating, Refrigerating and Air Conditioning Engineering, Inc., for energy efficiency; and compliance with efficiency standards is tested in accordance with methods of the American Society of Mechanical Engineers.
- LLNL also requires the use of late model, cleaner burning internal combustion diesel engines (Tier I or Tier II) for construction, and that construction equipment and vehicles be inspected daily for leaks of fuel, engine coolant, and hydraulic fluid.

LLNL has a transportation systems management program that provides and promotes alternative, environmentally responsible options for employee commuting, assists LLNL in complying with transportation-related *Clean Air Act* legislation, and resolves congestion management issues. LLNL plans to continue this program. No additional mitigation measures were required.

A.1.9 Water

Compliance with the California General Construction Stormwater NPDES Permit (or other individual NPDES permit) for construction projects disturbing 1 acre or more, including developing and implementing a project-specific stormwater pollution prevention plan, minimizes impacts to surface waters from construction-induced erosion.

As identified in the SW/SPEIS, LLNL will continue to remove contaminants from ground water and unsaturated zones (soil vapor) through a series of treatment facilities at the Livermore Site and Site 300. Ground water quality should continue to improve because extracted ground water will be collected and treated at the treatment facilities. No additional mitigation measures were required.

A.1.10 Noise

With the relatively large spatial area and perimeter buffer zone at the Livermore Site, noise from most LLNL activities is not expected to be discernible in offsite areas and is not expected to conflict with land use guidelines, or adversely impact offsite communities. No additional mitigation measures were required.

At Site 300, LLNL plans to continue high explosives research testing within the Contained Firing Facility and on open firing tables. The number of blasts and their intensity are not expected to change; and, therefore, impacts were expected to be the same as with the No Action Alternative. LLNL projects continue to use blast forecasting as a tool to determine if explosive tests would adversely impact the surrounding community, and to restrict operations when peak impulse noise levels are predicted to exceed the 126-dB (A) level in populated areas. No additional mitigation measures were required.

A.1.11 Traffic and Transportation

The traffic impacts identified in the SW/SPEIS were not proposed to be measurably different from the No Action Alternative. Onsite and offsite radiological transportation impacts were projected to be very small, much less than 1 LCF over the period of analysis. Accordingly, no additional mitigation measures were required.

A.1.12 Utilities and Energy

Energy consumption is a particular concern in California because of past energy shortages. The California Independent System Operator forecasts adequate resources available to meet forecasted power demand and meet minimum operating reserves. No mitigation measures beyond energy management practices were required.

A.1.13 Materials and Waste Management

The SW/SPEIS did not project any major changes in the types of waste streams that LLNL generates or in the materials used on site. Waste generation projects would not exceed waste treatment and disposal capacities. Waste would continue to be managed in accordance with existing federal and state regulations, DOE/NNSA orders and guidance, and LLNL procedures. Therefore, waste management operations would be conducted in a manner to ensure protection of the environment and the safety of LLNL workers. LLNL has a waste minimization and pollution prevention program. This program has been effective in reducing the levels of waste generation and has established goals for future reductions of waste levels. No additional mitigation measures were required.

A.1.14 Human Health and Safety

The Proposed Action increased the total occupational dose to 93 person-rems per year. Adverse human health effects to LLNL employees were not identified. The annual LCF calculated for this level of exposure was 0.055.

LLNL has an as low as reasonably achievable (ALARA) program to minimize worker dose. Worker exposures are reviewed and trended quarterly. These trends provide the basis for control measures, such as automating processes, adding remote operations, changing administrative procedures, and shielding improvements. The policy of DOE/NNSA and LLNL is to operate in a manner that protects the health and safety of employees and the public. ES&H is a priority consideration in the planning and execution of all work activities at LLNL. No additional mitigation measures were required.

A.1.15 Site Contamination

Continued operations carry the possibility of soil contamination and subsequent ground water contamination; however, LLNL operational procedures minimize this potential. Other than implementation of LLNL operational procedures, continued remediation, and cleanup milestones and goals already committed to by the DOE/NNSA, no additional mitigation measures were required.

A.1.16 Accidents

The SW/SPEIS identified Bounding Accident Scenarios in which postulated chemical and radiological accidents could potentially result in onsite and offsite consequences.

Management controls in the form of facility and operational safety procedures are used to minimize the probability of an accident and to reduce its consequences. However, in the event of an accident, LLNL has detailed response plans to further mitigate both the onsite and offsite consequences. The DOE has developed an ISMS, a comprehensive approach to improving safety. The ISMS includes defining the scope of the work, identifying the hazards, establishing suitable controls, performing the work safely, and providing feedback for improvement. The response activities would be closely coordinated with those of appropriate offsite emergency response organizations. LLNL personnel are trained and drilled in the protective actions to be taken if a release of radioactive or toxic material should occur. These protective actions comply with protective action guides established by the EPA. The underlying principle for the protective action guides is that under emergency conditions, all reasonable measures should be taken to minimize the radiation and chemical exposure to the general public and emergency workers. No additional mitigation measures were required.

A.1.17 Emergency Response and Protective Actions

LLNL has detailed plans for responding to several types of accidents, and the response activities would be closely coordinated with those of local communities, such as Alameda County. LLNL personnel are trained and drilled in the protective actions to be taken if a release of radioactive or otherwise toxic material occurs.

The underlying principle for the protective action guides is that under emergency conditions, all reasonable measures should be taken to minimize the radiation exposure to the general public and emergency workers. In the absence of significant constraints, protective actions could be implemented when projected doses are lower than the ranges given in the protective action guides. No credit was taken for emergency response and protective actions in the consequence analysis. No additional mitigation measures were required.