ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

Public Health Assessment for

LAWRENCE LIVERMORE NATIONAL LABORATORY SITE 300 (USDOE)
TRACY, SAN JOAQUIN COUNTY, CALIFORNIA
EPA FACILITY ID: CA2890090002
JANUARY 20, 2005

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
PUBLIC HEALTH SERVICE
Agency for Toxic Substances and Disease Registry

THE ATSDR PUBLIC HEALTH ASSESSMENT: A NOTE OF EXPLANATION

This Public Health Assessment was prepared by ATSDR pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) section 104 (i)(6) (42 U.S.C. 9604 (i)(6)), and in accordance with our implementing regulations (42 C.F.R. Part 90). In preparing this document, ATSDR has collected relevant health data, environmental data, and community health concerns from the Environmental Protection Agency (EPA), state and local health and environmental agencies, the community, and potentially responsible parties, where appropriate.

In addition, this document has previously been provided to EPA and the affected states in an initial release, as required by CERCLA section 104 (i)(6)(H) for their information and review. The revised document was released for a 30-day public comment period. Subsequent to the public comment period, ATSDR addressed all public comments and revised or appended the document as appropriate. The public health assessment has now been reissued. This concludes the public health assessment process for this site, unless additional information is obtained by ATSDR which, in the agency's opinion, indicates a need to revise or append the conclusions previously issued.

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PUBLIC HEALTH ASSESSMENT

LAWRENCE LIVERMORE NATIONAL LABORATORY SITE 300 (USDOE)

TRACY, SAN JOAQUIN COUNTY, CALIFORNIA

EPA FACILITY ID: CA2890090002

Prepared by:

Energy Section
Federal Facilities Assessment Branch
Division of Health Assessment and Consultation
Agency for Toxic Substances and Disease Registry

Foreword

The Agency for Toxic Substances and Disease Registry, ATSDR, is an agency of the U.S. Public Health Service. Congress established ATSDR in 1980 as part of the Comprehensive Environmental Response, Compensation, and Liability Act, also known as the *Superfund* law. This law set up a fund to identify and clean up our country's hazardous waste sites. The Environmental Protection Agency, EPA, and the individual states regulate the investigation and cleanup of the sites.

Since 1986, amendments to the Superfund Law have required ATSDR to conduct a public health assessment at each of the sites on the EPA National Priorities List. The aim of these evaluations is to find out whether people are being exposed to hazardous substances and, if so, whether that exposure is harmful and should be stopped or reduced. (The legal definition of a health assessment is included on the inside front cover of this health assessment.) If appropriate, ATSDR also conducts public health assessments when it is petitioned by concerned individuals. Public health assessments are conducted by environmental and health scientists from ATSDR and from the states with which ATSDR has cooperative agreements.

Exposure: As the first step in the evaluation, ATSDR scientists review environmental data to see how much contamination is at a site, where it is, and how people might come into contact with it. Generally, ATSDR does not collect its own environmental sampling data; rather, it reviews information provided by EPA, other government agencies, businesses, and the public. When insufficient environmental information is available, the report will indicate what further sampling data is needed.

Health Effects: If the review of the environmental data shows that people have or could come into contact with hazardous substances, ATSDR scientists then evaluate whether any harmful effects will result from these exposures. The health assessment focuses on public health, or the health impact on the community as a whole, rather than on individual risks. Again, ATSDR generally makes use of existing scientific information, which can include the results of medical, toxicological and epidemiological studies, and the data collected in disease registries. The science of environmental health is still developing, and sometimes scientific information on the health effects of certain substances is not available. When this is so, the health assessment will suggest what further research studies are needed.

Conclusions: The health assessment contains conclusions about the level of health threat, if any, posed by a site and, in its public health action plan, recommends ways to stop or reduce exposure. ATSDR is primarily an advisory agency, so usually these health assessments identify what actions are appropriate to be undertaken by EPA, by other responsible parties, or by the research or education divisions of ATSDR. But in the event of an urgent health threat ATSDR can issue a public health advisory warning people of the danger. ATSDR can also authorize health education or pilot studies of health effects, full-scale epidemiology studies, disease registries, surveillance studies, or research on specific hazardous substances.

Interactive Process: The health assessment process is interactive. ATSDR solicits and evaluates information from numerous city, state and federal agencies, the companies responsible for

cleaning up the site, and the community. It then shares its conclusions with them. Agencies are asked to respond to an early version of the report to make sure that the data they have provided is accurate and current. When informed of ATSDR's conclusions and recommendations, sometimes the agencies will begin to act on those recommendations before the final release of the report.

Community: ATSDR also needs to learn what people in the area know about the site and what concerns they may have about its impact on their health. Consequently, throughout the evaluation process ATSDR actively gathers information and comments from the people who live or work near a site, including residents of the area, civic leaders, health professionals, and community groups. To ensure that the health assessment responds to the community's health concerns, an early version is also distributed to the public for their comments. Those comments received from the public that are included in the final version of the public health assessment can be edited or consolidated, and not all comments are necessarily addressed. But every written public comment is kept with the original public health assessment file in Atlanta, Georgia. Upon prior written notice, these comments are available for public inspection.

Comments: If, after reading this health assessment, you have questions or comments, we encourage you to send them to us.

Letters should be addressed as follows:

Attention: Chief, Program Evaluation, Records and Information Services Branch, Agency for Toxic Substances and Disease Registry, 1600 Clifton Road (E-56), Atlanta, GA 30333.

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List of Abbreviations

ATSDR	Agency for Toxic Substances and Disease Registry
Bq	Becquerel
ºC	Degrees Centigrade (or Celsius)
CERCLA 1980	Comprehensive Environmental Response, Compensation, and Liability Act of
Ci	Curie
CSVRA	Carnegie State Vehicle Recreation Area
DNAPL	Dense Non-Aqueous Phase Liquid
DOE	Department of Energy
DTSC	California Department of Toxic Substances Control
EFA	East Firing Area
EPA	Environmental Protection Agency
ºF	Degrees Fahrenheit
FS	Feasibility Study
GSA	General Services Area
HE	High Explosive
HMX	Cyclotetramethylene-tetranitramine (High Melting Explosive)
kg	kilogram
L	Liter
LLNL	Lawrence Livermore National Laboratory
m	meter
m^3	cubic meter
MCL	Maximum Contaminant Level
mg	milligram
mg/kg	milligram per kilogram

µg	microgram
µg/L	microgram per liter
µg/m^3	microgram per cubic meter
MRL	Minimal Risk Level
NPL	National Priorities List
OU	Operable Unit
OSHA	Occupational Safety and Health Administration
PHA	Public Health Assessment
ppb	parts per billion
ppm	parts per million
RDX	1,3,5-trinitro-1,3,5,-triazine (Royal Demolition Explosive)
RfC	Reference Concentration
RfD	Reference Dose
RI	Remedial Investigation
ROD	Record of Decision
RWQCB	Regional Water Quality Control Board
SA	Study Area
SARA	Superfund Amendments and Reauthorization Act
SVE	Soil Vapor Extraction
SWFS	Site Wide Feasibility Study
SWRI	Site Wide Remedial Investigation
TCE	Trichloroethylene
VOCs	Volatile Organic Compounds
WFA	West Firing Area

Summary

Lawrence Livermore National Laboratory (LLNL) Site 300 is a Department of Energy (DOE) facility operated by the University of California. Site 300 is used as a high-explosives (HE) test facility in support of LLNL's Weapons Program Mission of research, development, and testing of non-nuclear components of nuclear weapons. Because of contaminants found in groundwater at Site 300 and the tonnage of material deposited in Site 300 landfills, Site 300 was added to the U.S. Environmental Protection Agency's (EPA's) Superfund National Priorities List (NPL) on August 30, 1990.

In the past, Site 300 operated dry wells, waste water lagoons, and solid waste landfills which historically accepted site waste. One of the landfills also received some waste from the LLNL Livermore Main Site and from Lawrence Berkeley National Laboratory. Current operations at the site include measuring the physical properties of explosives, vibration and shock testing, thermal materials testing, laser and particle beam developmental experimentation, and physical processing (fabrication, mechanical pressing, and machining) of shaped explosives and detonation devices.

LLNL Site 300 is in a rural area of north-central California. Private ranch land borders the site to the north and to the southeast. There is currently no residential development bordering Site 300, however, part of the Vieira Ranch along the north-east site perimeter is proposed for the Tracy Hills residential development. A private facility on the eastern border of Site 300 was previously used for explosives research and testing. This facility is currently leased by a fireworks company and used for assembly and storage. The California Department of Fish and Game has property which lies along the eastern boundary. Along most of the southern boundary of Site 300, across Tesla/Corral Hollow Road, is the Carnegie State Vehicular Recreation Area (CSVRA).

Fifty-seven contaminant release areas (Figure 2) affecting surface soil, subsurface soil, surface water, or groundwater have been identified at Site 300. The primary contaminants are volatile organic compounds (VOCs), HE compounds HMX and RDX, and tritium. Uranium-238, nitrate, and perchlorate were also found, but in lower concentrations. With the exception of two TCE plumes from the General Services Area (GSA), most of the contamination has remained within the site boundary. The TCE plume emanating from the eastern GSA historically extended over a mile along the Corral Hollow stream bed. After 8 years of treatment, by the fall of 1999 this TCE plume (as defined by a 5-µg/L contour line) had been restricted to Site 300 property (LLNL 2002). The TCE plume emanating from the central GSA extends approximately 200 feet off site and, in monitoring wells, is found at concentrations approaching 80 ppb. Downgradient water supply wells are not currently affected by this plume; in fact, Site 300 contaminants have never been detected in off-site residential groundwater wells.

The Agency for Toxic Substances and Disease Registry has concluded that there are no past or current exposures to contaminants associated with LLNL – Site 300, and the potential for future exposure is unlikely. Therefore, there is ***No Public Health Hazard*** *to residents near the site.*

Background

Site History and Description

Site History

Lawrence Livermore National Laboratory (LLNL) Site 300 is a Department of Energy (DOE) facility operated by the University of California since 1952. This facility is used to assure the safety and reliability of nuclear weapons. LLNL has not tested and does not test nuclear weapons; it tests only non-nuclear components of nuclear weapons. Prior to 1971, LLNL was a part of the University of California Radiation Laboratory (UCRL). In 1953, UCRL suggested the land that is now Site 300 be used as a high-explosives (HE) test facility in support of LLNL's Weapons Program Mission of research, development and testing of non-nuclear components of nuclear weapons. Testing began at Site 300 in 1955.

In the past, the site operated dry wells, waste water lagoons, and solid-waste landfills which historically accepted waste from Site 300. One of the landfills also received some waste from the Lawrence Livermore Main Site and from the Lawrence Berkeley National Laboratory (LBNL). Current operations at the site include measuring the physical properties of explosives, vibration and shock testing, thermal materials testing, laser and particle beam developmental experimentation, and physical processing (fabrication, mechanical pressing, and machining) of shaped explosives and detonation devices.

Site 300 was added to the U.S. Environmental Protection Agency's (EPA's) Superfund National Priorities List (NPL) on August 30, 1990 because of contaminants found by LLNL in groundwater at Site 300 and the total tonnage of material deposited in Site 300 landfills. Under the provisions of the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA) as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), LLNL performed a Remedial Investigation and Feasibility Study (RI/FS) with oversight by the EPA, the California Regional Water Quality Control Board (RWQCB), and the California Department of Toxic Substances Control (DTSC). The RI addressed such topics as subsurface geology, groundwater flow, contaminant fate and transport, and the nature and extent of contamination. The RI's purpose was to characterize on-site and off-site, or potential off-site, contamination, as well as evaluations of the risk and hazard associated with the contamination. The Feasibility Study developed and evaluated alternatives for remedial action to address contamination of environmental media at Site 300. In 2001, interim remedies were selected for most contaminated areas of the site in the Interim Site-Wide Record of Decision. These remedial actions for site cleanup are being implemented at the site. In 2007 a Record of Decision is expected to set cleanup levels.

Site Description

LLNL Site 300 is located approximately 60 miles east-southeast of San Francisco, CA. It is approximately 17 miles east of Livermore, CA and about 9 miles southwest of Tracy, CA city center – approximately 2 miles from the city boundary. Site 300 covers 11.8 mi^2 and lies mostly in San Joaquin County, with approximately one-sixth of the western portion in Alameda County.

Site 300 ranges in elevation from 500 feet above sea level in the southeast to about 1750 feet in the northwest. The climate is arid, with an average annual rainfall of 10.44 inches (1964–1997), and windy, typically from the west-southwest (LLNL 1999). The site generally experiences mild, rainy winters and warm, dry summers. The mean temperature for Site 300 in 2001 was 15ºC (59ºF), with a temperature range from -5ºC (23ºF) to 40ºC (104ºF).

For the purposes of the Site-Wide Remedial Investigation (SWRI), LLNL subdivided Site 300 into six study areas (SA) based on the process and operations in each. The six study areas are:

1. Building 833,
2. Building 834,
3. East Firing Area/West Firing Area (EFA/WFA),
4. Pit 6 Area,
5. High Explosives (HE) Process Area, and
6. General Services Area (GSA).

A summary description of each SA and processes within them is presented in Table 1.

Table 1: Site 300 Study Areas and the Processes in Each

Study Area	***Past/Current Processes***
GSA	Administrative and support services for Site 300, the motor pool, vehicle repair, painting and maintenance, as well as chemical storage were located in this study area.
Building 834	Thermal physical, environmental and dynamic materials testing including thermal shock, thermal cycling and exposure to long-term temperature extremes. TCE was used as a heat-transfer fluid.
Pit 6 Area	From 1964 to 1973, the pit 6 landfill was used to dispose of various wastes including: empty drums, capacitors, gas cylinders, depleted uranium, animal carcasses, other biological waste and miscellaneous building debris. Some of the debris came from the LLNL Livermore Site and LBNL. There is also a Small Firearms Training Facility along the south edge of the study area.
HE Process Area	Support facilities related to chemical formulation, fabrication, mechanical pressing, machining, and testing of shaped explosives and detonation devices.
EFA/WFA	Explosives experiments were conducted to develop detonation methods for nuclear weapons. Laser and particle-beam experiments were also conducted. Tritium, uranium, and beryllium contaminated gravels from the firing tables were disposed of in landfills in this area. This area includes landfill pits 1, 2, 3, 4, 5, 7, 8, and 9.

Study Area	*Past/Current Processes*
Building 830, 833, and 836	From 1959 to 1982, Buildings 833 and 830 were used to test the physical properties of explosives, but are now used for storage. Building 836, the Dynamic Test Complex, is used to test for the effects of vibration and shock on equipment.

Fifty-seven contaminant release areas affecting surface soil, subsurface soil, surface water, or groundwater have been identified at Site 300. Figure 2 shows these release areas. Note that all fifty-seven release areas are not identified in Figure 2 because there are multiple releases at a given area. The primary contaminants are volatile organic compounds (VOCs), HE compounds HMX and RDX, and tritium. Uranium-238, nitrate, and perchlorate were also found. VOCs—primarily trichloroethylene (TCE)—were found in groundwater at all six study areas, with the highest concentrations in the Building 833, Building 834, HE Process Area, and the GSA study areas. HE compounds were detected in groundwater in the southeastern portion of Site 300 (HE Process Area). Groundwater contamination in the EFA/WFA is primarily tritium, and uranium-238. Tritium and uranium-238 are the only radionuclides confirmed as groundwater contaminants. Most of the contamination has remained within the site boundary, with the exception of two TCE plumes from the GSA. The TCE plume emanating from the eastern GSA historically extended over a mile along the Corral Hollow stream bed. The TCE plume emanating from the central GSA extends approximately 200 feet off site at concentrations approaching 80 ppb in off-site monitoring wells. Remediation of the plume source is ongoing. Off-site drinking water wells are currently unaffected by the Site 300 contamination.

A similar subdivision of Site 300 was made for the Site-Wide Feasibility Study (SWFS). However, the SWFS delineation was based on groupings of similar and relatively proximal release sites and any associated environmental contamination. Eight operable units (OU) were defined:

1. (OU-1) General Services Area,
2. (OU-2) Building 834,
3. (OU-3) Pit 6,
4. (OU-4) HE Process Area,
5. (OU-5) Building 850/Pits 3 & 5,
6. (OU-6) Building 854,
7. (OU-7) Building 832 Canyon, and
8. (OU-8) Site 300,

This list includes release sites for which a monitoring-only remedy was selected. Figure 3 shows the eight OUs. In this PHA the subdivision of Site 300 into Operable Units will be referenced because of its relevance to environmental contamination and the potential for human exposure.

Additionally, because Site 300 was listed on the NPL and is undergoing CERCLA cleanup to address groundwater contamination, this PHA will concentrate on contaminated groundwater.

Because access to Site 300 is restricted, it is unlikely that anyone from the community will come in contact with contaminated soil at Site 300.

Site 300 lies in the southeast Altamont Hills of the Diablo Range. Six map-able geologic formations have been identified:

1. late Cretaceous Great Valley sequence (*Kgv*),
2. the late Paleocene to mid-Eocene Tesla Formation (*Tts*),
3. the mid-Miocene Cierbo Formation (*Tmss*),
4. the late Miocene Neroly Formation (*Tn*),
5. the Pliocene non-marine unit (*Tps*), and
6. Quaternary alluvial deposits (Qal).

Lithologic characteristics of these formations vary from fine-grained claystones to coarse conglomerates, and the stratigraphic units are discontinuous. Consequently, Site 300 is very hydrogeologically diverse (LLNL 1999).

Two main water-bearing zones facilitate most contaminant movement on and off site: the Neroly Formation (*Tn*) bedrock aquifer and the shallow, Quaternary alluvial aquifer (*Qal*). The Neroly Formation is broken into four distinct strata:

1. $Tnsc_2$, a claystone/siltstone layer that occurs in the HE Process Area, the Building 832 Canyon OU, and around Buildings 833 and 834;
2. $Tnsc_1$, a fine-grained layer that serves as a confining layer in the HE Process Area, Buildings 833, 834, central GSA, and in the northern part of the site; however, in the Building 832 Canyon OU, it is a contaminated water-bearing zone;
3. $Tnbs_1$, a major water-bearing zone that is present throughout the site; and
4. $Tnbs_2$, that is saturated in the southeast portion of Site 300. The *Qal* beds occur primarily off-site along the Corral Hollow River floodplain and as valley fill throughout the site (LLNL 1999).

Groundwater occurs in confined, unconfined and flowing artesian conditions at the site. However, there are extensive fractures and fissures in the bedrock, particularly claystone beds. Where present, these fractures can influence groundwater flow (LLNL 2002). Groundwater flow throughout Site 300 is generally influenced by the attitude of the underlying bedrock. Three low-amplitude folds exist on-site:

1. the East Firing Area (EFA) syncline, which has a broad trough and dips gently to the northeast;
2. the Patterson anticline, the largest and most influential fold, runs east to west through the Western Firing Area (WFA) with slopes to the north and south; and
3. the HE Process Area syncline, which is oriented to the southeast (LLNL 1999).

Groundwater also frequently occurs in perched aquifers under hilltops, usually in Quaternary landslide (*Qls*), terrace (*Qt*) and alluvial (*Qal*) deposits (LLNL 2002). The Site-Wide Feasibility Study (LLNL 1999), contains a complete and exhaustive description of the subsurface features of Site 300 and the surrounding area, and provides a thorough description of the hydrogeology of the Site, including groundwater flow direction.

On the site, groundwater is primarily used for site-related activities such as fire suppression, cooling towers, and HE processing. Off the site, groundwater is used for dust suppression (SVRA), stock watering (Connolly, Gallo Ranches), and fire fighting (Castle Rock Fire Station). Bottled water is the primary source of drinking water both on and off site (LLNL 1999). Appendix D lists contaminants, contaminant sources, and media affected for each OU. Contamination is present in the Tnbs1 regional aquifer in all operable units at Site 300, with the exception of the Building 834 operable unit. Only contaminated groundwater plumes that extend, or potentially could extend, off-site are discussed in this PHA.

Site Visit and Collection of Community Concerns

On January 10, 2000, at the Tracy Community Center, ATSDR both attended and set up a table at a DOE-sponsored workshop on Site 300. Approximately 10 community residents attended this meeting, and three persons discussed with an ATSDR representative their concerns about Site 300. The most recent formal site visit conducted by ATSDR staff was October 16, 2003. This site visit was conducted to gather relevant demographic and land-use data, and to investigate possible exposure pathways in the community near the site.

On October 16, 2003, a public availability session was held at the Tracy Community Center in Tracy, CA to collect community concerns. This availability session was informal and allowed community members the opportunity to discuss their concerns one-on-one with an ATSDR team member. Nine community members attended the meeting. The concerns expressed dealt largely with the possible impact of groundwater contaminants on private residential wells. The presence of radiological contamination at Site 300 was also a concern. These and other issues are discussed throughout this PHA. All community concerns are addressed individually in Appendix A.

Community concerns have also been collected through written correspondence. These comments and concerns have been added to Appendix A.

Demographics, Land Use, and Natural Resource Use

Demographics

Demographic information characterizes the populations in the communities potentially affected by the site, how long these populations have lived in the various communities, and the current population trends (LLNL 1999). Identifying the number of children and elderly people is particularly important because these sub-groups tend to be more sensitive to environmental exposures than the general population (LLNL 1999). Also, information on occupation, education level, poverty status, and household income can provide clues to factors such as access to health care and subsistence fishing, hunting, or farming. Demographic information is essential when analyzing health outcome data and behavior patterns in a community.

Site 300 lies predominantly in San Joaquin County, California. The western one-sixth of the site lies within Alameda County. According to 2000 U.S. Census data, Alameda County has a population of 1,443,741. Most, however, live along or near the San Francisco Bay, leaving the area around Site 300 sparsely populated. Alameda County's most populous city is Oakland, CA with a population of 399,484. Livermore is 17 miles from Site 300, and the Census 2000 population was 73,345. San Joaquin County has a population of 563,598. Stockton, CA is the largest city in San Joaquin County, with a population of 243,771. Tracy is the closest city to Site 300 the boundary of which is only 2 miles northeast of the site. Tracy's population in 2000 was 56,929. Complete demographic data from the U.S. 2000 Census can be found in Appendix C (Bureau of the Census 2000).

Table 2: U.S. Census 2000 Demographics Data for Alameda and San Joaquin Counties

	Alameda County	*San Joaquin County*	*California*
Total Population	1,443,741	563,598	33,871,648
Persons under 5 years old. (%)	6.8%	8.0%	7.3%
Persons under 18 years old (%)	24.6%	31.0%	27.3%
Persons 65 years old and older (%)	10.2%	10.6%	10.6%
Female persons (%)	50.9%	50.0%	50.2%
Housing Units	540,183	189,160	12,214,549
Land Area (mi^2)	738	1,399	155,959
Largest Metropolitan Area / Population	Oakland / 399,484	Stockton / 243,771	
Metropolitan Area Nearest Site 300 / Population	Livermore / 73,345	Tracy / 56,929	

The Carnegie State Vehicle Recreation Area (CSVRA) is located along the southern border of Site 300. Presently, 14 homes—both permanent and mobile homes—are on CSVRA property, and 4 of the homes are uninhabited. An estimated 20 to 25 persons, mostly park rangers and their families, are currently residing at CSVRA. Twelve of the 14 homes are located along Tesla Road in Alameda County. The other two residences are in a small tract of land owned by CSVRA that lies on the same side of Corral Hollow Road as Site 300 in San Joaquin County (Jones 2003). This small tract of land is visible in Figure 3 as a V-shaped notch on the southern border of Site 300.

Land Use

Land use patterns and natural resource use in the area of the site can demonstrate if or how persons could be exposed to environmental contaminants. Using well water, farming or gardening, and hunting or fishing are some of the activities that can result in exposure to site contaminants. Knowing the locations of schools, hospitals, and nursing homes is also important, given that the populations of the institutions tend to be elderly, sick, or very young, and consequently might be at higher risk for adverse health effects. Reviewing zoning patterns helps us understand future use of land around the site and helps us evaluate the potential hazard to the community.

As stated, LLNL Site 300 is in a rural area. Private ranch land borders the site to the north and to the southeast. Although currently no residential area borders Site 300, part of the Vieira Ranch along the north-east perimeter is the proposed site of the Tracy Hills residential development. A private facility on the eastern border of Site 300 was previously used for explosives research and testing. This facility is currently leased by a fireworks company and used for assembly and storage. The California Department of Fish and Game has property which lies along the eastern boundary. Along most of the southern boundary of Site 300, across Tesla/Corral Hollow Road, is the Carnegie State Vehicular Recreation Area (CSVRA).

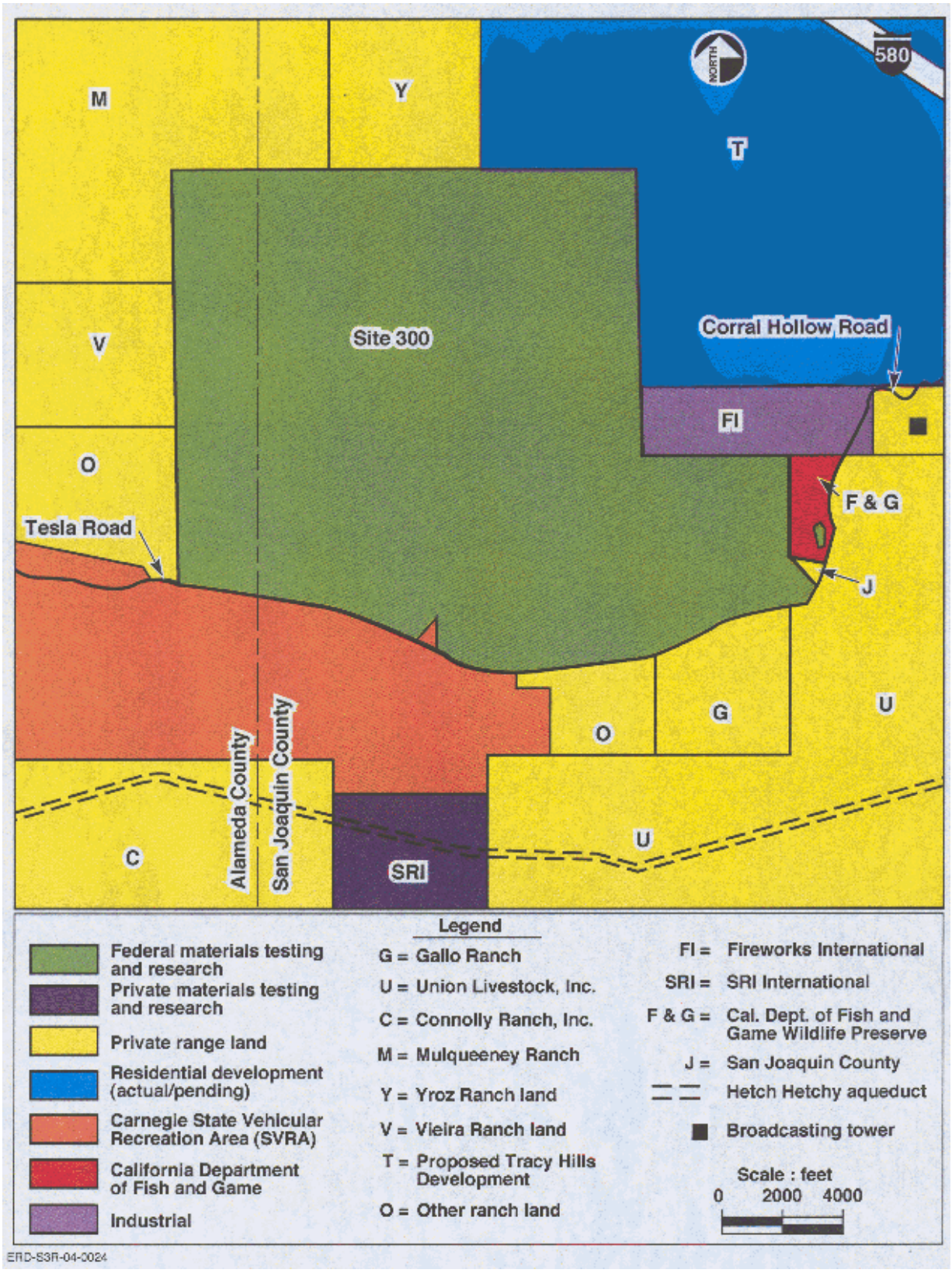


Figure 1: Land Use around Site 300

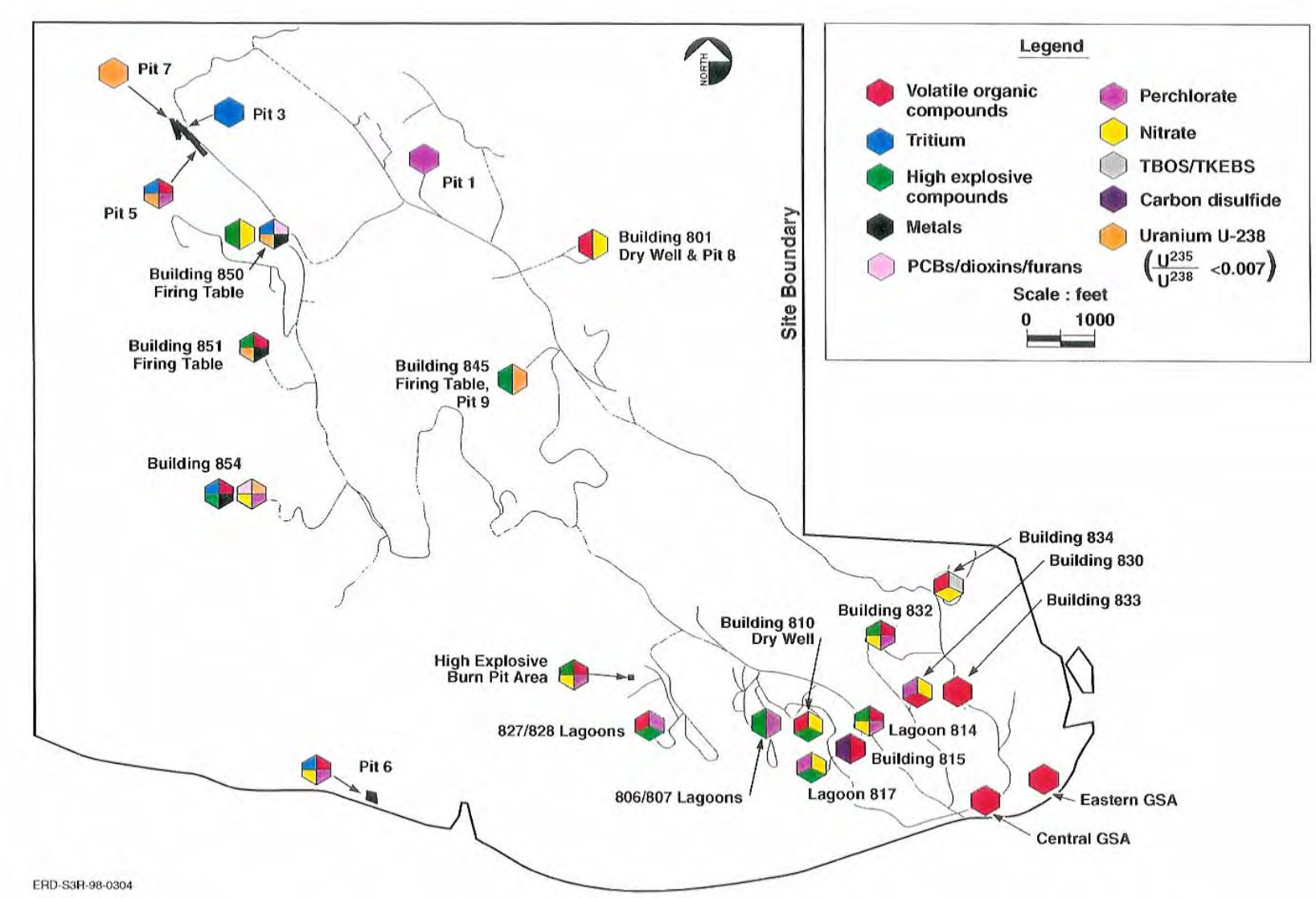


Figure 2: Release areas and Contaminants at LLNL Site 300

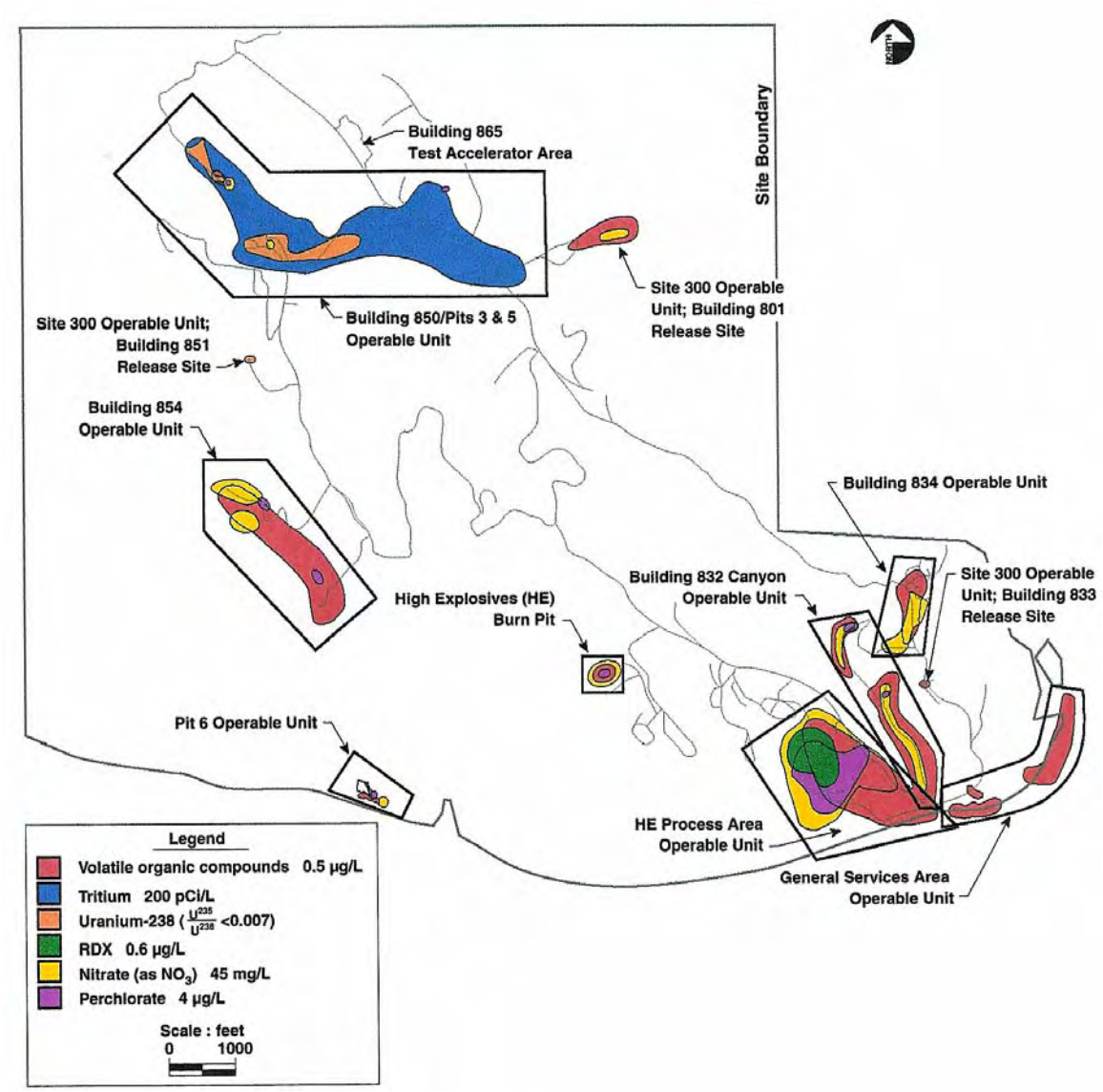


Figure 3: Site 300 Groundwater Contaminant Plumes and Operable Units (OU)

Natural Resource Use

The land that is now Site 300 was acquired in 1955. Previously, the land was used for sheep and cattle grazing. In the late 1800s the small town of Carnegie existed south of what is now Corral Hollow Road. This town developed around coal mining and a brick manufacturing plant. The brick plant utilized the ample supply of rich clay found in this area. The town and the brick plant were abandoned in 1912. The plant was destroyed and the area returned to its natural state in 1916.

Currently, natural resource use around Site 300 is limited to sheep and cattle grazing. The groundwater supply in the vicinity of Site 300 is not sufficient to support commercial agriculture irrigation (LLNL 1994).

State and Local Health Data

State and local health data were not reviewed because the surrounding public was not found to be exposed to contaminants originating from Site 300.

Environmental Contamination and Pathways Analysis

Introduction

This section discusses the various chemicals and radioactive materials (i.e., contaminants) evaluated for this site, how persons might come into contact with them, and what populations are potentially exposed. These discussions are presented for groundwater, air, surface water, soil and sediment, and food and biota.

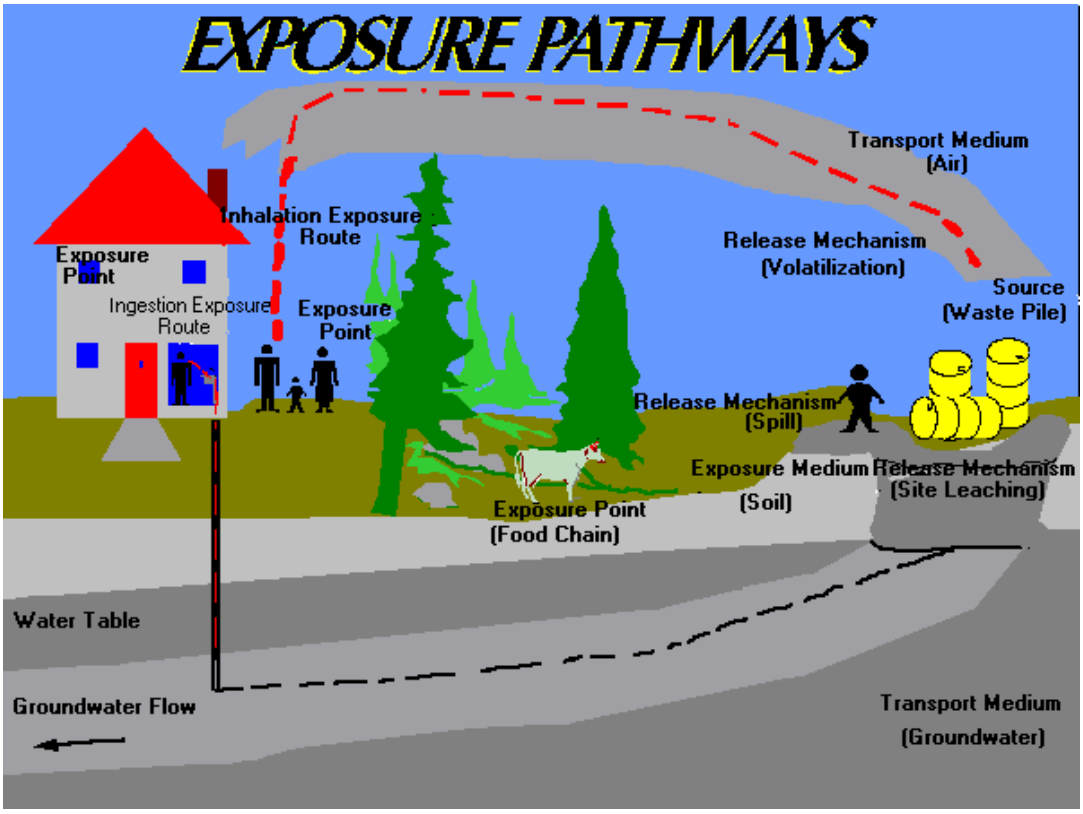


Figure 4: Pathways of Exposure to Contamination

A release of a chemical or radioactive material from a site does not always mean that this substance will be a contaminant of health concern to an off-site population. ATSDR scientists first determine if a chemical or radioactive substance in water, air, soil, or biota (plants and animals) should be considered a "*contaminant of concern*." The criteria we use include

1. environmental levels exceeding media-specific comparison values,
2. noted community health concerns, and

3. the quality and extent of the sampling data we can use to evaluate potential exposure and human health hazard.

For inorganic compounds (metals) and radionuclides, background values may also be considered, given that some of these substances occur naturally. For chemicals, the highest environmental concentration detected off site is matched with media-specific comparison values to determine whether further evaluation is warranted. Generally, if a contaminant's concentration exceeds one or more media-specific comparison values, the contaminant is further evaluated, both in this section and in the public heath implications section.

A release of a chemical or radioactive material into the environment does not always result in *human exposure*. For an exposure to occur, a *completed exposure pathway* must exist. A *completed exposure pathway* exists when all of the following five elements are present:

1. a source of contamination,
2. an environmental medium through which the contaminant is transported,
3. a point of human exposure,
4. a route of human exposure, and
5. an exposed population.

A *potential exposure pathway* exists when one or more of the elements are missing but available information indicates possible human exposure. An *incomplete exposure pathway* exists when one or more of the elements are missing and available information indicates that human exposure is unlikely to occur (ATSDR 2001). Figure 4 illustrates the necessary components of an exposure pathway. In addition, for each exposure pathway ATSDR scientists identify whether releases of contaminants and exposures are likely to have occurred in the past, are currently occurring, or could potentially occur in the future.

In this report, "*on-site contamination*" refers to contamination and releases of material within the fenced security area of the site or in areas for which public access is restricted. "*Off-site contamination*" refers to environmental media (soil, sediment, surface water, groundwater, air, or biota) that are contaminated as a result of chemical or radioactive contaminants leaving the site and are no longer controlled by DOE or LLNL. In this health assessment, on-site sources of contamination are considered only as sources of off-site contamination or for their impact on the community.

Table 3: Exposure Pathways

Pathway	*Source of Contamination*	*Fate and Transport*	*Point of Exposure*	*Route of Exposure*	*Receptor Population*	*Time Frame for Exposure*	*Conclusion for Pathway*
Contacting groundwater from private wells near GSA (OU-1)	GW plume from eastern GSA (drum storage, burial trenches)	Plume has been detected off-site, but has since been reduced to below drinking water standards. Contaminants from Site 300 have never been detected in water supply wells.	Potential use of contaminated groundwater from private wells	Ingestion, dermal contact, inhalation	There are two residential wells down-gradient of this plume	FUTURE	POTENTIALLY COMPLETE
Contacting groundwater from private wells near GSA (OU-1)	GW plume from central GSA (dry wells)	Plume has been detected off-site, but never in groundwater supply wells	Potential use of contaminated groundwater from private wells	Ingestion, dermal contact, inhalation	There are two residential wells down-gradient of this plume	PRESENT, FUTURE	POTENTIALLY COMPLETE
Contacting groundwater from state wells near CSVRA (OU-3)	GW plume from Pit 6 Area (leachate from unlined debris trenches and pits	No evidence of plume above drinking water standards migrating off-site	Potential use of contaminated groundwater from private wells	Ingestion, dermal contact, inhalation	There are two CSVRA water-supply wells located downgradient of the plumes	FUTURE	POTENTIALLY COMPLETE
Contacting contaminated soil around S300	None	No evidence of soil contamination off-site	N/A	N/A	N/A	PAST, PRESENT, FUTURE	INCOMPLETE
Contacting contaminated Surface water or sediment in Corral Hollow Creek	None	No evidence of surface water or sediment contamination off-site	N/A	N/A	N/A	PAST, PRESENT, FUTURE	INCOMPLETE
Contacting contaminated air at site boundary	None	No evidence of air contamination	N/A	N/A	N/A	PAST, PRESENT, FUTURE	INCOMPLETE

Groundwater

Background

CERCLA mandated groundwater investigations and remediation are underway at Site 300. Areas of known or suspected groundwater contamination are monitored regularly to determine whether contamination is present, and if so, to identify the magnitude and source of this contamination.

Remediation strategies for each OU have been developed, evaluated, and approved by regulatory agencies and the community for implementation (LLNL 2002).

Contaminants of Concern

Two VOC plumes exist in the GSA: one in the eastern GSA and one in the central GSA. The plume in the eastern GSA originated in the vicinity of the debris burial trench area. This plume extended eastward and migrated northward into the Corral Hollow alluvium. TCE has infiltrated into the $Tnbs_2$ regional aquifer at a point west of the sewage treatment pond where the $Tnsc_1$ confining layer is absent. However, TCE concentrations in the regional aquifer have been decreasing since treatment commenced in 1991 (LLNL 1997). At the time remediation began at the Eastern GSA, the VOC plume extended over a mile to the northeast along the Corral Hollow stream channel. After 8 years of treatment, by the fall of 1999, the TCE plume (as defined by a 5 µg/L contour line) had been restricted to Site 300 property (LLNL 2002). Figure 5 shows that this contaminated groundwater plume has, indeed, been drawn back on site.

There are three source areas for the central GSA contamination: Building 875 dry well, Building 872 dry well, and Building 873 dry well. But the contamination in groundwater has commingled and is considered one plume with contributions from three source areas(LLNL 1997). The highest groundwater concentrations of TCE (240,000 µg/L), PCE (25,000 µg/L), and 1,2-DCE (1,000 µg/L) occurred south of Building 875 near the former dry wells in a bailed sample taken in March of 1993. If a groundwater VOC concentration is 1 to 10% of that VOCs solubility in water, the VOC may be present in the form of a dense non-aqueous phase liquid (DNAPL). This high concentration (240,000 µg/L) of TCE indicates that it is most likely present as a DNAPL. DNAPLs are denser than water and tend to sink to the lowest point in the aquifer. Boreholes and soil sample data indicate that these DNAPLs are located at a depth of 20–35 feet in the $Tnbs_2$ regional aquifer at the contact point of the $Tnsc_1$ confining layer. Because no other wells in the GSA have shown VOCs in concentrations high enough to indicate the presence of DNAPLs, LLNL concluded that DNAPLs were confined on-site to the Building 875 dry well pad area (LLNL 1997). Public Comment #'s 7(iv), 8, 9 and 10 of the Final Record of Decision for the General Services Operable Unit (LLNL 1997) concerned these DNAPLs, and the potential for them to serve as a continuing source of TCE contamination in the groundwater. LLNL is addressing this concern by employing remediation technologies, namely soil vapor extraction (SVE), to remove DNAPLs from the Building 875 dry wells area. Continued monitoring will also evaluate whether DNAPLs are acting as a constant source of groundwater contamination.

The TCE plume emanating from the central GSA extends approximately 200 feet off site at concentrations approaching 80 µg/L in off-site monitoring wells. Remediation of the plume source is on-going, and the off-site drinking water wells are currently unaffected by the Site 300 contamination.

Groundwater Exposure Pathways

There are currently no residential developments adjacent to Site 300. There are, however, 14 homes (4 are vacant) located on CSVRA property. Although the State of California provides bottled drinking water to all CSVRA residents near Site 300, groundwater is still used in all of these homes for washing, bathing, cleaning, etc. Twelve of the 14 homes are situated along Tesla

Road in Alameda County—upgradient from all confirmed groundwater plumes on Site 300. The other two residences are located on a small tract of land owned by CSVRA that lies on the same side of Corral Hollow Road as Site 300. Wells located in this area also serve as the sole water source for visitors to CSVRA. These homes are downgradient from contaminant plumes originating from the Pit 6 OU (OU-3). These plumes are not predicted to go off-site at levels above the MCLs. The groundwater is filtered and chlorinated to control bacteria before use (Dana Jones, Acting District Director, Carnegie State Vehicle Recreation Area, personal communication, August 26, 2003). There have been no anthropogenic contaminants detected above comparison values at any of the wells on CSVRA property.

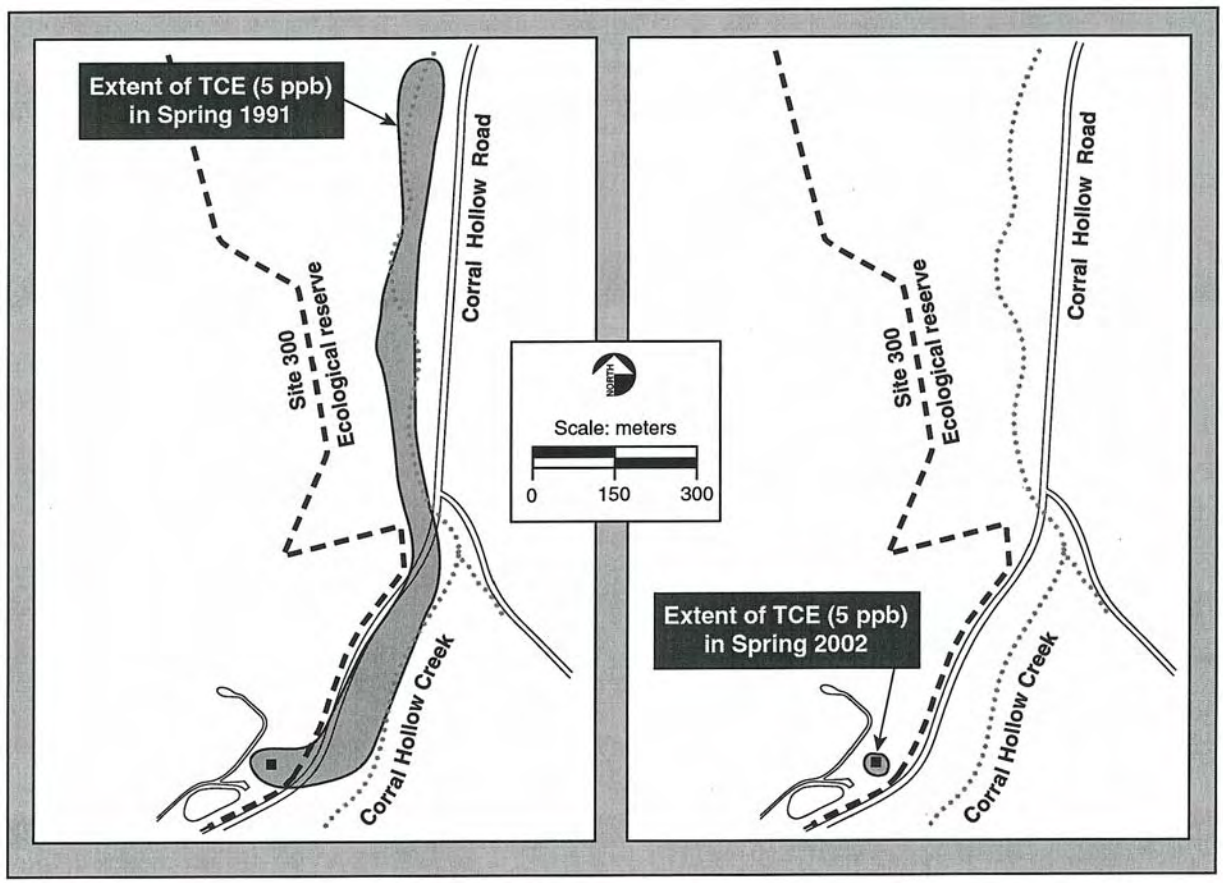
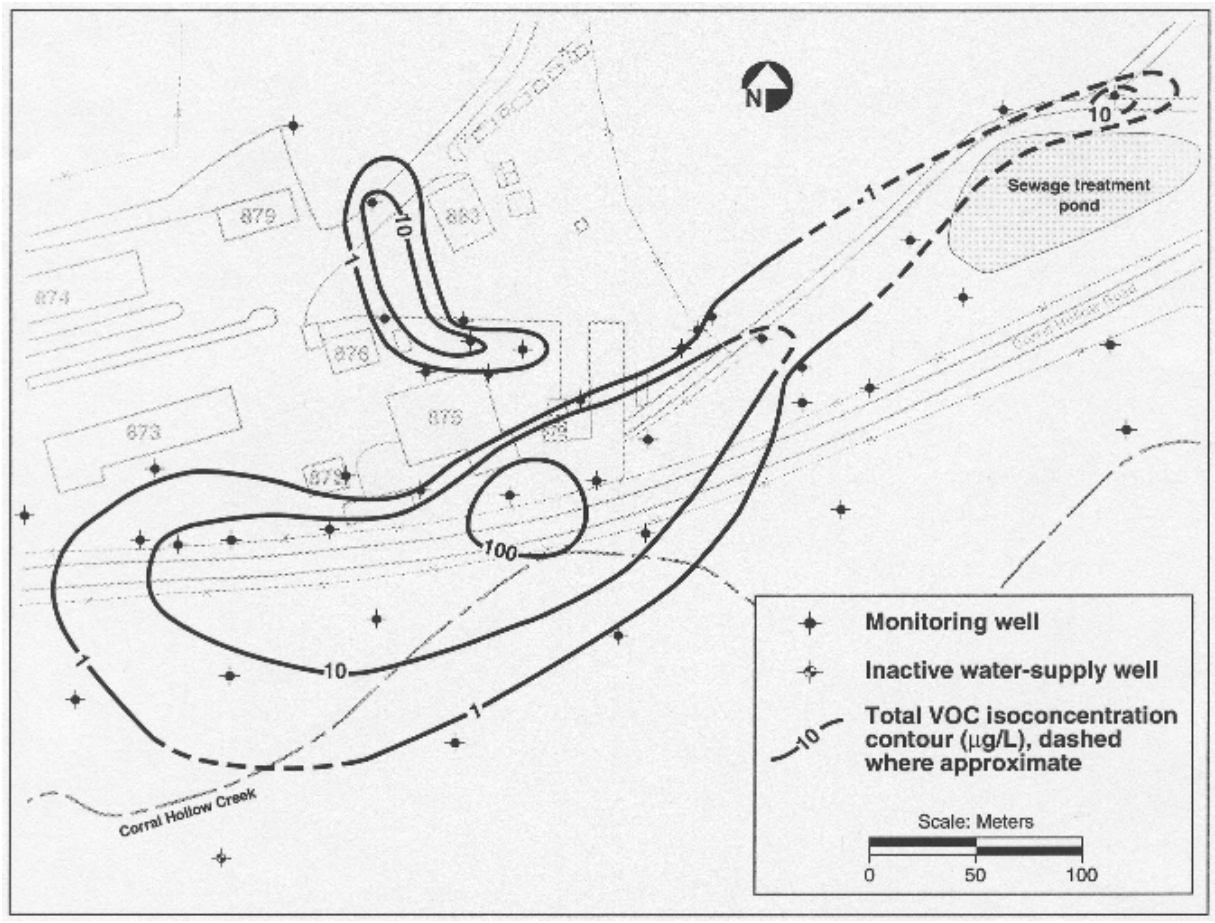


Figure 5: Successful Reduction of the TCE Plume at the GSA of Site 300

Current Exposure

Currently, off-site residents are not being exposed to contaminated groundwater originating from Site 300. Off-site contamination has only occurred in two locations at Site 300; both are in the GSA (OU-1). The eastern GSA plume has been treated to levels below drinking water standards off-site (Figure 5). Figure 6 shows VOC concentrations for the central GSA plume and the proximity of water supply wells. There are no *completed* pathways for current exposures because a *completed* pathway implies that a human is currently being exposed to contaminants from Site 300. No human is currently being exposed to off-site contaminated groundwater from Site 300. Nevertheless, the TCE plume emanating from the central GSA still extends beyond the site boundary (see Figure 6) at levels above drinking water standards. Because of this, ATSDR

Figure 6: Total VOC Concentrations in Groundwater in the Central GSA



scientists have classified current exposure to this plume as *potentially completed* even though the contaminants have not been detected in the downgradient water supply wells (CDF-1 and CON-1).

There are no completed past exposure pathways for contaminated groundwater. No contamination from Site 300 has ever been detected in off-site water supply wells. The town of Tracy, CA, approximately 9 miles to the northeast of Site 300, is hydrologically isolated from any contamination at Site 300. With respect to contaminated groundwater plumes emanating from the Pit 6 OU and the residents of the CSVRA, there has been no evidence of contamination migrating off-site to any of the water-supply wells, monitoring wells, or springs located in the CSVRA residential area. For these reasons, ATSDR scientists conclude that there is no completed past exposure pathway for contaminated groundwater.

Potential Future Exposure

Potential future exposures to both GSA plumes and to the groundwater plume from the Pit 6 OU have been classified as *potentially completed*. However, in light of LLNL's successful remediation thus far, its aggressive treatment strategy for the future, and the continued monitoring of site contaminant plumes, ATSDR scientists have concluded that exposure to Site 300 contaminants in the future is unlikely. Using current data, and provided that no new contaminant source develops and migrates off-site, potential residential developments near Site 300 will be unaffected by contamination originating at Site 300.

The Pit 6 landfill was capped in 1997 to prevent rainwater from infiltrating the landfill and leaching additional contaminants into the groundwater. Contaminated groundwater plumes from the Pit 6 OU are not predicted to migrate off-site (LLNL 2000). ATSDR scientists have concluded that in the future, residents of the CSVRA will not be exposed to contamination from the Pit 6 landfill.

Soil and Sediment

Background

LLNL has been monitoring surface soil near LLNL Site 300 since 1971. Soil sampling is conducted at 14 locations at Site 300 as part of a continuing LLNL monitoring program designed to measure any changes in environmental levels of radioactivity (LLNL 2001). Each of these locations is situated near firing tables and other areas of potential soil contamination. Soil samples were analyzed for gamma-emitting radiation and for beryllium. Plutonium analysis was discontinued for soil samples from Site 300 because since sampling began, plutonium levels have consistently been at background levels (i.e., levels expected from global fallout) (LLNL 2001). Soil and sediment samples are also collected and analyzed for VOCs, HE compounds, uranium, PCBs, metals, tritium, perchlorate, general minerals and nutrients as part of the CERCLA investigations.

There are no perennial streams at or near Site 300; therefore, no sediment sampling locations have been established. Overland flow occurs intermittently and often at relatively high flow rates, as in a storm; therefore sediment does not accumulate. For this reason, LLNL deemed sediment sampling at Site 300 unwarranted.

Contaminants of Concern

Although soil contamination exists on Site 300, particularly around the firing tables in the EFA/WFA and from surface spills throughout the site (see Table 3), there has been no evidence of off-site contaminated soil. Because access to Site 300 is limited, there is no exposure of the public to contaminated soil from Site 300. *There are no contaminants of concern in the off-site soil and sediment.*

Surface Water

Background

As stated, no perennial streams exist on or near Site 300. After heavy rains, surface runoff occurs through ravines, primarily Elk Ravine, and intermittent stream channels. Runoff that does not infiltrate the ground eventually discharges into Corral Hollow Creek. Corral Hollow Creek is an intermittent stream flowing west to east along the southern and southeastern boundaries of Site 300 (LLNL 1999). The impact of stormwater runoff from Site 300 is monitored in Corral Hollow Creek.

Fourteen wetlands have been identified on Site 300 based upon the type of vegetation found there. Ten of these wetlands are located at springs or low-lying areas where the soil is moist

enough to support diagnostic vegetation. The other four wetlands are artificial in that they result from cooling tower discharges or other processes at Site 300.

Contaminants of Concern

No anthropogenic substances have been detected in any off-site springs (LLNL 1994). Two sampling locations have been established along Corral Hollow Creek, one upstream (CARW), that is unaffected by Site 300, and one downstream (GEOCRK). LLNL procedures specify, if possible, sampling two storms per rainy season. Samples from 2001 resulted in gross alpha and gross beta levels (0.31 and 0.96 Bq/L, respectively) at around half of the maximum contaminant levels (MCLs) (0.56 and 1.85 Bq/L, respectively) (LLNL 2002). As part of the eastern GSA treatment facility NPDES permit, Corral Hollow Creek water has also been sampled for a wide variety of chemicals, but no contaminants of concern have been detected. *There are no contaminants of concern in the off-site surface water.*

Air

Background

LLNL evaluates the ambient air to ensure their compliance with local, state and federal laws and regulations. Concentrations of various radionuclides and beryllium are monitored at LLNL Site 300 and various other locations in the city of Tracy and throughout the Livermore Valley. Site 300 air monitoring results indicate levels of radionuclides such as plutonium 239+240, uranium 238, and tritium at levels that are not statistically different than background levels. The median gross alpha and gross beta activities are 6.3×10^{-5} Bq/m^3 (1.7×10^{-15} Ci/m^3) and 5.1×10^{-4} Bq/m^3 (1.4×10^{-14} Ci/m^3), respectively. The primary sources of gross alpha and beta activity are naturally occurring radioisotopes of uranium and thorium (LLNL 2002). Also, since surface soil analyses from Site 300 were negative for elevated (above background) levels of contaminants, it is evident that there has been no appreciable atmospheric transport or deposition of contaminants from on-site explosives testing.

Contaminants of Concern

There are no contaminants of concern in the ambient air at or in the vicinity of Site 300.

Quality Assurance and Quality Control

In preparing this PHA, ATSDR reviewed and evaluated environmental data provided to ATSDR scientists directly from LLNL or in various reports prepared by LLNL and the University of California. Documents prepared for LLNL Site 300 have oversight of the DOE San Francisco Field Office, LLNL, and LLNL contractors. Additional review of the data is provided by EPA Region IX, State of California Department of Toxic Substances Control (DTSC), and the State of California Regional Water Quality Control Board (RWQCB)—Central Valley. These agencies receive summary tables of all quarterly analytical reports received from contract analytical laboratories. ATSDR evaluation included the identification of inconsistencies and data gaps. The validity of analyses and conclusions drawn in this PHA are based on the reliability of the information referenced in reports related to LLNL Site 300. In our assessment, the quality of environmental data available in these documents is sufficient for public health decisions.

Public Health Implications

ATSDR scientists have determined that there are no *completed exposure pathways* for any media around Site 300. The only confirmed contamination to have migrated off site was from two TCE-contaminated groundwater plumes originating in the GSA. Because there are two water supply wells located downgradient from contaminant plumes in the GSA, ATSDR scientists have classified *future* exposures to these plumes as *potentially completed.* LLNL samples these wells monthly. No contamination from Site 300 has been detected in these, or any other, off-site water-supply wells. *Current* exposure to contaminated groundwater from the central GSA has also been classified as *potentially completed* based on the fact that the off-site plume is still above drinking water standards. However, available data shows that the central GSA plume is shrinking. ATSDR scientists have concluded that current and future exposure to these plumes is unlikely. The closest city to Site 300 is Tracy, CA, which is 9 miles to the northeast. The aquifer from which the town of Tracy pumps its water is not hydrologically connected to any of the contaminated aquifers under Site 300. Data from air monitoring around the site has been characterized as in the background range for radioactivity and beryllium. Surface water run-off from Site 300 is only intermittent, and access to the site is restricted. For these reasons, ATSDR scientists have determined that contamination emanating from Site 300 results in no public health implications.

Conclusions

1. Lawrence Livermore National Laboratory – Site 300 poses no public health hazard from currently known site-related contaminants. Such contaminants are subject to an ongoing CERCLA cleanup. It is unlikely that anyone can come into contact with the contaminants identified in surface soil or groundwater.

2. Available environmental data and current land use indicate that no one is exposed, has been exposed, or is about to be exposed to Site 300 contaminants at levels of health concern.

3. While contaminants such as uranium 238, tritium, and perchlorate have been detected in groundwater within the Site 300 boundaries, it is important to point out that none of these contaminants have been detected at levels above background in any off-site media. Because site related contaminants are subject to an ongoing CERCLA cleanup, and access to Site 300 is restricted, it is unlikely that residents of the Tracy area, the Site 300 area, or visitors to the CSVRA will be exposed to these substances.

4. *ATSDR determined that the environmental contamination related to Site 300 presents* ***No Public Health Hazard*** *based on the fact that exposure to contaminants from Site 300 is not occurring now, has not occurred in the past, and is not expected to occur in the future.* "No Public Health Hazard" means that people are not, have not, and are not expected to be exposed to hazardous substances associated with Site 300.

Recommendations

1. Continue the prescribed remedies identified in the Final Record of Decision for the General Services Area Operable Unit (LLNL 1997) and the Interim Site-Wide Record of Decision for Site 300 (LLNL 2001).
2. Continued monitoring of water supply wells (CDF-1 and CON-1) that are located downgradient from the TCE contaminated groundwater plume emanating from the central GSA.

Public Health Action Plan

The Public Health Action Plan for the Lawrence Livermore National Laboratory Site 300 describes the public health actions taken and planned to be taken by ATSDR, DOE, or other agencies at and near the site. The purpose of the Public Health Action Plan is to ensure that this public health assessment not only identifies public health hazards, but also provides a plan of action designed to mitigate and prevent adverse human health effects resulting from exposure to hazardous substances in the environment. The public health actions that are completed, being implemented, or planned are as follows.

Public Health Actions Taken

- DOE currently monitors air, ground and surface water, soil, and biota, as required by regulatory compliance with permitted air and water discharges, and plans on continuing such monitoring for site-specific chemical and radioactive contaminants.
- In consultation with regulatory agencies and the community, remediation strategies have been developed and implemented for all environmental releases at Site 300.

Public Health Actions Planned

- If additional information concerning potential exposures or off-site contaminant concentrations becomes available that potentially changes our public health findings, ATSDR will reevaluate the potential for adverse health effects from LLNL Site 300-specific sources or releases.

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Appendix A: Community Concerns

Groundwater Flow Direction:

Comments:

A citizen was concerned that contaminants from Site 300 could migrate off-site and eventually impact his drinking water wells. These wells are on his ranch, which lies about a mile west of Site 300 along Tesla Road. He wonders how LLNL can be sure that contamination is not migrating in his direction (west) if they do not sample wells in this area.

Another citizen was similarly concerned about whether Site 300 contaminants could reach his private wells located approximately 6 miles northwest of the site. He is concerned that perhaps Site 300 contaminants could have resulted in his wife's breast cancer and the cancer-related deaths of two family pets. This citizen hired a witcher/dowser, who told him that his groundwater emanated from Site 300.

Response:

Please refer to the Site Hydrogeology section of this document, which addresses groundwater flow direction. Groundwater flow has been well documented in the Site Wide Remedial Investigation (LLNL 1994) referenced in this public health assessment. In general, groundwater flow direction dictates where monitoring wells are situated. If your personal wells are not being routinely monitored by LLNL, it is likely because groundwater does not migrate in that direction and your wells are in no danger of contamination from Site 300.

Exposure to Radionuclides:

Comments:

Concern was raised about radionuclide contamination, particularly tritium and uranium-238, at Site 300. This was a general question about whether residents should be concerned about potential exposure to these radionuclides:

> "The toxic and radioactive elements in the soil and groundwater at Site 300 are a health risk to those of us who live in Livermore and Tracy and extremely hazardous to the people who work at Site 300. I am very concerned about contamination to my water supply in Livermore."
>
> "We know radiation has been connected to thyroid problems. My wife, who is a nurse, has never seen data to confirm our rumored impression that there is an unusually high experience of thyroid problems in the East Bay. Please make available the data on thyroid problems for employees and the Bay area."
>
> "[I am] concerned about current and long-term pollution from chemical and radioactive materials, and threats to human life from such pollution. [I

> am] concerned about threats to life on Earth from nuclear weapons development at Lawrence Livermore."

Response:

Site 300 operations have involved the use of several radionuclides including tritium (^{3}H) and uranium (^{234}U, ^{235}U, and ^{238}U). Depleted uranium (^{238}U) was used in certain experiments at Site 300 because it has similar properties and behavior as fissionable materials without the potential risks. Environmental releases of uranium have occurred in the EFA/WFA study area in the vicinity of the firing tables. However, measured activities of ^{234}U and ^{238}U in the EFA/WFA study area are only marginally above background levels. Uranium contamination is confined to the immediate vicinity of the release sites and has never been detected above background levels in any off-site well.

Prior to 1990, tritium (^{3}H) was used in explosives testing in the EFA/WFA study area and was concentrated in the gravels near the firing tables. This gravel was often sprayed, or "washed down" with water to control airborne dust. Eventually, contaminated gravel was disposed of in several pits around the Pit 7 Complex and in the Building 850 sand pile. The washing of the firing tables, and an elevated water table during a particularly heavy period of precipitation in 1982–1983, contributed to the mobilization of tritium into the groundwater. Currently, there are three commingling tritium plumes in the EFA/WFA study area. These plumes extend northeast and southeast along the Doall and Elk Ravines, respectively. Remediation practices, including source elimination, groundwater extraction, and monitored natural attenuation, are currently being utilized to prevent further contamination and to mitigate contaminant migration. Please refer to the Final Proposed Plan for Environmental Cleanup (LLNL 2000) for a detailed description of each of the remedial techniques. A tritium plume emanating from the Pit 6 landfill also exists; however, the measured activities are well below the state and federal drinking water standards. Tritium has not been detected in any off-site monitor or water-supply wells. This PHA concludes that potential past, current, and estimated future off-site exposures to radionuclides are below levels of public health concern.

ATSDR does not have medical records of employees of LLNL or residents of the Bay Area. For worker safety issues, please contact the National Institute of Occupational Safety and Health (NIOSH) and, for local health statistics, contact your local health department.

VOCs in Groundwater:

Comment:

A citizen was generally concerned about the TCE plume that originated at the General Services Area of Site 300:

> "Groundwater a toxic stew and in the past VOCs leaking out of pipes."

Response:

Please see "Groundwater" under the "Environmental Contamination and Pathways Analysis" section of this document.

Two VOC plumes exist in the GSA, one in the eastern GSA and one in the central GSA. The eastern GSA plume has been treated to levels below drinking water standards off-site. Nevertheless, the TCE plume emanating from the central GSA still extends beyond the site boundary at levels above drinking water standards. Remediation of the central GSA plume source is on-going, and the off-site drinking water wells are currently unaffected by the Site 300 contamination. No contamination from Site 300 has ever been detected in off-site water supply wells. In our assessment, current and future exposure to these plumes is unlikely.

Remedial Activities – Funding and Timeframe:

Comments:

Citizens commented:

> "What is being done to keep contaminants from going off-site? Is funding going to be adequate to continue the proposed monitoring programs?"
>
> "I have no immediate concerns; however, I would like to know when the toxic underground water plume will be completely cleaned up. Is there a progress report? Also, to the maximum extent possible, I would like work on radioactive and biologically active materials [to] be done further from major population centers."
>
> "The soil and groundwater contamination that has taken place at Site 300 needs to be cleaned up as soon as possible and should be an issue of the highest priority. The cleanup standards should be maintained or raised, and current timeframes for cleanup should be, if anything accelerated. I am concerned that while everyone talks and plans and re-plans, the contamination continues to exist, spread, and do its damage."
>
> "Finally, the hypocrisy of turning off cleaning equipment claiming that the area is cleaned up, but only because standards are lowered (I understand that's the new plan)."

Response:

LLNL and DOE have identified remedial activities for each of the eight Operable Units at Site 300. The major components include, but are not limited to

1. extracting and treating contaminated groundwater**:**
2. extracting and treating contaminated soil vapor where appropriate,
3. removal of tritium contaminated sand pile at Building 850,
4. implementation of exposure controls for site workers, the public and the environment, and
5. continuing monitoring of Site 300 and the immediate surrounding area.

These practices should not only prevent further releases but should also reduce contaminant concentrations in the environment. Although remedial activities are proposed for 30 years, contamination at many sites is predicted to be cleaned to below MCLs much sooner. For example, as of spring 2002 the TCE plume that once extended for over a mile along the Corral Hollow River basin from the eastern GSA in 1991 has been reduced to below EPA's MCL of 5.0 ppb (see the Groundwater section of this document).

Funding for long-term monitoring will be provided by the federal government and is assumed to be sufficient to meet the monitoring requirements publicly agreed upon by the appropriate regulatory agencies. LLNL Environmental Protection Department publishes a Site Annual Environmental Report (SAER) that is available at: http://www.llnl.gov/saer/. This report highlights the environmental monitoring and compliance effort at LLNL as well as an assessment of the environmental impact of operations at both LLNL and Site 300.

The clean-up standards for groundwater contamination at Site 300 are based on state and federal Maximum Contaminant Levels (MCLs). An MCL is an enforceable standard set by the EPA. This contaminant-specific value is based upon the maximum level of a contaminant in drinking water at which no known or anticipated adverse effect on the health of persons would occur. Additional safety factors are then utilized to make the MCL protective of human health. The MCL for trichloroethylene (TCE, the only contaminant detected off site) was established in 1989 and has not changed since. Active treatment will be completed when groundwater containing contaminant concentrations above MCLs is restored; however, groundwater monitoring will continue (LLNL 2000).

Airborne Contamination and LLNL Conducted Controlled Burns:

Comments:

Citizens expressed concerns about the controlled burns conducted by LLNL Site 300 and the possible effects on an asthma condition. Comments included

> Open-air tests of high explosives carried by winds.
>
> Wild fires or controlled burns carrying contaminated air.

Response:

Concentrations of various radionuclides and of beryllium are monitored at LLNL Main Site, Site 300, and various other locations in the city of Tracy and throughout the Livermore Valley. Air monitoring results from areas around Site 300 indicate that there has been no off-site atmospheric transport of contaminated particles resulting from weapons testing or otherwise. Detailed information concerning the air monitoring performed by LLNL can be found in the SAER referenced above.

Since 1960 LLNL has been conducting controlled burns at Site 300 for wildfire control (LLNL 2004). A Summary Document for Controlled Burning Operations at Site 300, which describes the steps taken to ensure the effectiveness and safety of these operations, has been released by

LLNL. This document is available at http://www-envirinfo.llnl.gov/. This public health assessment only addresses chemical or radiological contaminants from Site 300 operations.

Underground High Explosives (HE) Compounds:

Comment:

> "Is the water supply in danger as a result of explosives being buried underground?"

Response:

There are documented high explosives (HE) compounds releases in the HE Process Area. These releases are from either surface spillage or infiltration of HE rinsewater from disposal lagoons. The HE plume is localized and has not migrated to the site boundary. HE compounds have never been detected in monitor or water-supply wells outside of the Site 300 boundary. There is no evidence of environmental contamination from buried explosives or ordinance of any kind. Furthermore, no contaminants from Site 300 of any kind have ever been detected in off-site water supply wells.

Miscellaneous Comments:

Comments:

Concerns were also raised about the following topics:

1. whether testing is currently being done outdoors or in chambers,
2. are these chambers set up properly to ensure worker safety, and
3. does the ordinance stored at Site 300 make the site a potential terrorist target.

Response:

The purpose of this public health assessment is to determine whether people are being exposed to hazardous substances and, if so, whether that exposure is harmful and should be stopped or reduced. Therefore, ATSDR cannot address the above concerns as they do not directly relate to the public's potential exposure to environmental contaminants from Site 300. **Site**-specific questions should be directed to LLNL, DOE or the University of California at Berkeley. Worker safety issues should be directed to the National Institute for Occupational Safety and Health (NIOSH) or to the Occupational Safety and Health Administration (OSHA). Terrorism-related issues should be directed to the Department of Homeland Security.

Comment:

> "How can any National Laboratory preparing instruments of war not have a deleterious influence on its community? If toxics are not spread physically, the notion of preparing for destruction of others is, in itself, toxic to mental and emotional health. My years spent in Berkeley (CA), I was aware that all responses to fear such as Lawrence Livermore Lab and

its professionals make citizens less able to create an international community of good will and peace."

Response:

No response is necessary.

Appendix B: Public Comments

The Lawrence Livermore National Laboratory Site 300 Public Health Assessment was released for public comment from June 22, 2004 to August 27, 2004. ATSDR would like thank those that took the time to comment. This appendix includes a list of the comments received and our responses to each.

Comment:

The City of Tracy is only 2 miles from Site 300, not 9 miles as is stated in the Public Health Assessment (PHA).

Response:

While it is true that the border of the City of Tracy is approximately 2 miles from the border of Site 300, the distance used in this PHA of 9 miles is from Site 300 to the City center. This is a figure that has been commonly used in the past by LLNL, EPA and the State of California in various reports and figures. Thank you for pointing out this bit of confusion. A clarifying statement has been added to this document in the appropriate places to eliminate this confusion.

Comment:

The PHA relies solely on LLNL data and does not do its own independent sampling.

ATSDR must sample soil, air and water in locations between the monitors set up by LLNL.

The PHA fails to analyze uncharacterized contamination in many areas of Site 300, including the Sandia Test Site, Building 812 firing tables, and Building 865.

Response:

It is important to understand the purpose and limitations of a Public Health Assessment and of the ATSDR in general. As stated in the inside front cover of this document, ATSDR has collected data from all available sources in preparing this document. This document represents the Agency's best efforts, based on currently available data, to fulfill the statutory requirements outlined in CERCLA. ATSDR does not conduct sampling at a site, but can recommend that additional data be collected to fill any data gaps that may become apparent throughout the public health assessment process. With respect to the "uncharacterized" areas of Site 300, including the Sandia Test Site, Building 812 firing tables and Building 865, characterization is either on-going or planned (DOE 2004). This PHA can only assess currently available data.

If additional information concerning potential exposures or off-site contaminant concentrations becomes available that potentially changes our public health findings, ATSDR will reevaluate the potential for adverse health effects from LLNL Site 300-specific sources or releases.

Comment:

The PHA does not consider current health data in the Tracy community. There are many cancer victims in and around Tracy. Tracy has an elevated inhalation cancer risk that is three times the California State average.

Response:

The public health assessment process involves two primary scientific evaluations – the exposure evaluation and the health effects evaluation. The exposure evaluation is always performed first to determine how much contamination is at a site, where it is, and how people might come into contact with it. If a *completed exposure pathway* exists, a further, more in-depth analysis will be performed, often including a health effects evaluation. If the exposure evaluation concludes that people have or could have been exposed to site-related hazardous substances, ATSDR scientists will determine whether these exposures may result in harmful effects. Data collected in the health effects evaluation can include results of medical, toxicological and epidemiological studies and data collected in disease registries.

At Site 300, ATSDR scientists determined that there were no *completed exposure pathways*. This simply means that, based on currently available data, no one has been or is currently being exposed to contaminants related to Site 300 activities. Since exposure has not occurred, pursuing an in-depth investigation of health data of residents in the Tracy community is unnecessary.

Comment:

LLNL has recently proposed a new cleanup plan – the Risk Based End States Vision – that proposes to lower cleanup standards and limits on-site cleanup.

Response:

See the Response to the Comments under the Remedial Activities – Funding and Timeframe section of Appendix A.

The Risk Based End States Vision is a proposal for clean-up activities at Site 300 that are based upon and driven by human and ecological risk receptors. It describes projected site conditions 20 years into the future and assumes that current remediation strategies already in place have worked effectively over this time period. This means that off-site contamination will have been reduced to levels that allow unrestricted use of groundwater, and on-site contamination will have been reduced to a level that prevents further contaminated groundwater migration off-site. Once

this level of remediation has been achieved, all further groundwater contamination on-site would be addressed by monitored natural attenuation (DOE 2003). It is important to understand that the EPA National Primary Drinking Water Standard of 5 ppb for TCE – the only contaminant ever detected off-site – will remain unchanged.

Comment:

The report assumes that the current cleanup activities will continue for the foreseeable future and at present levels. Every year the community is forced to lobby the DOE just to get the necessary funding to continue ongoing cleanup efforts. At the present time it seems unlikely that even the current cleanup activities will continue.

Response:

See the Response to the Comments under the Remedial Activities – Funding and Timeframe section of Appendix A.

Comment:

In recent years, the Site has not received much rainfall. There is agreement among the experts that in wet years the water table rises and the unlined waste pits become saturated. The contamination is then spread into the surrounding groundwater and soils. The last few relatively dry years have not allowed the plumes to migrate; therefore current data is skewed due to limited contaminant releases in the last several years. Rainfall totals have been recorded as high as 32 inches at Site 300 but the average rainfall for the last six years has been 10.4 inches. (Draft Site Wide Environmental Impact Statement, DOE 2004).

Response:

Pursuant to the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), and under the oversight of the EPA, the California RWQCB, and the California Department of Toxic Substances Control, LLNL has conducted environmental sampling and investigations of chemical and radiological contamination both on and off-site areas of Site 300 since 1981. These data are extensive and span times of drought as well as times of heavy rainfall. The maximum annual rainfall at Site 300 was recorded in 1982-83 when the site received 20.09 inches – the City of Livermore experienced 32.37 inches during this time period (LLNL 1994, DOE 2004). The average annual rainfall at Site 300 is 10.09 inches, based on data from 1965-1992 collected from the Site 300 weather station. Therefore, the average rainfall for the last 6 years, as reported in the Draft Site-Wide Environmental Impact Statement (DOE 2004), of 10.4 inches is only slightly (0.31 inches) above the historical average for Site 300.

Comment:

The City of Tracy's groundwater wells are below Site 300 and the City has increased its groundwater pumping from 6000 AFY to 9000 AFY in the last year which may have an effect upon future plume migration.

This PHA fails to analyze the increased probability of exposure to contaminated groundwater due to the Tracy Hills Development.

Response:

The City of Tracy pumps drinking water from aquifers in the San Joaquin Valley. These aquifers are not hydrologically connected to any aquifer that underlies Site 300. Groundwater contamination at Site 300 only extends off-site at the Central GSA. This contamination extends approximately 200ft off-site and is being aggressively remediated to below drinking water standards. However, groundwater modeling suggests that neither this plume nor any other contaminated groundwater plume associated with Site 300 will come in contact with the groundwater used in the City of Tracy. Furthermore, the proposed Tracy Hills Residential area will also be connected with the City of Tracy's public water system and will, consequently, be unaffected by groundwater emanating from Site 300.

Comment:

The PHA does not consider radiological and non-radiological exposure to the community from controlled burns.

The PHA does not consider PM-10 and PM-2.5 particles that may result from current and planned construction activities.

LLNL air monitoring program is inadequate.

Controlled burns will be a nuisance to Tracy Hills residents and could contain radiological elements from uncharacterized areas of Site 300.

Response:

See the Response to the Comments under the Airborne Contamination and LLNL Conducted Controlled Burns section of Appendix A.

Appendix C: Demographic Data

Table C-1: Demographic Data for Alameda and San Joaquin Counties and the State of California (Source: US Census 2000)

People QuickFacts	*Alameda County*	*San Joaquin County*	*California*
Population, 2001 estimate	1,458,420	595,324	34,501,130
Population percent change, April 1, 2000-July 1, 2001	1.0%	5.6%	1.9%
Population, 2000	1,443,741	563,598	33,871,648
Population, percent change, 1990 to 2000	10.7%	17.3%	13.6%
Persons under 5 years old, percent, 2000	6.8%	8.0%	7.3%
Persons under 18 years old, percent, 2000	24.6%	31.0%	27.3%
Persons 65 years old and over, percent, 2000	10.2%	10.6%	10.6%
Female persons, percent, 2000	50.9%	50.0%	50.2%
White persons, percent, 2000 (a)	48.8%	58.1%	59.5%
Black or African American persons, percent, 2000 (a)	14.9%	6.7%	6.7%
American Indian and Alaska Native persons, percent, 2000 (a)	0.6%	1.1%	1.0%
Asian persons, percent, 2000 (a)	20.4%	11.4%	10.9%
Native Hawaiian and Other Pacific Islander, percent, 2000 (a)	0.6%	0.3%	0.3%
Persons reporting some other race, percent, 2000 (a)	8.9%	16.3%	16.8%
Persons reporting two or more races, percent, 2000	5.6%	6.0%	4.7%
Persons of Hispanic or Latino origin, percent, 2000 (b)	19.0%	30.5%	32.4%
White persons, not of Hispanic/Latino origin, percent, 2000	40.9%	47.4%	46.7%
Living in same house in 1995 and 2000, pct age 5+, 2000	50.8%	51.2%	50.2%

People QuickFacts	*Alameda County*	*San Joaquin County*	*California*
Foreign born persons, percent, 2000	27.2%	19.5%	26.2%
Language other than English spoken at home, pct age 5+, 2000	36.8%	33.7%	39.5%
High school graduates, percent of persons age 25+, 2000	82.4%	71.2%	76.8%
Bachelor's degree or higher, pct of persons age 25+, 2000	34.9%	14.5%	26.6%
Persons with a disability, age 5+, 2000	248,558	108,656	5,923,361
Mean travel time to work, workers age 16+ (minutes), 2000	30.8	29.2	27.7
Housing units, 2000	540,183	189,160	12,214,549
Homeownership rate, 2000	54.7%	60.4%	56.9%
Housing units in multi-unit structures, percent, 2000	37.6%	20.9%	31.4%
Median value of owner-occupied housing units, 2000	$303,100	$142,400	$211,500
Households, 2000	523,366	181,629	11,502,870
Persons per household, 2000	2.71	3	2.87
Median household money income, 1999	$55,946	$41,282	$47,493
Per capita money income, 1999	$26,680	$17,365	$22,711
Persons below poverty, percent, 1999	11.0%	17.7%	14.2%

Business QuickFacts	*Alameda County*	*San Joaquin County*	*California*
Private nonfarm establishments, 1999	35,707	9,980	784,935
Private nonfarm employment, 1999	613,225	147,642	12,356,363
Private nonfarm employment, percent change 1990-1999	21.3%	15.7%	9.2%
Nonemployer establishments, 1999	84,464	21,657	2,050,809
Manufacturers shipments, 1997 ($1000)	22,337,780	5,879,062	379,612,443
Retail sales, 1997 ($1000)	12,404,947	3,679,557	263,118,346
Retail sales per capita, 1997	$9,040	$6,814	$8,167
Minority-owned firms, percent of total, 1997	33.0%	27.6%	28.8%
Women-owned firms, percent of total, 1997	31.8%	26.2%	27.3%
Housing units authorized by building permits, 2000	4,054	5,392	145,575
Federal funds and grants, 2001 ($1000)	9,123,631	2,439,408	188,516,866
Local government employment - full-time equivalent, 1997	59,236	22,168	1,194,169

Geography QuickFacts	*Alameda County*	*San Joaquin County*	*California*
Land area, 2000 (square miles)	738	1,399	155,959
Persons per square mile, 2000	1,957.4	402.8	217.2
Metropolitan Area	Oakland, CA PMSA	Stockton-Lodi, CA MSA	

(a) Includes persons reporting only one race.

(b) Hispanics may be of any race, so also are included in applicable race categories.

FN: Footnote on this item for this area in place of data

NA: Not available

D: Suppressed to avoid disclosure of confidential information

X: Not applicable

S: Suppressed; does not meet publication standards

Z: Value greater than zero but less than half unit of measure shown

F: Fewer than 100 firms

Source: US Census Bureau State & County QuickFacts

Appendix D: Contaminant Releases

Table D-1: Contaminant Releases at Site 300 by Operable Unit

Location	*Contaminant Source*	*Contaminant*	*Media Contaminated*	*Off-Site?*
OU-1: GSA Operable Unit				
Eastern GSA	Leaching from disposal trenches	VOCs	Subsurface soil/rock, groundwater	**Yes** (groundwater)
Central GSA	Dry well discharges, drum rack spills, surface spills, bldg washdowns	VOCs	Soil, soil vapor, groundwater	**Yes** (groundwater)
OU-2: Building 834 Operable Unit				
Bldg 834 Complex	Approx. 550 gal released via: surface spillage, pump leakage, discharge from septic system, building wash-down discharges	VOCs, nitrate, silicone oil	Subsurface soil/rock, groundwater	No
OU-3: Pit 6 Operable Unit				
Pit 6	Leaching from land fill	VOCs, tritium, nitrate, perchlorate	Subsurface soil/rock, springs, groundwater	No

Location	*Contaminant Source*	*Contaminant*	*Media Contaminated*	*Off-Site?*
OU-4: HE Process Area Operable Unit				
Bldg 806/807	Infiltration from disposal lagoons and dry wells	HE compounds, nitrate, VOCs	Soil, groundwater	No
Bldg 810	Infiltration from dry wells	HE, compounds, nitrate, perchlorate, VOCs	Soil	No
Bldg 814	Infiltration from HE rinsewater disposal lagoon, building washdowns	HE compounds, VOCs	Soil, groundwater	No
Bldg 815	Surface spillage	VOCs, HE compounds, diesel fuel	Subsurface soil/rock, groundwater	No
Bldg 817	Infiltration from washdowns and disposal lagoons	HE compounds, nitrate, perchlorate	Soil, groundwater (HE only)	No
Bldg 825/826	Infiltration from HE rinsewater disposal lagoons	HE compounds, nitrate, perchlorate	Soil, groundwater	No
Bldg 827 Complex	Surface discharges, infiltration from HE rinsewater disposal lagoons, dry wells, possible	HE compounds, nitrate, perchlorate	Soil, groundwater	No

Location	*Contaminant Source*	*Contaminant*	*Media Contaminated*	*Off-Site?*
	septic system release			
Bldg 828	Infiltration from HE rinsewater disposal lagoon	HE compounds, nitrate, perchlorate	Soil, groundwater	No
Bldg 829	Surface spillage, leaching from surface soil by rainfall infiltration	HE compounds, VOCs, trace metals	Soil, groundwater	No
OU-5: Building 850/Pit 3 & 5 Operable Unit				
Pit 7 Complex subarea (pits 3, 4, 5, and 7)	Leaching from landfills: TCE-pit 5, tritium-pits 3 & 5	Tritium, ^{238}U, TCE, nitrate, perchlorate	Surface soil, subsurface soil/rock, groundwater	No
Bldg 850	Leaching from firing table gravel, subsoil, sand piles and fills constructed from firing table gravels	Tritium, ^{238}U, Cd, Cu, Be, Pb, PCBs, dioxins, furans, HMX	Subsurface soil/rock, groundwater, surface water	No
OU-6: Building 854 Operable Unit				
Bldg 854-Dynamic Test Complex	Drain outfall discharges, building washdowns, surface spillage	VOCs, nitrate, perchlorate, HMX, Pb, Zn	Surface soil, subsurface soil/rock, groundwater	No
OU-7: Building 832 Canyon				

Location	*Contaminant Source*	*Contaminant*	*Media Contaminated*	*Off-Site?*
Operable Unit				
Bldg 830/spring 3	Possible surface spillage	VOCs, nitrate, perchlorate	Surface soil, subsurface soil/rock, groundwater	No
Bldg 832	Pump leakage, possible surface spillage, building wash-down discharges	TCE, VOCs	Subsurface soil/rock, groundwater	No
OU-8: Site 300 Operable Unit				
Building 801 Dry Well/Pit 8	Leaching from firing table gravel	VOCs, nitrate, perchlorate, Cd, Cu, Be	Subsurface soil/rock, groundwater	No
Building 812 Firing Table	Leaching/washdown of firing table gravel, dry well infiltration, depleted U disposal	^{238}U, Pb, Cu, acid rinsewater, tritium, TCE, VOCs	Soil, shallow rock, possible groundwater	No
Building 833	Surface spillage, infiltration from disposal lagoon, discharge from septic system and settling basin, leaching from small earthen disposal pits	HMX, ^{238}U	Subsurface soil/rock, ephemeral groundwater, soil vapor	No
	Dispersal of firing table debris	VOCs, uranium, HE,	Surface soil,	No

Location	*Contaminant Source*	*Contaminant*	*Media Contaminated*	*Off-Site?*
Building 845/Pit 9 Landfill		Cd, Cu, Zn	subsurface soil/ rock, groundwater	
Building 851 Firing Table	Dispersal of firing table debris	Freon 113	Groundwater	No