Proposed Plan for Environmental Cleanup at Lawrence Livermore National Laboratory Site 300

Fact sheet version. A technical and expanded version of the Proposed Plan is available.

UCRL-TB-136376

United States Department of Energy • Oakland Operations Office • May 2000

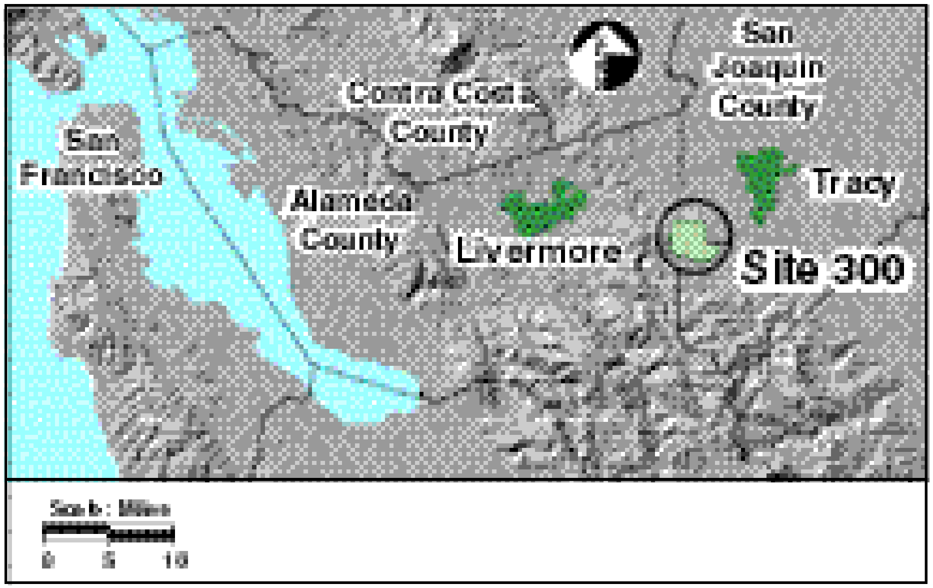


Figure 1. Location of LLNL Site 300.

The United States Department of Energy (DOE) presents this Proposed Plan for sitewide interim environmental cleanup actions at Lawrence Livermore National Laboratory (LLNL) Site 300 for public review and comment. DOE is the responsible party and lead agency for environmental investigations and cleanup for Site 300.

This Proposed Plan summarizes DOE's preferred interim cleanup actions for areas at Site 300 where contaminants were released. It includes information previously presented in numerous site investigation reports and the Site-Wide Feasibility Study (SWFS) for Site 300. It meets the reporting requirements of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA, or Superfund).

This is the fact sheet version of DOE's Proposed Plan. A more detailed technical version is available at the Information Repositories and on the LLNL website (see page 12). Both versions are intended to aid the public in commenting on DOE's proposed interim cleanup plans.

DOE encourages members of the local community and other concerned citizens to review and comment on the alternatives before an interim cleanup strategy is selected and approved. These comments will be considered when DOE selects the interim remedies to be performed at Site 300.

Following the public comment period, DOE will select a cleanup plan and describe it in a document called the Interim Record of Decision, which will be submitted to the regulatory agencies for approval. Public comments on the Proposed Plan will be addressed in a Responsiveness Summary, which will be included in the Interim Record of Decision. The Interim Record of Decision is scheduled to be finalized in December 2000. This Record of Decision will be considered interim because: (1) additional testing and evaluation of cleanup

How do I participate in the process?

DOE invites the public to attend a meeting at 6 p.m. on May 4, 2000 in the Tracy Community Center, 300 East 10th Street, Tracy, CA. Representatives from DOE, LLNL, U.S. EPA, and the state of California will discuss the proposed interim cleanup plan and answer questions during the meeting.

A30-day public review and comment period on this document begins on April 20 and ends on May 20, 2000. All interested members of the public are encouraged to review and comment on the proposed interim preferred remedies, and on all alternatives DOE considered. You can submit your comments verbally at the public meeting or in writing. Written comments should be received by May 22, 2000 by:

Roy Kearns
Site 300 Remedial Project Manager
Livermore Environmental Programs Division
DOE/OAK Operations Office
P.O. Box 808, L574
Lawrence Livermore National Laboratory
Livermore, CA 94551 (925) 422-1168

technologies is still taking place, (2) final cleanup standards are being negotiated, and (3) some areas of Site 300 still need to be investigated.

Significant or fundamental changes to the remedies will be supported and documented in an Explanation of Significant Differences or Record of Decision amendment, respectively. A Final Record of Decision, which will set final cleanup standards, will be submitted in 2007. The interim remedies selected are intended to be consistent with the final remedies, although the ultimate decision will be made in the Final Record of Decision. DOE has agreed that ground water cleanup standards will be no higher than drinking water standards during the interim cleanup.

Cleanup actions will be selected in consultation with the U.S. Environmental Protection Agency (EPA), the California Department of Toxic Substances Control, and the California Regional Water Quality Control Board.

Site 300 contains a number of contaminated areas, and the preferred cleanup strategy varies. In this fact sheet, DOE describes possible cleanup technologies, identifies alternatives, and explains the rationale for choosing the preferred remedies.

DOE intends that the interim and final cleanup plans will protect human health and restore the environment at Site 300 in a responsible, cost-effective manner.

Site background

LLNL Site 300 is a DOE facility operated by the University of California, and is located in the Altamont Hills approximately 17 miles east of Livermore and 8 miles southwest of Tracy (Figure 1). The site covers 11 square miles, most of which is in San Joaquin County. The western part of the site is in Alameda County.

Site 300 is primarily an experimental test facility that conducts research, development, and testing of high explosive materials. Access to Site 300 is restricted. Nuclear weapons have never been tested at Site 300, although non-fissionable radioactive materials may be included in explosive components that are tested during firing table activities.

Experiments began at Site 300 in 1955. In the course of operations at the site, a number of contaminants were released to the environment. These releases primarily occurred from surface spills, leaching from unlined landfills and pits, high explosive test detonations, and past disposal of waste fluids in lagoons and dry wells (sumps).

DOE began conducting environmental restoration at Site 300 in 1981. Prior to 1990, investigations of environmental contamination at Site 300 were conducted under the oversight of the California Regional Water Quality Control Board. In 1990, the U.S. EPAplaced Site 300 on the National Priorities List (Superfund). Since then, all investigation and cleanup activities have been conducted under regulations administered by the U.S. EPA and the state of California.

What contaminants are present, and where are they?

Environmental investigations have found 23 locations where contaminants were released to the environment. These release sites are shown on Figure 2.

The primary contaminants at Site 300 include trichloroethylene (TCE) and other volatile organic compounds (VOCs), high explosive (HE) compounds, perchlorate, tritium, uranium, nitrate, polychlorinated biphenyls (PCBs), silicone-based oil (TBOS/TKEBS), and metals. In some cases, ground water contamination has resulted from these releases, as shown on Figure 3.

All release sites at Site 300 have been assigned to one of eight operable units (OUs) to more effectively address cleanup (Figure 2). Operable units are a way to divide a large, complicated site into manageable projects. The eight OUs are briefly described below.

General Services Area (OU 1)

Past disposal of degreasing solvents caused VOC contamination in the subsurface. A Record of Decision for this operable unit was signed in 1997, and ground water and soil cleanup is underway. Since the cleanup strategy has been decided for this OU, it is not discussed further in the Proposed Plan.

Building 834 (OU 2)

Past TCE spills have resulted in soil and ground water contamination. Silicone-based lubricating oil (TBOS/TKEBS) is also present in ground water. Some TCE-contaminated soil was removed in 1983. An Interim Record of Decision was signed in 1995, and ground water and soil cleanup is underway. Innovative cleanup technologies are also being tested at Building 834.

Pit 6 Landfill (OU 3)

From 1964 to 1973, waste was buried in nine unlined debris trenches and animal pits at the Pit 6 Landfill. The waste included laboratory equipment, craft shop debris, and biomedical waste. VOCs, tritium, perchlorate, and

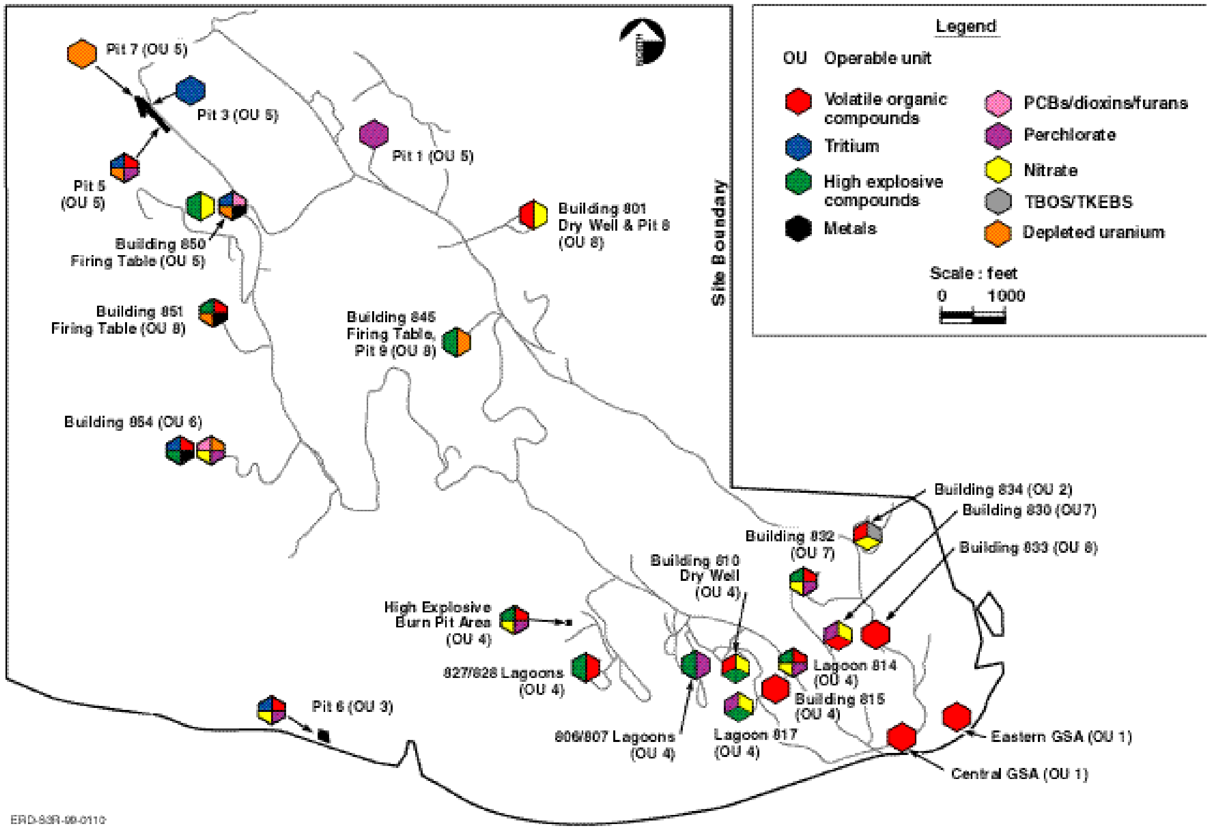


Figure 2. Contaminant release sites.

nitrate are found in ground water near the landfill. DOE excavated the portion of the waste containing depleted uranium in 1971. An impermeable cover system (cap) was placed over the landfill in 1997 to prevent infiltrating rain water from causing further leaching of contaminants from the buried waste.

HE Process Area (OU 4)

Spills occurred at the former Building 815 steam plant, where TCE was once used to clean pipelines. This resulted in soil contamination and a large plume of TCE in ground water. High explosives, nitrate, and perchlorate have also been found in the soil and ground water as a result of wastewater discharges to unlined lagoons, which were closed in 1989. Ground water extraction and treatment is underway to prevent TCE in ground water from Building 815 from moving offsite. Similar contaminants were also found in ground water near the former High Explosives Burn Pits, which were capped in 1998.

Building 850/Pits 3 & 5 (OU 5)

Tritium, uranium, high explosives, metals, PCBs, dioxins, and furans were found near the Building 850 firing table. PCB-contaminated shrapnel from explosive experiments around the firing table was removed in 1998. A sand pile contaminated with tritium is located on the edge of the firing table.

The nearby Pit 2 Landfill operated from 1956 to 1960 and contains firing table waste from Buildings 801 and 802. There is no evidence of contaminant releases from Pit 2.

From 1958 to 1988, a large volume of gravel and debris were generated by high-explosive firing table operations and placed in four unlined landfills at the Pit 7 Complex (Pits 3, 4, 5, and 7). Uranium and tritium have been, and continue to be released from the Complex. These releases cause ongoing contamination of the ground water. Several remedial alternatives for the Complex were presented in the Site-Wide Feasibility Study, but DOE and the regulatory agencies have agreed that additional site characterization and evaluation of cleanup options is required prior to selecting a remedy. Significant remaining issues include:

1. DOE is continuing to investigate the amount and distribution of tritium and uranium sources in the landfill waste. It is essential to characterize the main contaminant sources in the landfills before modeling can be performed or potential remedies evaluated.
2. The magnitude and extent of uranium contamination in ground water resulting from DOE activities relative to natural sources of uranium is still being determined.

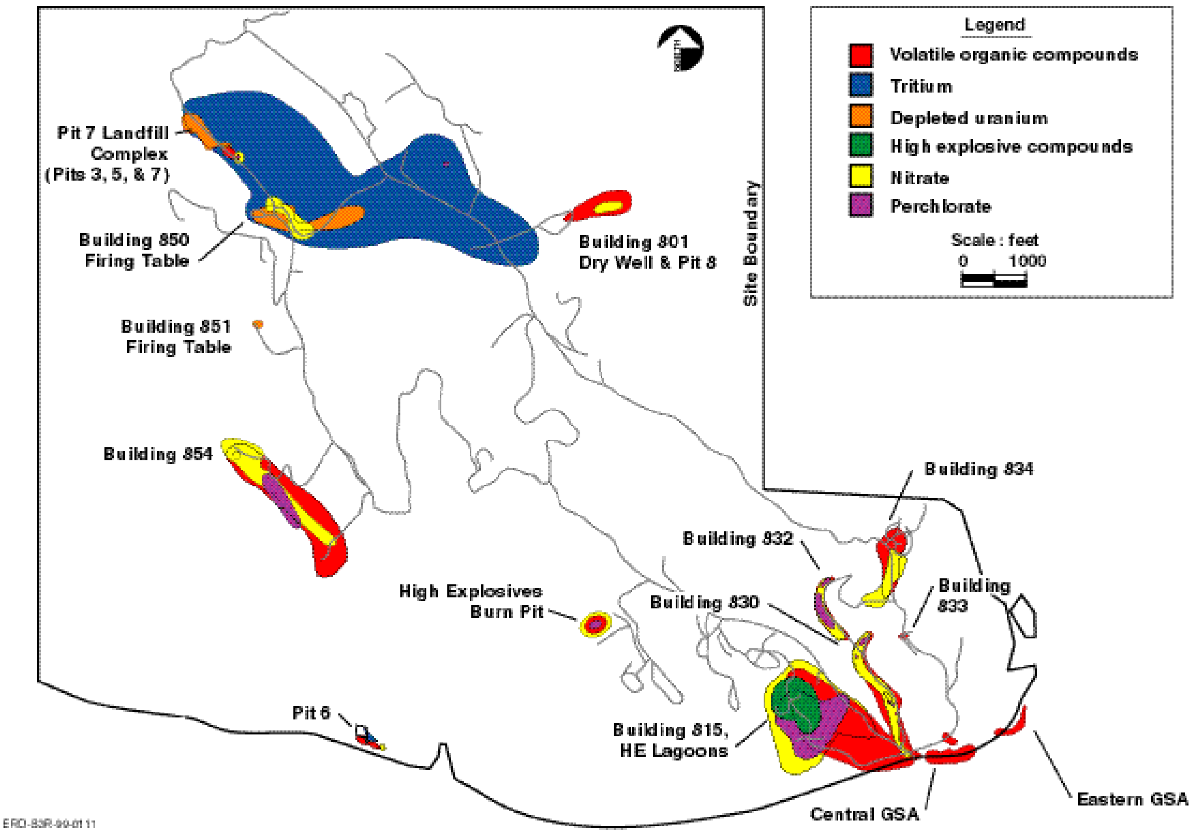


Figure 3. Extent of ground water contamination.

3. The implementability and permanence of permeable reactive barriers, *in situ* stabilization, freezing, or any other source control technologies other than excavation and/or capping have not been fully evaluated.

The regulatory agencies agree that the DOE should address the Complex separately, and not include a preferred remedy in the Proposed Plan. Proposed future activities include:

1. Continued characterization of the landfill waste,
2. Further investigations into the fate and transport of contaminants,
3. Modeling to predict the future extent of the tritium and uranium plumes without source control, and
4. Large and small scale treatability studies to evaluate remedial technologies.

The information obtained during these investigations will be included in a focused, area-specific Remedial Investigation/Feasibility Study (RI/FS) for the Pit 7 Complex. The feasibility study portion of this document will evaluate a wider range of technologies than were presented in the Site-Wide Feasibility Study. Following the focused RI/FS, a preferred remedy will be presented in a Pit 7 Complex Proposed Plan and at a public meeting. DOE will prepare an Interim Record of Decision for the Pit 7 Complex, which will be incorporated as an amendment to the Interim Site-Wide Record of Decision. The public will be encouraged to participate throughout the remedy selection process. A document and milestone schedule for the Pit 7 Complex will be determined with the regulatory agencies. The DOE believes that considering additional remediation alternatives for the Pit 7 Complex will result in the selection of a permanent, cost-effective solution while remediation activities continue at other Operable Units at Site 300.

Building 854 (OU 6)

TCE was used at Building 854 as a heat-exchange fluid, and is found in soil and ground water. Other contaminants at Building 854 include nitrate, perchlorate, tritium, PCBs, metals, and high explosives. Some of the TCE-contaminated soil was excavated in 1983. A treatability study to evaluate ground water extraction is underway.

Building 832 Canyon (OU 7)

VOCs, nitrate, high explosives, and perchlorate have been found in soil and ground water at Buildings 830 and 832. A treatability study is underway to see if ground water and soil vapor extraction will be effective for the VOCs.

Four subareas are combined into OU 8:

Building 801 and the Pit 8 Landfill

The Building 801 firing table was used for explosives testing, and operations resulted in contamination of adjacent soil with metals and uranium. No contaminants were found in ground water. Use of this firing table was discontinued in 1998, and the firing table gravel and some underlying soil were removed. Waste fluid discharges to the Building 801 dry well resulted in low concentrations of VOCs in soil and ground water. The dry well was decommissioned and filled with concrete in 1984.

Debris from the firing table was buried in the nearby Pit 8 Landfill until 1974, but there is no evidence of releases from Pit 8.

Building 833

TCE was used as a heat-exchange fluid at Building 833. Surface discharge of waste fluids caused contamination of soil and ground water.

Building 845 and the Pit 9 Landfill

The Building 845 firing table was used until 1963 to conduct explosives experiments. As a result, the soil is contaminated with uranium and high explosives.

Debris generated at the Building 845 firing table was buried in the Pit 9 Landfill, but no evidence of releases from the landfill has been found.

Building 851 Firing Table

This active firing table is used to conduct experimental high explosives research. These experiments have resulted in soil contamination by uranium, high explosives, metals, and VOCs, and uranium contamination in ground water.

What are the main contaminants at Site 300?

1. Volatile Organic Compounds (VOCs) were used as degreasing solvents and as a heat-exchange fluid in experiments. VOCs were released by spills and piping leaks. Trichloroethylene (TCE) is the most common VOC found at Site 300. Many VOCs are suspected human carcinogens if inhaled or ingested.
2. High Explosive (HE) compounds (primarily HMX and RDX) are formulated and tested at Site 300. These compounds were present in rinse water that was once placed in unlined ponds. RDX is a suspected human carcinogen if inhaled or ingested. HMX is toxic, but is not a human carcinogen.
3. Perchlorate is also used in high explosives. It is toxic if ingested, but is not a carcinogen.
4. Nitrate is: (1) a byproduct of the natural breakdown of HE compounds, (2) found in septic system drainage, and (3) present naturally in the bedrock at Site 300. Nitrate is not toxic to adults, but can cause health problems in infants. It is not carcinogenic.
5. Tritium is a weakly radioactive form of hydrogen used to enhance the yield of nuclear weapons. Although nuclear weapon testing has never been performed at Site 300, tritium was used in some of the high explosive experiments. Tritium was released during these detonations, and tritium-contaminated firing table debris was placed in unlined landfills and has leached into the ground water. Tritium naturally decays with a half-life of 12.3 years, and is a human carcinogen if inhaled or ingested.
6. Depleted uranium is natural uranium with the more radioactive uranium-235 isotope extracted leaving the less radioactive uranium-238 isotope. Depleted uranium was released during explosive tests and from unlined landfills. The half-life of uranium-238 is 4.5 billion years. Uranium is a human carcinogen if inhaled or ingested.
7. Polychlorinated biphenyls (PCBs) were contained in some of the equipment used for high explosive tests. The equipment was destroyed in the detonations, and PCBs were found in the surrounding soil. PCBs are known human carcinogens if ingested or inhaled.
8. TBOS/TKEBS is a silicone-based lubricating oil that was mixed with TCE to preserve pump seals in heat-exchange piping systems. It is relatively nontoxic.

What are the risks from contamination?

Abaseline risk assessment was conducted for Site 300 to evaluate risks to people, plants, and animals that may be exposed to contaminants in soil, air, surface water, or ground water. Risk assessments predict the magnitude, if any, of adverse health effects.

The baseline risk assessment identified the contaminants and potential exposure pathways that may need to be addressed by cleanup actions. The Site 300 baseline risk assessment evaluated present and future risks under the assumption that no cleanup would take place. Selection of cleanup actions will be based in part on the extent to which they can reduce these risks. The Site 300 baseline risk assessment used conservative assumptions that favored protecting public health and the environment. Therefore, actual human or ecological exposure and risk are likely to be much lower than those calculated in the baseline risk assessment.

Carcinogenic (cancer) risk for humans is expressed as the probability of developing cancer over a lifetime. For example, an additional cancer risk of one in one million (10^{-6}) means that a person exposed to a specified concentration of that chemical over the course of a lifetime could potentially increase their cancer risk by one in one million (over and above the cancer risk of one in three for Californians). An additional cancer risk of one in one million or less is considered acceptable by the U.S. EPA. An additional cancer risk between one in ten thousand (10^{-4}) and one in one million (10^{-6}) may be acceptable provided the risk is properly managed.

For noncarcinogens, a Hazard Index (HI) is calculated. Hazard Indices less than one are considered protective.

Baseline human health risks and hazards for Site 300 were estimated using adult onsite industrial exposure and offsite residential exposure scenarios. The onsite industrial exposure scenario estimates health risk where an adult is presumed to work in the immediate vicinity of worst-case contamination 8 hours a day, 5 days a week, over a 30 year period of employment at the site. The residential exposure scenario estimates the risk to a hypothetical family living at the site boundary.

Risk estimates for most release sites and contaminants were well below the threshold designated as being protective by the U.S. EPA. Onsite risks above this threshold were generally associated with workers potentially inhaling VOCs or tritium volatilizing from the subsurface or direct skin contact with PCBs and dioxins in the soil. Onsite risks were also associated with drinking contaminated ground water, but well water is not used for drinking at Site 300.

Offsite residential risks were associated with people potentially drinking contaminated ground water, or inhaling vapors volatilizing from contaminated surface water. However, no members of the public are being exposed to any contaminants from Site 300.

Numerical baseline risk estimates for each area at Site 300 are included and discussed in the technical version of the Proposed Plan.

The Site 300 ecological assessment evaluated the potential for adverse impact to plants and animals from long-term exposure to contaminants, and focused on potential reproductive damage and reductions in reproductive life span rather than the risk of developing cancer. The ecological risk assessment identified potential impacts to several sensitive animal species at Site 300. LLNL wildlife biologists are closely monitoring these species but have found no adverse effects due to contamination.

What kinds of cleanup did DOE consider?

DOE evaluated a number of ways to address areas where soil, ground water, or surface water is currently contaminated, or could become contaminated in the future.

The approaches evaluated in the Site-Wide Feasibility Study are summarized below.

Risk and Hazard Management

The overall goals of risk and hazard management are to control exposure to contaminants and to ensure the remedies are protective of human health and the environment.

Administrative controls are the basis of risk management, such as restricting building access and measures to prevent people from drinking contaminated ground water.

DOE assumes that Site 300 will remain under its control, and that the site access restrictions currently in place (fencing and security patrols) will continue for the foreseeable future.

All remedies would be reevaluated if any transfer of ownership or change in land use is anticipated.

Monitored Natural Attenuation

Monitored natural attenuation allows contaminants to degrade naturally in the environment. Under certain conditions it is an option to address contamination. This method has proven effective for certain contaminants (for example, gasoline and radionuclides with short halflives). Monitored natural attenuation may also be appropriate for other contaminants found at Site 300, such as VOCs and high explosives.

For this approach to be acceptable, appropriate long-term monitoring must be conducted, there must be no active source of contamination, and human health and the environment must be protected. A monitored natural attenuation remedy must also achieve cleanup goals in a timeframe comparable to active remediation.

Ground Water Extraction and Treatment

Extraction consists of pumping or siphoning contaminated ground water from specially designed wells, then treating it to remove contaminants before discharge to the ground or reinjection. The extracted water can be treated using granular activated carbon, bioreactors, or ion-exchange systems, depending on the contaminant.

The objectives of extraction may include reducing the amount and concentration of contamination, stopping the spread of contaminants, reducing risk, and/or restoring beneficial uses of ground water.

Extraction of ground water containing tritium is not easily implementable or safe, because no cost-effective technology to remove tritium from water is available, and bringing tritiated water to the surface could result in increased risk to humans.

Soil Vapor Extraction and Treatment

Contaminated vapors in the soil above the water table are pumped from special wells, then treated to remove contaminants before discharging the cleansed air to the atmosphere. This technology is effective only for volatile contaminants, such as TCE. The extracted vapor is treated using granular activated carbon. Soil vapor extraction is often combined with ground water extraction.

Enhanced *In situ* Bioremediation

In situ (in place) bioremediation is a process through which microbes already living in the ground ingest contaminants and break down the contamination into non-toxic compounds. This process can be enhanced by injecting additional nutrients into the subsurface.

***In situ* Reactive Barriers**

In this technology, a trench is excavated to a depth below the ground water table. The trench is filled with a permeable material designed to react with and remove contaminants from ground water flowing through the material.

In situ reactive barriers can be used to control the migration of VOCs, metals, and uranium in ground water.

Excavation of Soil and Bedrock at Firing Tables

Though costly, excavating contaminated soil under the firing tables is effective for reducing health risks and stopping further ground water contamination. At some firing tables, explosive tests contaminated the adjacent soil. This soil can be removed to prevent worker exposure.

Any excavated waste would be either transported to an approved offsite disposal facility, or contained onsite.

Landfill Waste Characterization, with Contingent Monitoring, Capping, or Excavation

The process addresses potential releases from the Pit 2, 8, and 9 Landfills. It begins with detailed investigations of the contents of the landfills, followed by modeling to estimate potential impacts to ground water, and risk assessments to evaluate potential impacts to humans and the environment.

The results of these activities would be used to help design the most appropriate cleanup. Many opportunities for stakeholder input are included throughout the process.

DOE is considering at least five possible approaches to address the landfills: (1) monitoring only, (2) capping, (3) partial excavation with capping, (4) partial excavation without capping, or (5) total excavation.

Any excavated waste would be either transported to an approved offsite disposal facility, or contained onsite.

How does DOE propose to clean up Site 300?

In the Feasibility Study, several cleanup alternatives for each area were evaluated using the EPA criteria shown in Figure 4. Using the results of this evaluation, DOE compared the alternatives and selected a preferred remedy for each area of the site. In most areas at Site 300, the remedies are made up of a combination of technologies. DOE's preferred cleanup alternatives for each area at Site 300 are shown in Table 1.

The estimated costs shown on the table are the sum of capital, operation, and maintenance costs over 30 years, expressed as present-worth values. The costs of any previous cleanup actions are not included in the estimates. The total estimated 30-year present worth cost to clean up Site 300 is approximately $85,000,000. The major components of DOE's proposed cleanup remedies are:

1. Extract and treat contaminated ground water at Buildings 834, 830, 832, 854, and in three parts of the High Explosives Process Area. This cleanup will restore the beneficial uses of ground water beneath Site 300 and

Technology	Building 834			Landfill Pit 6			HE Process Area		Building 850 Firing Table				Pit 2 Landfill			Building 854		Building 832 Canyon		Building 801, Pit 8 Landfill			Building 833			B845 Firing Table, Pit 9 Landfill			Building 851 Firing Table		
Alternative	1	2	3	1	2	3	1	2	1	2	3	4	1	2	3	1	2	1	2	1	2	3	1	2	3	1	2	3	1	2	3
Monitoring		✔	✔		✔	✔		✔		✔	✔	✔		✔	✔		✔		✔		✔	✔		✔	✔		✔	✔		✔	✔
Risk and hazard management		✔	✔		✔	✔		✔		✔	✔	✔					✔		✔					✔	✔						
Monitored natural attenuation					✔					✔	✔	✔																			
Ground water extraction		✔	✔			✔		✔				✔					✔		✔						✔						✔
Soil vapor extraction		✔	✔														✔		✔						✔						
Enhanced *in situ* bioremediation			✔																												
In situ reactive barriers												✔																			
Excavation of soil and bedrock beneath firing tables											✔	✔																			
Removal of surface soil adjacent to firing tables										✔	✔	✔																			
Landfill waste characterization with contingent monitoring, capping, or excavation															✔							✔						✔			
Estimated 30-year cost of alternatives	$0	$12.1M	$14.5	$0	$2.4M	$8.0M	$0	$27.6M	$0	$4.0M	$8.3M	$16.1M	$0	$0.5M	$22.2M	$0	$9.1M	$0	$28.8M	$0	$0.5M	$21.7M	$0	$0.8M	$4.3M	$0	$0.5M	$7.1M	$0	$0.5M	$4.2M

Shaded columns are DOE's preferred remedies. Alternative 1 is always "no action".

Table 1. Cleanup alternatives for LLNL Site 300.

protect offsite ground water supplies.

2. Extract and treat soil vapor contaminated with VOCs at Buildings 834, 830, 832, and 854. Removing VOCs from the soil and bedrock above the water table will reduce risks to humans and protect the underlying ground water from further contamination.

3. Remove the tritium-contaminated sand pile at the Building 850 Firing Table. This will prevent further leaching of tritium into the soil and ground water. Also at Building 850, remove PCB-contaminated surface soil in the area adjacent to the firing table to reduce health risk to site workers.

4. Allow tritium in soil, bedrock, and ground water to decline naturally through monitored natural attenuation at Building 850. DOE also proposes a monitored natural attenuation remedy for tritium and TCE at the Pit 6 Landfill.

5. Implement exposure controls in any area where an elevated risk or hazard to humans or the environment remains. During cleanup, DOE will implement a formal risk and hazard management program which will include periodically collecting additional samples, reviewing building occupancy and land use, and refining risk and hazard estimates. Exposure controls will manage risks to site workers, the public, and the environment.

6. Continue monitoring throughout Site 300 and the adjacent offsite area. Monitoring will determine if the cleanup is adequately protecting humans and the environment and will help measure the progress of cleanup.

7. Continue to closely monitor the Pit 2, 8, and 9 Landfills. There is no evidence of contaminant releases from these landfills. DOE will install additional monitoring equipment at these landfills to ensure early detection

Each alternative was assessed against the first eight CERCLA evaluation criteria described below. Using results of this assessment, DOE/LLNL compared the alternatives and selected a preferred alternative for the site. Community acceptance will be addressed after public comments have been received.

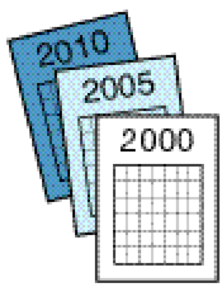
Threshold Criteria

1. **Overall Protection of Human Health and the Environment:** Addresses whether a remedy provides adequate protection and describes how risks posed through each pathway are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls.

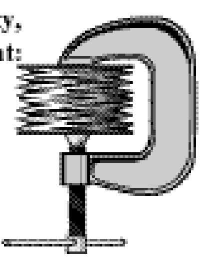
2. **Compliance with Applicable or Relevant and Appropriate Requirements (ARARs):** Addresses whether a remedy will meet all ARARs of federal and state environmental statutes .

Balancing Criteria

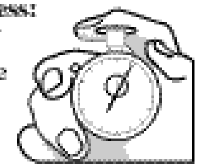
3. **Long-term Effectiveness and Permanence:** Refers to the ability of a remedy to maintain reliable protection of human health and the environment over time once cleanup goals have been met.



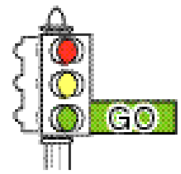
4. **Reduction of Toxicity, Mobility, or Volume Through Treatment:** Refers to the anticipated ability of a remedy to reduce the toxicity, mobility, or volume of the hazardous components present at the site.



5. **Short-term Effectiveness:** Addresses the period of time needed to complete the remedy, and any adverse impact on human health and the environment that may be posed during the construction and implementation period.



6. **Implementability:** Refers to the technical and administrative feasibility of a remedy, including the availability of materials and services needed to carry out a particular option.

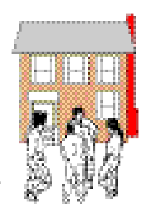


7. **Cost:** Evaluates the estimated capital, and operation and maintenance costs of each alternative.

State/Community Acceptance Criteria

8. **State Acceptance:** Indicates whether, based on its review of the information, the state concurs with, opposes, or has no comment on the preferred alternatives.

9. **Community Acceptance:** Indicates whether community concerns are addressed by the remedy and whether the community has a preference for a remedy. Although public comment is an important part of the final decision, DOE is compelled by law to balance community concerns with all of the previously mentioned criteria.



ERD-S3R-99-0112

Figure 4. The EPA evaluation criteria.

of any future releases of contaminants, and will upgrade and formalize the landfill maintenance program. DOE also plans to reengineer the surface water drainage near the Pit 2 Landfill.

8. Take no further action for contaminants in soil and bedrock at some areas where certain contaminants: (1) are found in low concentrations, (2) pose no risk to humans or the environment, and (3) cannot be cleaned up cost-effectively. DOE does not propose a no further action remedy for any of the contaminated ground water at Site 300.

The time it will take to complete the cleanup of Site 300 will be long, possibly greater than 30 years. This is primarily due to the difficulty in removing contaminants dissolved in the ground water. Predictive tools (for example, computer modeling) are not reliable for such long time frames. Because of this, at this time the total time to achieve cleanup cannot be estimated accurately.

In 2002, DOE will submit a Site-Wide Contingency Plan. This document will anticipate how DOE might respond if any part of the cleanup does not go as planned, or for any migration or expansion of ground water contaminant plumes. The Contingency Plan will also anticipate how the cleanup might be modified in the event of any future changes in land use at Site 300, or if a transfer of site ownership is anticipated.

What was the Rationale for Choosing the Preferred Remedies?

The key factors in selecting the interim remedies for each area are summarized below. All of the preferred remedies meet the two U.S. EPA threshold evaluation criteria of: (1) protecting human health and the environment, and (2) complying with all applicable laws and regulations (see Figure 4). DOE did not select Alternative 1 (No Action) for any area because this alternative does not meet the threshold criteria. The preferred remedies provide the best combination of tradeoffs among the alternatives in terms of the balancing criteria. All preferred remedies include long-term monitoring and risk and hazard management.

Building 834 Preferred Remedy:
Ground water and soil vapor extraction and treatment (Alternative 2)

Alternative 2 will permanently remove contaminants (VOCs, TBOS/TKEBS, and nitrate) from the subsurface, reduce the toxicity, mobility, and volume of these contaminants, restore and protect the beneficial uses of ground water, and reduce human health risk. This alternative is readily implementable because ground water and soil vapor extraction and treatment systems are already successfully operating at Building 834. The estimated cost of Alternative 2 ($12.1M) is $2.4M lower than Alternative 3 (which adds enhanced *in situ* bioremediation), and a major portion of the capital costs have already been incurred. Alternative 3 was not selected because of effectiveness concerns, but DOE will continue to evaluate enhanced *in situ* bioremediation and may add this technology to the remedy in the future.

Pit 6 Landfill Preferred Remedy:
Monitored natural attenuation (Alternative 2)

Monitored natural attenuation will permanently remove VOCs and tritium from the subsurface, reduce the toxicity, mobility, and volume of these contaminants through irreversible chemical degradation and radioactive decay, and achieve cleanup standards in a timeframe comparable to active remediation. The cap installed over the landfill in 1997 is designed to prevent further releases. The estimated cost of Alternative 2 ($2.4M) is $3.6M lower than Alternative 3 (ground water extraction). Alternative 3 was not selected because of effectiveness concerns.

High Explosives Process Area Preferred Remedy:
Ground water extraction and treatment (Alternative 2)

Alternative 2 will permanently remove contaminants (VOCs, HE compounds, perchlorate, and nitrate) from the subsurface, reduce the toxicity, mobility, and volume of these contaminants, and restore and protect the beneficial uses of ground water. This alternative is readily implementable, using cost-effective, well-proven technologies. A portion of the ground water extraction system are already in place. The estimated cost of Alternative 2 is $27.6M.

Building 850 Firing Table Area Preferred Remedy:
Monitored natural attenuation, soil removal (Alternative 2)

Monitored natural attenuation will permanently remove tritium from the subsurface, reduce toxicity, mobility, and volume through radioactive decay, and achieve cleanup standards in a timeframe comparable to active remediation. Depleted uranium in ground water is below drinking water standards. Excavating PCB-contaminated surface soil will protect site workers, and removing the tritium-contaminated sand pile will protect ground water. The estimated cost of Alternative 2 ($4.0M) is $4.3 million lower than Alternative 3 (which adds excavation of soil and bedrock directly beneath the firing table), and $12.1 million less than Alternative 4 (which adds an *in* *situ* permeable reactive barrier and ground water extraction to Alternative 3). Alternatives 3 and 4 were not selected because of implementability, effectiveness, and/or safety concerns.

Pit 2 Landfill Preferred Remedy: Enhanced monitoring, surface water control (Alternative 2)

Since there have been no releases from the landfill, the criteria for reducing toxicity, mobility, and volume of contaminants do not apply. The alternative is readily implementable because part of the monitoring network is already in place. Alternative 2 provides a way to detect any future releases from the landfill that could pose a risk or hazard to human health or ecological receptors or impact ground water. Reengineering the surface water drainage near the landfill will ensure that erosion or flooding do not cause releases. The estimated cost of Alternative 2 ($0.5M) is $21.7 million lower than Alternative 3 (which adds landfill capping or excavation). Alternative 3 was not selected because of implementability concerns.

Building 854 Preferred Remedy: Ground water and soil vapor extraction and treatment (Alternative 2)

Alternative 2 will permanently remove contaminants (VOCs, nitrate, and perchlorate) from the subsurface, reduce the toxicity, mobility, and volume of these contaminants, restore and protect the beneficial uses of ground water, and reduce human-health risk. This alternative is readily implementable, using well proven, cost-effective technologies. A ground water extraction and treatment system is already operating at Building 854. The estimated cost of Alternative 2 is $9.1M.

Building 832 Canyon Preferred Remedy: Ground water and soil vapor extraction and treatment (Alternative 2)

Alternative 2 will permanently remove contaminants (VOCs, nitrate, and perchlorate) from the subsurface, reduce the toxicity, mobility, and volume of these contaminants, restore and protect the beneficial uses of ground water, and reduce human-health risk. This alternative is readily implementable, using well proven, cost-effective technologies. A ground water extraction and treatment system is already operating at Building 832. The estimated cost of Alternative 2 is $26.8M.

Building 801 and the Pit 8 Landfill Preferred Remedy: Enhanced monitoring (Alternative 2)

TCE concentration in ground water near Building 801 is below drinking water standards, and since there have been no releases from the Pit 8 Landfill, the criteria for reducing the toxicity, mobility, and volume of this contaminant do not apply. Alternative 2 is readily implementable because part of the monitoring network is already in place. Alternative 2 provides a way to detect any future releases from the landfill that could pose a risk or hazard to human health or ecological receptors or impact ground water. The estimated cost of Alternative 2 ($0.5M) is $21.2 million lower than Alternative 3 (which adds landfill capping or excavation). Alternative 3 was not selected because of implementability concerns.

Building 833 Preferred Remedy: Monitoring (Alternative 2)

Data indicate that natural processes should reduce VOC concentrations in ground water to below drinking water standards in 5 to 10 years. This alternative is readily implementable because the monitoring network is already in place. Exposure controls during monitoring would ensure short-term effectiveness. The estimated cost of Alternative 2 ($0.8M) is $3.5 million less than Alternative 3 (which adds ground water and soil vapor extraction). Alternative 3 was not selected due to effectiveness concerns.

Building 845 and the Pit 9 Landfill Preferred Remedy: Enhanced monitoring (Alternative 2)

Contaminants in soil at Building 845 (uranium, HMX) do not pose a threat to human health or ground water, and since there have been no releases from the Pit 9 Landfill, the criteria for reducing the toxicity, mobility, and volume of these contaminants do not apply. The alternative is readily implementable because part of the monitoring network is already in place. Alternative 2 provides a way to detect any future releases from the landfill that could pose a risk or hazard to human health or ecological receptors or impact ground water. The estimated cost of Alternative 2 ($0.5M) is $6.6 million lower than Alternative 3 (which adds landfill capping or excavation). Alternative 3 was not selected because of implementability concerns.

Building 851 Firing Table Preferred Remedy: Monitoring (Alternative 2)

Contaminants in soil (VOCs, uranium, and metals) do not pose a threat to human health or ground water, so the criteria for reducing the toxicity, mobility, and volume of these contaminants do not apply. Uranium in ground water is below the drinking water standard. Alternative 2 is readily implementable because the monitoring network is already in place. The estimated cost of Alternative 2 ($0.5M) is $3.7 million lower than Alternative 3 (which includes ground water extraction for uranium). Alternative 3 was not selected because of effectiveness concerns.

Ongoing studies

DOE is continuing to evaluate innovative approaches to remediation. If appropriate, these will be used to maximize the cost-effectiveness, efficiency, and safety of the cleanup. These approaches include:

1. Investigating ways to stabilize landfill waste in place to prevent leaching of contaminants into the ground water. This may be an alternative to excavating or capping some landfills.
2. Evaluating new technologies to remove tritium from ground water. Currently, no cost-effective technology exists.
3. Studying innovative, environmentally friendly ("green") cleanup technologies to apply at Site 300. The technologies include using gravity, solar, or wind power to run extraction and treatment facilities, and using plants or microbes to treat contaminants in extracted ground water.

Constructing the cover over the Pit 6 Landfill in 1997.

Who do I contact for more information?

U.S. Department of Energy:
Roy Kearns
Site 300 Remedial Project Manager
Livermore Environmental Programs Division
DOE/OAK Operations Office
P.O. Box 808, L574
Lawrence Livermore National Laboratory
Livermore, CA 94551 (925) 422-1168

Lawrence Livermore National Laboratory:
John Ziagos
Site 300 Program Leader
Environmental Restoration Division
P.O. Box 808, L544
Lawrence Livermore National Laboratory
Livermore, CA 94551 (925) 422-5479

Bert Heffner
Environmental Community Relations Manager
P.O. Box 808, L790
Lawrence Livermore National Laboratory
Livermore, CA 94551 (925) 424-4026

Regulatory Agencies:
Mark Piros
Remedial Project Manager
California Department of Toxic Substances Control
700 Heinz Avenue, Suite 200
Berkeley, CA 94710 (510) 540-3832

Kathy Setian
Remedial Project Manager
United States Environmental Protection Agency
Region IX
75 Hawthorne Street SFD-8-1
San Francisco, CA 94105 (415) 744-2254

Susan Timm
Remedial Project Manager
California Regional Water Quality Control Board
Central Valley Region
3443 Routier Road, Suite A
Sacramento, CA 95827 (916) 255-3057

Where are the information repositories?

Copies of the Site-Wide Remedial Investigation, Site-Wide Feasibility Study, the technical version of the Proposed Plan, and other documents for LLNL Site 300 are available at:

LLNL Visitors Center
Enter from Greenville Road
Livermore, CA 94551 (925) 422-9797

Tracy Public Library
20 East Eaton Avenue
Tracy, CA 95376 (209) 835-2221

Both the fact sheet and technical versions of the Proposed Plan are available on the LLNL Environmental Public Information website: ***http://www-envirinfo.llnl.gov***