Management Summary

UCRL-AR-122289

Environmental Restoration
at

Lawrence Livermore National Laboratory
Livermore Site
Livermore, California

U.S. Department of Energy

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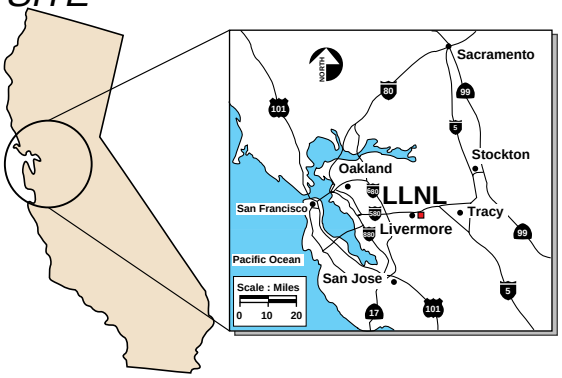
Management Summary

SITE



This management summary describes the status of environmental cleanup at Lawrence Livermore National Laboratory (LLNL) Livermore site, Livermore, California. Optimized hydraulic control, source removal, and advanced technologies are being used to clean up ground water contaminated with volatile organic compounds (VOCs), fuel hydrocarbons (FHCs) and chromium by using a network of treatment facilities employing ultraviolet (UV)/oxidation, air stripping, ion exchange, and granular activated carbon (GAC) technologies. Initial treatment began in 1989 and additional capacity is being phased in through an ongoing evaluation process. Soil vapor extraction (SVE) is the primary technology being employed to clean up the vadose zone at LLNL source areas.

SITE CHARACTERISTICS

Site History/Release Characteristics

• The 800-acre LLNL site was converted from agricultural use into a flight training base and aircraft assembly and repair facility by the Navy in 1942. In 1951, the Atomic Energy Commission converted the site into a weapons design and basic physics research laboratory. Later site missions have included programs in biomedicine, energy, lasers, magnetic fusion energy, and environmental science.

• Initial releases of hazardous materials occurred in the mid to late 1940s. There is also evidence that subsequent localized spills, leaking tanks and impoundments, process cooling water and landfills released VOCs, FHCs, chromium and tritium to sediments and ground water, primarily from 14 major areas of concern.

• In 1983, VOCs were detected by LLNL in domestic water supply wells west of the site. A regulatory order to investigate ground water quality was issued by the state in 1984 and ultimately lead to investigation of over 350 potential release sites.

• Bottled drinking water was supplied to nearby residents beginning in 1983 and all affected supply wells were permanently sealed between 1985 and 1989 by LLNL. Waste pits and a landfill were excavated and backfilled in 1982/83 and 1984, respectively. The LLNL Livermore site was added to the National Priorities List in 1987.

Site Conditions

• The ground surface slopes gently to the northwest changing in elevation from 670 ft above mean sea level (MSL) to 570 ft above MSL from the southeast to northwest corners. Two intermittent streams, the Arroyo Seco and the Arroyo Las Positas, traverse the area.

• Climate is semiarid with annual precipitation about 14 inches/year.

• Land north and south of the site is zoned for industrial use, high-density residential areas are west of the site, and east of the site is primarily agricultural land.

• Municipal water supply wells in downtown Livermore approximately 1.6 miles away from the contaminant plume are the primary drinking water source for over 10,000 of Livermore's 60,000 plus residents.

Nature and Extent of Contaminants

VOCs:

• VOCs are found in saturated sediments underlying approximately 85% of the Livermore Site and occupy an area of about 1.4 square miles. The VOC ground water plumes vary between 10 and 100 ft in thickness and are generally found above 200 ft in depth.

• TCE is the predominant VOC, with maximum concentrations on the order of 5000 ppb; PCE, 1,1-DCE, 1,2-DCA, 1,1,1-TCA, carbon tetrachloride, chloroform, Freon 113 and Freon 11 are also frequently present.

• VOCs are also found in the vadose zone in several areas that are impacting ground water.

FHCs:

• Fuel hydrocarbons, including free product, are present in saturated sediments associated with previous gasoline releases near the southern boundary of the site.

• Dynamic underground steam stripping, electrical heating, and ground water and vapor extraction have removed approximately 10,000 gallons of gasoline product from the subsurface.

• Residual fuel hydrocarbons are still present up to 2 ppm in ground water within 300 ft. of the source and up to approximately 10,000 ppm in soils at one location.

• Remediation by natural bioattenuation of hydrocarbon compounds appears promising and is currently under active investigation.

Metals: • Metals from both natural conditions and facility activities exceed drinking water standards in several locations. Chromium, naturally occurring and used as a corrosion inhibitor in cooling towers in the past, is found in concentrations up to 160 ppb in ground water.

Radiological Parameters: • Ground water in the few wells where tritium is detected is expected to decay below federal and state drinking water standards before the water migrates offsite if no remediation was conducted.

Contaminants of Concern

VOCs:		Toluene	(T)
Trichloroethylene	(TCE)	Ethylbenzene	(E)
Perchloroethylene	(PCE)	Xylenes	(X)
1,1 & 1,2-Dichoroethylene	(DCE)	Ethylene dibromide	(EDB)
1,1 & 1,2-Dichloroethane	(DCA)	**Metals:**	
Carbon tetrachloride	(CCl_4)	Chromium	(Cr)
1,1,1-Trichloroethane	(TCA)	Trivalent chromium	(Cr^{3+})
Chloroform	(HCl_3)	Hexavalent Chromium	(Cr^{6+})
FHCs:		**Radiological Parameters:**	
Benzene	(B)	Tritium	(H^3)

Remediation Plan

The overall long-term environmental remediation strategy for the LLNL Livermore Site uses ground water extraction and treatment that is based on an hydraulic control philosophy including:

- detailed site characterization, including hydrostratigraphic unit (HSU) analysis
- validated modeling, and decision support
- phased implementation of remediation,
- directed extraction and injection; and
- adaptive time-managed pumping.

This unique approach will:

- enable testing and optimization of extraction, injection and treatment systems, their efficiencies, and hydraulic capture and contaminant removal prior to full-scale implementation;
- employ dynamic management of wellfields and optimizing of cleanup through field monitoring and modeling; and
- continue to involve and inform the stakeholders to ensure continued regulatory and community acceptance.

Dynamic management of the wellfield involves operation of individual wells either continuously, intermittently, or not at all depending upon the results of field monitoring and the estimates of models and optimization routines: