4.15 MATERIALS AND WASTE MANAGEMENT

This section provides an overview of management responsibilities regarding receipt, transfer, and shipment of radioactive, controlled, and hazardous materials and wastes as well as mixed and medical wastes at LLNL. Additional supporting information and analyses, including descriptions of programs and buildings associated with use of these materials, are provided in Appendices A and B. The use of these materials historically has resulted in both their planned and inadvertent releases to the environment. The consequences of using radioactive, controlled, and hazardous materials are discussed in the sections associated with the affected media. For example, releases to the air associated with the use of radioactive materials are discussed in Section 4.10, and releases affecting vegetation are discussed in Section 4.9. The workplace use of these materials and associated occupational exposures are discussed in Section 4.16. Pollution prevention and waste minimization are discussed in Appendix O.

4.15.1 Materials

4.15.1.1 *Regulatory Setting*

LLNL's materials management operations are conducted pursuant to DOE orders and to various applicable Federal, state, and local laws and regulations. Regulatory oversight is vested among various Federal, state, and local agencies. Major laws, regulations, and orders are summarized in Table 4.15.1.1–1.

4.15.1.2 *Radioactive, Controlled, and Hazardous Materials Management*

Radionuclide Inventories

LLNL uses radioactive materials in a wide variety of operations including scientific and weapons R&D, diagnostic research, research on the properties of materials, and isotope separation. A list of Livermore Site selected facility inventories, approximate quantities, and status by radionuclide is provided in Table 4.15.1.2–1. Radioactive material quantity limits for Site 300 are included in Table 4.15.1.2–2. Based on facility design and operation, LLNL establishes administrative limits for fissile, special use, radioactive, and sealed materials. An administrative limit is the total amount of certain materials allowed in a specific building at LLNL. These limits are used in determining potential risks associated with accidents. For a discussion on accidents and materials at risk, see Section 5.5, Bounding Accident Scenarios. Actual inventories may be classified.

Chemical Inventories

Because of the wide variety of research activities performed at LLNL, the amounts and concentrations of chemicals maintained vary at any given time and from facility to facility. Most research operations use small quantities of a wide variety of chemicals; however, in some operations, chemicals are used in large quantities. In general, the following chemical types are used and stored at LLNL:

- Corrosives (acids and bases)
- Toxics (poisonous chemicals)
- Flammables and combustibles (solids, liquids, and gases)
- Reactives (materials that are inherently readily capable of detonation or becoming flammable at normal temperatures and pressures)
- Asphyxiants (physical asphyxiants are materials capable of physically displacing the volume of air in a given space; chemical asphyxiants are materials that inhibit oxygen transfer from blood tissues or within cells when breathed)
- Carcinogens (materials capable of inducing cancer)

The primary management strategy for the control and management of hazardous chemicals at LLNL is to prevent overexposures to hazardous substances in accordance with the requirements of 29 CFR Part 1910, Subpart Z. Procedures for chemical management at LLNL include personnel training, inventory control and monitoring, safety assessments, and handling. Additionally, standard operating procedures, operating procedures, and operating instructions are prepared for specific activities to establish safe procedures, barriers, controls, and safe work practices with regard to hazardous operations, including chemical use and storage.

As part of the chemical management strategy, LLNL maintains a centralized chemical inventory database, the ChemTrack system, for tracking hazardous and chemicals in primary (those containers shipped by the manufacturer). The ChemTrack system requires bar coding of chemical containers as they enter LLNL to allow container tracking and access to online chemical inventory data. The bar-coded chemical containers are tracked to provide location and usage information from arrival at LLNL through disposal of the container by the waste management program. LLNL links the bar-coded chemical containers to a location and a chemical custodian (a person[s] or organization); the material safety data sheets, if available; related chemical property and hazardous data; and regulatory information. The ChemTrack system serves as the chemical inventory resource used for meeting Federal *Emergency Planning and Community Right-to-Know Act* (EPCRA) reporting and California community right-to-know requirements.

In 2001, more than 166,000 chemical containers, ranging from 55-gallon drums to small-quantity vials, were in use or stored at LLNL (LLNL 2002cc). Table 4.15.1.2–3 presents a representative list of FY2001 hazardous chemicals at the Livermore Site. A detailed list of chemicals at the NIF is provided in Appendix M. A detailed list of chemicals at LLNL is provided in Appendix B.

A representative listing of chemical inventories in FY2001 for Site 300 is presented in Table 4.15.1.2–4. Site 300 operations generally require smaller chemical inventories than the Livermore Site due in part to fewer operations and programs. More details on chemical inventories at Site 300 are provided in Appendix B.

TABLE 4.15.1.2–4.—*Types of Hazardous Chemicals (Partial List[a]) in Use at Site 300*

Chemical	Chemical Abstract Number	Average Maximum/Average Quantity[b]
Paints/Solvents		
Paint (variety)	NA	7,200/1,200 lb
Thinner, lacquer	NA	310/95 gal
Methyl alcohol	67-56-1	90/5 gal
Acetone	67-64-1	400/30 gal
Metals		
Lead bricks or ingots	NA	25,000/25,000 lb
Acids/bases/oxidizers		
Oxygen, compressed	7782-44-7	16,000/5,000 ft^3
Sulfuric acid	7664-93-9	845/60 lb
Cyanuric acid	108-80-5	500/50 lb
Industrial Gases		
Argon, compressed	7440-37-1	30,000/30,000 ft^3
Helium	7440-59-7	25,000/25,000 ft^3
Hydrogen, compressed	1333-74-0	700/700 ft^3
Nitrogen, compressed (liquified, gaseous)	7727-37-9	312,000/280,000 ft^3
Carbon dioxide	124-38-9	44,000/5,000 ft^3
Refrigerants		
Freon 113 (1,1,2-Trichloro-1,2,2-trifluoroethane)	76-13-1	150/10 gal
Freon 22 (Chlorodifluoromethane)	75-45-6	1,400/870 lb
Freon 12 (Dichlorodifluoromethane)	75-71-8	660/220 lb
Freon 13 (Chlorotrifluoromethane)	75-72-9	478/478 ft^3
Freon 14 (Tetrafluoromethane)	75-73-0	2,000/500 ft^3
Explosives		
More than one type and class	NA	100,000/10,000 lb

Source: NNSA 2002c.
[a] For a comprehensive list covering other chemicals like chlorine, please refer to Appendix B.
[b] Represents average maximum and average quantity based on one or more buildings as reported in 2001 and 2002. The inventories represent a snapshot and are intended to give the reader an understanding of the variety and relative quantities of materials.
ft^3 = cubic feet ; gal = gallons; lb = pounds; NA = not available.

Explosive Materials

LLNL uses explosives in various R&D and test applications. Explosive quantities used per activity range from milligrams to several kilograms; however, for special test applications several hundred kilograms may be handled. Overall, the quantities of explosive material maintained onsite are restricted by the approved explosive capacity of various storage areas.

Site 300 is the primary laboratory location for explosives storage. This site is designated as a limited area accessible to approved personnel only. In 2001, 59 locations handled explosives. The explosives storage includes nearly 40 earth-covered explosive storage magazines, approximately 10 magazettes, and 1 packaging/receiving building. Other facilities include those for machining, assembling, pressing, testing, and firing explosives (see Appendix A). At the Livermore Site, the HEAF conducts explosive R&D (see Appendix A).

An explosives safety program is used to manage explosives at LLNL. The LLNL Explosives Safety Committee provides continual review, interpretation, and necessary revision to the explosives safety program. As part of its explosive material management strategy, LLNL uses facility-based explosives inventory systems to track and manage explosive inventories. The inventory systems maintain information on material composition, characteristics, and shipping requirements; life cycle cost information; plan of use; security and hazard classifications; and compatibility codes. When an explosive material is transferred (delivery or receipt), the system requires a safety check to ensure that the intended storage location can accept the type and quantity of material received. The facility-based inventory systems flag any storage capacity overages and incompatible explosive items.

Onsite Receipt and Distribution

LLNL classifies certain materials as controlled materials for environment, safety, and health (ES&H) protection, security, strategic importance, monetary value, or programmatic urgency reasons. Some of these materials are also classified as hazardous. Examples of controlled materials include explosives, radioactive materials, special nuclear materials, classified substances and parts, and precious metals.

All Category 3 hazardous materials and some Category 1 materials (see text box for category descriptions) shipped by commercial vendors or other DOE sites are received by the Receiving Section of the Materials Distribution Division (MDD), Procurement and Materiel Department. An exception is made when MDD and the ES&H Team Leader have reviewed and authorized a specific, direct delivery area. Direct delivery areas must meet established ES&H requirements that include both administrative and physical controls. Figure 4.15.1.2–1 illustrates conceptually how materials move at LLNL. Special arrangements are in place for industrial gases and 55-gallon chemical and solvent drums that are received at the Industrial Gas Yard by the Industrial Gases Section of MDD, Building 518.

Hazardous materials enter Site 300 through the Receiving Group of MDD; explosives and other controlled materials are delivered to and received by the Site 300 Controlled Materials Group of the Materials Management Section.

The Materials Management Section of the Mechanical Engineering Department receives Category 1 materials from vendors, the MDD, and other DOE sites. These include radioactive materials, accountable nuclear material, nuclear explosive-like assemblies, classified parts, and controlled or classified hazardous materials (e.g., some alkali metals and carcinogens). Fissile materials are sent only to the main Livermore Site through Materials Management, whereas explosives are sent only to Site 300 through Materials Management. The Materials Management Section, along with the requester, arranges for storage and transportation of these materials and delivers them to qualified end users.

The Industrial Gases Section of MDD ensures that the material received is properly packaged and secured. Bar codes are placed on each primary chemical container, which is then entered into the ChemTrack system at the time of receipt.

The Radioactive and Hazardous Waste Management (RHWM) Division of the EPD receives reusable hazardous materials (Chemical Exchange Warehouse, Figure 4.15.1.2–1) and hazardous waste, including hazardous waste generated from the use of Category 1 and 3 materials (some limitations apply). At the Chemical Exchange Warehouse, RHWM staff arranges for the reuse or temporary storage and/or transportation of such materials to RHWM treatment and storage facilities in accordance with LLNL guidelines and applicable RHWM operational procedures.

The Site 300 Controlled Materials Group (CMGRAMS) of the Materials Management Section (of the Mechanical Engineering Department) is responsible for packaging, marking, and labeling explosives shipments leaving Site 300 and the Livermore Site in a manner that complies with U.S. Department of Transportation (DOT), DOE, and LLNL standards. To ensure that the standards are observed, all explosives shipments to or from offsite locations are delivered in accordance with Document 21.2, "Onsite Hazardous Materials Packaging and Transportation Safety Manual" (LLNL 1996a) in the ES&H Manual. Controls for shipping and transporting explosives offsite are described in Document 21.4, "Shipping Explosives Offsite" (LLNL 2001h) in the ES&H Manual. All incoming explosive material is labeled and the transport is placarded DOT Division 1.1, 1.2, 1.3, 1.5, or 1.6 (see text box).

Explosive Materials

An explosive is any substance or article, including a device, which is designed to function by explosion or which, by chemical reaction within itself, is able to function in a similar manner even if not designed to function by explosion (unless the article is otherwise classified under a provision of 49 CFR).

Division 1.1 Explosives are explosives that have a mass explosion hazard. A mass explosion is one that affects almost the entire load instantaneously.

Division 1.2 Explosives are explosives that have a projection hazard, but not a mass explosion hazard.

Division 1.3 Explosives are explosives that have a fire hazard and either a minor blast hazard or a minor projection hazard or both, but not a mass explosion hazard.

Division 1.4 Explosives are explosives that present a minor explosion hazard. The explosive effects are largely confined to the package and no projection of fragments of appreciable size or range would be expected. An external fire must not cause virtually instantaneous explosion of almost the entire contents of the package.

Division 1.5 Blasting Agents are very insensitive explosives. This division comprises substances that have a mass explosion hazard but are so insensitive that there is very little probability of initiation or of transition from burning to detonation under normal conditions of transport.

Division 1.6 Explosives are extremely insensitive articles that do not have a mass explosion hazard. This division comprises articles that contain only extremely insensitive detonating substances and that demonstrate a negligible probability of accidental initiation or propagation.

Specific authorization and training are required to transport explosives. Transportation at each site requires individual authorization. Only CMGRAMS and Site 300 Procurement & Materiel Department MDD personnel may transport explosives offsite.

4.15.1.3 *Nonhazardous Materials*

The Central Stores, Building 411, is located in the southeast quadrant of the Livermore Site. This 69,505-gross-square-foot building is managed by the Procurement and Materiel Department and handles all onsite receiving and temporary storage and offsite shipment of materials to Site 300. Material deliveries (nonhazardous, hazardous, and radioactive) are received and sorted and then forwarded to the requesting program. Only standard (nonhazardous) supply items are placed in the storage area in Building 411, and program representatives may obtain needed material from Central Stores.

For Site 300, no central storage facility is currently in operation. Materials are shipped from the Livermore Site directly to the user facility at Site 300.

4.15.1.4 *Decontamination of Equipment and Facilities*

At LLNL, decontamination of equipment and facilities must be done in accordance with LLNL safety procedures that are based on DOE orders and other Federal and State of California laws and guidelines. It is also the policy of LLNL that decontamination of equipment must be managed in a safe manner to ensure the protection of employees.

Decontamination of equipment is done at the facility where the equipment is located, provided that no hazardous waste treatment is performed as part of this process. Equipment that cannot be decontaminated is reduced in size, if necessary, and disposed of through waste management procedures. Size reduction for large pieces of equipment (e.g., gloveboxes, pumps, machining tools, and tanks) contaminated with hazardous and/or mixed waste or hazardous chemical

constituents can be done in Building 612. These pieces of equipment may be vacuumed, wiped down, or steam cleaned to remove residual contaminants. The equipment is then dismantled using a cutoff saw, or is taken apart with hand tools. Contaminated areas of equipment exposed during dismantling are vacuumed or wiped down. Equipment contaminated with transuranic (TRU) radionuclides, such as plutonium, is not decontaminated; when removed from service, the equipment is managed as TRU waste.

4.15.1.5 *Excess Properties Salvage and Reclamation*

LLNL follows a process for the disposal of excess equipment through a policy of making this property available for other needs at the site, to other Federal and state agencies, or for sale to reduce the cost of LLNL operations. The LLNL custodian is responsible for providing an explanation of the condition of the item on an excess equipment card and making arrangements for delivery of the items to storage, excess, or recycling.

The equipment custodian (with support from several organizations) is responsible for screening, reusing, and disposing of items declared excess to the needs of LLNL.

The excess and recycling operations use approximately 25,500 gross square feet of covered space.

4.15.2 Waste Management

This section describes the regulatory setting, waste generation, waste management practices, and treatment/storage facilities at LLNL and offsite disposal of waste. For a brief discussion on pollution prevention and waste minimization, see Section 4.14.5, with an expanded discussion in Appendix B. The waste generation rates (1993 to 2002) presented in this section represent actual data based on NNSA and LLNL records (see Appendix B). Because multiple organizations generate and manage waste at the two sites, with a high degree of integration, the term LLNL includes the Livermore Site and Site 300, unless otherwise specified. Further, because multiple organizations, including plant engineering; the Chemistry and Material Sciences Directorate; and the Safety and Environmental Protection Directorate, manage waste facilities at LLNL, the term RHWH includes all waste management facilities, unless otherwise specified.

Waste management activities consist of managing, treating, storing, and preparing for offsite disposal of all wastes in accordance with applicable Federal and state regulations, permits obtained under these regulations, and DOE orders. The waste categories routinely generated onsite under normal operations include radioactive waste (low-level waste [LLW], mixed low-level waste [MLLW], and TRU waste); hazardous waste, which includes *Resource Conservation and Recovery Act* (RCRA) hazardous (chemical and explosives) waste; state-regulated waste; TSCA waste (primarily asbestos, PCBs, and biohazardous [medical] waste); nonhazardous solid waste; and process wastewater. Figure 4.15.2–1 shows locations of the Decontamination and Waste Treatment Facility (DWTF) and other RHWM facilities.

Generally, wastes generated at individual buildings are accumulated at the point of generation in satellite accumulation areas. Generators, with support from RHWM staff, must segregate, identify, characterize, separate, package, label, document, and transfer waste to designated waste accumulation areas (LLNL 2002n). These wastes (with the exception of medical waste) are then transferred to waste accumulation areas where hazardous and mixed wastes may be stored for up to 90 days. Wastes are collected from waste accumulation areas or retention tanks by hazardous waste technicians. The wastes are either transferred to onsite waste management facilities for treatment, storage, and/or preparation for offsite disposal or to various offsite permitted treatment, storage, and disposal facilities. Some LLW and all TRU radioactive wastes are currently being stored awaiting shipment to the Nevada Test Site, the Waste Isolation Pilot Plant, or another DOE-approved facility for storage or disposal. LLNL legacy mixed wastes are being managed in accordance with the *Federal Facility Compliance Act* Site Treatment Plan. Medical wastes are typically collected at the generator facility before being treated onsite or shipped offsite for treatment and disposal.

Table 4.15.2–1 lists the waste management facilities at LLNL, including maximum inventory quantities. Table 4.15.2–1 includes information on the facility type and waste types managed. Most facilities manage both radioactive and hazardous wastes. However, certain facilities are restricted to only one waste type (for example the Explosive Waste Treatment Facility). The DWTF, Area 612, and Area 514 are the primary waste management facilities. Appendix B describes these facilities in detail.

Normal (Routine) Operations

The affected environment considered in this LLNL SW/SPEIS is limited to those facilities that generate waste under normal (routine) operations at LLNL. Normal operations encompass all current operations that are required to maintain R&D at LLNL facilities.

New Operations

Several new operations are currently in the planning stages at LLNL. However, they are considered outside of the scope of the current affected environment description for this LLNL SW/SPEIS because they have not yet reached operational status. New operations are defined as programmatically planned projects with defined implementation schedules that will take place in the future. Two facilities, the NIF and BioSafety Level (BSL)-3 Laboratory, are examples of these new operations and have had separate NEPA evaluations.

Special (Nonroutine) Projects

Special (nonroutine) projects are limited-duration projects, such as construction, that are considered separately from facility operations. These projects can make a large contribution to the overall waste generation activities at LLNL. Three areas are considered special projects: construction, decontamination and decommissioning (D&D), and environmental restoration. The wastes generated from these areas are identified as nonroutine. Typically, the projects are well defined to allow waste management activities to directly support the project.

For several years, excess facility management activities have been underway to remove legacy facilities, material, and equipment from the site. This effort has removed over 260,000 square feet of facility space (DOE 2002d). One hundred and sixty-one buildings, accounting for approximately 700,000 gross square feet (an estimated 46,000 tons of construction debris), are potentially scheduled for removal. As much as 99 percent of the construction debris would be diverted wastes and recoverable assets (LLNL 2003bd). Future space reduction at LLNL will focus on buildings that are beyond their useful lives. These buildings will become vacant after new buildings are built. Twenty-three buildings, accounting for 53,500 gross square feet, are categorized as being in poor condition, beyond their useful life (DOE 2002d).

Waste Categories

Low-Level Waste (LLW)—LLW is waste that contains radioactivity and is not classified as high-level waste, TRU waste, or spent nuclear fuel or byproduct tailings containing uranium or thorium from processed ore (as defined in Section 11[e][2] of the *Atomic Energy Act* [42 U.S.C. §2011]). Test specimens of fissionable material, irradiated for research and development only and not for the production of power or plutonium, may be classified as LLW, if the concentration of transuranic is less than 100 nanocuries per gram.

Mixed Low-Level Waste (MLLW)—MMLW is waste that contains both hazardous waste, regulated under RCRA, and low-level waste.

Transuranic Waste (TRU)— TRU waste is waste containing more than 100 nanocuries of alpha-emitting TRU isotopes per gram of waste, with a half-life greater than 20 years, except for high-level radioactive waste. TRU waste is waste that the DOE Secretary has determined, with concurrence of the Administrator of EPA, does not need the degree of isolation required by the disposal regulations or waste that the U.S. Nuclear Regulatory Commission has approved for disposal on a case-by-case basis in accordance with 10 CFR Part 61.

Mixed Transuranic Waste (Mixed TRU)—Mixed TRU waste contains both hazardous wastes, regulated under the RCRA, and TRU waste.

RCRA Hazardous Waste—RCRA hazardous waste is any solid waste (definition includes semisolid, liquid, or gaseous material) listed in Subpart D of 40 CFR Part 261 or having the characteristics of ignitability, corrosivity, toxicity, or reactivity, as defined by RCRA.

LLNL Hazardous Waste—LLNL hazardous waste includes RCRA hazardous waste, state-regulated waste, TSCA waste, and biohazardous waste.

TSCA Waste—TSCA waste contains materials exceeding identified limits in TSCA. LLNL manages two TSCA-regulated materials: PCBs and asbestos.

Sanitary Solid Waste—Sanitary solid waste includes nonhazardous office and laboratory trash.

Building debris estimates associated with D&D projects are included in the assessments of the waste generated from existing operations (potentially 53,000 tons of debris). However, separate NEPA review may be required in the future depending on the scale and extent of the work involved.

This LLNL SW/SPEIS considers environmental restoration activities as nonroutine operations due in part to the fluctuation of year-to-year waste quantities. To comply with CERCLA groundwater remedial actions at the Livermore Site, Environmental Restoration Division (ERD) has designed, constructed, and operated 5 fixed groundwater treatment facilities and associated pipeline networks and wells, 20 portable groundwater treatment units, 2 catalytic dehalogenation units, and 3 soil vapor extraction facilities (see Appendix B), to date. In 2001, ERD operated 4 fixed, 19 portable, 2 catalytic reductive dehalogenation, and 2 soil vapor treatment units. ERD also installed an electro-osmosis system to improve its ability to remove contaminants from fine-grained sediments.

At Site 300, ERD has designed, constructed, and operated 3 soil vapor extraction facilities and 11 groundwater extraction and treatment facilities. In addition, ERD has capped and closed four landfills and the High Explosives Rinse Water Lagoons and Burn Pits, excavated and closed numerous wastewater disposal sumps, and removed contaminated waste and soil to prevent further impacts to groundwater at Site 300.

The environmental restoration program also generates soil, personal protective equipment, and sampling tools during soil boring, well installation, equipment maintenance (filters, pumps, tubing), and trenching activities. The quantities of waste generated are highly variable depending on the purpose of the activity. The quantities are characterized within the nonroutine quantities presented in Section 4.15.2.2.

4.15.2.1 *Regulatory Setting*

Management of hazardous, radioactive, mixed, and medical wastes generated at LLNL is pursuant to applicable DOE orders and Federal, state, and local laws and regulations. LLNL waste management programs implement site-wide plans and operating practices to comply with permits and other regulatory requirements. LLNL operates under three RCRA Part B permits (one for the Livermore Site and two for Site 300). Inspections and findings of the Livermore Site and Site 300 by external agencies in 2001 are listed in Table 4.15.2.1–1. A summary of permitting activities is presented in Table 4.15.2.1–2. Major laws, regulations, and orders are summarized in Table 4.15.2.1–3.

TABLE 4.15.2.1–3.—*Summary of Major Laws, Regulations, and Orders Relevant to Waste Management*

Laws, Regulations, and Orders	Description
Solid Waste Disposal Act of 1976 (42 U.S.C. §6902)	This Act regulates the management of solid waste. Solid waste is broadly defined to include any garbage, refuse, sludge, or other discarded material including solid, liquid, semisolid, or contained gaseous materials resulting from requirements and controls for transport, test procedures, and administrative requirements. Schedules include industrial, commercial, mining, or agricultural activities. Source-special nuclear or by-product material, as defined by the *Atomic Energy Act* (AEA), is specifically excluded as solid waste.
Resource Conservation and Recovery Act of 1976 (42 U.S.C. §6901)	This Act amends the *Solid Waste Disposal Act* and establishes requirements and procedures for the management of hazardous wastes. As amended by the *Hazardous and Solid Waste Amendments* of 1984 (HSWA), RCRA defines hazardous wastes that are subject to regulation and sets standards for generation, treatment, storage, and disposal facilities. The HSWA emphasize reducing the volume and toxicity of hazardous waste. They also establish permitting and corrective action requirements for RCRA-regulated facilities. RCRA was also amended by the *Federal Facilities Compliance Act* (FFCA) in 1992. It requires EPA, or a state with delegated authority, to issue an order for compliance. A Federal facilities compliance order was issued by the Cal-EPA, requiring DOE and LLNL to comply with the FFCA. Compliance with the order is achieved through Site Treatment Plans prepared by DOE.
Underground Storage Tanks (42 U.S.C. §6901, Subtitle I)	Underground storage tanks (USTs) are regulated as a separate program under RCRA, which establishes regulatory requirements for USTs containing hazardous or petroleum materials. Cal-EPA has been delegated authority for regulating LLNL.
Federal Facility Compliance Act of 1992 (42 U.S.C. §6961)	This 1992 Act waives sovereign immunity from fines and penalties for RCRA violations at Federal facilities. However, it postponed the waiver for three years for storage prohibition violations with regard to land disposal restrictions for DOE's mixed wastes. It required DOE to prepare plans for developing the required treatment capacity for each site at which it stores or generates mixed waste. The state or U.S. EPA must approve each plan (referred to as a Site Treatment Plan) after consultation with other affected states, consideration of public comments, and issuance of an order by the regulatory agency requiring compliance with the plan. The Act further provides that DOE will not be subject to fines and penalties for storage prohibition violations for mixed waste as long as it complies with an existing agreement, order, or permit. The FFCA requires that Site Treatment Plans contain schedules for developing treatment capacity for mixed waste for which identified technologies exist. DOE must provide schedules for identifying and developing technologies for mixed waste without an identified existing treatment technology. A Federal Facility Compliance Order was signed in 1997 to address treatment prior to disposal of mixed waste, as well as characterization and disposal of mixed TRU waste.
Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as Amended (42 U.S.C. §9601, et seq.)	This Act, commonly referred to as the CERCLA, or Superfund, establishes liability standards and governmental response authorization to address the release of a hazardous substance or contaminant into the environment. EPA is the regulating authority for the Act. CERCLA was amended by the *Superfund Amendments and Restoration Act* (SARA) in 1986. SARA Title III establishes additional requirements for emergency planning and reporting of hazardous substance releases. These requirements are also known as the *Emergency Planning and Community Right-to-Know Act* (EPCRA), which, due to its unique requirements is discussed separately below. SARA also created liability for damages to or loss of natural resources resulting from releases into the environment and required the designation of Federal and state officials to act as public trustees for natural resources. LLNL is subject to, and required to report releases to the environment under the notification requirements in 40 CFR Part 302 (Designation, Reportable Quantities, and Notification) and EPCRA, as applicable. Pursuant to CERCLA, Section 120, DOE signed a Federal Facility Agreement for LLNL in 1989.

TABLE 4.15.2.1–3.—*Summary of Major Laws, Regulations, and Orders Relevant to Waste Management (continued)*

Laws, Regulations, and Orders	Description
Pollution Prevention Act of 1990 (42 U.S.C. §13101)	This Act sets the national policy for waste management and pollution control that focuses first on source reduction, followed sequentially by environmentally safe recycling, treatment, and disposal. In response, DOE committed to voluntary participation in EPA's 33/50 Pollution Prevention Program, as set forth in Section 313 of SARA.
Toxic Substances Control Act of 1977 (15 U.S.C. §2601)	TSCA, unlike other statutes that regulate chemicals and their risk after they have been introduced into the environment, was intended to require testing and risk assessment before a chemical is introduced into commerce. It also establishes record-keeping and reporting requirements for new information regarding adverse health and environmental effects of chemicals. The Act governs the manufacture, use, storage, handling, and disposal of PCBs; sets standards for cleaning up PCB spills; and establishes standards and requirements for asbestos identification and abatement in schools. It is administered by EPA. Because LLNL's R&D activities are not related to the manufacture of new chemicals, PCBs are LLNL's main concern under the Act. Activities at LLNL that involve PCBs include, but are not limited to, management and use of authorized PCB-containing equipment, such as transformers and capacitors; management and disposal of substances containing PCBs (dielectric fluids, contaminated solvents, oils, waste oils, heat transfer fluids, hydraulic fluids, paints, slurries, dredge spoils, and soils); and management and disposal of materials or equipment contaminated with PCBs as a result of spills. At LLNL, PCB-contaminated wastes are transported offsite for treatment and disposal unless they also have a radioactive component. Nonradioactive wastes containing PCBs are disposed of at an offsite facility that has been approved by EPA for such disposal (provided that strict requirements are met with respect to notification, reporting, record-keeping, operating conditions, environmental monitoring, packaging, and types of wastes disposed). Radioactive PCB waste, typically known as mixed TRU waste or mixed waste, is currently stored at one of LLNL's hazardous waste storage facilities until the Waste Isolation Pilot Project, or other approved facility, accepts this waste for final disposal. LLNL conducts asbestos abatement projects in accordance with OSHA requirements (29 CFR Part 1926), applicable requirements of the *Clean Air Act* and the California Solid Waste Management Regulations.
EO 13148, "Greening the Government through Leadership in Environmental Management"	This EO directs all Federal agencies to develop and implement environmental management systems to support environmental compliance; right-to-know and pollution prevention; reducing toxic chemical releases; reducing use of toxic chemicals, hazardous substances, and other pollutants; reducing ozone-depleting substances; and promoting environmentally and economically beneficial landscaping.
Atomic Energy Act	The AEA of 1954 makes the Federal government responsible for regulatory control of the production, possession, and use of three types of radioactive material: source, special nuclear, and byproduct (includes waste). Regulations promulgated by the U.S. Nuclear Regulatory Commission (NRC) under the AEA establish standards for the management of these radioactive materials (including waste).
Hazardous Waste Control Act (California Health and Safety Code § 25100 et seq.)	This act is the state authorization to implement the state hazardous waste programs pursuant to RCRA.
Hazardous Waste Reduction Act (California Health and Safety Code § 25244.12-25)	This act expands the State of California's hazardous waste source reduction activities to accelerate reduction in hazardous waste generation.

TABLE 4.15.2.1–3.—*Summary of Major Laws, Regulations, and Orders Relevant to Waste Management (continued)*

Laws, Regulations, and Orders	Description
Medical Waste Management Act (California Health and Safety Code § 117600-11860)	The *Medical Waste Management Act* establishes a comprehensive program for regulating the management, transport, and treatment of medical wastes that contain substances that may potentially infect humans.
40 CFR Part 260 Series	The implementing regulations established by EPA governing hazardous waste.
Title 22 CCR Division 4.5	The implementing regulations established by Cal-EPA for management of hazardous waste.
DOE O 435.1, "Radioactive Waste Management"	DOE O 435.1 establishes the policies, guidelines, and minimum requirements by which DOE and its contractors manage radioactive waste, mixed waste, and contaminated facilities. This order establishes DOE policy that radioactive and mixed wastes be managed in a manner that ensures protection of the health and safety of the public, DOE, contractor employees, and the environment. In addition, the generation, treatment, storage, transportation, and disposal of radioactive wastes, and the other pollutants or hazardous substances they contain, must be accomplished in a manner that minimizes the generation of such wastes across program office functions and complies with all applicable Federal, state, and local environmental, safety, and health laws and regulations and DOE requirements.
DOE O 450.1, "Environmental Protection Program"	This order directs facilities to implement sound stewardship practices that are protective of the air, water, land, and other natural and cultural resources impacted by DOE operations and by which DOE cost-effectively meets or exceeds compliance with applicable environmental, public health, and resource protection laws, regulations, and DOE requirements.

Source: LLNL 2002cc.

4.15.2.2 *Radioactive Waste*

Radioactive waste generated at LLNL includes LLW, MLLW, TRU waste, and mixed TRU waste. LLNL does not manage or generate high-level waste (a highly radioactive material that results from the reprocessing of spent nuclear fuel). LLW, MLLW, and TRU waste are produced primarily in laboratory experiments and component tests. Mixed wastes are discussed in Section 4.15.2.4. See Appendix B for a detailed description of radioactive waste, storage quantities, and treatment quantities.

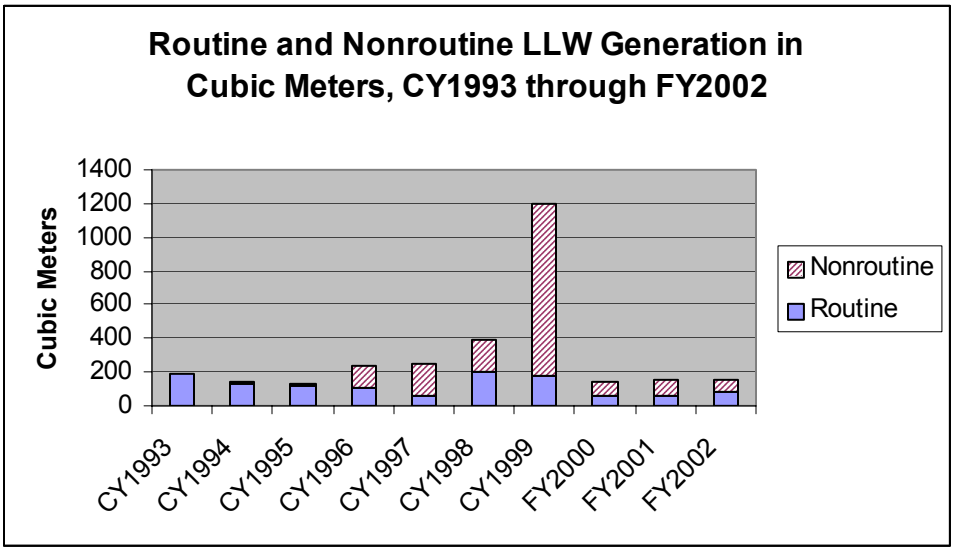
DOE O 435.1 permits onsite storage of LLW and TRU wastes until appropriate disposal becomes available. Currently, there are no regulatory restrictions on the length of time this waste may be stored onsite, provided that disposal or offsite storage options are being pursued and the waste is stored in accordance with all applicable regulations. LLNL maintains the capability to treat solid radioactive wastes onsite. LLNL has treated liquid radioactive wastes at the Area 514 Tank Farm. The DWTF is replacing Area 514 (LLNL 2002ca). LLNL disposes of solid LLW offsite at the Nevada Test Site. Available storage space for LLW and TRU waste is limited by exposure considerations (i.e., radiation exposure to personnel) at a given storage location. However, radioactive wastes, unlike RCRA-regulated wastes, can be stored at various locations onsite provided that the wastes are properly packaged, labeled, and monitored. Radioactive waste management facilities are listed in Table 4.15.2–1.

As part of the effort to minimize the total quantity of radioactive waste that is generated at LLNL, facilities that generate this type of waste are designated as a Radioactive Materials

Management Area (RMMA). An RMMA is an area where a reasonable potential exists for contamination due to the presence of unconfined or unencapsulated radioactive material or an area that is exposed to sources of radioactive particles (such as neutrons and protons) capable of causing activation. Managers of facilities must document the location of all RMMAs. Procedures to minimize the generation of radioactive wastes are then developed.

Historic and Current Radioactive Waste Generation

Radioactive waste has historically been generated from R&D activities that used radioactive materials. Figure 4.15.2.2–1 summarizes historic routine and nonroutine LLW quantities generated onsite from calendar years (CYs) 1993 through fiscal year (FY) 2002. Annual routine TRU waste generation ranged from 0 to 12 cubic meters. Annual nonroutine TRU waste was 0 cubic meters, with the exception of 10 cubic meters in 1995.



Source: DOE 2002s.

FIGURE 4.15.2.2–1.—*Routine and Nonroutine Waste Generation*

4.15.2.3 *Hazardous Waste*

Hazardous waste refers specifically to nonradioactive waste, including RCRA chemical and explosives waste, state-regulated hazardous waste, biohazardous (for this document medical is included) waste, and TSCA waste (primarily asbestos and PCBs). Almost all buildings at LLNL generate hazardous wastes, ranging from common household items such as fluorescent light bulbs, batteries, and lead-based paint to solvents, metals, cyanides, toxic organics, pesticides, asbestos, and PCBs.

RCRA allows onsite management of hazardous waste at the point of generation or in designated waste accumulation areas or storage in permitted storage facilities. There are regulatory restrictions on the length of time that waste may be stored onsite and it must be stored in accordance with all applicable regulations. LLNL does maintain the capability to treat certain hazardous wastes onsite. LLNL treats explosive wastes at Site 300. Except for empty-container crushing, hazardous wastes are usually not treated before offsite shipment to a licensed treatment, storage, and disposal facility. Hazardous wastes are shipped offsite through licensed

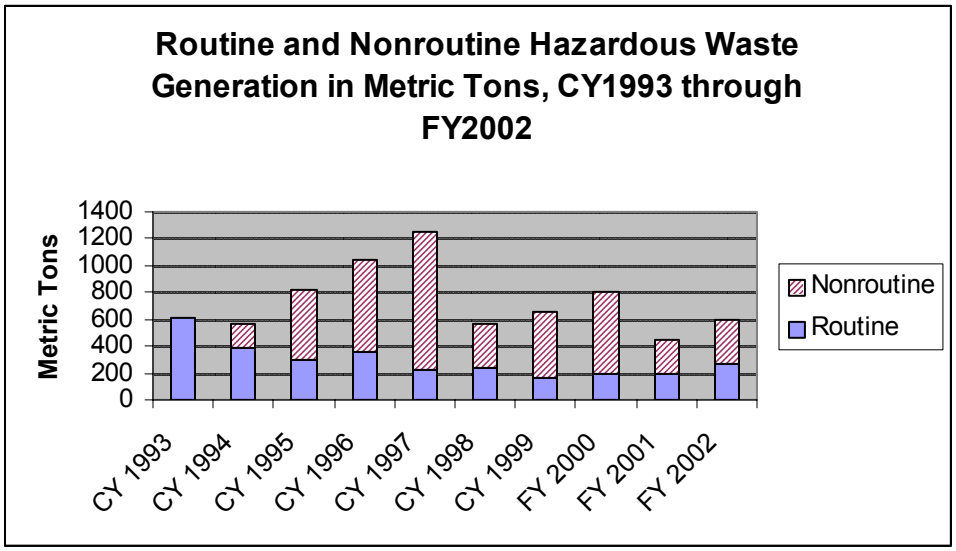
commercial transporters to various permitted treatment, storage, and disposal facilities. See Appendix B for a more detailed description of hazardous waste-related topics.

Historic and Current Hazardous Waste Generation

The hazardous waste generated at LLNL is predominantly chemical laboratory trash generated from experiments, tests, other R&D activities, and infrastructure fabrication and maintenance. Figure 4.15.2.3–1 illustrates the quantities of routine and nonroutine hazardous waste generated for all operations from CY1993 through FY2001. From CY1993 to FY2002, annual total (routine plus nonroutine) RCRA hazardous waste generation ranged from 126 to 514 metric tons. During the same period, total annual state-regulated and total annual TSCA waste ranged from 155 to 723 metric tons and 9 to 515 metric tons, respectively.

Explosive Waste

The explosive waste generated at LLNL ranges from explosives and analytical chemicals to wastewater contaminated with explosives. In 2002, 6,000 pounds of explosive waste were managed. Waste explosives are treated at the EWTF (approximately 2,700 pounds in 2002). For further details, see Appendix B.

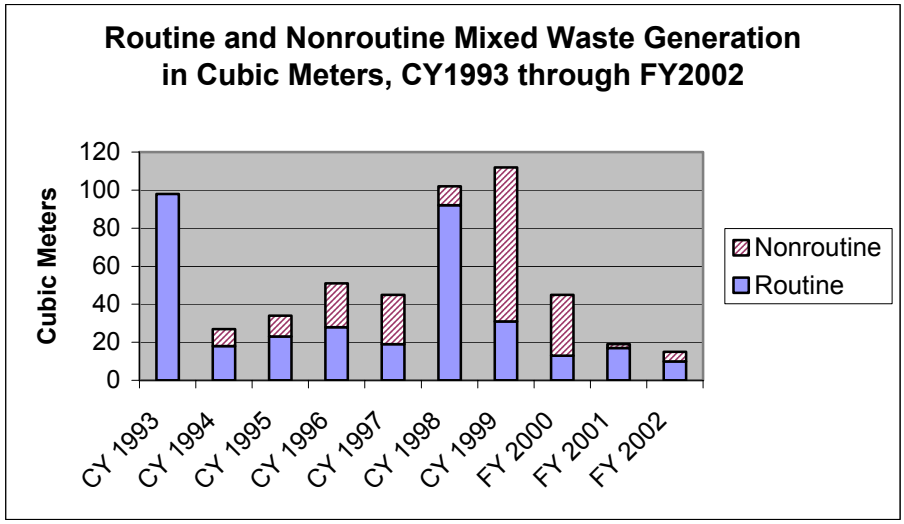


Source: DOE 2002s.

FIGURE 4.15.2.3–1.—*Routine and Nonroutine Hazardous Waste Generation*

4.15.2.4 *Mixed Wastes*

MLLW and mixed TRU waste are produced primarily in laboratory experiments and component tests. Figure 4.15.2.4–1 illustrates the quantities of MLLW generated from CY1993 through FY2002. Mixed TSCA waste is produced primarily during D&D and environmental restoration activities. Most years, LLNL does not generate mixed TRU and mixed TSCA waste; however, one or more metric tons are possible in any given year.



Source: DOE 2002s.

FIGURE 4.15.2.4–1.—*Routine and Nonroutine Mixed Waste Generation*

LLNL does not maintain the capability to treat or dispose of solid mixed wastes onsite. In the past, LLNL treated liquid mixed wastes at the Area 514 Tank Farm (LLNL 2002p). The DWTF is designed to replace Area 514. LLNL treats and disposes MLLW offsite under the Federal Facility Compliance Order issued to DOE and requires DOE to direct the University of California, Davis (current operator), to comply fully (LLNL 2002cc, DOE 1997g). LLNL is continuing to work with DOE to maintain compliance with the *Federal Facilities Compliance Act* Site Treatment Plan (STP) for LLNL that was signed in February 1997 (DOE 1997g). All milestones for 2001 were completed on time. Reports and certification letters were submitted to DOE as required. An agreement was reached with DTSC to extend all FY2002 and FY2003 milestones to allow LLNL to concentrate resources on characterizing and disposing of mixed TRU waste. LLNL continued to pursue the use of commercial treatment and disposal facilities that are permitted to accept mixed waste. These facilities provide LLNL greater flexibility in pursuing the goals and milestones set forth in the Site Treatment Plan.

4.15.2.5 *Biohazardous Wastes*

Division 104, Part 14, Sections 117600-118360 of the California Health and Safety Code is known as the *California Medical Waste Management Act*. This Act is a comprehensive program for regulating the management, transport, and treatment of medical wastes. The California Department of Health Services (known as DHS) administers the *California Medical Waste Management Act* and has given authority to Alameda County Health Care Services Agency to oversee LLNL's medical waste management practices.

The Livermore Site is considered a large-quantity generator of medical waste, which means that 200 or more pounds of medical waste are generated in any month of a 12-month period. Therefore, the Livermore Site is subject to annual inspections conducted by Alameda County, annual waste generator/treatment permit fees, and maintenance of the Medical Waste Management Plan that contains emergency plans for each program at LLNL that generates and treats medical waste.

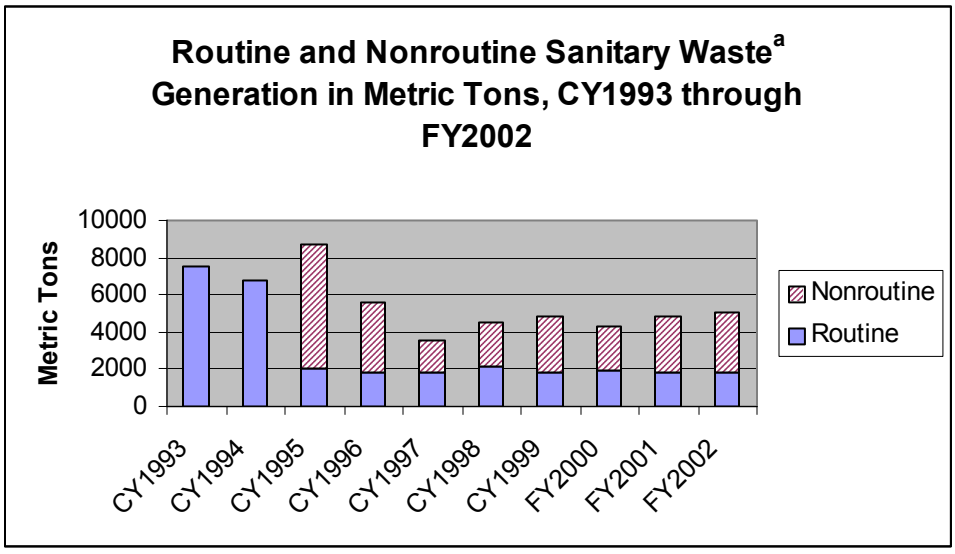
Medical waste plus hazardous waste is designated as hazardous waste and is subject to regulation as specified in the statutes and regulations applicable to hazardous waste. Medical waste plus radioactive waste is designated as radioactive waste and is subject to regulation as specified in the statutes and regulations applicable to radioactive waste.

Site 300 is considered a small-quantity generator of medical waste, which means that less than 200 pounds of medical waste is generated per month. Therefore, Site 300 is not subject to medical waste generator and treatment permit fees and is not subject to annual inspections by San Joaquin County. Site 300 does, however, submit a minimal annual fee for a Limited Quantity Hauling Exemption, which allows registered LLNL haulers to transport medical waste generated at Site 300 to the Livermore Site for waste consolidation prior to offsite shipment.

4.15.2.6 *Other Wastes*

Sanitary Solid Waste

Routine sanitary solid waste consists predominantly of office and laboratory nonhazardous trash. Nonroutine sanitary solid waste consists predominately of nonhazardous building debris generated from major construction and D&D activities. All solid waste from the Livermore Site is currently disposed of at the Altamont Landfill in Livermore, California or diverted for recycling (see Appendix O). The Altamont Landfill has a remaining capacity of approximately 15 million cubic yards (over 10 years) (CIWMB 2002). There are two active landfills in San Joaquin County that have over 10 years of capacity. Figure 4.15.2.6–1 summarizes historic sanitary solid waste quantities generated onsite from CY1993 through FY2002 showing portions of routine and nonroutine generated each year with the exception of CY1993 and CY1994. In FY2001 and FY2002, LLNL generated 1,900 and 1,800 metric tons of routine sanitary waste each year and 3,000 and 3,300 metric tons of nonroutine sanitary waste, respectively (DOE 2002s).



Source: DOE 2002s.
[a] Nonroutine quantities included in routine total for CY1993 and CY1994.

FIGURE 4.15.2.6–1.—*Sanitary Waste Generation in Metric Tons*

Environmental Restoration Wastes

For a discussion of onsite contamination, placement on the National Priorities List (NPL), and the nature and extent of contamination, see Section 4.17. A general discussion of treatment is provided below.

Current activities include 30 treatment facilities; there are 28 groundwater treatment facilities and 2 vapor treatment facilities. Eighty-four groundwater extraction wells operated at an average flow rate of 2,540 liters per minute. Two vapor extraction wells operated at an average flow rate of 0.27 cubic meters per minute. Table 4.15.2.6–1 presents the treatment area and VOCs removed from groundwater and soil at the Livermore Site. Table 4.15.2.6–2 summarizes FY2002 and cumulative totals of volumes and masses of contaminants removed from groundwater and soil vapor at Site 300.

Other environmental restoration wastes (soil, personal protective equipment, sampling tools) are rolled into nonroutine radioactive, hazardous, and sanitary solid waste categories previously discussed.

TABLE 4.15.2.6–1.—*Volatile Organic Compounds Removed From Groundwater and Soil at the Livermore Site*

		2002		Cumulative Total	
Treatment Area	**Startup Date**	**Water Treated (million liters)**	**VOCs Removed (kilograms)**	**Water Treated (million liters)**	**VOCs Removed (kilograms)**
TFA	1989	251.4	5.7	3,658	154
TFB	1990	130.2	6.1	787	54.2
TFC	1993	107.9	7.1	595	53.9
TFD	1994	281.3	68.4	1,505	500
TFE	1996	110.5	17.5	544	139
TFG	1996	12.1	0.7	70.4	3.7
TF406	1996	40.5	1.0	211	7.7
TF518	1998	4.9	0.6	37.1	4.3
TF5475	1998	0.72	0.7	2.3	4.8
		Soil Vapor Treated (thousand cubic meters)	**VOCs Removed (kilograms)**	**Soil Vapor Treated (thousand cubic meters)**	**VOCs Removed (kilograms)**
VTF518	1995	0	0	425	153
VTF5475	1999	143.5	37.7	659	306

Source: LLNL 2003l.
TF = Treatment Facility; VOC = volatile organic compound; VTF = Vapor Treatment Facility.

Industrial Wastewater

Industrial wastewater is waste that contains constituents at concentrations too high to allow discharge to the sanitary sewer but does not meet the criteria to be designated as hazardous waste. The majority of wastewater is treated and discharged to the sanitary sewer. Several thousand gallons of wastewater are routinely held pending analysis. After treatment, the wastewater is discharged to the sanitary sewer if discharge criteria are met. For additional information, see Section 4.11.

At Site 300, Buildings 801, 806, 807, 809, 825, and 826 process nonhazardous wastewater through several steps (e.g., filters) into Class II surface impoundments (LLNL 2002cc, LLNL 2000a, LLNL 1999d).

TABLE 4.15.2.6–2.—*Volatile Organic Compounds Removed From Groundwater and Soil Vapor at Site 300*

		2002		Cumulative Total	
Treatment Area	**Startup Date**	**Water Treated (million liters)**	**VOCs Removed (kilograms)**	**Water Treated (million liters)**	**Volatile Organic Compounds Removed (kilograms)**
GSA-Eastern GWTF	1991	78.7	0.17	806.6	6.19
GSA-Central GWTF	1993	4.19	0.59	29.16	10.66
Building 834	1995	0.11	0.81	0.93	31.84
High Explosives Process Area	1999	4.5	0.012	10.5	0.058
Building 832	1999	1.90	0.12	5.68	0.44
Building 854	1999	3.67	0.78	12.25	6.14
Pit 6	1998	Not Applicable	Not Applicable	0.268	0.0014
		Soil Vapor Treated (thousand cubic meters)	**Volatile Organic Compounds Removed (kilograms)**	**Soil Vapor Treated (thousand cubic meters)**	**Volatile Organic Compounds Removed (kilograms)**
GSA-Central	1994	293.58	1.54	1,987.18	66.16
Building 834	1998	406.18	5.19	1,657.56	108.26
Building 832	1999	96.2	0.28	282.5	1.39

Source: LLNL 2003l.
GSA = general services area; GWTF = groundwater treatment facility; VOC = volatile organic compound.

Sanitary (Domestic) Wastewater

Liquid effluents with contaminants below limits specified by the city of Livermore are released to the city of Livermore sewer system. In FY2002, LLNL discharged approximately 240,000 gallons per day (LLNL 2002l). The sewer system capacity is approximately 1,685,000 gallons per day (DOE 2002d). In FY2001, Site 300 (GSA) generated approximately 2,100 gallons per day (LLNL 2002cc, LLNL 2000a, LLNL 1999d). Site 300 remote facilities use septic systems.