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UCRL-AR-138470

Interim Site-Wide Record of Decision for Lawrence Livermore National Laboratory Site 300

February 2001

Environmental Protection Department
Environmental Restoration Division

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Certification

I certify that the work presented in this report was performed under my supervision. To the best of my knowledge, the data contained herein are true and accurate, and the work was performed in accordance with professional standards.

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1. Declaration

1.1. Site Name and Location

This Interim Record of Decision (ROD) is for the following Operable Units (OUs) at Lawrence Livermore National Laboratory (LLNL) Site 300 (EPA Superfund Site Identification No. 0902742), located west of Tracy, California:

- Building 834 (OU 2)
- Pit 6 Landfill (OU 3)
- High Explosives (HE) Process Area (OU 4) including:
    - Building 815
    - HE Lagoons
    - HE Burn Pit
- Building 850/Pits 3&5 (OU 5) including:
    - Building 850 Firing Table subarea
    - Pit 2 Landfill subarea
- Building 854 (OU 6)
- Building 832 Canyon (OU 7) including:
    - Building 830
    - Building 832
- Buildings 801, 833, 845, and 851 and the Pit 8 and Pit 9 Landfills (OU 8)

The Building 850/Pits 3&5 area (OU 5) is divided into three subareas: the Building 850 Firing Table, the Pit 2 Landfill, and the Pit 7 Complex which consists of the Pit 3, 4, 5, and 7 Landfills. This Interim ROD only addresses the Building 850 Firing Table and Pit 2 Landfill subareas of OU 5. The Pit 7 Complex subarea will be addressed in a separate amendment to this Interim ROD. The Department of Energy (DOE) and regulatory agencies have agreed that additional site characterization and evaluation of cleanup options is required prior to selecting a preferred remedy for this subarea. An OU-specific ROD was signed in January 1997 for the General Services Area (OU 1). Since the cleanup strategy has been determined and implemented for OU 1 it is not discussed further in this Interim ROD.

This ROD is considered interim because: (1) additional testing and evaluation of technologies is still taking place, (2) final cleanup standards are being negotiated, and (3) some areas of Site 300 still need further investigation. Cleanup of surface soil and the sand pile at the Building 850 Firing Table subarea is anticipated to be completed before a Final Site-Wide ROD is issued. Consequently, those specific cleanup activities are considered final actions. A Final Site-Wide ROD is scheduled for 2007.

1.2. Statement of Basis and Purpose

This decision document presents the selected interim remedies for the OUs specified above at LLNL Site 300, which were chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA) and the National Contingency Plan (NCP). This decision is based on the Administrative Record for Site 300.

The State of California Department of Toxic Substances Control (DTSC), the Central Valley Regional Water Quality Control Board (RWQCB), and the United States Environmental Protection Agency (EPA), Region IX, concur with the selected interim remedies and final actions for cleanup of surface soil and the sand pile at Building 850.

Unless otherwise specified, use of “remedy” or any derivations thereof implies that such measures are interim.

1.3. Assessment of the Site

The response actions selected in this Interim ROD are necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment.

1.4. Description of the Selected Remedy

In June 1992, a Federal Facility Agreement (FFA) for cleanup of the LLNL Site 300 Experimental Test Facility was signed by the U.S. EPA, the California DTSC, the RWQCB, and DOE. DOE is the responsible party and lead agency for environmental investigations and cleanup. A number of cleanup alternatives were evaluated in the Site-Wide Feasibility Study (SWFS) (Ferry et al., 1999). DOE’s preferred alternatives were presented in the Proposed Plan (Dresen et al., 2000). The selected cleanup remedies for each area at Site 300 addressed in this Interim ROD and their estimated present-worth costs are shown in Table 1.4-1. The cleanup decisions documented in this Interim ROD may be modified by the Final ROD scheduled for 2007.

The major components of DOE’s interim cleanup for Site 300 are:

1. Extract and treat contaminated ground water at Buildings 834, 830, 832, 854, and in three parts of the HE Process Area to restore the beneficial uses of ground water beneath Site 300 and protect offsite ground water supplies.
2. Extract and treat soil vapor containing volatile organic compounds (VOCs) at Buildings 834, 830, 832, and 854. Removing VOC vapors 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 to prevent further leaching of tritium into the soil and ground water. Also, remove polychlorinated biphenyl (PCB)-, dioxin-, and furan-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. Monitored natural attenuation was also selected as the remedy for tritium and trichloroethylene (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 that 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, the environment, and hazards to ecological receptors.

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 release from these landfills. DOE will install additional vadose zone and ground water monitoring equipment at these landfills to ensure early detection of any future releases of contaminants and will upgrade and formalize the landfill maintenance program. DOE will also re-engineer 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, (3) pose no threat to ground water, and (4) cannot be cleaned up cost-effectively. DOE did not select a no further action remedy for any of the contaminated ground water at Site 300.

If these approaches work as intended, they could become the final remedies subject to the Final ROD evaluation in 2007. Significant or fundamental changes to the remedies will be supported and documented in an Explanation of Significant Differences or ROD Amendment, respectively.

The estimated costs shown on Table 1.4-1 are the sum of capital and operation and maintenance (O&M) costs over 30 years, expressed as present-worth values. The present-worth costs are based on conceptual designs and are presented for comparison purposes only. Based on DOE's selected cleanup alternatives, the estimated 30-year present-worth cost to clean up the Site 300 OUs described in this Interim ROD is approximately $85,000,000.

1.5. Statutory Determinations

The Site 300 selected interim remedies protect human health and the environment, comply with Federal and State requirements that are applicable or relevant and appropriate to the remedial actions, are cost-effective, utilize permanent solutions and alternative treatment technologies to the maximum extent practicable, and provide adequate protection until a Final ROD is signed. These remedies also satisfy the statutory preference for treatment as a principal element of the remedy (i.e., reducing the toxicity, mobility or volume of hazardous substances, pollutants, or contaminants as a principal element through treatment). Because these remedies will result in hazardous substances, pollutants, or contaminants remaining onsite above levels that allow for unlimited use and unrestricted exposure, a statutory review will be conducted every five years after initiation of remedial action to ensure that the remedies are or will be protective of human health and the environment.

1.6. National Environmental Policy Act (NEPA) Integration

Section II.E. of the DOE Secretarial Policy Statement on the National Environmental Policy Act (NEPA) requires that when DOE remedial actions under CERCLA trigger the procedures set forth in NEPA, the procedural and documentation requirements of NEPA and CERCLA are to be integrated. Integration is to be accomplished by conducting the NEPA and CERCLA environmental planning and review procedures concurrently to avoid duplication, conflicting analysis, and delays in implementing remedial action on procedural grounds. In the past, the primary instrument for this integration was the Remedial Investigation/Feasibility Study (RI/FS) process, supplemented as needed to meet the requirements of NEPA. Each remedial alternative was reviewed and evaluated for potential environmental impacts under NEPA.

However, due to the scope and complexity of the remedial alternatives presented in this Interim ROD, DOE and the regulatory agencies decided to conduct the NEPA evaluation separately. The NEPA evaluation is being issued as a separate report (U.S. DOE, 2000a).

The NEPA evaluation provides the additional information necessary to evaluate potential environmental impacts of each remedy under NEPA in compliance with the requirements of the DOE NEPA Implementing Procedures (10 CFR 1021), Section II.E. of the Secretarial Policy Statement on NEPA (issued June 1994), and the Council of Environmental Quality (CEQ) Regulations for Implementing the Procedural Provisions of the NEPA (40 CFR 1500–1508, July 1986, as amended).

As appropriate, this evaluation includes a discussion of the:

1. Relationship of the remedy to other activities at LLNL.
2. Environmental setting and potentially affected environment including:
    - Land use and socioeconomics.
    - Vegetation, wildlife, and sensitive species.
    - Air quality.
    - Noise and traffic.
    - Aesthetics.
    - Floodplains and wetlands.
    - Cultural resources.
3. Potential environmental impacts of the remedy.
4. Potential accidents.
5. Cumulative impacts to human health, land use, air quality, and surface water.

1.7. ROD Data Certification Checklist

The following information is included in the noted sections of the Decision Summary portion of this Interim ROD. Additional information can be found in the Administrative Record for this site.

- Contaminants of concern (COCs) and their respective concentrations (Sections 2.5.3 and 2.7.1).
- Baseline risk represented by the COCs (Section 2.7).
- Cleanup standards established for COCs and the basis for these standards (Section 2.11.4.3).
- How source materials constituting principal threat wastes are addressed (Section 2.12).
- Current and reasonably anticipated future land use assumptions and current and potential beneficial uses of ground water (Sections 2.6 and 2.11.4).
- Potential land and ground water use that will be available as a result of the selected remedies (Sections 2.6 and 2.11.4).
- Estimated capital, annual O&M, and total present-worth costs, discount rate, and the number of years over which the remedy cost estimates are projected (Section 2.11.3).
- Key factors that led to selecting the remedy (Section 2.11.1).

1.8. Authorizing Signatures and Support Agency Acceptance

Each representative of the undersigned party certifies that he or she is fully authorized to enter into the terms and conditions of this agreement and legally bind such party to this agreement.

IT IS SO AGREED:

Daniel A. Meer 2/23/01

Date

Daniel A. Meer
Chief, Federal Facilities Cleanup Branch
Superfund Division
U.S. Environmental Protection Agency
Region IX

2/14/2001

Date

Barbara J. Cook, P.E.
Chief, Northern California Coastal Cleanup Operations Branch
California Department of Toxic Substances Control

3/2/2001

Date

Gary M. Carlton
Executive Officer
State of California Regional Water Quality Control Board
Central Valley Region

02/13/01

Date

James T. Davis
Assistant Manager for Environment and Nuclear Energy
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U.S. Department of Energy

2. Decision Summary

2.1. Site Name, Location, and Description

LLNL Site 300 is a DOE experimental test facility operated by the University of California. The facility is located in the eastern Altamont Hills about 17 miles east of Livermore and 8.5 miles southwest of Tracy (Figure 2.1-1). The site covers 11 square miles (mi^2), most of which is in San Joaquin County. The western one-sixth of the site is located in Alameda County.

Site 300 is primarily an experimental test facility that conducts research, development, and testing associated with high explosives (HE) materials. This work includes explosives processing, preparation of new explosives, and pressing, machining, and assembly of explosives components. Site 300 activities also include hydrodynamic testing for verifying computer simulation results, obtaining equation-of-state data for explosive materials, evaluating material behavior at assembly joints and welds, evaluating the quality and uniformity of implosion, and evaluating the performance of post-nuclear test design modifications. Access to Site 300 is restricted by fencing and full-time security guards.

DOE began environmental restoration at Site 300 in 1981. Prior to August 1990, investigations of potential chemical contamination at Site 300 were conducted under the oversight of the California RWQCB-Central Valley Region. Site 300 was placed on the National Priorities List (NPL) in August 1990. Since then, all investigations, including the preparation of the Site-Wide Remedial Investigation (SWRI) report (Webster-Scholten, 1994), have been conducted in accordance with CERCLA under the oversight of the three supervising regulatory agencies: EPA, RWQCB, and DTSC.

DOE is the lead agency for all environmental restoration activities at Site 300 and is the sole source of funding.

The EPA Superfund identification number for LLNL Site 300 is 0902742.

2.2. Site History and Enforcement Activities

LLNL currently consists of two non-contiguous sites—Livermore Site and Site 300. Each is designated as a separate and distinct entry on U.S. EPA's National Priorities List. LLNL is operated by the University of California for DOE and began weapons research operations at the Livermore Site in 1952. At that time LLNL was a part of what was then the University of California Radiation Laboratory (UCRL). UCRL proposed the Site 300 location for an HE test site along Corral Hollow between Livermore and Tracy in July 1953. Experiments with HE began at Site 300 in 1955. The size of the original site was approximately 3 mi^2. In 1957, the site was enlarged to 11 mi^2. The Livermore Site and Site 300 portion of UCRL became LLNL in 1971. Prior to acquisition by UCRL, land use in the area of Site 300 was limited to sheep and cattle grazing.

During past LLNL Site 300 operations, 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).

2.3. Community Participation

The SWFS (Ferry et al., 1999) and the Proposed Plan (Dresen et al., 2000) for LLNL Site 300 were made available to the public in November 1999 and April 2000, respectively. These documents can be found in the Administrative Record file and the Information Repositories located in the LLNL Visitor's Center in Livermore, California and in the Tracy Public Library in Tracy, California. A public comment period on the Proposed Plan was held from April 20 to May 20, 2000. In addition, a public meeting was held on May 4, 2000 to present the Proposed Plan to a broader community audience than those that had already been involved in the site's cleanup process. At this meeting, representatives from the DOE, LLNL, U.S. EPA, and the State of California answered questions about environmental contamination at the site and the remedial alternatives. U.S. EPA also used this meeting to encourage greater public participation in the CERCLA process and evaluation of interim cleanup options. The DOE's responses to the comments received during this period and at the community meeting are included in the Responsiveness Summary which is Section 3 of this document.

DOE/LLNL has prepared a Community Relations Plan (CRP) to meet the following objectives:

- Provide accurate and timely information to interested members of the community.
- Provide for an open dialogue on Site 300 cleanup issues between DOE/LLNL and the public, and factor community concerns into the ongoing environmental investigation.
- Continue to work closely with the neighbors of Site 300.
- Be responsive to the special information needs of elected officials, agency representatives, and interested members of the public, including the environmental and peace activists.
- Seek to increase the level of understanding in the community with regard to Site 300 cleanup plans.
- Respond to changes in community concerns and interest levels.

Reviews of the objectives and the methods described in the CRP are conducted regularly to assure the objectives are being met.

The public is invited to attend various CERCLA-required and voluntary public meetings and workshops to learn about and comment on planned environmental restoration activities at Site 300. Tri-Valley Communities Against a Radioactive Environment (CAREs) has held a Technical Assistance Grant from the U.S. EPA since 1994 and representatives meet quarterly with DOE, regulators, and LLNL staff to discuss on-going and planned project status. The local community is currently provided, and will continue to be provided, with information by way of local repositories, newsletters and public workshops.

2.4. Scope and Role of the Response Action

Environmental investigations identified 23 locations at Site 300 where contaminants were released to the environment. The nature and location of these release sites are shown on Figure 2.4-1. All release sites at Site 300 have been assigned to one of eight OUs to more effectively manage the site cleanup. The OU designations are based on the nature and extent of contamination and topographic and hydrologic considerations. The OU to which each release site is assigned is also shown on Figure 2.4-1.

The contaminants at Site 300 include the solvent TCE and other VOCs, HE compounds, perchlorate, tritium, uranium, nitrate, PCBs, dioxins and furans, silicone-based oils (tetra-butyl-orthosilicate or TBOS, and tetra-kis-2-ethylbutyl-orthosilicate or TKEBS), and metals. In some cases, these compounds have migrated into ground water as shown on Figure 2.4-2.

The overall site cleanup plan for LLNL Site 300 is presented in Table 2.4-1. This table summarizes all past and ongoing responses, as well as those proposed in this Interim ROD. It is the intent of this Interim ROD that the selected interim response actions for each individual operable unit will be consistent with the final actions selected for Site 300 in the Final ROD, scheduled for April 2007.

Sections 2.4.1 through 2.4.11 briefly describe the OUs at the site.

2.4.1. General Services Area (OU 1)

Past disposal of degreasing solvents caused VOC contamination in the subsurface. A ROD for this operable unit was signed in 1997 and ground water and soil cleanup is underway. Since the cleanup strategy (ground water and soil vapor extraction and treatment) has been selected and implemented for this OU, it is not discussed further in this Interim Site-Wide ROD.

2.4.2. 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 OU-specific Interim ROD was signed in 1995 and ground water and soil vapor extraction and treatment are underway. The Building 834 area is included in this Interim Site-Wide ROD. Innovative cleanup technologies are also being tested at Building 834.

2.4.3. 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. DOE/LLNL excavated the portion of waste containing depleted uranium in 1971. VOCs, tritium, and perchlorate are present in ground water immediately downgradient from the landfill. The landfill was capped in 1997 to prevent infiltrating rain water from further leaching contaminants from the buried waste and to mitigate potential inhalation risks. Nitrate has also been found about 500 feet downgradient of the landfill. Ground water contaminants in this OU are addressed in this Interim ROD.

2.4.4. HE Process Area (OU 4)

Spills occurred at the former Building 815 steam plant where TCE was once used to clean pipelines, resulting in soil contamination and a 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 are underway to prevent TCE in ground water from the Building 815 area from moving offsite. Similar contaminants were also found in ground water near the former HE Burn Pits which were capped in 1998. Ground water contamination from the Building 815 area, the HE lagoons, and the HE Burn Pit area are all addressed in this Interim ROD. A treatability study is underway at the Building 815 source area to evaluate (1) the best treatment technologies for the combination of contaminants present and (2) how best to reduce contaminant mass in the source area.

2.4.5. Building 850/Pits 3 and 5 (OU 5)

This OU has been divided into 3 subareas for cleanup evaluation purposes: the Pit 7 Complex, the Building 850 Firing Table area, and the Pit 2 Landfill area.

2.4.5.1. Pit 7 Complex

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 SWFS but DOE and the regulatory agencies agreed in February, 2000 that additional site characterization and evaluation of cleanup options are required prior to selecting a remedy. Consequently, the Pit 7 Complex is not covered by this Interim ROD. 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.
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 with DOE to address the Pit 7 Complex separately and not include a remedy in this Interim ROD. 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.
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 RI/FS for the Pit 7 Complex. The feasibility study portion of this document will evaluate a wider range of technologies than was presented in the SWFS. 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 amendment to the Interim ROD that will include the selected remedies for the Pit 7 Complex. 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. DOE believes that considering additional remediation alternatives for the Pit 7 Complex will result in selection of a permanent, cost-effective solution while remediation activities continue at other OUs at Site 300.

2.4.5.2. Building 850 Firing Table

Tritium, uranium, high explosives, metals, and PCBs with associated dioxins and furans were found near the Building 850 Firing Table. Shrapnel contaminated with PCB, dioxins, and furans from explosive experiments was removed in 1998. A sand pile contaminated with tritium is located on the edge of the firing table and is addressed in this Interim ROD.

2.4.5.3. Pit 2 Landfill

The Pit 2 Landfill operated from 1956 to 1960 and contains firing table waste from Buildings 801 and 802. VOCs were reported in ground water in 1989 but have not been detected since that time. There is no evidence of any other contaminant release from the Pit 2 Landfill.

2.4.6. Building 854 (OU 6)

TCE was used at Building 854 as a heat-exchange fluid and was 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 began in 1999 at Building 854 to determine how effective ground water extraction and treatment will be in reducing TCE mass in the source and center-of-mass portions of the ground water plume.

2.4.7. 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 evaluate whether ground water and soil vapor extraction will be effective cleanup measures.

2.4.8. Building 801 Dry Well and Pit 8 Landfill (OU 8)

The Building 801 firing table was used for explosives testing, and operations resulted in contamination of adjacent soil with metals and uranium. These contaminants have not been detected 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 contaminant releases from the Pit 8 Landfill.

2.4.9. Building 833 (OU 8)

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

2.4.10. Building 845 Firing Table and Pit 9 Landfill (OU 8)

The Building 845 firing table was used until 1963 to conduct explosives experiments. As a result, the soil was 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 release from the landfill has been found.

2.4.11. Building 851 Firing Table (OU 8)

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

2.4.12. CERCLA/RCRA Relationship

As stated in the Site 300 FFA, DOE intends to integrate CERCLA response obligations and Resource Conservation and Recovery Act (RCRA) corrective action obligations that relate to the release(s) of hazardous substances, hazardous wastes, pollutants or contaminants. Therefore, the FFA signatories intend that activities covered by the Site 300 FFA will achieve compliance with CERCLA, 42 U.S.C. Section 9601 et seq.; satisfy the corrective action requirements of RCRA Section 3004(u) & (v), 42 U.S.C. Section 6924(u) & (v) for a RCRA permit, and RCRA Section 3008(h), 42 U.S.C. Section 6928 (h) for interim status facilities; and meet or exceed all applicable or relevant and appropriate Federal and State laws and regulations to the extent required by CERCLA Section 121, 42 U.S.C. Section 9621.

DOE also intends that any remedial action selected, implemented, and completed will protect human health and the environment such that remediation of releases covered by this Interim ROD shall obviate the need for further corrective action under RCRA (i.e., no further corrective action shall be required). DOE agrees that with respect to releases of hazardous waste covered by this Interim ROD, RCRA shall be considered an applicable or relevant and appropriate requirement (ARAR) pursuant to CERCLA Section 121, 42 U.S.C. Section 9621.

Two previous response actions have been completed under RCRA. These are:

1. Capping and closure of the Pit 1, Pit 4, and Pit 7 Landfills in 1992, and
2. Capping and closure of the High Explosives Burn Pits in 1998.

Long term monitoring of these closures is included in formal Post-Closure Plans.

2.5. Site Characteristics

2.5.1. Geology

Regional geologic maps and stratigraphic columns for Site 300 that were based on studies prior to 1981, have been modified by more recent investigations conducted by LLNL during and subsequent to the preparation of the SWRI report. Detailed geologic logs have been prepared for most boreholes and monitor wells at Site 300. A detailed discussion of Site 300 geology is presented in Chapter 3 of the SWRI report.

Bedrock strata exposed within Site 300 have been correlated with five mappable geologic units. The units are the late Cretaceous Great Valley sequence (Kgv), the late Paleocene to mid-Eocene Tesla Formation (Tts), the mid-Miocene Cierbo Formation (Tmss), the late Miocene Neroly Formation (Tn), and the Pliocene nonmarine unit (Tps). The bedrock units are locally overlain by mid- to late-Pleistocene terrace deposits and late Pleistocene to Holocene floodplain, ravine fill, landslide and colluvial deposits.

Site 300 is located in an area of historic seismicity and Quaternary folding. The bedrock sequence within Site 300 has been slightly deformed into several gentle, low-amplitude folds.

Rocks within Site 300 are pervasively fractured. Fractures include joint sets, fractures subparallel to bedding planes, and shear zones. Frequently, thin-bedded claystones are intensively and randomly fractured. Joint sets are observed most often in the well indurated rocks present within Site 300. These rocks include the Great Valley sequence, Tesla Formation, and Neroly Formation. Joint sets are locally observed in more indurated portions of the Pliocene nonmarine unit, but well-defined joints are uncommon in these sediments and in the poorly indurated Cierbo Formation strata.

2.5.2. Hydrogeology

This section describes the general framework of the Site 300 hydrogeology, including the occurrence of surface water and ground water.

2.5.2.1. Surface Water

There are no perennial streams at Site 300. Surface water at the site consists of intermittent runoff, springs, and natural and man-made ponds. Surface water sometimes occurs locally as a result of discharge from cooling towers. Twenty-four springs have been identified at Site 300. Most of the springs have very low flow rates and are recognized only by small marshy areas, pools of water, or vegetation. Vegetation surrounding the springs includes cattails, nettles, willows, and grass. Only a few of the springs have flow rates greater than one gallon per minute (gpm).

Site 300 contains three man-made surface water bodies. A sewage treatment pond is located in the southeast corner of the site in the General Services Area (GSA) and two, lined HE rinse-water impoundments are located in the HE Process Area OU. The Carnegie State Vehicular Recreation Area (SVRA) residence pond is located offsite immediately east of the Pit 6 Landfill. In addition, there are four small, offsite stock watering ponds in the area north and west of Site 300.

There is an ephemeral pool in the northwest corner of Site 300 within the East Firing Area (EFA)/West Firing Area (WFA) created by ponding of surface water in a natural depression.

2.5.2.2. Ground Water

Site 300 is a large and hydrogeologically diverse site. Due to the steep topography and structural complexity, the stratigraphic units are discontinuous across the site. Consequently, unique hydrogeologic conditions govern the occurrence and flow of ground water and the fate and transport of contaminants beneath each OU. The hydraulic relationships between the northwest and southeast portion of the site, however, have not been well established due to sparse borehole control in the center of the site. Separate potentiometric surface contours for the five hydrogeologic units at Site 300 are shown in Figure 2.5-1.

In the northeast part of Site 300, ground water occurs under unconfined to confined conditions primarily within the Neroly Formation Lower Blue Sandstone ($Tnbs_1$) and the Cierbo Formation (Tmss) stratigraphic units which are part of the Qal-Tmss hydrogeologic unit. General ground water flow in the EFA/WFA is to the east and is controlled primarily by the dip of the bedding planes. Perched water-bearing zones also occur within the Quaternary alluvial sands and gravels and fractured siltstones and claystones of the $Tnbs_1$ and Tmss stratigraphic units. These perched zones are highly discontinuous and of variable character.

The $Tnbs_1$ hydrogeologic unit is a continuous, regional water bearing zone throughout most of the southeastern part of Site 300. Ground water in the $Tnbs_1$ hydrogeologic unit occurs within sandstones of the $Tnbs_1$ stratigraphic unit under confined to flowing artesian conditions. Ground water generally flows to the south and southeast (i.e., in the direction of dip) in the southeastern and southern parts of Site 300 as indicated by the potentiometric surface contours.

Other water-bearing zones that exist in the southeastern part of the site include the Neroly Formation Upper Blue Sandstone ($Tnbs_2$) and Tps hydrogeologic units. Ground water occurs under unconfined to artesian conditions in the $Tnbs_2$ hydrogeologic unit beneath the HE Process Area OU. The ground water flow direction in this unit is also dip-controlled and sub-parallels the flow direction in the underlying $Tnbs_1$. Perched ground water occurs primarily in gravel channels within the Tps hydrogeologic unit beneath the Building 834 and HE Process Area OUs. The ground water flow direction within these shallow, perched zones is controlled by the channel geometry of the water-bearing unit and the dip direction.

The claystone and siltstone of the Neroly Formation Lower Siltstone/Claystone ($Tnsc_1$) unit are present throughout significant portions of Site 300. Hydraulic test data indicate that this low permeability unit acts as a confining layer where present. In the Building 832 Canyon area, sandy units within the $Tnsc_1$ are important water-bearing zones that are contaminated.

The two primary hydrogeologic units where most contaminant transport occurs at Site 300 are the alluvial-shallow bedrock and bedrock water-bearing zones within the Neroly Formation. In the alluvium, which is poorly indurated, fracturing is insignificant. In addition, mass transport within the alluvium is much more significant than the influence of a fracture in the shallow bedrock underlying the alluvium. This is because the alluvium is capable of transporting a much higher volume of water per unit time.

Hydraulic test data from the Neroly Formation indicate that the Neroly behaves as a porous medium hydraulically. Observed anisotropy is not significant enough to indicate a fracture-dominated system In addition, the contaminant plumes at Site 300 generally appear to have the characteristics associated with flow through a porous media, although exceptions have been observed at Elk Ravine where the tritium plume follows bedrock shear zones and at Pit 6 where the Carnegie fault influences ground water flow.

Claystone in the Neroly Formation exhibits near-horizontal, bedding-parallel shear planes that are probably closed in the subsurface and incapable of transmitting significant volumes of subsurface fluids.

2.5.3. Nature and Extent of Contamination

Environmental investigations at Site 300 began in 1981 and are ongoing. A number of specific release sites within Site 300 have been the focus of many of these environmental investigations. The determination of the nature and extent of contamination at Site 300 is based on a detailed process performed in accordance with EPA guidelines. This process includes: records searches, interviews with operating personnel and retirees, examination of aerial photographs, site visits, and, subsurface investigations which have included soil vapor surveys, and soil, rock, ground water, and surface water analyses. Summaries of the contaminants of concern and volume of contamination (above background) are given in Table 2.5-1.

Whereas DOE and the regulatory agencies agree that characterization is sufficient to select the interim remedies documented herein, there is also agreement that continued characterization may be necessary in some cases to complete the Remedial Design documents and effectively implement the remedies. A schedule for the Remedial Design documents will be presented in the Remedial Design Work Plan due in 2001.

2.5.3.1. Identification of Contaminants of Concern (COCs)

As part of the SWFS (Ferry et al., 1999), a screening and evaluation process was conducted for the contaminants of potential concern identified in the SWRI. The objective of this evaluation process was to determine which contaminants of potential concern were actual contaminants of concern (COCs) based on the:

- Frequency with which each contaminant has been detected.
- Concentration of the contaminant relative to background concentrations.
- Risk or hazard presented by the contaminant.
- Potential for a contaminant present in soil or rock to affect ground water.

The criteria used in this evaluation process were as follows:

1. The frequency with which each contaminant has been detected. Contaminants in ground water and surface soil detected at less than 2% frequency of detection were not considered COCs. The 2% frequency of detection criteria was applied to each environmental medium (i.e., ground water, surface soil, subsurface soil, and surface water).
2. Concentration of the contaminant relative to background concentrations. If a contaminant was detected in an environmental medium at Site 300 but was reported at concentrations within the range of natural background concentrations, it is not considered a COC.
3. Risk or hazard presented by the contaminant. Contaminants in surface and subsurface soil and VOCs in surface water are not considered COCs if the calculated risk was less than 10^{-6} and the hazard index was less than one. These criteria were not used to determine COCs in ground water. Contaminants previously identified in ground and surface water but not detected for an extended period of time (at least two years) have been screened out as not indicating a degradation in water quality and thus not presenting a cause for remediation.

4. Potential for a contaminant in soil or rock to affect ground water. Contaminants in surface soil and subsurface soil or rock are not considered COCs if the modeling results indicate the contaminant does not present a threat to ground water.

Table 2.5-2 lists contaminants in ground water and surface water screened out because of criteria 2 through 4.

Also, naturally occurring compounds or radioisotopes that were not considered COCs in the Post-Closure Plan Monitoring Programs for waste disposal units were not considered COCs here. The constituents of concern selected for a specific waste disposal unit in the Post-Closure Plan Monitoring Programs were based on one or more of the following criteria:

- Records specifically identify the constituent of concern as being disposed of in the waste disposal unit or potentially associated with the buried waste.
- The constituent of concern has been detected above background concentrations in soil, ground water and/or surface water in the immediate vicinity of the waste disposal unit indicating a previous release.
- The constituent of concern is a contaminant or breakdown product that can be reasonably expected to be associated with the type of waste disposed of in the waste disposal unit.

Any contaminant detected in surface soil at greater than 2% frequency and above background concentrations is considered to be a COC if (1) a risk above 10^{-6} or hazard quotient above one was calculated for complete exposure pathways for the contaminant and media, and/or (2) the contaminant presents a potential threat to ground water as determined by modeling.

Any contaminant detected in subsurface soil above background concentrations is considered a COC if (1) a risk above 10^{-6} or hazard quotient above one was calculated for complete exposure pathways for the contaminant and media, and/or (2) the contaminant presents a potential threat to ground water as determined by modeling.

Any constituent detected in ground water at greater than 2% frequency and above background concentrations and not screened out by one of the above criteria is considered a COC.

VOCs recently detected in surface water are considered to be COCs if a risk greater than 10^{-6} or hazard quotient greater than one was calculated for an inhalation pathway. Non-VOC constituents detected at greater than 2% frequency were compared to COCs in ground water in the same OU. If a non-VOC constituent detected in surface water is present as a COC in ground water, that contaminant will be addressed in the ground water remedial alternatives.

2.5.3.2. Sources of Contamination

Historical information and analytic data have been used to identify the nature and extent of anthropogenic contamination in environmental media. These data were also used to identify contaminants of potential concern at Site 300 and within each OU for contaminant fate and transport modeling and baseline risk analyses.

As a result of detailed site-wide and OU-specific environmental investigations, a number of locations where contaminants have been released to the environment were identified. Because of the complex nature and history of Site 300, a variety of contaminant sources exist at the site.

These sources include: (1) surface spills, (2) leakage from transfer pumps, piping, and tanks, (3) landfills and pits, (4) underground fuel tanks, (5) disposal lagoon discharges, (6) dry well discharges, (7) leaching from contaminated gravel, and (8) septic tank discharges.

2.5.3.3. Nature and Extent of Contamination in Soil and Rock

Many of the borehole soil, rock, and surface soil samples collected at Site 300 have been analyzed for semivolatile compounds and VOCs, California and EPA-listed metals, pesticides, and herbicides, HE compounds, tritium, and uranium. Although a number of these substances that have been detected in soil and rock are attributed to Site 300 operations, some occur naturally. Background concentrations for naturally occurring substances (i.e., some metals, and radionuclides) were established in Section 4.2.2 of the SWRI and Appendix A of the SWFS.

In general, the highest concentrations and greatest extent of soil and rock contamination coincide with areas of known surface or near surface releases. The compounds most frequently found in release areas in soil and rock at Site 300 are TCE, perchloroethylene (PCE), certain HE compounds, and tritium. Analytic and historical data indicate that solvents containing VOCs were released to the environment via surface spills, discharges to some disposal lagoons, leachate from landfills, pits and debris burial trenches, dry wells, and pipe leaks from facility equipment. Table 2.5-1 provides a description of each release site with its associated COCs. VOCs have been identified as COCs in subsurface soil/rock in the Building 834, HE Process Area, Building 854 and Building 832 Canyon OUs, as well as at the Building 801 dry well, Building 833, and Building 851 firing table release sites.

Prior to 1990, tritium was used during explosives testing in the EFA/WFA and became entrained in gravel used to cover the firing tables. The firing table gravels were periodically disposed of in several disposal pits in the northern portion of the site. Tritium was identified as a COC in subsurface soil/rock in the Building 850 Firing Table area.

The HE compounds high melting explosives (HMX) and research department explosives (RDX) have been found primarily at decommissioned rinsewater lagoons in the HE Process Area, but have also been reported sporadically in samples collected in other portions of the site. HE compounds were identified as COCs in surface soil in the HE Process Area OU, Building 854 OU, Building 832 Canyon OU, the Building 850 Firing Table, and the Building 851 firing table area. HE compounds were also identified as COCs in the vadose zone at the HE Process Area OU, Building 832 Canyon OU, and the Building 845 firing table release site.

Other less frequently detected contaminants in surface and/or subsurface soil/rock include uranium, metals, PCBs, dioxins, furans, and nitrate. Uranium has been identified as a COC in surface and/or subsurface soil/rock in the vicinity of the Building 850 Firing Table and the Building 845 and Building 851 firing tables.

Metals were identified as COCs in surface soil near Building 854, and in the vicinity of the Building 850 and Building 851 firing tables. Surface soil in the vicinity of the Building 850 Firing Table and Building 854 is contaminated with PCBs. Dioxins and furans have also been detected in surface soil near Building 850. Nitrate has been detected in the vadose zone in the Building 832 Canyon OU, however it is not certain whether the nitrate is anthropogenic or naturally occurring. This issue is currently being investigated.

2.5.3.4. Nature and Extent of Contamination in Ground Water

Ground water has been encountered in multiple hydrogeologic units beneath Site 300. LLNL has installed more than 500 ground water monitor wells throughout Site 300 since environmental investigations began in 1981. Analytic data from sampling of these wells have been used to assess the nature and extent of ground water contamination. Ground water samples from these wells have been analyzed for metals regulated by drinking water standards, regulated inorganic compounds, organic compounds including VOCs, HE compounds, ions (including general minerals), radiologic substances (including uranium and tritium), PCBs, pesticides, phenols, phenolics, and perchlorate.

Although a variety of compounds have been detected in ground water, various metals, radionuclides, inorganic compounds, and ions occur naturally in ground water. To determine whether these substances are naturally occurring, background concentration data from Site 300 and from a ground water quality database maintained by the United States Geological Survey (USGS) were evaluated in the SWRI. Site 300 ground water concentration and/or activity data were also analyzed, as appropriate, on a well-by-well basis for the presence of a statistically significant positive trend.

Because VOCs and HE compounds detected at Site 300 are known to be anthropogenic in origin, there are no background concentrations for these substances. Perchlorate and TBOS/TKEBS have also been identified as anthropogenic contaminants in ground water at Site 300. As a result, these compounds are classified as chemicals of potential concern if their frequency of detection is $\geq$2%, unless sufficient evidence exists that the detection of a compound was not related to a release or that the contaminant is no longer present in ground water.

VOCs, including chloroform, 1,1-dichloroethylene (DCE), 1,2-DCE, 1,2-dichloroethane (DCA), 1,1,1-trichloroethane (TCA), TCE, and PCE are routinely detected in ground water at several locations throughout the site (i.e., at process and test complexes, maintenance facilities, and a few disposal pits). Generally, TCE constitutes the major VOC component in ground water; comprising up to 98% of the total VOCs in some areas. The highest VOC concentration detected was 800,000 micrograms per liter (µg/L) of TCE beneath the Building 834 Complex in the southeastern portion of the site.

Tritium has been detected in ground water beneath and downgradient from several disposal pits and firing tables at Site 300. The highest tritium activities detected in ground water were 2,660,000 picocuries per liter (pCi/L) at the Pit 3 Landfill and 471,000 pCi/L at the Building 850 Firing Table.

Other contaminants frequently detected in ground water at numerous locations throughout the site include nitrate in the HE Process Area, Pit 6 Landfill area, and at Buildings 834, 850, 854, 830, and 832; and perchlorate in the HE Process Area, the Pit 6 Landfill, and at Buildings 850, 854, 830, and 832.

Contaminants detected less frequently in ground water at Site 300 include depleted uranium at Pits 3, 5, and 7, Building 850, and the Building 851 firing table; HE compounds (RDX, HMX, and 4-amino-2,6-dinitrotoluene [DNT]) in the HE Process Area; and TBOS/TKEBS at Building 834.

Several compounds that were listed as ‘contaminants of concern’ in the SWFS and Proposed Plan have subsequently been determined to be of no concern because they have not been detected for a number of years. These include acetone and toluene in the Building 834 OU, toluene in the Pit 6 Landfill OU, carbon disulfide, toluene and xylenes in the HE Process Area OU, tritium and uranium in the Building 854 OU, benzene and toluene in the Building 833 area, and all VOCs at the Building 851 firing table.

Updated isoconcentration maps (Figures 2.5-2 through 2.5-26) have been prepared for the Site 300 OUs to reflect more recent data obtained since the SWFS and Proposed Plan. These maps, showing concentrations of the primary contaminants in ground water, are based on the latest data available through the end of calendar year 1999 and are discussed below.

- Building 834 OU: Distribution of TCE (Fig. 2.5-2) and nitrate (Fig. 2.5-3) in ground water. Ground water contamination is restricted to a perched zone of limited extent in the Qt-Tpsg and Tps-$Tnsc_2$ units. There has been no impact on the underlying $Tnbs_1$ regional aquifer.
- Pit 6 Landfill OU: Distribution of TCE (Fig. 2.5-4), tritium (Fig. 2.5-5), and perchlorate and nitrate (Fig. 2.5-6) in ground water. Shallow ground water and the regional aquifer are contaminated and may be in hydraulic communication. The contamination is of limited extent with concentrations near and below drinking water Maximum Contaminant Levels (MCLs). Guard wells demonstrate that there is no contamination offsite.
- HE Process Area OU: Distribution of TCE (Figs. 2.5-7 and 2.5-8), RDX (Fig. 2.5-9), nitrate (Fig. 2.5-10), and perchlorate (Fig. 2.5-11) in ground water; distribution of TCE (Fig. 2.5-12), nitrate (Fig. 2.5-13), and perchlorate (Fig. 2.5-14) in ground water in the vicinity of the HE Burn Pit portion of the HE Process Area. The highest concentrations are in the Tps unit in which ground water exists as discontinuous perched zones of limited extent. Concentrations near the site boundary are below MCLs. TCE also exists in the $Tnbs_2$ aquifer which is artesian near the site boundary, but offsite wells indicate no significant contamination. Water from the $Tnbs_2$ unit is used offsite for agricultural purposes. Actions are underway to contain contamination onsite. Contamination at the Burn Pit area involves isolated water-bearing zones in the $Tnsc_1$, which are locally perched and of limited extent.
- Building 850: Distribution of tritium and perchlorate in the Building 850 area (Fig 2.5-15), depleted uranium (Fig. 2.5-16), and nitrate (Fig. 2.5-17). Tritium contamination in the shallow alluvial/bedrock water-bearing zone in the vicinity of Building 850 is separated from the underlying deep aquifer in the Cierbo Formation by a thick claystone confining layer.
- Pit 2 Landfill: VOCs were detected in ground water in 1989 but have not been detected since that time. There is no evidence of further releases from the Pit 2 Landfill. Data indicate that the tritium in the Pit 2 Landfill area originates from Building 850.
- Building 854 OU: Distribution of TCE (Fig. 2.5-18), nitrate (Fig. 2.5-19), and perchlorate (Fig. 2.5-20) in ground water. Contamination occurs in a perched water-bearing zone within the Neroly bedrock and is separated from the underlying deep aquifer in the Cierbo Formation by a thick claystone confining layer.

- Building 832 Canyon OU: Distribution of TCE (Fig 2.5-21), nitrate (Fig. 2.5-22), and perchlorate (Fig. 2.5-23) in ground water. Contamination is primarily present in the Qal, $Tnbs_2$, and $Tnsc_1$ units.
- Building 801/Pit 8 Landfill: TCE (Fig. 2.5-24) occurs in ground water in the $Tnbs_1$ regional aquifer. TCE concentrations are below MCLs. Nitrate, which was previously depicted as a plume based on a single analysis and detection at greater than 45 milligrams per liter (mg/L), is no longer present in any wells above the 45 mg/L MCL.
- Building 833: Distribution of TCE (Fig. 2.5-25) in ground water. TCE exists in a very limited, shallow, perched water-bearing zone (Qt, Tps, $Tnsc_2$) which is isolated from the underlying $Tnbs_1$ regional aquifer.
- Building 851 firing table: Distribution of depleted uranium (Fig. 2.5-26) in ground water. A small amount of uranium contamination exists in ground water in the Qal-Tmss hydrogeologic unit.

2.5.3.5. Nature and Extent of Contamination in Surface Water

No perennial streams exist at or near Site 300. Runoff occurs within ravines and intermittent stream channels during and following heavy rains. Except for small areas in the northeastern and northwestern portions of Site 300, runoff that does not infiltrate into the ground eventually discharges into Corral Hollow Creek. This creek is an intermittent stream which flows west to east near the southern perimeter of the site. Such discharges, however, are rare.

Other surface water bodies and discharges at Site 300 include 24 seeps and springs located throughout the site; two double-lined, State-regulated Class II surface-water impoundments at the HE process area that are used to evaporate HE process rinsewater; cooling tower discharge locations; and a lined sewage pond located in the southeast corner of the site. The lined sewage pond accepts sewage from the GSA for biotreatment and evaporation. Septic tanks and leach fields provide for sewage discharge from other facilities at the site. The HE process rinsewater surface impoundments; the sewage treatment pond, sewer lagoons, septic tanks and leach fields; and the cooling tower discharges are all regulated under existing Waste Discharge Orders.

Surface water samples have been collected and analyzed from Corral Hollow Creek, smaller drainages and other ephemeral surface water runoff sources in the vicinity of Site 300 facilities, and from several springs across the site. VOCs or tritium have been detected periodically in several springs throughout the site. VOCs have been detected in surface water in the Pit 6 Landfill OU (Spring 7, sampled at well BC6-13), Building 832 Canyon OU (Spring 3), and the HE Process Area OU (Spring 5, sampled at W-817-03A). Of these, only Spring 3 in the Building 832 Canyon has any potential for offsite flow.

2.6. Current and Potential Future Site and Resource Uses

2.6.1. Current Onsite Land Uses

Site 300 is primarily an experimental test facility that conducts research, development, and testing associated with high-explosives materials. This work includes explosives processing, preparation of new explosives, and pressing, machining, and assembly of explosives components. Site 300 activities also include hydrodynamic testing for verifying computer simulation results, obtaining equation-of-state data for explosives materials, evaluating material behavior at assembly joints and welds, evaluating the quality and uniformity of implosion, and evaluating the performance of post-nuclear test design modifications. Access to Site 300 is restricted.

2.6.2. Reasonably Anticipated Future Onsite Land Use

LLNL Site 300 is a federal facility owned by the U.S. DOE and operated by the University of California. DOE plans for LLNL Site 300 to function as an experimental test facility to support the Department's mission of research, development, and testing of high explosives materials. Statements from Congressional representatives and the Administration regarding the importance of the National Laboratories to the nation's continued scientific and defense interests indicate that Site 300 will continue as a research facility, and active DOE control of the site is expected to continue. Provisions in the Site 300 FFA and in law assure that DOE will not transfer lands with unmitigated contamination that could cause potential harm. Because of DOE's current intentions and these assurances, non-DOE land uses for Site 300 have not been considered in any future land use assumptions.

The Site 300 Federal Facility Agreement provides:

Section 28.1 The Department of Energy shall retain liability in accordance with CERCLA, not withstanding any change in ownership or possession of the real property interests comprising the Federal Facility. The Department of Energy shall not transfer any real property interests comprising the Federal Facility except in compliance with Section 120(h) of CERCLA, 42 U.S.C. § 9620 (h).

CERCLA Section 120 (h) provides:

Section (3) (A) . . . in the case of any real property owned by the United States on which any hazardous substance was stored for one year or more, known to have been released, or disposed of, each deed entered into for transfer of such property by the United States to any other person or entity shall contain –

(ii) a covenant warranting that

(l) all remedial action necessary to protect human health and the environment with respect to any such substance remaining on the property has been taken before the date of such transfer, and

(II) any additional remedial action found necessary after the date of such transfer shall be conducted by the United States.

[or](C)(i)... the Administrator or Governor, as the case may be, determines that the property is suitable for transfer, based on a finding that –

(I) the property is suitable for transfer for the use intended by the transferee, and the intended use is consistent with protection of human health and the environment; …

2.6.3. Current Offsite Land Use

Offsite land use in close proximity to the Site 300 boundary (Fig 2.6-1) includes:

- The Gallo ranch to the south and Connolly ranch to the south and east, primarily used for cattle grazing.

- California Department of Fish and Game ecological preserve to the east.
- Carnegie State Vehicular Recreation Area (SVRA) to the southwest; an outdoor recreational facility for private and commercial off-road motorcycle riding, testing, and racing.
- Primex, Inc. to the northeast; a privately owned HE testing facility.
- Vieira ranch land to the northeast (proposed Tracy Hills Development) and west.
- Yroz ranch land and Mulqueeny ranch land to the north and northwest, respectively.

2.6.4. Reasonably Anticipated Future Offsite Land Use

Site 300 was selected as the LLNL test site because of the sparsely populated surrounding area. Many of the neighboring land owners do not live on their properties. On the basis of the residential population, the average density around the perimeter of Site 300 is less than one person per square mile. The surrounding land is used for cattle grazing, a State recreational vehicle park, high explosives testing by a private firm, and an ecological reserve. Recently, a developer purchased land to the north and east of Site 300. Plans are underway to build a housing development on this property. However, a Final Environmental Impact Report prepared for the City of Tracy proposes to designate land adjoining the east portion of the Site 300 north border and the northern portion of the Site 300 east border as open space. The open space (shown in Figure 2.6-1) would create a buffer of approximately one to one and a half miles in width between Site 300 and residential elements of the development. The buffer zone would be used for cattle or sheep grazing, and would have limited access points at existing trails for hikers, mountain bikers and equestrians. In the past, development in the immediate vicinity of Site 300 has been hindered by the absence of potable water, opposition to development by local residents and land owners, and endangered species habitat issues. If these issues are resolved in the future, it is possible that residential development of the land in the vicinity of Site 300 could occur.

2.6.5. Current Ground and Surface Water Uses

Offsite, ground water is currently used for:

2. Dust suppression,
3. Stock watering,
4. Irrigation,
5. Fire suppression, and
6. Drinking.

Onsite, ground water is used for

1. Cooling towers,
2. HE processing,
3. Fire suppression, and
4. Drinking.

Onsite, bottled water is the primary source of drinking water, however ground water from uncontaminated aquifers is available as necessary. Offsite, some water-supply wells are used as a drinking water source. In 2002, Site 300 is anticipated to be connected to the Hetch Hetchy water system and ground water will be used only for emergency fire suppression.

There is no current onsite use of surface water. Offsite, a pond at the Carnegie SVRA is used for fire suppression. This pond is primarily replenished by ground water from a nearby well.

2.6.6. Potential Ground and Surface Water Uses

The California RWQCB-Central Valley Region's Water Quality Control Plan (Basin Plan) establishes beneficial uses and water quality objectives (WQOs) for ground water and surface waters in the Central Valley region. State Water Quality Control Board (SWRCB) Resolution No. 88-63 specifies that all surface and ground waters of the State are considered suitable or potentially suitable, for municipal or domestic water supply with the following exceptions: (1) those water bodies with yields below 200 gallons per day (gpd), (2) total dissolved solids exceeding 3,000 mg/L parts per million (ppm), or (3) contamination that cannot reasonably be treated for domestic use by either best management practices or best economically achievable treatment practices. In the absence of a Basin Plan Amendment excluding certain ground water bodies, all ground water below Site 300 and adjacent properties is presumed potentially suitable for municipal or domestic supply.

Although a formal EPA ground water classification analysis has not been performed for Site 300, it is likely that ground water in several of the deeper aquifers in the area would be classified as Class IIA (current source of drinking water) or Class IIB (potential source of drinking water). A number of the smaller, discontinuous perched ground water bodies within Site 300 would probably be designated as Class III (not a potential source of drinking water and of limited beneficial use).

Figure 2.6-2 shows the relationship of ground water contamination to onsite and offsite water-supply wells. Water-supply Well 20 currently provides all potable water used at Site 300. This well is screened from 387 to 518 ft below ground surface (bgs). Although several nearby wells screened in the overlying aquifer contain TCE, Well 20 does not provide a conduit to or affect ground water flow in the upper aquifer because it is sealed through this upper aquifer. No contaminants have ever been detected in this well. Well 18 is also used as a backup water-supply well. Well 18 has had sporadic detections of TCE throughout its sampling history, but has not exceeded 1 µg/L since 1992. Low concentrations of VOCs have been sporadically detected in offsite wells Gallo-1 and CDF-1 and the owners of these wells are aware of these impacts. No other offsite wells are threatened by contamination from Site 300.

Figure 2.6-2 also shows the direction of ground water flow where known. Several onsite wells have been sealed and abandoned or their use has been discontinued due to impacts from contaminants or to eliminate the possibility of the wells acting as conduits for contaminant migration. "Well 11" was drilled in March 1959 to a total depth of 310 ft bgs. The water level soon after drilling was 230 ft below the surface. However, the borehole went dry shortly thereafter and was abandoned without being cased. Thus, it is highly unlikely that this borehole could affect ground water movement. Although not documented, it is assumed that "abandoned" means that the borehole was backfilled with grout and/or cuttings to the surface, as was common during this time period.

"Well 14" was drilled in November 1960 to a total depth of 185 ft bgs. Water was never encountered in this borehole, it was never cased and was subsequently abandoned. As with

"Well 11", it is unlikely that this borehole has had any impact on contaminant migration or ground water flow. The best available information indicates that the site of the "Well 14" borehole lies beneath Building 853, a water pumping station for Building 850.

WM1 and WM2 were two former "windmill" wells that existed before Site 300 became a federal facility. There is no available information on the completion or current status of these wells. Field searches have failed to locate the wells.

Wells W-MS1, W-MS2, W-MS3, W-MS4, and W-HS1 were also wells that pre-date Site 300. These wells have not been located in the field. There is no record of their completion details or current disposition. Because these wells (and WM1) are not in areas of known ground water contamination, this knowledge is less critical.

Offsite wells STONEHAM1, ELISS-1, Gallo-1, CDF-1, and CON-1 are currently used for offsite domestic and/or stock supply. The Gallo-2 and CON-2 wells are currently not used. Well CARNRW1 provides potable supply for visitors and employees of the Carnegie State Vehicle Recreation Area (SVRA). CARNRW2 provides fire suppression water. CARNRW3 through CARNRW6 are not currently used.

2.7. Summary of Site Risks

A baseline risk assessment was conducted for Site 300 (Webster-Scholten, 1994) to evaluate risks to people, plants, and animals that may be exposed to contaminants in soil, air, surface water, or ground water.

2.7.1. Basis for Action

The response actions selected in this Interim ROD are necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances from this site. Selection of cleanup actions is based in part on the extent to which they can reduce these risks.

Although ground water in several areas of Site 300 contains high concentrations of contaminants, there is no current exposure to human receptors.

The primary COCs at Site 300 are organic solvents, HE compounds, and tritium in soil and ground water, and PCBs, chlorinated dibenzo-p-dioxins (CDDs), and dibenzofurans (CDFs) in surface soils. Nitrate, perchlorate, and uranium have also been identified in ground water, but do not generally drive the cleanup decisions. Tables 2.7-1 through 2.7-4 list the COCs at each OU addressed in this Interim ROD, along with the historical maximum concentration and the maximum concentration in ground water and surface water reported in 1999.

2.7.2. Human Health Risks

The baseline risk assessment estimated the site risks if no cleanup action were taken. It provides a basis for taking action and identifies the contaminants and exposure pathways that need to be addressed by the remedial actions. This section of the Interim ROD summarizes the results of the baseline risk assessment for Site 300.

Figure 2.7-1 shows the conceptual site model of how risks and hazards are evaluated. It includes the primary sources, release mechanisms, pathways, exposure routes, and receptors.

At Site 300, the baseline risk assessment consists primarily of a study conducted in 1993 and presented in the SWRI (Webster-Scholten, 1994). This has been supplemented with assessments described in the Building 850 SWRI Addendum (Taffet et al., 1996), the Building 854 Characterization Summary Report (U.S. DOE, 1998), and the Building 832 Canyon Characterization Summary Report (Ziagos and Ko, 1997). A summary was presented in the SWFS (Table 1-18). Exposure concentrations were determined from the 95% upper confidence limit of observed concentrations, along with standard modeling techniques where appropriate.

Since the baseline assessments were performed, some significant changes have occurred. Remedial actions have taken place or have been initiated in some locations. At other locations, concentrations of major contaminants have decreased and/or the understanding of the extent of contaminants has changed—especially where further sampling has indicated greater extents of nitrate and perchlorate. Where those changes are important to the selected remedy, they are explained qualitatively in this Interim ROD. The next formal recalculation of risks will take place as part of a formal risk and hazard management program.

For carcinogens, risks are generally expressed as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to a carcinogen. Excess lifetime cancer risk is calculated from the following equation:

$$\text{Risk} = \text{CDI} \times \text{SF}$$

where:

risk = a unitless probability (e.g., 2×10^{-5}) of an individual developing cancer.

CDI = chronic daily intake averaged over assumed exposure period (mg/kg-day).

SF = slope factor, expressed as $(\text{mg/kg-day})^{-1}$.

These risks are probabilities that usually are expressed in scientific notation (e.g., 1×10^{-6}). An excess lifetime risk of 1×10^{-6} indicates that an individual experiencing the reasonable maximum exposure estimate has a 1 in 1,000,000 chance of developing cancer as a result of site-related exposure. This is referred to as an “excess lifetime cancer risk” because it would be in addition to the risks of cancer individuals face from other causes such as smoking or exposure to ultraviolet radiation. The chance of an individual developing cancer from all other causes has been estimated to be as high as one in three. EPA’s generally acceptable risk range for site-related exposures is 1×10^{-4} to 1×10^{-6}. U.S. EPA requires that cancer risks above one in one million must be addressed by various risk controls and/or remedial actions.

The potential for noncarcinogenic effects is evaluated by comparing an exposure level over a specified time period (e.g., life-time) with a reference dose (RfD) derived for a similar exposure period. An RfD represents a level to which an individual may be exposed that is not expected to cause any deleterious effect. The ratio of exposure to toxicity is called a hazard quotient (HQ). An HQ less than 1 indicates that a receptor’s dose of a single contaminant is less than the RfD and that toxic noncarcinogenic effects from that chemical are unlikely. The Hazard Index (HI) is generated by adding the HQs for all chemical(s) of concern that affect the same target organ (e.g., liver) or that act through the same mechanism of action within a medium or across all media to which a given individual may reasonably be exposed. An HI less than 1 indicates that, based on the sum of all HQs from different contaminants and exposure routes, toxic noncarcinogenic effects from all contaminants are unlikely. An HI greater than 1 indicates that site-related exposures may present a risk to human health.

The HQ is calculated as follows:

Non-cancer HQ = CDI/RfD

where:

CDI = Chronic daily intake.

RfD = reference dose.

CDI and RfD are expressed in the same units and represent the same exposure period (i.e., chronic, subchronic, or short-term).

Baseline human health risks and hazards for Site 300 were estimated using industrial adult onsite exposure and offsite residential exposure scenarios. The adult onsite exposure scenario estimates health risk where an adult is assumed to work in the immediate vicinity of worst-case contamination 8 hours a day, 5 days per week, for 30 years. The residential exposure scenario estimates the risk to a family living adjacent to the site. The risks associated with ingestion of ground water were calculated for residents drinking water from hypothetical wells at the site boundary and from existing private wells near the site.

Risk estimates for most release sites and contaminants were well below the protective 1×10^{-6} threshold designated by the U.S. EPA. Adult onsite risks above this threshold were generally associated with: (1) workers inhaling VOCs volatilizing from the subsurface or (2) direct skin contact and incidental ingestion of PCBs, dioxins, and furans in the soil. Risks greater than 10^{-6} and HIs greater than 1 are listed in Table 2.7-5. Onsite risks are also associated with drinking contaminated ground water. However, ground water from contaminated aquifers is not used for drinking at Site 300.

Estimated offsite residential risks were associated with people potentially drinking contaminated ground water over a 70-year period or inhaling vapors volatilizing from contaminated surface water. However, no members of the public are currently being exposed to any contaminants from Site 300.

Human health risks for the OUs addressed in this Interim ROD are summarized in the following sections.

2.7.2.1. Summary of Human Risks for the Building 834 Area

The Building 834 area baseline risk assessment prepared as part of the SWRI (Webster-Scholten, 1994) determined that the only exposure route that could potentially result in unacceptable risk is for onsite workers exposed to VOC vapors evaporating from subsurface soil in and around facility buildings. Based on soil sample analyses made in 1983, an excess human cancer risk from inhalation of VOC vapors inside of Building 834D was calculated as 1×10^{-3} (one in one thousand) with an HI of 36. This means that a person spending 8 hours a day, 5 days a week, for 30 years inside Building 834D could have a one in one thousand additional chance of contracting cancer and would have a risk of experiencing a non-cancerous medical effect. This potential exposure route is limited to employees working within Building 834D. Building 834D is currently used as a storage facility without any regular occupants.

The baseline risk assessment also indicated a human cancer risk of 6 $\times 10^{-4}$ (six in ten thousand) and an HI of 21 for inhalation of TCE by workers outdoors in the vicinity of Building 834D. This potential exposure is limited to employees working onsite in the vicinity of Building 834D.

These risk calculations assumed no remedial action would occur. Full scale ground water extraction began in 1995 and soil vapor extraction began in August 1998 to mitigate VOC inhalation risk in the Building 834 area.

Although the perched ground water in the Building 834 area contains high concentrations of contaminants, there is no current exposure from ground water to human receptors. Modeling indicates that contaminants from the Building 834 area would not significantly impact offsite water-supply wells.

The Building 834 area is isolated and access is restricted by full-time security patrols and fencing that surrounds Site 300 and public exposure is unlikely.

2.7.2.2. Summary of Human Risks for the Pit 6 Landfill

The baseline risk assessment for the Pit 6 Landfill area determined that there was a risk to onsite workers who may inhale VOC vapors evaporating from subsurface soil in the landfill. An excess human cancer risk from inhalation of VOC vapors from the landfill was calculated as 5×10^{-6} (five in one million). This means that a person spending 8 hours a day, 5 days a week, for 30 years at the landfill near a release site may have a five in one million additional chance of contracting cancer. This potential exposure route is limited to employees working onsite in the immediate vicinity of the landfill. The landfill cap, installed as part of a CERCLA removal action in 1997, mitigates this inhalation risk.

A cancer risk of 4×10^{-5} (four in one hundred thousand) was also identified for onsite workers inhaling VOC vapors from surface water at Spring 7 (Figure 2.5-4). Since it has been dry for several years, there is currently no potential for VOC inhalation from this spring. However, if the spring were to become active again, VOC analyses of nearby shallow ground water strongly suggest that VOC concentrations will be far below those used in the baseline risk assessment.

The baseline risk assessment also identified a future cancer risk for offsite residents inhaling TCE volatilizing from the surface of the State Vehicular Recreational Area residence pond located east of the landfill (Figure 2.5-4). This risk scenario assumed no cleanup actions would be taken and that VOCs would migrate to the water supply wells used to fill the pond. However, VOCs have not migrated to the water-supply wells, the landfill cap was installed to prevent further releases of VOCs, and ground water TCE concentrations upgradient have substantially diminished.

2.7.2.3. Summary of Human Risks for the HE Process Area

The baseline risk assessment for the HE Process Area determined that there was a risk to onsite workers who may inhale VOC vapors evaporating from subsurface soil in the vicinity of

Building 815. The excess human cancer risk from inhaling VOC vapors in the Building 815 area was calculated as 5×10^{-6} (five in one million). This means that a person spending 8 hours a day, 5 days a week, for 30 years in the vicinity of Building 815 may have a five in one million additional chance of contracting cancer. The potential exposure route is limited to employees working onsite in the immediate vicinity of Building 815. The maximum historical VOC concentration detected in shallow subsurface soil was TCE at 0.05 ppm in 1987.

An excess cancer risk of 1×10^{-5} (one in one hundred thousand) was also identified for onsite workers potentially inhaling VOC vapors from surface water at Spring 5. This risk was calculated from VOC concentrations in an adjacent well since the actual flow in Spring 5 is too low to measure and the spring consists of moist soil with wetland vegetation. It was assumed for risk assessment purposes that the same water-bearing unit in which the well is completed feeds the spring. The baseline assessment also assumed that the concentrations in the shallow ground water were the same as in the spring. No one regularly works in the vicinity of Spring 5 and VOC concentrations in ground water that feeds the spring have decreased over time. More than half of the calculated risk resulted from the presence of 1,1-DCE which has not been detected in ground water in the area since 1987.

Modeling also indicated a potential exposure at the site-boundary if a well were placed there and used to supply drinking water. The calculated risks for ingestion of VOCs and the HE compound RDX sum to 1×10^{-5}. Ground water extraction began in 1999 immediately upgradient of the site boundary to prevent any offsite migration of contaminants. Furthermore, upgradient concentrations in ground water have substantially decreased since the baseline risk assessment was performed.

Although the ground water in the HE Process Area source areas contains high concentrations of contaminants, there is no exposure to human receptors from ground water.

2.7.2.4. Summary of Human Risks for the Building 850 Area

The baseline risk assessment calculated a risk of 5×10^{-4} (five in ten thousand) associated with potential inhalation/ingestion of resuspended particulates and direct dermal exposure with surface soil contaminated with PCBs at the Building 850 Firing Table area. In addition, a risk of 1×10^{-4} (one in ten thousand) was calculated for potential inhalation/ingestion of suspended particulates and direct dermal contact with surface soil contaminated with chlorinated dibenzo-p-dioxins (CDDs) and dibenzofurans (CDFs).

No unacceptable risk or hazard associated with tritium and uranium in subsurface soil/rock in the Building 850 area has been identified. However, tritium in the sand pile could pose a potential threat to ground water. Although ground water in the Building 850 area contains high concentrations of tritium, there is no current exposure from ground water to human receptors.

2.7.2.5. Summary of Human Risks for the Pit 2 Landfill Area

No COCs emanating from the Pit 2 Landfill have been identified in any environmental media and thus no risk or hazard to human health was identified in the baseline risk assessment.

2.7.2.6. Summary of Human Risks for the Building 854 Area

No unacceptable risk or hazard to human health has been identified in this area associated with lead, zinc, HMX, or tritium. A baseline human health risk of 7×10^{-5} (seven in one hundred thousand) is posed by incidental ingestion and direct dermal contact with PCB-contaminated soil. The calculated risk means that an onsite worker exposed 8 hours a day, 5 days a week for 30 years could have a seven in one hundred thousand additional chance of developing cancer. This was based on PCB concentrations reported from a single sample; PCBs were not reported in any other sample. The Building 854 facility is no longer used, so the exposure scenario does not currently apply.

A baseline risk assessment inhalation risk of 5×10^{-6} (five in one million) for adult onsite workers was calculated for inhalation of VOCs in air inside Building 854F based on VOCs detected in ambient air sampling in 1996 (Ziagos and Reber-Cox, 1998). Building 854F is not currently used for daily operations. Therefore, there is currently no regular human exposure to VOCs within this building.

The baseline risk assessment also identified a risk of 1×10^{-5} (one in one hundred thousand) for VOCs in the air outside of Building 854F. This was also based on ambient air measurements made in 1996. Concurrent measurements of VOC flux from the subsurface failed to detect any VOCs. Furthermore, the VOCs reported (chloroform and 1,2-DCA) are not significant contaminants at the site.

Although the ground water in the Building 854 area contains high concentrations of contaminants, there is no current exposure from ground water to human receptors.

2.7.2.7. Summary of Human Risks for the Building 832 Canyon Area

A baseline cancer risk of 3×10^{-6} (three in one million) was calculated for inhalation of VOCs by onsite workers inside Building 830. The risk was calculated using data from ambient air samples collected within Building 830 (Ziagos and Ko, 1997). The total VOC inhalation risk was based on a calculated cancer risk of 2.5×10^{-6} risk for vinyl chloride and 3×10^{-7} for TCE. The vinyl chloride inhalation risk was based on one of two soil vapor flux measurements in which vinyl chloride was detected. Vinyl chloride is not a COC in the Building 832 Canyon OU and has not been detected in either ground water or the vadose zone in the Building 830 area. In addition to the collection of ambient air samples, soil vapor flux measurements were made concurrently at Building 830 to better quantify VOC vapor concentrations and help eliminate possible contributions from sources other than subsurface soil. Vinyl chloride was not detected in any of the soil vapor flux measurements, suggesting that there is probably no source related to subsurface soil contamination.

A baseline risk of 1×10^{-5} (one in one hundred thousand) was calculated for onsite workers inhaling VOCs outside Building 830. The risk was calculated using data from ambient air samples collected outside in the vicinity of Building 830. The total VOC inhalation risk was based on calculated cancer risks of 4×10^{-6} for chloroform, 4×10^{-6} for 1,2-DCA, and 2×10^{-6} risk for vinyl chloride. The risks for chloroform, 1,2-DCA, and vinyl chloride were based on single detections. These three compounds were not detected in ambient air samples collected in the vicinity of Building 830 the following day. Vinyl chloride and 1,2-DCA are not COCs at Site 300 and these compounds have not been detected in the vadose zone in the Building 830 area. As discussed previously, soil vapor flux measurements were made concurrently with the ambient air sampling. Vinyl chloride, 1,2-DCA, and chloroform were not detected in any of the flux measurements, suggesting that there is probably no source of these compounds in subsurface soil.

A baseline cancer risk of 3×10^{-6} (three in one million) was calculated for inhalation of dichloropropane by onsite workers inside Building 832. The risk was calculated using data from ambient air samples collected within Building 832 (Ziagos and Ko, 1997). Dichloropropane is not a COC in the Building 832 Canyon OU, and has not been detected in either ground water or the vadose zone in the Building 832 area. In addition to the collection of ambient air samples, soil vapor flux measurements were made concurrently at Building 832 and dichloropropane was not detected in any of the flux measurements, suggesting that there is probably no source related to subsurface soil contamination.

The baseline risk assessment also identified an inhalation risk of 6×10^{-5} (six in one hundred thousand) for adult onsite workers for TCE and PCE volatilizing from surface water at Spring 3 to ambient air. There are no site employees that regularly work in the vicinity of Spring 3. Therefore the exposure assumption that a worker would be inhaling VOCs volatilizing from the spring for 8 hours a day, 5 days a week for 30 years, on which the baseline risk calculation was based, does not currently apply. TCE concentrations in Spring 3 have decreased from a maximum of 200 µg/L in 1985 to 27 µg/L in 1998. PCE has not been detected at the spring in the last five years. Therefore, the current risk is probably lower than calculated in the baseline risk assessment.

Although the ground water in the Building 832 Canyon area contains high concentrations of contaminants, there is no current exposure to human receptors from ground water.

No risk or hazard associated with HMX in the subsurface soil/bedrock in these areas have been identified.

2.7.2.8. Summary of Human Risks for the Building 801 Dry Well and Pit 8 Landfill

No unacceptable risk or hazard associated with contaminants in surface soil, subsurface soil/bedrock, or ground water were identified for the Building 801 Dry Well or Pit 8 Landfill in the baseline risk assessment.

2.7.2.9. Summary of Human Risks for the Building 833 Area

The baseline risk assessment for the Building 833 area determined that there was a risk to onsite workers who may inhale VOC vapors evaporating from subsurface soil in Building 833. An excess human cancer risk from inhalation of VOC vapors was calculated as 1×10^{-6} (one in one million) inside of Building 833. This means that a person spending 8 hours a day, 5 days a week, for 30 years inside Building 833 may have a one in one million additional chance of contracting cancer. This potential exposure route is limited to employees working onsite inside Building 833. The baseline risk assessment also determined that no other Site 300 workers are affected or potentially affected by contaminated soil or soil vapor at this facility.

Although the perched ground water in the Building 833 area contains high concentrations of VOCs, there is no current exposure to human receptors from ground water. Modeling indicates that contaminants from the Building 833 area would not impact offsite water-supply wells. In addition, exposure, use, or ingestion of the contaminated ground water is highly unlikely because the perched water-bearing zone is naturally unsuitable for drinking water, contaminants are geologically isolated from the regional aquifer, and a San Joaquin County ordinance prohibits installation of shallow water-supply wells.

2.7.2.10. Summary of Human Risks for the Building 845 Firing Table and Pit 9 Landfill

No unacceptable risk or hazard associated with contaminants in surface soil, subsurface soil/bedrock, or ground water were identified for the Building 845 firing table or the Pit 9 Landfill in the baseline risk assessment.

2.7.2.11. Summary of Human Risks for the Building 851 Firing Table

No risk or hazard associated with contaminants in surface soil, subsurface soil/bedrock, or ground water was identified for this area in the baseline risk assessment. Uranium in ground water is below the drinking water standard and at similar levels to those at which uranium naturally occurs in ground water in this area. The water-bearing zone in the Building 851 firing table area affected by the contamination is not used for drinking water. No unacceptable risk or hazard to human health was identified for VOCs, uranium, RDX, cadmium, copper, and zinc in surface or subsurface soil/rock.

2.7.3. Ecological Hazard Assessment

The Site 300 baseline ecological assessment (Webster-Scholten, 1994) 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 animal species that could potentially visit or migrate into contaminated areas at Site 300. Table 2.7-6 summarizes ecological hazards identified for each OU. HQs for individual ground squirrels exceeded 1 for TCE and PCE in the Building 834 and Pit 6 Landfill OUs. In addition, HQs for cadmium exceeded 1 for adult animals in the Building 834, HE Process, and Building 850 areas. However, an evaluation of the percentage of the affected population, as well as the distribution of the ground squirrel population (both in space and time), provides evidence that the Site 300 ground squirrel population has not been adversely impacted by contaminants at the site.

HQs for individual deer exceeded 1 for cadmium in the Building 834, HE Process, Building 850, and Building 801 areas. In 1994, additional soil samples were collected throughout the site and a detailed record of deer sightings was maintained and analyzed. Areas with deer sightings generally had low to non-detectable cadmium levels, indicating that the localized presence of cadmium does not pose a significant threat to the deer populations as their primary habitat does not exhibit elevated cadmium levels. The source of the cadmium is unknown.

HQs for individual San Joaquin kit fox (a listed endangered species) exceeded 1 for TCE, PCE, and cadmium in the Building 834 OU, and for TCE and PCE in the Pit 6 Landfill OU. While there is no evidence that kit fox currently use these areas, individual kit fox living in dens in these areas in the future are potentially at risk.

A single observation of a Swainson's Hawk (a threatened species) was made in the California Department of Fish and Game Ecological Reserve located adjacent to Site 300. However, Site 300 is not its preferred habitat. The Swainson Hawk's normal territory is from about 2,000 to 10,000 acres and it is unlikely that any single individual would spend significant time at Site 300. Therefore, localized contamination at Site 300 is unlikely to cause any adverse impacts.

2.7.3.1. Summary of Ecological Hazards for the Building 834 Area

The Building 834 area baseline ecological assessment prepared as part of the SWRI (Webster-Scholten, 1994) determined a risk from TCE, PCE and cadmium existed for ground squirrels, deer and kit fox. Individual juvenile ground squirrels and individual kit fox are at risk from inhalation of TCE and PCE (the combined inhalation HI exceeded 1 for these species). Individual adult ground squirrels, kit fox and deer are also at risk from ingestion of cadmium. The combined oral and inhalation pathway HQ exceed 1 for these species, which was driven by the oral pathway. Site-wide population surveys and area-specific presence/absence surveys to identify the true risk to these biota found no current adverse impacts.

2.7.3.2. Summary of Ecological Hazards for the Pit 6 Landfill

The Pit 6 Landfill baseline ecological assessment prepared as part of the SWRI (Webster-Scholten, 1994) determined a risk from VOCs (primarily TCE and PCE) existed for ground squirrels and kit fox. Individual ground squirrels and individual kit fox are at risk from inhalation of VOCs (the combined inhalation HI exceeded 1 for these species). An engineered layer was installed as part of the landfill cap to prevent exposure of squirrels and kit fox to contaminants in the pit. Site-wide population surveys and area-specific presence/absence surveys to identify the current risk to these biota found no adverse impacts.

2.7.3.3. Summary of Ecological Hazards for the HE Process Area

The HE Process Area baseline ecological assessment prepared as part of the SWRI (Webster-Scholten, 1994) determined a risk from copper and cadmium existed for aquatic organisms, ground squirrels, and deer. Aquatic organisms are at risk from copper in the shallow, near surface ground water at a location designated as Spring 5. The Toxicity Quotient using California Applied Action Levels exceeded 1 for copper in ground water samples from this location. Individual adult ground squirrels and individual adult and juvenile deer are at risk from ingestion of cadmium. The combined oral and inhalation pathway HQ exceed 1 for these species, which was driven by the oral pathway. Surveys for the presence of surface water at Spring 5, and algae and micro-invertebrate bioassays conducted to identify the true risk to aquatic organisms found no current adverse impact. Similarly, site-wide population surveys to identify the current risk to deer and ground squirrels found no adverse impacts.

2.7.3.4. Summary of Ecological Hazards for the Building 850 Area

The Building 850 area baseline ecological assessment prepared as part of the SWRI (Webster-Scholten, 1994) and the SWRI addendum (Taffet et al. 1996) determined a risk from copper, zinc, cadmium and PCBs/CDDs/CDFs existed for ground squirrels, deer and kit fox at Building 850. Individual adult ground squirrels and individual adult and juvenile deer are at risk from ingestion of cadmium. The combined oral and inhalation pathway HQ exceeded 1 for these species, which was driven by the oral pathway. Individual ground squirrels, deer and kit fox were determined to be at risk from PCBs/CDDs/CDFs due to the capacity of these contaminants to bioaccumulate in the environment.

The baseline ecological assessment also indicated that aquatic organisms are at risk from copper and zinc and individual adult ground squirrels are at risk from combined copper and cadmium at Spring 6. The Toxicity Quotient using California Applied Action Levels exceeded 1 for zinc, and exceeded 1 for copper using the Federal Ambient Water Quality criteria. Algae and micro-invertebrate bioassays conducted to identify the current risk to aquatic organisms at Spring 6 found no current impacts. Similarly, site-wide population surveys and area-specific presence/absence surveys to identify the current risk to vertebrate biota found no adverse impacts.

2.7.3.5. Summary of Ecological Hazards for the Pit 2 Landfill Area

No COCs emanating from the Pit 2 Landfill have been identified in any environmental media and no risk or hazard to ecological receptors was identified in the baseline risk assessment.

2.7.3.6. Summary of Ecological Hazards for the Building 854 Area

No unacceptable hazard to ecological receptors in the Building 854 area has been identified. There are no exposure pathways for receptors because the affected portions of the Building 854 area are paved and do not provide sufficient ecological habitat.

2.7.3.7. Summary of Ecological Hazards for the Building 832 Canyon Area

The Building 832 Canyon baseline ecological assessment prepared as part of the SWRI (Webster-Scholten, 1994) determined that there were no unacceptable impacts from VOCs to ecological receptors at Buildings 830 and 832.

2.7.3.8. Summary of Ecological Hazards for the Building 801 Dry Well and Pit 8 Landfill

No unacceptable risk or hazard associated with contaminants in subsurface soil/bedrock or in ground water was identified in the Building 801 dry well or Pit 8 Landfill in the baseline risk assessment.

2.7.3.9. Summary of Ecological Hazards for the Building 833 Area

The Building 833 area baseline ecological assessment prepared as part of the SWRI (Webster-Scholten, 1994) determined that contaminants in the area do not pose an unacceptable threat to plants or animals.

2.7.3.10. Summary of Ecological Hazards for the Building 845 Firing Table and Pit 9 Landfill

No unacceptable risk or hazard associated with contaminants in surface soil or subsurface soil/bedrock was identified in the Building 845 firing table or the Pit 9 Landfill area in the baseline risk assessment.

2.7.3.11. Summary of Ecological Hazards for the Building 851 Firing Table

No unacceptable risk or hazard associated with contaminants in surface soil and subsurface soil/bedrock was identified in this area in the baseline risk assessment. No unacceptable risk or hazard to ecological receptors was identified for VOCs, uranium, RDX, cadmium, copper, and zinc in surface or subsurface soil/rock.

2.8. Remedial Action Objectives

The National Oil and Hazardous Substances Pollution Contingency Plan (NCP) specifies that Remedial Action Objectives (RAOs) be developed which address: (1) contaminants of concern, (2) media of concern, (3) potential exposure pathways, and (4) preliminary remediation levels.

The development of these goals involves consideration of action-specific ARARs and requirements that may become ARARs in the Final ROD, along with the results of the baseline human and ecological risk assessment in the SWRI. All proposed actions are based upon the assumption that cleanup standards for ground water contaminant concentrations in the Final ROD will be between MCLs and background. RAOs for the Site 300 OUs addressed by this Interim ROD are:

For Human Health Protection:

- Restore ground water containing contaminant concentrations above cleanup standards which will be set in the Final ROD.
- Prevent human incidental ingestion and direct dermal contact with contaminants in surface soil that pose an excess cancer risk greater than 1×10^{-6} or an HQ greater than 1, a cumulative excess cancer risk (all carcinogens) in excess of 1×10^{-4}, or a cumulative HI (all noncarcinogens) greater than 1.
- Prevent human inhalation of VOCs and tritium volatilizing from subsurface soil to air that pose an excess cancer risk greater than 1×10^{-6} or HQ greater than 1, a cumulative excess cancer risk (all carcinogens) in excess of 1×10^{-4}, or a cumulative HI (all noncarcinogens) greater than 1.
- Prevent human inhalation of VOCs and tritium volatilizing from surface water to air that pose an excess cancer risk greater than 1×10^{-6} or HQ greater than 1, a cumulative excess cancer risk (all carcinogens) in excess of 1×10^{-4}, or a cumulative HI (all noncarcinogens) greater than 1.
- Prevent human inhalation of contaminants bound to resuspended surface soil particles that pose an excess cancer risk greater than 1×10^{-6} or HQ greater than 1, a cumulative excess cancer risk (all carcinogens) in excess of 1×10^{-4}, or a cumulative HI (all noncarcinogens) greater than 1.
- Prevent human exposure to contaminants in media of concern that pose a cumulative excess cancer risk (all carcinogens) greater than 1×10^{-4} and/or a cumulative HI greater than 1 (all noncarcinogens).

For Environmental Protection:

- Restore water quality, at a minimum, to protect beneficial uses within a reasonable timeframe. Prevent migration of contaminants into pristine waters. This will apply to both individual and multiple constituents that have additive toxicology or carcinogenic effects.
- Ensure ecological receptors important at the individual level of ecological organization (State of California or federally listed or endangered species or State of California species of special concern) do not reside in areas where relevant HIs exceed 1.
- Ensure existing contaminant conditions do not change so as to threaten wildlife populations and vegetation communities.

To the degree that these cleanup objectives are achieved by interim measures, the interim measures may be selected as the final cleanup remedies for the site pending review of their effectiveness and any needed contingency plans. The Final ROD will make the ultimate determination.

2.9. Description of Alternatives

This section describes the interim remedial alternatives considered to address COCs in the Site 300 OUs presented in this Interim ROD. To develop these remedial alternatives, DOE/LLNL retained technologies based on applicability, implementability, effectiveness, cost, site- and OU-specific requirements, and best professional judgment. Innovative technologies will continue to be considered for cleanup application throughout the process of remediation, and will only be implemented following appropriate regulatory reviews. These technologies may be introduced into the process if site conditions change or technology development and testing indicate a potential for cost-effective and/or expedited remediation.

Presumptive remedies and/or technologies were incorporated into the alternatives where appropriate. Presumptive remedies are preferred technologies for common categories of sites, based on historical patterns of remedy selection and scientific and engineering evaluation of technology performance data by the U.S. EPA. The objective of the U.S. EPA presumptive remedy program is to “use the program’s past experience to streamline site investigation and speed up selection of cleanup actions.” As stated in EPA Guidance, “the use of presumptive remedies simplifies and streamlines the remedy selection process by:

1. Reducing the large number and diverse assortment of technologies to relatively few technology types.
2. Eliminating the need to perform the technology screening portion of the FS.
3. Allowing, in some cases, further consideration and selection among the presumptive technologies to be deferred from the Feasibility Study and ROD to the Remedial Design (RD), which prevents duplication of effort and allows selection to be based on additional data collected during the RD.”

In some cases, it may be appropriate to specify a general remedial strategy for a release site, but defer selection of specific technologies until the RD. Remediation-specific details, such as the number and location of extraction wells used for a pump-and-treat alternative, are approximations based on best professional judgment and are presented in this Interim ROD for purposes of costing and strategy presentation only. The actual site- and technology-specific details will be based on additional data and design criteria which will be presented in the RDs.

A no-action alternative is required by the NCP to provide a baseline for comparison to other remedial alternatives and is the postulated basis of the baseline risk assessment. Under a no-action response for an area, DOE would not be required to perform further investigation, monitoring, reporting, or risk management. For each area at Site 300, a no-action alternative was included as Alternative 1.

In some areas, 'no further action' is considered for specific contaminants and media and included as a remedy component in other alternatives. No further action is considered only in areas where (1) no risk or hazard is posed by contaminants, (2) there is no potential of further impact to ground water, and (3) natural processes will continue to reduce contaminant concentrations over time. The only media for which no further action remedies are presented are surface soil or subsurface soil/bedrock. DOE assumes that ground water and surface water monitoring would be required, regardless of whether or not an active remedy is implemented. COCs are only considered for no further action where no risk greater than 1×10^{-6} or HI greater than 1 is present and no significant threat to ground water has been identified.

There are no costs associated with the no-action alternatives and no further action measures.

The interim remedial alternatives for all OUs are summarized in Table 2.9-1, along with their total estimated cost.

2.9.1. Common Elements of Alternatives

Sections 2.9.1.1 and 2.9.1.2 describe elements that are common to many of the alternatives. The common elements are not described further in Section 2.9, but are included in the comparative evaluation of alternatives (Section 2.10).

2.9.1.1. Monitoring

Although not considered a ground water response or remedial technology, monitoring is included in all alternatives except for a no-action response.

Monitoring is defined as the routine, periodic, baseline sampling and analysis of contaminated media not associated with the operation and optimization of remediation systems.

In most cases, monitoring will consist of collecting ground water samples from existing monitor wells and surface water bodies. Collecting water or vapor samples from extraction wells is not included in monitoring costs, but is included in extraction and treatment costs. Ground water monitoring would be conducted at all OUs to:

- Track changes in plume concentration and size that results from remediation or natural processes.
- Evaluate the effectiveness of the remedial action.
- Determine when cleanup standards are achieved. Cleanup standards are to be set in the Final ROD.
- Detect any future releases of contaminants.

Every five years, physical surveys of plant and wildlife communities will be conducted at Site 300 to determine species composition for the purpose of identifying new species of potential concern (i.e., rare, threatened or endangered) that may be at risk from contaminants at Site 300. Should such species be determined to be present in areas of contamination at Site 300, the appropriate regulatory agency will be consulted and a preliminary screening assessment will be conducted as required.

The sampling and water level measurement frequency is assumed to be quarterly. Analyses will include all COCs. For cost estimation purposes only, DOE/LLNL assumes that monitoring will be performed for a period of 30 years. Details of the actual monitoring based on site-specific needs will be submitted in the Site-Wide Compliance Monitoring Plan (CMP) in 2002.

2.9.1.2. Risk and Hazard Management

The overall goal of risk management is to control exposure to contaminants and ensure the remedies protect human health and the environment while RAOs are being achieved.

Risk and hazard management is included where the risk at any exposure point exceeds 1×10^{-6} or the HI is greater than 1, exclusive of ingestion of contaminated ground water. Measures to prevent ingestion of ground water are included in risk management wherever ground water contamination exists above concentrations protective of human health.

Administrative controls are the basis of most risk management measures, i.e., building access restrictions, ventilation controls, and measures to prevent people from drinking contaminated ground water. DOE/LLNL will implement these measures to ensure that the selected remedies protect human health and the environment. Site 300 access is currently restricted by fencing and a full time security force. Building occupancy and land use are controlled by Site 300 Management. Therefore, only risk and hazard management measures that supplement existing controls are included. Land-use restrictions include controls on installing water-supply wells, where applicable, to prevent establishing complete exposure pathways for ingestion of contaminated ground water.

It is assumed that Site 300 will remain under the control of DOE and that the access restrictions to the site (fencing, security patrols) currently in place will continue. All remedies would be re-evaluated if any transfer of ownership or change in land use is anticipated. DOE will meet its commitments in the Site 300 FFA, Sections 28 (Transfer of Real Property) and 37 (Facility Closure), regarding its cleanup obligations if property ownership and/or land use changes in the future (see Section 2.6.2 for the details of these provisions).

To ensure that human health is protected, access to Site 300 will continue to be restricted and all personnel working onsite will be briefed on areas of contamination and possible hazards. Site 300 is enclosed within a security fence, posted with signs noting the restricted access, and manned by a full-time security force to prevent unauthorized intrusion. Future property use at those areas identified in the Interim ROD to have baseline cancer risks greater than 10^{-6} or non-carcinogenic hazard indices greater than 1 will be restricted to current uses, remediation activities, and surface storage of equipment or material, until such time as new risk assessments show the risk and hazard have fallen below those thresholds.

No excavation shall occur within areas of contamination or at landfills except for approved remedial actions. Activities in landfill areas will be restricted to those that will not expose landfill material or compromise the integrity and protectiveness of landfill caps. No activity inconsistent with this use restriction may commence without the prior written concurrence of the FFA signatories. The maintenance of operating facilities at Site 300 will be governed by institutional controls managed through DOE's Integrated Safety Management program, which will be referenced in the CMP.

DOE shall provide DTSC, RWQCB, and U.S. EPA with prior written notification of any action that would be inconsistent with the above use restrictions. Such written notification shall include an evaluation of the risk to human health or the environment posed by the proposed activity and propose any necessary changes to the remedial action selected in the Interim ROD. U.S. EPA will advise whether a ROD amendment or an Explanation of Significant Differences would be required. DOE will not take action without first receiving written concurrence from DTSC, RWQCB, and U.S. EPA concerning DOE's evaluation of risk and proposal for any changes to the remedial action.

During remediation, DOE will implement a formal risk and hazard management program which will include periodically: (1) collecting additional environmental samples at locations where a human health risk is above 1×10^{-6} or a HI greater than 1 has been identified in the baseline risk assessment, (2) reviewing exposure pathway-related conditions such as building occupancy and land use, (3) refining the risk and hazard models using current data, and (4) reporting the results to the stakeholders. A set of standard sampling conditions such as time of year, range of acceptable temperatures, and wind speed will be developed to minimize variability in ambient air and surface soil samples.

The Site 300 Contingency Plan **(**CP) will include actions to be proposed in the event a remedy does not achieve RAOs, or if any new contaminants are found for which the selected remedies are not adequate to achieve RAOs. The Site 300 CP will address possible property transfer or change in land use. The Site 300 CP will also address situations where the existing access restrictions are removed or relaxed. No significant or fundamental changes to the remedies chosen herein shall be made without an Explanation of Significant Differences or ROD Amendment, as required by CERCLA and the NCP.

As part of the LLNL program to mitigate impacts to wildlife, biologists will monitor those areas in which the relevant ecological HI exceeds 1. Currently, the only threatened, endangered or species of special concern that may be potentially exposed to unacceptable levels of contaminants are predatory fossorial species (e.g., the San Joaquin kit fox). Thus, areas where the ecological HI for the San Joaquin kit fox exceeds 1 will be monitored. Should kit fox or other predatory fossorial species of special concern to wildlife agencies be found in these areas, DOE will consult with the appropriate wildlife agency to develop response actions, such as monitoring or animal relocation.

Biologists will monitor Site 300 for the presence of sensitive species not previously identified. The life history of these species will be reviewed to determine the potential for unacceptable exposure to contaminants present at the site. Should it be determined that new species have a potential risk of exposure, their presence in areas where relevant HIs exceed 1 (such as those for ground squirrels or deer) will be determined and discussed with the regulatory agencies.

The current LLNL program of conducting ecological resource surveys for sensitive species prior to the initiation of any ground-disturbing activities will also continue. The need for detailed ecological resource surveys will be evaluated every five years as part of the contract renewal negotiations between the University of California and DOE.

The following activities are included in risk and hazard management actions, as appropriate to that release site or OU:

1. Implement institutional controls to manage risks:
   - Establish building occupancy and/or land use restrictions to ensure that the risks and hazards estimated in the baseline risk assessment are not exceeded due to changing conditions at the site, and that the remedy remains protective of human health and the environment; and
   - Erect warning signs to ensure compliance with area access restrictions and site-specific building occupancy and land use restrictions.
2. Develop and implement a risk and hazard monitoring and assessment program:
   - Collect and analyze air, water, or soil samples to determine current exposure concentrations of COCs;
   - Where applicable, conduct wildlife surveys by biologists to evaluate the presence of the San Joaquin kit fox or other fossorial vertebrate species of special concern and if found, consult with the appropriate wildlife agencies to develop response actions such as monitoring or animal relocation, and evaluate the presence of new species of special concern;
   - Integrate these data into risk assessment calculations to determine any changes in risks and hazards; and
   - Review these data to evaluate compliance with RAOs.
3. Develop and implement Operational Safety Plans for all remedial actions where risks or hazards can be foreseen.

The risk and hazard monitoring and assessment program for Site 300 will be presented in detail in the Site 300 CP. The Landfill Maintenance Program will be documented in the CMP, scheduled for 2002.

All required institutional controls will be implemented jointly by LLNL environmental and facilities management staff. Table 2.9-2 provides an itemization of the institutional controls included in each appropriate alternative and OU.

2.9.1.3. Discharges of Treated Ground Water

Where ground water is extracted and treated, the treated ground water may be discharged to the surface in compliance with Substantive Requirements from the RWQCB. The effluent limitations and other invariable provisions that will be included in Substantive Requirements issued by the RWQCB are provided in Appendix B. No runoff from the discharge locations will occur. The actual Substantive Requirements will become attached to the CMP. DOE will comply with all prohibitions, limitations, specifications and provisions specified in the

Substantive Requirements and Monitoring and Reporting Program issued by the RWQCB. The Monitoring and Reporting Program will be replaced and superceded by the CMP when it is finalized.

2.9.2. Remedial Alternatives for Building 834 (OU 2)

Past spills at the core of the Building 834 complex have resulted in the contamination of subsurface soil/bedrock and ground water. The COCs in subsurface soil/bedrock are primarily VOCs, predominantly TCE. COCs in ground water include VOCs, TBOS/TKEBS, and nitrate. Ground water contaminants are present in a shallow perched aquifer (Qt-Tpsg).

Dense non-aqueous-phase liquids (DNAPLs) and light non-aqueous-phase liquids (LNAPLs) may be present in ground water. In general, if a ground water VOC concentration is 1% to 10% of the solubility of that VOC in ground water, a DNAPL may be present. The aqueous solubility of TCE is 1,100,000 µg/L and thus TCE concentrations in the range of 11,000 to 110,000 µg/L or greater may indicate DNAPL.

Ground water and soil vapor extraction and treatment have been ongoing since 1995 under an Interim ROD for this OU. The Building 834 OU is now included in this Interim Site-Wide ROD. Remediation has reduced TCE concentrations from a historical maximum of 800,000 µg/L to 94,000 µg/L in 1999 and TBOS/TKEBS concentrations from 7,300,000 µg/L to 720,000 µg/L in 1999. Nitrate concentrations have decreased from a historical maximum of 480 mg/L to 320 mg/L. No new subsurface soil data are available to determine recent VOC concentrations in soil/bedrock, although soil vapor extraction (SVE) has reduced soil/bedrock mass and concentrations by removing approximately 45 kilograms of VOCs from the vadose zone since 1995. Other remedial activities performed at Building 834 include the excavation of VOC-contaminated soil in 1983 and installation of a surface water drainage diversion system in 1998 to prevent rainwater infiltration in the source area.

Three remedial alternatives were assembled to address COCs in environmental media in the Building 834 OU as described below.

Alternative 1—No Action

Alternative 2—Monitoring, Exposure Control, Ground Water and Soil Vapor Extraction and Treatment

The primary components of Alternative 2 include:

1. Monitoring of soil vapor and ground water.
2. Risk and hazard management to prevent human exposure to COCs and to mitigate impacts to ecological receptors.
3. Extraction and treatment of ground water and soil vapor at the Building 834 Complex source area to mitigate risk and hazards posed by VOCs in subsurface soil and to protect and restore beneficial uses of ground water. Extraction and treatment of ground water will also be conducted downgradient of the source area to control plume migration and restore beneficial uses of ground water.

Ground water and soil vapor remediation would be continued to: (1) reduce soil VOC concentrations in the vadose zone to acceptable risk- and hazard-based concentrations, (2) reduce soil vapor VOC concentrations in the vadose zone to levels protective of ground water, and (3) reduce COC concentrations in ground water to meet RAOs and to achieve mass removal and plume migration control.

COCs in ground water at the source area include VOCs, TBOS/TKEBS, and nitrate. The primary VOC mass removal mechanism would be by SVE. SVE is an *in situ* process that physically removes contaminants from the vadose zone by inducing air flow through the soil/bedrock. The flowing air strips VOCs from the soil/bedrock and carries them to the extraction wells and eventually to a treatment system. SVE and treatment would also address residual DNAPLs. SVE has been identified as a technology that can effectively remediate volatile DNAPLs in the unsaturated zone and prevent uncontrolled migration of VOCs in soil gas. Ground water extraction wells will be used primarily to dewater the perched water-bearing zone, thereby enhancing remediation by SVE. Soil vapor and ground water would be simultaneously extracted (dual-phase extraction) from approximately 25 wells completed in the shallow, perched water-bearing zone (Tps). This dual-phase extraction is considered a presumptive remedy by EPA for remediation of VOCs and other contaminants in subsurface formations.

Dual-phase extraction will be continued at approximately seventeen wells located in the Building 834 Complex core area for source area mass removal. Ground water and soil vapor will be extracted from about eight additional wells located from 300 to 700 feet downgradient of the Building 834D source area to control plume migration. All extracted ground water and soil vapor would be treated using the existing treatment systems. VOCs in ground water would be treated using an air sparging unit with aqueous-phase granular-activated carbon (GAC) polish or other similar technology capable of removing VOCs. The final component of the treatment train would consist of phytoremediation or other appropriate technology demonstrated to be effective in removing nitrate. Air sparging and GAC are listed by EPA as presumptive technologies for the treatment of dissolved organic contaminants such as VOCs. Vapor from the ground water treatment system would be treated using vapor-phase GAC. An oil-water gravity separator would be used to separate TBOS/TKEBS from ground water prior to entering the air sparging system. Treated ground water effluent would be pumped to an effluent storage tank and later discharged onsite through an air misting system to a sloped, undeveloped grassy area east of the Building 834 Complex. Air misting would be conducted in a manner to maximize evaporation. The low discharge rate would not create surface flow or attract wildlife. The treated effluent would be discharged in accordance with Substantive Requirements issued by the RWQCB. Extracted soil vapor would be treated using vapor-phase GAC and discharged to the atmosphere in accordance with the permit requirements issued by the San Joaquin Valley Unified Air Pollution Control District (SJVUAPCD). The spent GAC from the soil vapor and ground water treatment systems would be disposed or regenerated at an offsite treatment facility.

As part of the hazard management program to mitigate impacts to the kit fox, biologists will monitor the Building 834 area. Should the kit fox or other fossorial vertebrate species of special concern to wildlife agencies be found in the Building 834 area, DOE will consult with the California Department of Fish and Game to develop response actions, such as animal relocation.

The estimated present-worth cost of Alternative 2 for the Building 834 OU is $12,125,000 based on 30 years of monitoring, exposure control, and ground water and soil vapor extraction.

Alternative 3—Monitoring, Exposure Control, and Ground Water and Soil Vapor Extraction and Treatment, and Plume Migration Control by Enhanced In Situ Bioremediation

Alternative 3 combines the monitoring, exposure control, and ground water and soil vapor extraction described in Alternative 2 with downgradient plume control and mass removal by enhanced *in situ* bioremediation of VOCs. The enhanced *in situ* bioremediation component would consist of injecting a carbon source into approximately 12 injection wells located downgradient of Building 834. Indigenous microorganisms use the carbon as an electron donor and consume available oxygen as an electron acceptor. The indigenous denitrifying bacteria begin to use nitrate as an electron acceptor, converting nitrate (NO_3^-) to nitrite (NO_2^-) when dissolved oxygen concentrations decrease below 2 mg/L. With a continued supply of an electron donor, the bacteria will further reduce the NO_2^- to innocuous nitrogen gas. Indigenous bacteria begin the reductive dechlorination of TCE once the available dissolved oxygen and nitrate supplies are exhausted.

As part of Alternative 3, about eight of the downgradient wells located 300 to 700 feet downgradient of the Building 834D source area would be used for both ground water/soil vapor extraction, as well as enhanced *in situ* bioremediation. A suitable carbon source would also be injected in approximately four wells located at the distal portion of the TCE plume approximately 800 to 1,200 ft from Building 834D for additional plume migration control.

The estimated present-worth cost of Alternative 3 for the Building 834 OU is $14,504,000 based on 30 years of monitoring, exposure control, ground water and soil vapor extraction, and *in situ* bioremediation.

2.9.3. Remedial Alternatives for the Pit 6 Landfill (OU 3)

From 1964 to 1973, approximately 1,900 cubic yards of waste was buried in nine unlined debris trenches and animal pits at the landfill, resulting in the contamination of surface water and ground water. The material buried included laboratory and shop debris and biomedical waste. The COCs in surface water include VOCs, primarily TCE. COCs in ground water include VOCs (primarily TCE), tritium, nitrate, and perchlorate. Contaminants in ground water are restricted to the uppermost section (Qt and $Tnbs_1$) of the Qt-Tmss hydrogeologic unit.

VOC concentrations in ground water have naturally attenuated over the past several years and are close to or below MCLs in all wells. VOC concentrations in ground water have declined from a historical TCE maximum of 250 µg/L in 1988 to 6.3 µg/L in 1999. Concentration plots of TCE versus 1,2-DCE concentrations indicate that TCE is degrading naturally.

Tritium activities are above background in ground water samples from four wells indicating a localized release from one area within the landfill. This release may be the result of rainwater infiltration through areas of subsidence in the landfill prior to installation of the pit cap. The maximum tritium activity detected in ground water (2,520 pCi/L) is below the 20,000 pCi/L State MCL. No evidence of anthropogenic releases of other radioactive contaminants has been detected in soil or ground water samples collected during environmental investigations.

Perchlorate has been detected in ground water at a maximum of 65 µg/L in one well. Nitrate has also recently been detected in ground water at one well at a concentration of 228 mg/L.

In 1988, shallow subsurface ground water samples collected from the Spring 7 area contained TCE at 110 µg/L, but by 1999 had dropped to 0.83 µg/L. All other VOCs were below 1 µg/L in 1999. No contaminants other than VOCs have been detected at Spring 7.

A landfill cap was installed as a CERCLA removal action in 1997 to prevent infiltrating precipitation from further leaching contaminants from the buried waste. Other remedial activities performed at the Pit 6 Landfill include removal of waste contaminated with depleted uranium in 1971.

Three remedial alternatives were assembled to address COCs in environmental media in the Pit 6 Landfill OU as discussed below.

Alternative 1—No Action

Alternative 2—Monitoring, Exposure Control, and Monitored Natural Attenuation

The primary components of Alternative 2 include:

1. Monitoring ground water and surface water.
2. Risk and hazard management to prevent human exposure to COCs and to mitigate impacts to ecological receptors.
3. Monitored natural attenuation of VOCs and tritium in ground water.

Alternative 2 includes natural attenuation to reduce VOC concentrations and tritium activities in ground water to meet RAOs. EPA defines natural attenuation as "the naturally occurring process in soil and groundwaters that act without human intervention to reduce the mass, toxicity, mobility, volume, or concentration of contaminants in those media." Contaminant concentrations may naturally attenuate *in situ* through the processes of degradation or decay, dispersion, dilution, sorption, precipitation, volatilization, and/or chemical and biochemical stabilization of contaminants. Natural attenuation may be demonstrated through a variety of lines of evidence including static or retreating plume concentration contours, the presence of contaminant breakdown products, or the formation or depletion of geochemical indicator compounds. As part of the CP, performance criteria will be established and contingent remedies will be described. No significant or fundamental changes to the remedies chosen herein shall be made without an Explanation of Significant Differences or ROD Amendment, as required by CERCLA and the NCP.

Source control measures have been implemented at the Pit 6 Landfill through the installation of the landfill cap in 1997.

The following activities would be conducted to monitor the effectiveness of monitored natural attenuation (MNA):

1. Measure ground water levels.
2. Perform ground water and surface sampling and analysis.

3. Manage, analyze, and present data.
4. Perform fate and transport modeling to predict the spatial distribution of COCs over time and demonstrate the efficacy of monitored natural attenuation in meeting RAOs and other requirements that may be established as ARARs in the Final ROD. If modeling does not support MNA, alternate remedies will be proposed.
5. Install additional monitoring wells, if required.

Because ground water monitoring data for perchlorate and nitrate are limited, DOE/LLNL will continue to monitor ground water to determine if and when an active remedy for these COCs might be necessary. Monitoring of shallow subsurface water will continue at CARNRW2 until all VOCs are below cleanup standards. Risk and hazard management measures would be implemented if exposure or hazard becomes a problem in the future. The risk and hazard management program will include: (1) implementing restrictions for construction in the area, (2) reviewing exposure pathway-related conditions such as facility and land use, (3) refining risk and hazard modeling using current data, and (4) reporting the results to the stakeholders.

The estimated present-worth cost of Alternative 2 for the Pit 6 Landfill OU is $2,376,000 based on 30 years of monitoring, exposure control, and monitored natural attenuation.

Alternative 3—Monitoring, Exposure Control, Monitored Natural Attenuation of Tritium in Ground Water, and Extraction and Treatment of VOCs and Perchlorate in Ground Water

Alternative 3 combines the ground water monitoring, exposure control, and monitored natural attenuation of tritium in ground water described in Alternative 2 and adds the extraction and treatment of VOCs and perchlorate in ground water.

The ground water extraction and treatment component of this alternative includes extracting ground water from wells located downgradient (east-southeast) of the Pit 6 Landfill. TCE and perchlorate in extracted ground water would be treated using aqueous-phase GAC. A fixed-film bioreactor would be added to the treatment system if necessary to reduce perchlorate concentrations to meet discharge requirements. As there is currently no cost-effective technology available for the treatment of tritiated ground water, the treated water containing only tritium would be re-injected into the subsurface. Treated ground water effluent would be discharged onsite under Substantive Requirements issued by the RWQCB. The spent GAC would be disposed or regenerated at an offsite treatment facility.

The estimated present-worth cost of Alternative 3 for the Pit 6 Landfill OU is $5,939,000 based on 30 years of monitoring, exposure control, MNA, and ground water extraction and treatment.

2.9.4. Remedial Alternatives for the HE Process Area (OU 4)

Surface spills at the drum storage and dispensing area for the former Building 815 steam plant resulted in the release of TCE and other VOCs to the vadose zone and ground water. Other COCs in ground water include HE compounds, nitrate, and perchlorate. The presence of these contaminants is likely the result of wastewater discharges to former unlined rinsewater lagoons. HE compounds have also been detected in surface soil and the vadose zone. In addition, VOCs, nitrate, and perchlorate have been detected in ground water in the vicinity of the former HE Burn Pits.

Contaminants in ground water in the vicinity of Building 815 have been detected in the clays and silts of the Tps unit and in shallow $Tnbs_2$ and $Tnsc_1$ bedrock. VOC concentrations in ground water in the Building 815 area have decreased over time, with TCE decreasing from an historical maximum of 450 µg/L to 160 µg/L in 1999. Other VOCs have shown a similar decrease, with most VOC concentrations below the analytical method detection limit, and are all below their MCL. Plume migration control measures were implemented at the site boundary as a CERCLA Removal Action in June 1999 to prevent offsite migration of the TCE plume emanating from Building 815.

Ground water contamination in the vicinity of the HE rinsewater lagoons has been detected in the Tps and shallow $Tnbs_2$ bedrock. In the HE lagoon area, RDX and 4-amino-2,6-dinitrotoluene have shown steady decreasing concentration trends in ground water. HMX concentrations in ground water fluctuate but show a generally decreasing trend. Excavation and capping of these lagoons, completed in 1989, should prevent further releases of VOCs, HE compounds and associated constituents (nitrate and perchlorate).

TCE and cis-1,2-DCE, nitrate, and perchlorate have been detected in ground water in the $Tnsc_1$ bedrock in the vicinity of the HE Burn Pit. The HE Burn Pit area is isolated from other contaminated areas in the HE Process Area. Soil analytic data indicate that low levels of HE compounds are present in the upper 10 ft in the vicinity of the burn pits, and trace concentrations of VOCs are present. The HE Burn Pits were capped in 1998 and RCRA closure reports are being finalized.

In 1987, samples collected from well W-817-03A, which is screened 5 to 10 ft below ground surface adjacent to Spring 5, contained TCE at 150 µg/L. The 1999 analyses indicated a maximum TCE concentration of 93 µg/L. No contaminants other than VOCs have been detected in well W-817-03A. The VOCs are believed to have migrated downgradient in the Tps water-bearing unit from Building 815 and discharged at well W-817-03A/Spring 5. The well and spring are located approximately 800 ft south of Building 815.

Two remedial alternatives were developed for the HE Process Area, as described below.

Alternative 1—No Action

Alternative 2—No Further Action for VOCs and HE Compounds in Soil and Rock, Monitoring, Exposure Control, Ground Water Extraction and Treatment

The primary components of Alternative 2 are:

1. No further action for VOCs in subsurface soil/rock at the HE rinsewater lagoon release sites, and VOCs and HMX/RDX in subsurface soil/rock at the HE burn pit release sites.
2. Monitoring ground water and surface water for COCs.
3. Risk and hazard management to prevent human exposure to COCs and to mitigate impacts to ecological receptors.

4. Contaminant migration control by ground water extraction and treatment of VOCs and nitrate at the leading edge of the Building 815 TCE plume.
5. Plume migration control through ground water extraction and treatment of VOCs, HE compounds, nitrate, and perchlorate released from Building 815 and the HE rinsewater lagoons.
6. Plume migration control through ground water extraction and treatment of VOCs, nitrate, and perchlorate released from the HE Burn Pits.

TCE, HMX, and RDX have been detected in subsurface soil/bedrock in the vicinity of the HE Burn Pits at historical maximum concentrations of 0.028, 3.12, and 0.9 mg/kg, respectively. HMX and RDX have also been detected in surface soil at concentrations of 4.0 and 0.18 mg/kg, respectively. The HE Burn Pits were capped and closed under RCRA in 1998. This should prevent further releases of contaminants to ground water by preventing infiltration of precipitation into the burn pits. There is no unacceptable risk to human health or ecological receptors associated with VOCs in subsurface soil/bedrock or HMX and RDX in surface or subsurface soil/bedrock at the HE Burn Pits. HMX and RDX have not been identified as COCs in ground water underlying the Burn Pits. The preliminary remediation goal (PRG) for HMX in ground water is 1,800 µg/L. No further action is proposed for these COCs in surface soil and subsurface soil/bedrock because: (1) source control measures have already been implemented to prevent further impact to ground water, (2) there is no risk or hazard to human health or ecological receptors posed by these contaminants, and (3) ground water COC contamination is addressed through ground water extraction and treatment.

Ground water extraction and treatment is proposed in this alternative to control the migration of contaminant plumes originating from source areas in the HE Process Area OU.

Ground water extraction and treatment was implemented at the leading edge of the Building 815 TCE plume in June 1999 as part of the Building 815 Removal Action. The objective of this removal action was to prevent ground water in the $Tnbs_2$ aquifer containing VOCs from migrating offsite. This will be accomplished by pumping and treating ground water from well W-35C-04 located near the Site 300 boundary. The ground water treatment system consists of aqueous-phase GAC contained in a Solar-powered Water Activated Carbon Treatment (SWAT) unit. GAC is considered to be a presumptive technology for the treatment of VOCs in ground water. Ground water pumped from this well currently contains only low TCE concentrations (2 to 5 µg/L). Samples are also analyzed for nitrate (as NO_3). If nitrate is detected above its MCL in extracted ground water in the future, additional treatment may be necessary. Treated ground water effluent is discharged onsite under Substantive Requirements issued by the RWQCB. The spent GAC will be disposed or regenerated at an offsite treatment facility. As part of Alternative 2, ground water extraction at the leading edge of the Building 815 TCE plume would continue, and a second ground water extraction well in this area would be employed. The purpose of this extraction well would be to ensure capture of any potential offsite flow of contaminants.

Ground water remediation would be implemented at the Building 815, HE rinsewater lagoons, and the HE Burn Pit source areas to reduce COC concentrations in ground water to meet RAOs by reducing contaminant concentrations and mass, and to achieve source control. The purpose of this treatment would be to reduce the mass of contaminants near the source.

COCs in ground water at the Building 815 source area include VOCs, RDX, perchlorate, and nitrate. Ground water would be extracted from wells completed in the $Tnbs_2$ and Tps hydrogeologic units in the vicinity of Building 815. COCs in ground water at the HE rinsewater lagoon source areas include HE compounds, nitrate, and perchlorate. Ground water would be extracted from wells completed in the $Tnbs_2$ and Tps hydrogeologic units in the vicinity of the HE rinsewater lagoon source areas. COCs in ground water at the HE Burn Pit source area include VOCs, nitrate, and perchlorate. Ground water would be extracted from wells completed in the $Tnsc_1$ hydrogeologic unit in the vicinity of HE Burn Pit source area.

Extracted ground water would be treated using aqueous-phase GAC treatment units. A treatability test conducted on well W-817-03A in the HE Process area indicated that GAC effectively removes HE compounds from ground water to levels below method detection limits. GAC removes perchlorate, however perchlorate breaks through the GAC significantly faster than HE compounds or VOCs. Where GAC breakthrough by perchlorate may significantly shorten the useful lifetime of the GAC, ion exchange units and/or bioreactors will be used to enhance perchlorate treatment. Nitrate in ground water would be treated through phytoremediation, by a fixed-film bioreactor, or through the use of other technologies demonstrated to effectively remove nitrate. Treated ground water effluent would be discharged onsite under Substantive Requirements issued by the RWQCB. The spent GAC would be disposed or regenerated at an offsite treatment facility.

In addition, surface water monitoring will continue to monitor contaminant concentrations and trends in Spring 5 through sampling of well W-817-03A.

The estimated present-worth cost of Alternative 2 for the HE Process Area OU is $27,621,000 based on 30 years of monitoring, exposure control, and ground water remediation.

2.9.5. Remedial Alternatives for Building 850 (OU 5)

High explosives experiments have been conducted at the Building 850 Firing Table since 1960. Tritium was used in hydrodynamic experiments at the firing table, primarily between 1963 and 1978. In addition, the experimental test assemblies sometimes contained depleted uranium and metals. Leaching of contaminants from firing table debris has resulted in tritium and uranium contamination of subsurface soil and ground water. Nitrate has also been identified as a COC in ground water in this area. As a result of the dispersal of contaminated shrapnel during explosives testing, surface soil was contaminated with various metals, PCBs, HMX, and uranium. Dioxins and furans have also been identified as COCs in surface soil in the vicinity of the firing table. Gravel was removed from the firing table in 1988 and placed in the Pit 7 Landfill.

From 1962 to 1972, a large volume of sand was stockpiled near the Building 850 Firing Table and was periodically used and reused during large experiments, gradually becoming contaminated with tritium. Leaching from this sandpile resulted in the release of tritium to the vadose zone and the ground water.

Ground water contaminants have been detected in shallow alluvial deposits (Qal) and sandstone ($Tnbs_1$) and claystone (Tmss) bedrock. The tritium plume emanating from the Building 850 source area extends east of the building (Figure 2.5-15). Tritium activities in ground water in the Building 850 source area have significantly decreased from 1985 to 1999, and the portion of the tritium plume with activities exceeding the 20,000 pCi/L MCL has decreased in size over the 14-year period.

Four remedial alternatives were assembled to address COCs in surface soil, subsurface soil/bedrock, surface water, and ground water in the Building 850 area, as described below.

Alternative 1—No Action

Alternative 2—Monitoring, Exposure Control, Monitored Natural Attenuation of Tritium in Ground Water and Surface Water, and Sandpile/Soil Removal

The primary components of Alternative 2 include:

1. Monitoring ground water and surface water for COCs.
2. Risk and hazard management to prevent human exposure to COCs and mitigate impacts to ecological receptors.
3. Monitored natural attenuation of tritium in ground water and surface water.
4. Source control through removal and disposal of the contaminated sand pile and surface soil in the vicinity of Building 850.
5. Exposure control measures may be implemented, if necessary, to prevent exposure to dioxins and furans in surface soil until soil removal occurs as described above.

The risk and hazard management program will include: (1) maintaining land use restrictions in the area, (2) reviewing exposure pathway-related conditions such as facility and land use, (3) refining risk and hazard modeling using current data, and (4) reporting the results to the stakeholders.

Alternative 2 includes natural attenuation to reduce tritium activities in ground water to meet RAOs.

EPA's OSWER Directive 9200.4-17 states that monitored natural attenuation may be appropriate as a remedial approach where it can be demonstrated to be capable of achieving a site's remedial objectives within a time frame that is reasonable compared to that offered by other methods and given the particular circumstances of the site. According to this directive, the elements that are important to establish an MNA remedy are: (1) the contamination is not currently posing an unacceptable risk, (2) source control measures have been implemented or the data show that the source is no longer releasing contaminants to the environment, and (3) plume contours are static or retreating. Because of its 12.3 year radioactive half-life, tritium activities will decrease as long as there is no active source. The historical maximum tritium activity in ground water near Building 850 was 566,000 pCi/L in 1984. Tritium activities in ground water monitor wells have shown a steadily decreasing trend over time with a maximum activity in 1999 of 99,400 pCi/L. Tritium in Well 8 Spring, which has analytical data dating back to 1971, has declined by more than 95% over the past 27 years. Extreme storm events have occurred intermittently since tritium was first detected in Well 8 Spring in the early 1970s. Elevated tritium activities have never been detected in alluvium anywhere along the surface water flow path along Elk Ravine. This is presumably due to the extreme dilution that would occur, the fact that there is no baseflow within the alluvium, and the fact that this water quickly infiltrates the ground after the storm.

Modeling of tritium fate and transport in ground water from the Building 850 area predicted that tritium activities will decrease below the drinking water standard of 20,000 pCi/L within 45 years without impacting ground water offsite above the MCL. The modeling results were based on health-conservative assumptions which assumed a continuous tritium point source located beneath the Building 850 Firing Table. The decreasing tritium activities over time in the vicinity of the Building 850 Firing Table indicate that the source is diminishing.

The Site 300 CP will include actions to be implemented in the event that monitored natural attenuation of tritium in ground water does not achieve RAOs. No significant or fundamental changes to the remedies chosen herein shall be made without an Explanation of Significant Differences or ROD Amendment, as required by CERCLA and the NCP. The following activities would be conducted to monitor the effectiveness of monitored natural attenuation:

1. Measure ground water levels.
2. Perform ground water sampling and analysis and continue to monitor contaminant concentrations and trends in Well 8 Spring.
3. Manage, analyze and present data.
4. Perform fate and transport modeling to predict the spatial distribution of tritium over time and demonstrate the efficacy of monitored natural attenuation in meeting RAOs and other requirements that may be established as ARARs in the Final ROD.
5. Install additional monitoring wells, if required.

Tritium was detected at activities up to 204,000 pCi/L_{sm} in the sand pile in 1990. As part of Alternative 2, approximately 460 yd^3 of sand would be removed from the area adjacent to Building 850. The material would be transported to and disposed of at an offsite disposal facility permitted to accept mixed waste.

In addition, surface soil in the vicinity of the Building 850 Firing Table contaminated with various metals, PCBs, dioxins, furans, metals, HMX, and uranium would be removed. The estimated removal area is 43,700 ft^2 and 0.5 ft deep. The actual depth of removal would be sufficient to reach clean soil, as defined by cleanup standards presented in Section 2.11.4.3.1. To estimate costs, DOE/LLNL assumed the total estimated volume of material to be removed is 800 yd^3. This surface soil would be removed to mitigate the risks associated with potential inhalation of resuspended particulates, and incidental ingestion and direct dermal contact with surface soil contaminated with PCBs, and chlorinated dibenzo-p-dioxins and dibenzofurans. The material to be removed is assumed to be mixed low-level radioactive and hazardous waste and would be transported and disposed at an offsite disposal facility permitted to accept mixed waste.

The estimated present-worth cost of Alternative 2 for the Building 850 area is $4,033,000 based on 30 years of monitoring, exposure control, monitored natural attenuation, and sandpile/soil removal.

Alternative 3—Monitoring, Exposure Control, Monitored Natural Attenuation of Tritium in Ground Water and Surface Water, Sandpile/Soil Removal, and Soil/Rock Excavation

Alternative 3 combines ground water and surface water monitoring, exposure control, monitored natural attenuation, and sand pile/soil removal described in Alternative 2 with excavation of contaminated soil/bedrock under the Building 850 Firing Table. The leaching of contaminants from firing table debris has resulted in tritium and uranium contamination of subsurface soil. Tritium was detected at a maximum activity of 11,000,000 pCi/L_{sm} in 1988 in subsurface soil 5 ft bgs in a shallow borehole drilled beneath the firing table gravel. Tritium activities up to 2,790,000 pCi/L_{sm} were detected in subsurface bedrock in boreholes directly adjacent to the firing table at depths up to 20 ft below ground surface (bgs). Uranium has also been detected in subsurface soil at a maximum uranium-238 activity of 28.2 pCi/g.

As part of Alternative 3, approximately 5,000 yd^3 of subsurface soil and bedrock underlying and in the vicinity of the Building 850 Firing Table would be excavated. For purposes of costing, it was assumed that soil and bedrock would be excavated over an area of approximately 6,750 ft^2 to a depth of 20 ft. It is assumed that the subsurface soil and bedrock removed from the area adjacent to the firing table would be classified as mixed low-level radioactive and hazardous waste. This material would be transported and disposed at an offsite disposal facility permitted to accept mixed waste.

The estimated present-worth cost of Alternative 3 for the Building 850 area is $8,246,000 based on 30 years of monitoring, exposure control, monitored natural attenuation, sand pile/soil removal, and excavation of bedrock underlying the firing table and soil adjacent to the firing table.

Alternative 4—Monitoring, Exposure Control, Monitored Natural Attenuation of Tritium in Ground Water and Surface Water, Sandpile/Soil Removal, Soil/Rock Excavation, Ground Water Extraction and Treatment, and Uranium Plume Migration Control

Alternative 4 combines all the elements of Alternative 3 with extraction and treatment of uranium- and nitrate-contaminated ground water and uranium plume migration control using an *in situ* reactive permeable barrier.

Depleted uranium has been identified in ground water in the vicinity of Building 850 at a maximum historical uranium-238 activity of 18.4 pCi/L. Uranium-238 activities in ground water have decreased to a maximum of 5.1 pCi/L in 1999. Nitrate concentrations in ground water have similarly decreased from an historical maximum of 140 mg/L in 1995 to 88 mg/L in 1999.

The extraction component of Alternative 4 consists of providing source and plume migration control for depleted uranium and nitrate in ground water. Uranium and nitrate concentrations and mass would be reduced by extracting ground water from approximately 4 wells near the center of mass of depleted uranium in ground water in the vicinity of Building 850. Ground water would also be extracted from approximately 3 wells located downgradient of Building 850 to control plume migration. Extracted ground water would be treated using an ion-exchange treatment unit to remove uranium followed by a fixed-film bioreactor or other technology demonstrated to be effective in removing nitrate. Treated ground water effluent from the treatment systems that does not contain tritium would be discharged onsite under Substantive Requirements issued by the RWQCB. As there is currently no cost-effective technology available for the treatment of tritiated ground water, the treated water containing only tritium would be reinjected into the subsurface downgradient of Building 850. Safety precautions would need to be implemented to prevent exposure to tritium during the extraction and reinjection process. The specific location of injection wells would be discussed with the regulatory agencies when the remedial design for the relevant OU is prepared.

Alternative 4 also includes additional plume migration control for depleted uranium in ground water through installation of an *in situ* permeable reactive barrier. The barrier would be installed downgradient of Building 850 in the saturated alluvial fill of Doall Ravine to prevent migration of uranium in the alluvium (Qal). For costing, it was assumed the *in situ* reactive barrier would be approximately 150 ft long and 10 ft wide, excavated to a depth of 30 ft and filled with a suitable reactive material (i.e., iron filings or resins) capable of removing uranium from ground water from a depth of 10 to 30 ft bgs. The reactive barrier would be designed to reduce the concentrations of uranium below detection limits. Tritium would be unaffected by the barrier. The reactive material would be encased in resistant netting so it can be removed every 10 years for replacement and to remove the precipitated uranium. It is assumed that the spent reactive material will be a mixed low-level radioactive waste which would be transported and disposed at an offsite disposal facility permitted to accept mixed waste.

The estimated present-worth cost of Alternative 4 for the Building 850 area is $16,097,000 based on 30 years of monitoring, exposure control, monitored natural attenuation, sand pile/soil removal, excavation of bedrock underlying the firing table and soil adjacent to the firing table, ground water extraction, and plume migration control using an *in situ* reactive barrier.

2.9.6. Remedial Alternatives for the Pit 2 Landfill (OU 5)

The Pit 2 Landfill was used for disposal of firing table debris and gravel from Buildings 801 and 802. The Pit 2 Landfill has a surface area of 6,000 yd^2 and contains about 25,412 yd^3 of firing table waste. The total pit depth is estimated to be 12 to 14 ft with 2 ft of overburden. Waste material was buried to depths of 6 to 8 ft and covered with local soil.

VOCs were detected in ground water in 1989 but have not been detected since that time. Although tritium has been detected in subsurface soil/rock, the depth of maximum tritium detection indicates that the tritium has probably migrated in ground water from the Building 850 area. No unacceptable risk or hazard to human health or ecological receptor has been associated with the Pit 2 Landfill. There are no COCs identified in any media in the vicinity of the landfill.

Three alternatives were developed for the Pit 2 Landfill, as described below.

Alternative 1—No Action

Alternative 2—Monitoring

Alternative 2 consists of sampling and analysis of ground water from monitor wells in the area to monitor for future releases of contaminants. The landfill surface would also be inspected annually to ensure that no damage threatens a release from the waste. Additional monitor wells may be installed, if necessary, for complete detection monitoring.

No COCs emanating from the Pit 2 Landfill have been identified in surface soil, subsurface soil/bedrock, ground water or surface water. Characterization of soil, rock, and ground water in the vicinity of the Pit 2 Landfill was conducted as part of the SWRI. A series of shallow (2 to 6 ft) subsurface soil samples were collected from the Pit 2 Landfill area. In addition, soil and rock samples were collected and analyzed from 6 pilot boreholes for wells located in the vicinity of the Pit 2 Landfill. Ground water has been routinely monitored for possible contamination in these wells. Although data indicate a rise in ground water elevation in the vicinity of the Pit 2 Landfill during the wet winters of 1997 and 1998, the water table is still in excess of 65 ft below the pit and there is no risk of inundation.

Monitoring would be conducted to:

1. Detect future releases from the landfill, if any, that might impact ground water.
2. Verify continued compliance with RAOs.

Monitoring costs include water level measurements, ground water sampling and analysis, well maintenance, QA/QC, database management, and data evaluation. The costs for monitoring in Alternative 2 assume that samples will be collected and analyzed for possible contaminants that could leach from the landfill and that water levels will be measured in all monitor wells in the Pit 2 Landfill area on a quarterly basis for 30 years.

The ground water data obtained as part of the Alternative 2 monitoring program would be re-evaluated regularly. If data indicate that contaminants are detected or ground water flow direction and/or velocity have changed, the monitoring program would be reevaluated.

The surface water drainage near the Pit 2 Landfill would be reengineered to prevent water from flowing from the landfill or causing erosion.

The estimated present-worth cost of Alternative 2 for the Pit 2 Landfill area is $515,000 based on 30 years of monitoring.

Alternative 3—Monitoring, and Waste Characterization with Contingent Monitoring, Capping, and/or Excavation

Alternative 3 combines the monitoring described in Alternative 2 and characterization of waste in the Pit 2 Landfill with contingent monitoring, capping, and/or excavation of the pit, depending on the waste characterization results. The depth to ground water is 65 feet or more beneath the Pit 2 Landfill and there is no risk of inundation of the pit that could result in releases.

Characterization of soil, rock, and ground water in the vicinity of the Pit 2 Landfill was conducted as part of the SWRI. Data collected during the SWRI indicate there are no COCs emanating from the Pit 2 Landfill in surface soil, subsurface soil/bedrock, ground water, or surface water. Some of the waste buried in the landfill may have contained depleted uranium, beryllium, thorium, and tritium. VOCs and heavy metals may also have been buried in this landfill. Several contaminants including depleted uranium and metals were detected in the gravel from the Building 845 firing table. Because potentially contaminated gravel from this firing table was disposed in the Pit 2 Landfill, this alternative includes evaluation of the potential for contamination of the subsurface beneath the pit as a result of future releases from the landfill waste. A strategy has been developed for addressing potential releases of contaminants from landfills. The process begins with a detailed characterization of the contents of the landfill for potential contaminant sources, followed by modeling to estimate potential impacts to ground water and a risk assessment to evaluate impacts to human health and the environment. The results of these activities would be used to support decisions on remedial actions. Documentation of the work planned and data collected would be provided throughout the landfill characterization and remediation process. DOE has preliminarily identified five possible remedial approaches to address actual or potential releases of contaminants from the Pit 2 Landfill including:

1. Monitoring only.
2. Capping.
3. Partial excavation with capping.
4. Partial excavation without capping.
5. Total excavation.

If waste excavation were selected as the remedial option for this landfill, two options are available for the disposition of excavated waste. Disposal options include:

1. Transportation to an offsite permitted facility for treatment, destruction, and/or disposal.
2. Placement of excavated waste in an onsite engineered containment unit either at the location of an existing landfill or outside the areas of existing contamination within a Corrective Action Management Unit.

The estimated present-worth cost of Alternative 3 for the Pit 2 Landfill area falls between $767,000 and $22,250,000 based on 30 years of monitoring and waste characterization, and depending on the amount of waste excavated.

2.9.7. Remedial Alternatives for Building 854 (OU 6)

TCE was released to subsurface soil and ground water through leaks and discharges of TCE-based heat exchange fluid from a TCE brine system that was removed in 1989. TCE concentrations in ground water have decreased from a historical maximum of 2,900 µg/L to 270 µg/L in 1999. Other COCs in ground water include nitrate and perchlorate. Ground water contamination exists in a 10- to 20- ft thick, shallow water-bearing zone comprised of the lower $Tnbs_1$ sandstone and upper Cierbo Formation. This zone appears to be perched as there is unsaturated permeable material below the low permeability siltstone/claystone confining layer located at the base of the shallow water-bearing zone. No contamination has been detected in the deeper water-bearing zone located at least 50 ft below the first water-bearing zone.

TCE has also been identified as a COC in the vadose zone at concentrations up to 1,000 mg/kg in subsurface bedrock. This sample was collected in the vicinity of the Building 854H drain outfall from which contaminated soil was excavated and removed in 1983. COCs in surface soil include lead, zinc, HMX, tritium, and PCBs. Contaminated surface soil was removed at the northeast corner of Building 854F in 1983.

A presumptive remedy has been identified for this OU. Therefore, only two alternatives, a no action alternative required by the NCP and EPA guidance and the presumptive remedy, are presented and discussed below.

Alternative 1—No Action

Alternative 2—No Further Action for Metals, HMX, PCBs, and Tritium in Surface Soils, Monitoring, Exposure Control, Ground Water and Soil Vapor Extraction and Treatment

The primary components of Alternative 2 include:

1. No further action for metals, HMX, PCBs, and tritium in surface soil.
2. Monitoring ground water and surface water for COCs.
3. Risk and hazard management to prevent human exposure to COCs and mitigate impacts to ecological receptors.
4. Source mass removal and mitigation of any inhalation risk at Buildings 845A and 854F through extraction and treatment of VOCs in ground water and soil vapor and nitrate in ground water.

Lead, zinc, HMX, tritium, and PCBs have been identified as COCs in surface soil in the Building 854 OU. Lead, zinc, and HMX have been detected at concentrations of 98 mg/kg, 1,400 mg/kg, and 150 mg/kg, respectively. Tritium was detected at concentrations of 317 pCi/L in soil moisture, slightly above background concentrations of 300 pCi/L. No risk or hazard to human health or ecological receptors have been identified in this area associated with lead, zinc, HMX, or tritium. Modeling indicates that lead and zinc in surface soil will not impact ground water above MCLs. Modeling indicates that HMX could reach ground water at concentrations of 1.79 mg/L (MCL: 1.7 mg/L) in 500 years. No further action is proposed for these COCs in surface soil because (1) there is no risk or hazard to human health or ecological receptors posed by these contaminants, and (2) there is no significant impact to ground water indicated by modeling.

A baseline human health risk of 7×10^{-5} was identified that results from incidental ingestion and direct dermal contact with PCB-contaminated soil. The risk calculation was based on an onsite worker exposure scenario of 8-hours/day, 5 days/week for 30 years. PCB 1242 and 1248 were detected in one surface soil sample at concentrations of 34 mg/kg and 52 mg/kg, respectively. PCBs were not detected in any other sample. Under Alternative 2, exposure controls would be implemented.

For surface soils, further investigations will be conducted and if PCBs in surface soil are found above health-protective levels, they will be removed. This will be addressed in the Site 300 CP, if not sooner.

Baseline inhalation risks of 8.7×10^{-6} and 5.1×10^{-6} for adult onsite workers were identified for TCE volatilizing from subsurface soil to air inside Buildings 854F and 854A, respectively. The maximum historical soil concentration of TCE detected in the subsurface soil was 30.7 mg/kg, in 1983. Of the almost 200 soil samples from the Building 854 area analyzed since 1983, no TCE result has exceeded 0.06 mg/kg. Neither Building 854F nor 854A are currently used for daily operations. Since these facilities are not manned, there is currently no exposure pathway for TCE volatilizing from subsurface soil into building to affect humans.

The risk and hazard management program will include: (1) analyzing indoor air at Building 854A and 854F annually for a minimum of two years [If air concentrations indicate that the inhalation risk exceeds 10^{-6} or the HI exceeds 1, institute restrictions for building use, or if building use is again anticipated, install a building ventilation system and operate it whenever the building is occupied], (2) conducting semi-annual wildlife surveys to evaluate the presence of any species of concern, (3) reviewing exposure pathway-related conditions, such as building and land use, (4) refining risk and hazard models using current data, and (5) reporting the results to the stakeholders. These measures will prevent exposure while soil vapor remediation activities described below reduce TCE concentrations in subsurface soil and mitigate this risk.

Ground water and soil vapor remediation would be implemented at Building 854 to: (1) reduce soil vapor TCE concentrations in the vadose zone to acceptable risk- and hazard-based concentrations, (2) reduce soil vapor TCE concentrations in the vadose zone to levels protective of ground water, and 3) reduce TCE, perchlorate, and nitrate concentrations in ground water to meet RAOs by reducing contaminant concentrations and mass to achieve plume migration control. COCs in ground water at the Building 854 OU include TCE, perchlorate, and nitrate. The primary TCE mass removal mechanism would be by SVE. Ground water extraction wells would be used primarily to dewater the perched water-bearing zone and thereby facilitate SVE of TCE. Soil vapor and ground water would be simultaneously extracted from approximately six wells and soil vapor would be extracted from about 6 other wells. Dual-phase extraction is considered a presumptive remedy by EPA for remediation of TCE and other contaminants in the subsurface. Dual-phase extraction would be implemented at approximately six wells located in the Building 854 Complex core area for source mass removal. Ground water would be extracted from an additional three wells located from 200 to 500 feet downgradient of the Building 854 source area to control plume migration. TCE and perchlorate in ground water would be treated using aqueous-phase GAC followed by a bioreactor to treat nitrate and perchlorate, and ion exchange units when necessary to enhance perchlorate treatment. GAC, as well as aerobic biological reactors, are listed by EPA as presumptive technologies for the treatment of dissolved organic contaminants such as TCE. Extracted soil vapor would be treated using vapor-phase GAC and discharged to the atmosphere in accordance with the permit requirements issued by the San Joaquin Valley Unified Air Pollution Control District (SJVUAPCD).

A second treatment facility would be installed to treat ground water extracted from wells located 600 to 1,300 ft downgradient from the source area. Extracted ground water would be treated using aqueous-phase GAC followed by a bioreactor to treat nitrate and perchlorate, and ion exchange units when necessary to enhance perchlorate treatment. The second extraction and treatment system would be installed to reduce TCE and nitrate concentrations in downgradient portions of the plume and provide plume migration control in the $Tnbs_1$ aquifer. Treated ground water effluent from both treatment systems would be discharged onsite in accordance with Substantive Requirements issued by the RWQCB. The spent GAC from the soil vapor and ground water treatment systems would be disposed or regenerated at an offsite treatment facility.

The estimated present-worth cost of Alternative 2 for the Building 854 OU is $9,167,000 based on 30 years of monitoring, exposure control, and ground water and soil vapor extraction.

2.9.8. Remedial Alternatives for the Building 832 Canyon (OU 7)

Contaminants, primarily VOCs, were released from Buildings 830 and 832 through piping leaks and surface spills where TCE was used as a heat exchange fluid as part of testing activities at these buildings. TCE in ground water in the Building 830 area has decreased over time from an historical maximum of 30,000 µg/L to 8,400 µg/L in 1999. TCE has also been detected in ground water at Building 832 at an historical maximum of 1,800 µg/L in 1998. Nitrate and perchlorate are also present in ground water at both Building 830 and 832. Nitrate contamination in ground water may be the result of a combination of HE-related testing and septic system releases with a possible contribution from naturally occurring nitrate from local geologic units. Although the source of perchlorate is not known at this time, it may be that perchlorate was a component of HE test assemblies. COCs in ground water at Buildings 830 and 832 are present in the shallow alluvium (Qal) and underlying sandstone ($Tnbs_2$ and $Tnbs_1$) and siltstone/claystone ($Tnsc_1$) bedrock.

TCE has also been detected in subsurface soil/bedrock in the vicinity of Buildings 830 and 832 at concentrations of 6 mg/kg and 0.16 mg/kg, respectively.

Rinsewater containing HE compounds was disposed via floor drains in Building 830 which led to a surface discharge outside the building. As a result, HMX has been detected in surface soil and bedrock. However, no HE compounds have been detected in ground water. Low concentrations of HMX (0.2 mg/kg in 1994) have been detected in Building 832 subsurface soil/bedrock. Nitrate has also been detected in subsurface soil/bedrock at Building 830.

A treatability study began in the fall of 1999 to evaluate dual phase (ground water and soil vapor) extraction at Building 832.

A presumptive remedy has been identified for this OU. Therefore, only two alternatives, a no action alternative required by the NCP and EPA guidance and the presumptive remedy, are presented below.

Alternative 1—No Action

Alternative 2—No Further Action for Non-VOC Contaminants in Surface and Subsurface Soil, Monitoring, Exposure Control, Ground Water and Soil Vapor Extraction and Treatment, and Downgradient Plume Migration Control

The primary components of Alternative 2 include:

1. No further action for HMX in surface soil and nitrate in subsurface soil/bedrock at Building 830 and HMX in subsurface soil/bedrock at Building 832.
2. Monitoring ground water and surface water for COCs.
3. Risk and hazard management to prevent human exposure to COCs and to mitigate impacts to ecological receptors.
4. Mass removal and mitigation of VOC inhalation risk at Building 830 through extraction and treatment of VOCs in ground water and soil vapor, and nitrate and perchlorate in ground water.

5. Mass removal at Building 832 through extraction and treatment of VOCs in ground water and soil vapor, and nitrate and perchlorate in ground water.
6. Plume migration control through downgradient ground water extraction using a siphon with *ex situ* treatment of VOCs.

HMX has been detected at extremely low concentrations in surface soil at Building 830 and subsurface bedrock at Building 832. HMX was detected at a maximum concentration of 0.2 mg/kg in 1994 in Building 830 surface soil. The HMX concentration in a duplicate of this sample was reported at 0.07 mg/kg. The maximum concentration of HMX detected in subsurface soil/bedrock at Building 832 was 0.2 mg/kg in 1994. No risk or hazard associated with HMX in these areas has been identified. HE compounds are not COCs in ground water at either Building 830 or 832. Vadose zone modeling of HMX at Building 832 indicates that there will be no significant impact to ground water. No further action is proposed for HMX in surface soil at Building 830 and subsurface bedrock at Building 832 because there is (1) no unacceptable risk or hazard to human health or ecological receptors posed by these contaminants, and (2) no impact to ground water.

Monitoring for HMX in ground water will be conducted to evaluate whether HMX in surface soil and subsurface soil/bedrock impacts ground water.

Nitrate has also been detected at extremely low concentrations in subsurface soil/bedrock at Building 830. The maximum reported concentration was 13.5 mg/kg. No unacceptable risk or hazard associated with nitrate in subsurface soil/bedrock in these areas has been identified. Nitrate is a ground water COC at both Buildings 830 and 832, however it may be that the levels of nitrate detected in ground water are due in part to septic system releases, with a possible contribution of naturally occurring nitrate from local geologic units. Nitrate has been detected in the alluvium (Qal) and bedrock ($Tnsc_1$) in the Building 832 Canyon area and nitrate may be naturally high in the Tps hydrogeologic unit. No further action is proposed for nitrate in subsurface soil/bedrock at Building 830 because: (1) there is no unacceptable risk or hazard to human health or ecological receptors posed by these contaminants, (2) nitrate in ground water is believed to be in part from other than anthropogenic sources, and (3) nitrate in ground water would be addressed through extraction and treatment. Studies are underway to determine the source(s) of nitrate in ground water in the Building 832 Canyon OU.

The risk and hazard management program will include: (1) sampling and analyzing outdoor ambient air in the vicinity of Building 830 and Spring 3 for VOCs annually, (2) analyzing indoor air at Building 830 annually for a minimum of two years [If air concentrations indicate that the inhalation risk exceeds 10^{-6} or the HI exceeds 1, institute restrictions for building use or, if building use is again anticipated, install a building ventilation system and operate it whenever the building is occupied], (3) reviewing exposure pathway-related conditions, such as building and land use, (4) refining risk and hazard models using current data, and (5) reporting the results to the stakeholders. These measures will prevent exposure while soil vapor remediation activities described below reduce TCE concentrations in subsurface soil and surface water (Spring 3) and mitigate this risk.

Ground water and soil vapor remediation would be implemented at both Buildings 830 and 832 to: (1) reduce soil vapor VOC concentrations in the vadose zone to acceptable risk- and hazard-based concentrations, (2) reduce soil vapor VOC concentrations in the vadose zone to levels protective of ground water, and (3) reduce VOC and nitrate concentrations in ground water and surface water to meet RAOs by reducing contaminant concentrations and mass to achieve source and plume migration control.

COCs in ground water at Buildings 830 and 832 include VOCs, nitrate, and perchlorate. The primary VOC mass removal mechanism in the Buildings 830 and 832 source areas would be by SVE. Ground water extraction wells would be used primarily to dewater the water-bearing zone thereby facilitating SVE of VOCs. Dual-phase extraction would be implemented at approximately ten wells located in the Building 832 Complex source area for mass removal. VOCs, nitrate, and perchlorate in ground water at the Building 832 source area would be treated using aqueous-phase GAC followed by a bioreactor to treat nitrate and perchlorate, and ion exchange units when necessary to enhance perchlorate treatment. GAC, as well as aerobic biological reactors, are listed by EPA as presumptive technologies for the treatment of dissolved organic contaminants such as VOCs. Extracted soil vapor will be treated using vapor-phase GAC and discharged to the atmosphere in accordance with the permit requirements issued by the SJVUAPCD.

In addition, Spring 3, which is located downgradient of Building 830, will be monitored to evaluate whether the active remediation at Building 830 successfully reduces TCE concentrations in the spring. One to two treatment facilities would be installed to treat ground water extracted from approximately four wells located several hundred feet downgradient from the Building 832 source area. Extracted ground water would be treated using aqueous-phase GAC followed by a bioreactor to treat nitrate and perchlorate, and ion exchange units when necessary to enhance perchlorate treatment. The additional extraction and treatment system(s) would be installed to reduce VOC and nitrate concentrations in downgradient portions of the Building 832 plume to provide plume migration control. One treatment facility would be installed to treat ground water extracted from about ten wells located in the immediate vicinity of the Building 830 source area. Extracted ground water would be treated using aqueous-phase GAC followed by a bioreactor to treat nitrate and perchlorate, and ion exchange units when necessary to enhance perchlorate treatment. Additional extraction and treatment systems would be installed to reduce VOC and nitrate concentrations in downgradient portions of the Building 830 plume, providing plume migration control.

An iron filings treatment system would be installed to treat ground water extracted from wells located in the downgradient portion of the Building 830 plume to control plume migration and prevent contamination of ground water offsite. Ground water would be extracted using a siphon technology that utilizes gravity to extract and transport ground water to the treatment system. VOCs in extracted ground water would be treated using an *ex situ* iron filings treatment system. The capability of iron filings to reduce nitrate concentrations is being investigated. If the iron filings system does not effectively remove nitrate, a fixed-film bioreactor or other appropriate technology would be added to the treatment train for nitrate removal. In the event the siphon extraction system does not effectively capture the plume, an additional extraction and aqueous-phase GAC treatment system may be installed in the downgradient plume.

Treated ground water effluent from Buildings 832 and 830 treatment systems would be discharged onsite in accordance with Substantive Requirements issued by the RWQCB. The spent GAC from the soil vapor and ground water treatment systems would be disposed or regenerated at an offsite treatment facility. Spent iron filing would be disposed offsite.

The estimated present-worth cost of Alternative 2 for the Building 832 Canyon OU is $26,842,000 based on 30 years of monitoring, exposure control, and ground water and soil vapor extraction.

2.9.9. Remedial Alternatives for the Building 801 Dry Well and the Pit 8 Landfill (OU 8)

Waste fluid discharges to a dry well located adjacent to Building 801 resulted in the release of VOCs to the subsurface. The dry well was decommissioned and filled with concrete in 1984. TCE concentrations in ground water in the Building 801 area have slightly decreased over time to a maximum of 4.6 µg/L in 1999. Nitrate is also present in ground water at up to 47 mg/L (as NO_3). COCs in ground water at Building 801 are present in the shallow alluvium (Qal) and underlying sandstone bedrock ($Tnbs_1$). TCE has also been detected in subsurface soil/bedrock in the vicinity of Building 801 at a maximum historical concentration of 0.057 mg/kg.

The Pit 8 Landfill was used to dispose of debris from the Building 801 firing table until 1974 when an earthen cover was installed. The total estimated volume of material disposed in the Pit 8 Landfill is about 24,700 yd^3. No COCs have been identified in surface soil, subsurface soil/bedrock, ground water or surface water in the Pit 8 Landfill area.

Three remedial alternatives were assembled to address COCs in subsurface soil/bedrock and ground water at Building 801 and the Pit 8 Landfill, as described below.

Alternative 1—No Action

Alternative 2—No Further Action for VOC Contaminants in Subsurface Soil and Monitoring

The primary components of Alternative 2 include:

1. No further action for VOCs in subsurface soil/bedrock in the Building 801 dry well area.
2. Monitoring ground water for COCs and potential contaminants from the Pit 8 Landfill.

TCE has been detected in subsurface soil at extremely low concentrations below the Building 801 dry well. The historical maximum concentration of TCE was 0.057 mg/kg reported at a depth of 21 ft in 1989. No unacceptable risk or hazard associated with TCE in this area was identified in the baseline risk assessment. No viable remedial technology has been identified to address such extremely low concentrations. The dry well source was closed in 1984. No further action is proposed for TCE in subsurface soil/bedrock at the Building 801 dry well because: (1) there is no unacceptable risk or hazard to human health or ecological receptors posed by TCE in this medium, (2) the dry well source has been removed and closed, and (3) VOC concentrations in ground water are near or below MCLs (TCE: 4.6 µg/L in 1999) and are gradually declining, indicating a diminishing source of VOCs in subsurface soil/bedrock.

Sampling and analysis of ground water from monitor wells in the area will continue to monitor COCs in the subsurface. The landfill surface will also be inspected annually to ensure that no damage could result in a release from the waste. Additional monitor wells may be installed, if necessary for leak detection in the vicinity of the Pit 8 Landfill.

As part of Alternative 2, ground water in the wells in the vicinity of this landfill will be monitored for metals, tritium, uranium, and thorium to detect any future releases of contaminants from the landfill. Additional monitor wells may be added if necessary to provide a complete release detection monitoring network for the landfill.

The estimated present-worth cost of Alternative 2 for the Building 801 dry well and Pit 8 Landfill release sites is $535,000 based on 30 years of monitoring with increased detection monitoring at the Pit 8 Landfill.

Alternative 3—No Further Action for VOC Contaminants in Subsurface Soil; Monitoring; and Waste Characterization with Contingent Monitoring, Capping, and/or Excavation of Pit 8 Landfill

Alternative 3 combines no further action for subsurface soil/bedrock and monitoring described in Alternative 2 with characterization of waste in the Pit 8 Landfill with contingent monitoring, capping, and/or excavation of the pit, depending on the waste characterization results.

Characterization of soil, rock, and ground water in the vicinity of the Pit 8 Landfill was conducted as part of the SWRI. Soil and rock samples were collected from the pilot boreholes for five wells located in the vicinity of the Pit 8 Landfill. Ground water has been routinely monitored for possible contamination. No COCs emanating from the Pit 8 Landfill have been identified in surface soil, subsurface soil/bedrock, ground water or surface water.

Contaminants including depleted uranium and several metals were detected in the analysis of gravel from the Building 801 firing table. As potentially contaminated firing table gravel from this firing table was disposed in the Pit 8 Landfill, this alternative presents methods for evaluating the potential for contamination of the subsurface beneath the pit as a result of future releases from the landfill waste. The depth to ground water is 120 feet or more beneath the Pit 8 Landfill and there is no risk of inundation of the pit that could result in releases.

A strategy has been developed for addressing potential releases of contaminants from landfills. The process begins with a detailed characterization of the contents of the landfill for potential contaminant sources, followed by modeling to estimate potential impacts to ground water and a risk assessment to evaluate impacts to human health and the environment. The results of these activities will be used to support remedial action decisions. Documentation of the work planned and data collected would be provided throughout the landfill characterization and remediation process.

DOE has preliminarily identified five possible remedial approaches to address actual or potential releases of contaminants from the Pit 8 Landfill including:

1. Monitoring only.
2. Capping.
3. Partial excavation with capping.
4. Partial excavation without capping.
5. Total excavation.

If waste excavation is selected as the best remedial option for this landfill, two options are available for the disposition of excavated waste. Disposal options include:

1. Transportation to an offsite permitted facility for treatment, destruction, and/or disposal.
2. Placement of excavated waste in an onsite engineered containment unit either at the location of an existing landfill or outside the areas of existing contamination within a Corrective Action Management Unit.

The estimated present-worth cost of Alternative 3 for the Building 801 dry well release site and Pit 8 Landfill falls between $742,000 and $21,600,000 based on 30 years of monitoring and waste characterization and depending on the amount of waste excavated from the Pit 8 Landfill.

2.9.10. Remedial Alternatives for the Building 833 (OU 8)

TCE was used as a heat-exchange fluid in the Building 833 area. Surface discharge of waste fluids containing TCE occurred through spills, building washdown, rinsewater from the test cell and settling basin, and rinsewater disposal in a lagoon adjacent to Building 833. As a result, VOC contamination of the shallow soil/bedrock and perched ground water has occurred. However, analytical data indicate that the deeper regional aquifer has not been impacted.

TCE has been identified in the vadose zone at a maximum concentration of 1.5 mg/kg. TCE was generally found in relatively shallow soil at depths less than 12 ft below ground surface (bgs) and is rarely present, if at all, greater than 15 feet below the gravel-silty claystone interface. This vertical distribution of TCE suggests that TCE may have migrated downward through sand and gravel lenses but was impeded from further downward vertical migration by the silty claystone deposits at about 28 to 60 ft bgs. This silty claystone deposit appears to be a significant barrier to downward vertical migration of TCE.

Ground water rarely occurs in the upper water-bearing units. Discontinuous areas of perched ground water have been encountered in only two of the nine wells that monitor the shallow (less than 35 ft bgs) gravel lenses within these units. Water level data indicate that ground water is present in these wells primarily after periods of rainfall. When ground water is present, the saturated thickness of this perched zone is approximately one to four feet. Ground water TCE concentrations in this perched zone have decreased from an historical maximum of approximately 2,000 µg/L in 1992 to approximately 30 µg/L in 1999.

VOCs have not been detected in ground water samples collected from the regional aquifer, based on VOC ground water concentration data from 1991 through 1999. These data indicate that the regional aquifer has not been impacted by VOCs.

Three remedial alternatives were assembled to address COCs in subsurface soil/bedrock and ground water at Building 833, as discussed below.

Alternative 1—No Action

Alternative 2—Monitoring and Exposure Control

The primary components of Alternative 2 include:

1. Monitoring ground water for VOCs.

2. Risk and hazard management to prevent human exposure to COCs and to mitigate impacts to ecological receptors.

The risk and hazard management program will include: (1) analyzing indoor air at Building 833 annually for a minimum of two years, and if air concentrations indicate that the inhalation risk exceeds 10^{-6} or the HI exceeds 1, institute restrictions for building use or if building use is again anticipated, installing a building ventilation system and operating it whenever the building is occupied, (2) reviewing exposure pathway-related conditions such as building and land use, (3) refining risk and hazard models using current data, and (4) reporting the results to the stakeholders.

The estimated present-worth cost of Alternative 2 for the Building 833 release site is $819,000 based on 30 years of monitoring and exposure control.

Alternative 3—Monitoring, Exposure Control, and Ground Water and Soil Vapor Extraction and Treatment

Alternative 3 combines the monitoring and exposure control described in Alternative 2 with VOC mass removal through ground water and/or soil vapor extraction and treatment at Building 833.

As part of Alternative 3, ground water and/or soil vapor remediation would be implemented at Building 833 to: (1) reduce soil vapor VOC concentrations in the vadose zone to acceptable risk- and hazard-based concentrations, (2) reduce soil vapor VOC concentrations in the vadose zone to levels protective of ground water, and/or (3) reduce VOC concentrations in ground water to meet RAOs by reducing contaminant concentrations and mass to achieve source and plume migration control.

COCs in ground water at Building 833 consist of TCE and cis-1,2-DCE. Cis-1,2-DCE was below analytical method detection limits in the most recent ground water samples. The primary VOC mass removal mechanism would be by SVE. Ground water extraction wells would be used primarily to dewater the water-bearing zone to enhance SVE of VOCs. Dual-phase extraction is considered a presumptive remedy by EPA for remediation of VOCs and other contaminants in subsurface formations. Dual-phase extraction would be implemented at approximately two wells located in the Building 833 area for mass removal. VOCs in ground water would be treated using aqueous-phase GAC. Extracted soil vapor would be treated using vapor-phase GAC and discharged to the atmosphere in accordance with the permit requirements issued by the SJVUAPCD. Treated ground water effluent from the Building 833 treatment system would be discharged onsite in accordance with Substantive Requirements issued by the RWQCB. The spent GAC from the soil vapor and/or ground water treatment system would be disposed or regenerated at an offsite treatment facility.

The estimated present-worth cost of Alternative 3 for the Building 833 release site is $4,256,000 based on 30 years of monitoring, exposure control, and ground water and soil vapor extraction.

2.9.11. Remedial Alternatives for the Building 845 Firing Table and Pit 9 Landfill (OU 8)

High explosives experiments were conducted at the Building 845 firing table from 1958 to 1963. Leaching of contaminants from firing table debris has resulted in the contamination of subsurface soil. Depleted uranium and HMX have been detected in shallow silty clay, silt, and gravels (Qls) and shallow $Tnbs_1$ bedrock at concentrations of 1.2 pCi/g and 0.054 mg/kg, respectively. No contamination has been detected in ground water under the Building 845 firing table. In 1988, a total of 1,942 yd^3 of Building 845 firing table gravel and 390 yd^3 of soil from the firing table berm were removed and disposed in Pit 1.

The Pit 9 Landfill was used until 1968 to dispose of approximately 4,400 yd^3 of firing table debris generated at the Building 845 firing table. The firing table debris buried in the pit may have contained tritium, uranium, and/or HE compounds. However, soil, rock, and ground water analytical data indicate that contaminants have not been released from the Pit 9 Landfill. Depth to ground water in this area is about 140 ft below ground surface.

No unacceptable risk or hazard to human health or ecological receptors in the Building 845 firing table or Pit 9 Landfill has been identified.

Three remedial alternatives were assembled to address COCs in subsurface soil/bedrock at the Building 845 firing table and in the Pit 9 Landfill, as described below.

Alternative 1—No Action

Alternative 2—No Further Action for HMX and Uranium in Subsurface Soil/Rock and Monitoring

The primary components of Alternative 2 include:

1. No further action for HMX and uranium in subsurface soil/rock.
2. Monitoring ground water for future releases of HMX and uranium from subsurface soil/rock and contaminants that may be present in the Pit 9 Landfill waste.

The only COCs identified for the Building 845 firing table area were HMX and uranium in subsurface soil/rock. In 1988, 1,942 yd^3 of gravel from the firing table and 390 yd^3 of soil from the firing table berm were removed and disposed in Pit 1. In the baseline risk assessment, no risk or hazard to human health or ecological receptors posed by HMX or uranium in subsurface soil/rock was identified. No contamination has been detected in ground water under the Building 845 firing table. Monitoring for HMX and uranium in ground water would indicate if contamination in subsurface soil/rock has impacted ground water and enable assessment of changes in risk or hazard that would affect human health and the environment.

Sampling and analysis of ground water from monitor wells in the Building 845 firing table and Pit 9 Landfill area will continue in order to monitor for future potential impacts to ground water from: (1) contaminants in subsurface soil/bedrock at the Building 845 firing table or (2) waste buried in the Pit 9 Landfill. The landfill surface would also be inspected annually to ensure that no damage threatens a release from the waste.

Ground water in the vicinity of the Building 845 firing table will be monitored to determine if uranium-238 and HMX, detected in subsurface soil and bedrock, migrates to and impacts ground water.

No COCs have been identified in surface soil, subsurface soil/bedrock, ground water or surface water in the vicinity of the Pit 9 Landfill. However, ground water monitoring for tritium, uranium and HE compounds will be conducted to detect any future releases of contaminants from the landfill and resulting impact to ground water. Additional monitoring wells may be added, if necessary, to provide a complete release detection monitoring network for the landfill.

The ground water data obtained as part of the Alternative 2 monitoring program will be re-evaluated regularly. If data indicate that contaminant concentrations, ground water flow direction, and/or velocity have changed, the monitoring program will be reevaluated.

The estimated present-worth cost of Alternative 2 for the Building 845 firing table and Pit 9 Landfill is $488,000 based on 30 years of monitoring.

Alternative 3—No Further Action for HMX and Uranium in Subsurface Soil/Rock; Monitoring; and Waste Characterization with Contingent Monitoring, Capping, and/or Excavation of the Pit 9 Landfill

Alternative 3 combines monitoring and no further action for HMX and uranium in subsurface soil/rock described in Alternative 2 and characterization of waste in the Pit 9 Landfill with contingent monitoring, capping, and/or excavation of the pit, depending on the waste characterization results.

Characterization of soil, rock, and ground water in the vicinity of the Pit 9 Landfill was conducted as part of the SWRI. Soil and rock samples were collected from the pilot boreholes for four wells located in the vicinity of the Pit 9 Landfill. Ground water has been routinely monitored for possible contamination. No COCs emanating from the Pit 9 Landfill have been identified in surface soil, subsurface soil/bedrock, ground water or surface water.

Several contaminants including uranium and metals were detected in the analysis of gravel from the Building 845 firing table. Because potentially contaminated firing table gravel from this firing table was disposed in the Pit 9 Landfill, this alternative presents methods for evaluating the potential for contamination of the subsurface beneath the pit as a result of releases of contaminants that may be present in the landfill waste.

A strategy has been developed for addressing potential releases of contaminants from landfills. The process begins with a detailed characterization of the contents of the landfill for potential contaminant sources followed by modeling to estimate possible impacts to ground water, and a risk assessment to evaluate impacts to human health and the environment. The results of these activities would be used to support remedial action decisions. Documentation of the work planned and data collected would be provided throughout the landfill characterization and remediation process.

DOE has preliminarily identified five possible remedial approaches to address actual or potential releases of contaminants from the Pit 9 Landfill including:

1. Monitoring only.

2. Capping.
3. Partial excavation with capping.
4. Partial excavation without capping.
5. Total excavation.

Because the depth to ground water is 140 feet or more beneath the Pit 9 Landfill, there is no risk of inundation of the pit that could result in releases.

If waste excavation is selected as the best remedial option for this landfill, two options are available for the disposition of excavated waste. Disposal options include:

1. Transportation to an offsite permitted facility for treatment, destruction, and/or disposal.
2. Placement of excavated waste in an onsite engineered containment unit either at the location of an existing landfill or outside the areas of existing contamination within a Corrective Action Management Unit.

The estimated present-worth cost of Alternative 3 for the Building 845 firing table and Pit 9 Landfill release sites falls between $693,000 and $7,065,000 based on 30 years of monitoring and waste characterization, and depending on the amount of waste excavated from the Pit 9 Landfill.

2.9.12. Remedial Alternatives for the Building 851 Firing Table (OU 8)

The Building 851 firing table has been used to conduct high explosives research. These explosives experiments have resulted in the release of VOCs and depleted uranium to subsurface soil. Analytical data also indicate that cadmium, copper, zinc, RDX, and depleted uranium were released to surface soil surrounding the Building 851 firing table. No risk or hazard associated with these COCs in surface soil and subsurface soil/bedrock was identified in this area in the baseline risk assessment.

Depleted uranium has been detected in ground water in four wells in the vicinity of the Building 851 firing table. The maximum historical activity of uranium-238 detected in these wells was 1.3 pCi/L. Depleted uranium in ground water at the Building 851 firing table was present in the shallow gravel and sand (Qls) and shallow bedrock ($Tnbs_1$). In 1988, the firing table gravel was removed and has been replaced periodically since then.

Three remedial alternatives were assembled to address COCs in subsurface soil/bedrock at the Building 851 firing table, as described below.

Alternative 1—No Action

Alternative 2—No Further Action for VOCs and Uranium in Subsurface Soil/Rock and for RDX, Metals, and Uranium in Surface Soil, and Monitoring

The primary components of Alternative 2 include:

1. No further action for VOCs and uranium in subsurface soil/bedrock, and for RDX, cadmium, copper, zinc, and uranium in surface soil.

2. Monitoring ground water for COCs.

Ground water has not been impacted by the RDX, cadmium, copper, or zinc in surface soil in the vicinity of the Building 851 firing table. Modeling indicates that cadmium and copper may reach ground water in 20,000 years in concentrations of 0.0024 mg/L and 0.054 mg/L, respectively. The MCLs for cadmium and copper are 0.005 mg/L and 1,000 mg/L, respectively with background concentrations of 0.0015 mg/L and 0.05 mg/L, respectively. The model indicated that zinc and RDX in surface soil would result in ground water concentrations of 0.041 mg/L in 10,000 years for zinc and RDX in ground water at 2.5 µg/L in 400 years. The MCL for zinc is 5 mg/L with background concentrations of 0.01 mg/L. The method detection limit for RDX is 0.7 µg/L. There is no risk or hazard for human or ecological receptors posed by these contaminants in surface soil. The maximum concentrations of VOCs detected in subsurface soil were TCE at 0.0003 mg/kg and cis-1,2-DCE at 0.012 mg/kg.

Concentrations of TCE and other VOCs previously detected at very low concentrations in ground water have declined below analytical method detection limits, indicating that VOCs in subsurface soil/rock are not a continuing source of contamination in ground water. No risk or hazard for VOCs in subsurface soil has been identified.

Depleted uranium has been detected in surface soil and subsurface soil/rock at maximum uranium-238 activities of 14 pCi/g and 11 pCi/g, respectively. Depleted uranium was detected in ground water at a maximum historical uranium-238 activity of 1.3 pCi/L (1990), slightly above the cancer preliminary remediation goal (PRG) of 1.1 pCi/L and below the MCL and background activities for total uranium. The water-bearing zone affected by the contamination is not currently a drinking water source. No unacceptable risk or hazard to human health or ecological receptors was identified for uranium in surface or subsurface soil/rock.

The estimated present-worth cost of Alternative 2 for the Building 851 firing table release site is $530,000 based on 30 years of monitoring.

Alternative 3—No Further Action for VOCs and Uranium in Subsurface Soil/Rock, Uranium, Metals and RDX in Surface Soil, Monitoring, and Ground Water Extraction and Treatment of Uranium

Alternative 3 combines the no further action and monitoring described in Alternative 2 with uranium mass removal at Building 851 firing table through ground water extraction and treatment.

As part of Alternative 3, ground water remediation would be implemented at the Building 851 firing table to reduce uranium concentrations in ground water to achieve plume migration control. Depleted uranium has been detected in ground water from four wells in the Building 851 firing table area with uranium-238 activities up to 1.3 pCi/L (1990), slightly above the cancer PRG for uranium (1.1 pCi/L) but below the general background activity for uranium. Ground water would be extracted from these four wells to achieve uranium source mass removal. Uranium in ground water would be treated using an ion exchange treatment system. Treated ground water effluent from the Building 851 treatment system would be discharged onsite in accordance with Substantive Requirements issued by the RWQCB. The spent resin from the ground water treatment system would be disposed or regenerated at an offsite treatment facility.

The estimated present-worth cost of Alternative 3 for the Building 851 firing table release site is $4,198,000 based on 30 years of monitoring and ground water extraction and treatment for uranium.

2.10. Comparative Analysis of Alternatives

This section presents a comparison of the interim remedial alternatives for each area of Site 300 OUs. The NCP identifies nine criteria to be used in the detailed analysis of alternatives as described in Section 2.10.1.

2.10.1. Evaluation Criteria

Threshold Criteria

Overall Protection of Human Health and the Environment

This criterion addresses whether the alternative achieves and maintains protection of human health and the environment during implementation and after remediation objectives are achieved.

Compliance with ARARs

Unless a waiver is obtained, the alternative or combination of alternatives that are finally selected must comply with all location-, action-, and applicable chemical-specific ARARs.

Balancing Criteria

Long-Term Effectiveness and Permanence

This criterion is used to evaluate how each alternative maintains protection of human health and the environment. This includes evaluating residual risk and management obligations after meeting the RAOs.

Reduction of Toxicity, Mobility, and Volume

This criterion is used to evaluate if and how well each alternative reduces the toxicity, mobility, and/or volume of contaminants through treatment. It also addresses the amount of contaminants remaining onsite after completion of remedial measures.

Short-Term Effectiveness

This criterion addresses the effectiveness of each alternative to protect human health and the environment during construction and implementation of each remedial action. This includes the safety of workers and the public, disruption of site and surrounding land uses, and time necessary to achieve protective measures.

Implementability

This criterion addresses the technical and administrative feasibility of each alternative. Factors considered include:

- Availability of goods and services.
- Flexibility of each alternative to allow additional modified remedial actions.
- Effectiveness of monitoring.
- Generation and disposal of hazardous waste.
- Substantive permitting requirements.

Cost

Capital, operation and maintenance, monitoring, and contingency costs are estimated for each alternative and are presented as 1999 present-worth costs using a 5% discount rate. The present-worth costs presented are based on conceptual designs and are provided for comparison purposes only.

Modifying Criteria

State Acceptance

The California Department of Toxic Substances Control (DTSC) and Regional Water Quality Control Board-Central Valley Region (RWQCB) have reviewed and commented on this document. Analysis of technical and administrative concerns that these agencies had regarding each of the alternatives have been addressed. The State agencies have participated in the selection of the remedies for this Interim ROD. The State agencies will also participate in the selection of the final remedies and cleanup standards for Site 300 which will be codified in the Final ROD.

Community Acceptance

A Public Meeting was held on May 4, 2000 during the 30-day comment period for the Proposed Plan, to present and receive public input on the proposed remedial alternatives for the Site 300 OUs. Public comments made during the Public Meeting and 30-day comment period are addressed in the Responsiveness Summary (Section 3). General community concerns are also summarized at the beginning of Section 3.

2.10.2. Comparative Evaluation of Remedial Alternatives for the Building 834 OU

This section compares the characteristics of each alternative against the other Building 834 OU alternatives with respect to the EPA/NCP criteria.

2.10.2.1. Overall Protection of Human Health and the Environment

The only human health risks are possible ingestion of ground water with contaminants at concentrations exceeding MCLs and inhalation of VOC vapors above health-based concentrations in and around Building 834D. There is no existing exposure to contaminated ground water. Fate and transport modeling indicated that contaminants from the Building 834 Complex would not significantly impact offsite water-supply wells.

Alternative 1 would not protect human health because no active measures are taken to reduce contaminant concentrations in ground water or in the vadose zone.

Alternatives 2 and 3 both address risk to human health from potential inhalation of VOC vapors above health-based concentrations by reducing soil vapor VOC concentrations through soil vapor extraction. Both alternatives include the same measures to prevent exposure to contamination while contaminant concentrations are being reduced through ground water and soil vapor extraction such as administrative controls to prevent access to contaminated ground water.

Alternatives 2 and 3 use active remediation to reduce contaminant concentrations and mass at the Building 834 source area and at several locations downgradient through dual-phase ground water and soil vapor extraction. Thus, both alternatives would provide long-term protection of human health and restore beneficial uses of ground water.

Alternative 3 provides additional mass removal and plume control by enhanced *in situ* bioremediation of VOCs downgradient of the Building 834 Complex.

2.10.2.2. Compliance with ARARs

In Alternative 1 (no action), concentrations of VOCs and nitrate would remain above MCLs or any more stringent State requirements that may be established as cleanup ARARs in the Final ROD.

The goals of Alternatives 2 and 3 are to use active soil vapor and ground water remediation to achieve all RAOs and acquire data that will help in meeting cleanup ARARs, which will be established in the Final ROD. The remedial actions described in Alternative 2 will be designed and implemented to comply with action-specific ARARs. Although permits are not required for meeting the substantive requirements for air discharges, DOE/LLNL has chosen to meet those requirements by obtaining air permits from the San Joaquin Valley Unified Air Pollution Control District (SJVUAPCD). Air permits N-472-12-3 and N-472-54-2 have been issued for the soil vapor unit and bubbler tank, respectively.

2.10.2.3. Long-Term Effectiveness and Permanence

Alternative 1 (no action) does not permanently reduce COC concentrations or provide long-term effectiveness in meeting RAOs, MCLs, or more stringent State requirements that may be established as ARARs in the Final ROD. Alternatives 2 and 3 provide long-term effectiveness through mass removal of COCs from the vadose zone and ground water. Ongoing SVE at Building 834 over the past year has demonstrated that SVE is effective in removing VOCs from the subsurface. The dewatering elements of Alternatives 2 and 3 would enhance mass removal in the saturated zone.

2.10.2.4. Reduction of Toxicity, Mobility, and Volume

Alternative 1 does not remove COCs from the subsurface. Therefore, implementation of this alternative would not reduce the toxicity, mobility, or volume of the COCs.

Under Alternatives 2 and 3, remedial actions involve removing VOCs from the vadose zone and ground water by transferring VOCs to an air stream and absorption to carbon. The toxicity and volume of these VOCs are then eliminated through thermal destruction of the VOCs sorbed to carbon. TBOS/TKEBS would be removed from ground water and disposed of offsite as hazardous waste, therefore the toxicity and volume of this contaminant would not be reduced. The toxicity and volume of nitrate would be reduced through phytoremediation. Contaminant volume and mobility in the vadose zone and ground water would be reduced irreversibly by SVE, dewatering, plume control, and contaminant recovery by both Alternatives 2 and 3. Any residual DNAPL would be removed by the dewatering and SVE. If any free-product DNAPL is found, it would be extracted by direct pumping.

As the rate of degradation through enhanced *in situ* bioremediation is unknown, the ability of this Alternative 3 component to further reduce the mobility and volume of contaminants above that attained through ground water and soil vapor extraction in Alternative 2 is not certain. Ongoing studies would provide data on the viability of *in situ* bioremediation to further reduce the mobility and volume of contaminants when used with SVE and ground water pumping.

2.10.2.5. Short-Term Effectiveness

Since there would be no remediation-related construction occurring under Alternative 1, there would be no impact to human or ecological receptors.

Due to the remoteness of the site and the vertical distance between the perched water-bearing zone and the regional aquifer, remedial actions under Alternatives 2 and 3 would have minimal impact on the public during the construction and subsequent operation of the remedial systems. A health and safety plan would be developed prior to implementation of the selected remedial action to protect the health of onsite workers. In addition, workers would follow Site 300 operational procedures and use appropriate personal protective equipment and clothing to mitigate potential risks.

It is unlikely that risk protection would be achieved significantly faster under Alternative 3 than under Alternative 2. For both alternatives, the ground water and soil vapor extraction will reduce concentrations. Concentration trends indicate that DNAPLs, if present, have been significantly reduced and continued ground water and soil vapor extraction will complete the remediation in about 30 years. Detailed modeling with refined cleanup time estimates will be presented in the Remedial Design report.

Biological resource surveys will continue to be conducted prior to any construction activities at Site 300 to ensure there are no impacts to ecological receptors.

2.10.2.6. Implementability

Each of the alternatives can be implemented. However, implementation becomes more complicated with each alternative. Alternative 1 can be implemented easily by shutting down the existing treatment facilities.

The treatment technologies incorporated into Alternative 2 are well proven, have been identified as presumptive technologies for VOCs in soil vapor and ground water, and are already in place and operating. To fully implement this alternative, additional extraction wells would be connected to the treatment systems.

For Alternative 3, the implementability of the enhanced *in situ* bioremediation component of the alternative is limited by: (1) the ability to find suitable enhancing materials, (2) access to drill sites in the rough terrain, and (3) permitting requirements for injection of enhancing fluids. The operation of the *ex situ* ground water treatment system for Alternative 3 would require Substantive Requirements from the RWQCB for the discharge of treated effluent. In addition, the enhanced *in situ* bioremediation component of Alternative 3 may require Substantive Requirements designed to ensure that residual materials or byproducts protect beneficial uses of ground water.

2.10.2.7. Cost

The estimated present worth of the life-cycle costs for the Building 834 alternatives range from no cost for Alternative 1 to $14,504,000 for Alternative 3. Capital, O&M, monitoring, and risk and hazard management costs were developed for Alternatives 2 and 3.

Significant differences in the costs of the alternatives are due to the following differences in the alternatives. Compared to the other alternatives:

- Alternative 1 has no cost as no remedial action would occur.
- Alternative 2 has a present worth of $12,125,000, which consists primarily of wellfield expansion and O&M for the existing treatment facility. The majority of the capital construction costs have already been incurred.
- Alternative 3 costs exceed those of Alternative 2 by $2.4 million, which includes the capital and O&M costs for the enhanced *in situ* bioremediation system.

2.10.2.8. State Acceptance

The California DTSC and RWQCB provided ARARs and information about other requirements that will be evaluated as possible cleanup standards in the Final ROD and that were used as the basis for developing the selected interim remedy. These State agencies reviewed and evaluated the remedial technologies and alternatives, participated in the selection of the interim remedy, and provided oversight and enforcement of state environmental regulations. In addition, the regulatory agencies have monitored and reviewed public acceptance of the selected interim remedy.

2.10.2.9. Community Acceptance

General comments on community acceptance are included at the beginning of the Responsiveness Summary (Section 3). The responding members of the community appear to support the proposed ground water and soil vapor extraction and treatment action but have concerns that the entire plume be captured.

2.10.3. Comparative Evaluation of Remedial Alternatives for the Pit 6 Landfill OU

This section presents a comparative evaluation of the characteristics of each alternative against the other alternatives for the Pit 6 Landfill OU with respect to the EPA/NCP criteria.

2.10.3.1. Overall Protection of Human Health and the Environment

In the baseline risk assessment, an inhalation risk of 5×10^{-6} for onsite workers was identified for VOCs volatilizing from subsurface soil in the vicinity of the Pit 6 Landfill. A landfill cap was installed in 1997 to mitigate the risk of exposure to VOCs vaporizing from the landfill. An inhalation risk of 4×10^{-5} and HI of 1.5 for onsite workers was also identified for VOCs volatilizing from Spring 7 to ambient air. The risk and hazard estimates were based on an exposure to maximum historical concentrations of VOCs detected in Spring 7 (110 µg/L). However, in 1999 only TCE was detected in shallow ground water near Spring 7 at a concentration of 4.4 µg/L. There is no current exposure to contaminated ground water. An HI greater than 1 was identified for potential exposure of kit fox to contaminants in soil in the vicinity of the pit. The landfill cap was designed to prevent burrowing and thus exposure by animals to the pit contents.

Alternative 1 (no action) may not protect human health and the environment. Although contaminant concentrations may be reduced to health- and environmentally-protective levels through natural attenuation, potential changes in plume concentrations/activities and size that could result in impacts to downgradient receptors would not be monitored or detected.

Alternatives 2 and 3 both address risk to human health from potential ingestion of contaminated ground water. Ground water contaminant levels may be reduced to health-protective levels more rapidly through extraction and treatment in Alternative 3 than by natural attenuation of contaminants in Alternative 2. Both alternatives include the same measures to prevent exposure to contamination by human and ecological receptors while contaminant concentrations are being reduced, such as administrative controls to prevent access to contaminated ground water.

Alternatives 2 and 3 both include measures to reduce contaminant concentrations and mass in ground water. Thus, both alternatives would provide long-term and effective protection of human health and the environment.

Alternative 3 provides for more rapid contaminant mass removal and concentration reduction through extraction and treatment of contaminated ground water. However, the additional mass removed in Alternative 3 would provide no significant quantifiable health risk benefit compared to Alternative 2 because ground water in this area is not used for drinking water.

2.10.3.2. Compliance with ARARs

Alternative 1 (no action) may meet all RAOs, MCLs or more stringent State requirements that may be established as cleanup ARARs in the Final ROD if natural attenuation reduces contaminant concentrations as expected. However, there are no provisions in this alternative to monitor the progress of natural attenuation toward meeting RAOs or determining when these goals are met.

Alternatives 2 and 3 both include measures to reduce contaminant concentrations and mass in ground water to meet all RAOs. Data indicate that COCs (except nitrate) are naturally attenuating and will achieve MCLs and any more stringent State requirements that may be established as cleanup ARARs in the Final ROD in a reasonable timeframe as proposed in Alternative 2. However, cleanup may be achieved in shorter timeframe through the active remediation presented in Alternative 3.

Although permits are not required for meeting the substantive requirements for air discharges, DOE/LLNL has chosen to meet those requirements by obtaining air permits from the SJVUAPCD. If Alternative 3 were chosen, an appropriate air permit would be obtained.

2.10.3.3. Long-Term Effectiveness and Permanence

Alternative 1 (no action) may permanently reduce COC concentrations and provide long-term effectiveness in meeting RAOs, MCLs, or more stringent State requirements that may be established as cleanup standards in the Final ROD, however there are no mechanisms included in this alternative for establishing the achievement of these goals.

Alternatives 2 and 3 both provide long-term effectiveness by permanently reducing contaminant concentrations to meet RAOs, MCLs, or more stringent State requirements that may be established as cleanup standards in the Final ROD. Alternative 2 would effectively and permanently reduce contamination in ground water through irreversible chemical degradation and radioactive decay (natural attenuation). Under Alternative 3, VOCs and nitrate are actively removed from ground water through extraction and treatment. However, Alternative 3 relies on monitored natural attenuation to reduce tritium activities in ground water. Alternatives 2 and 3 provide monitoring to determine the long-term effectiveness and permanence of the remedies.

2.10.3.4. Reduction of Toxicity, Mobility, and Volume

While Alternative 1 does not remove COCs from the subsurface, natural attenuation of contaminants may result in the long-term reduction of the toxicity, mobility, and volume of contamination in the subsurface. However there are no mechanisms included in this alternative for establishing the achievement of these goals.

Alternative 2 relies on monitored natural attenuation to achieve the long-term reduction of the toxicity, mobility, and volume of contamination in the subsurface. Alternative 3 actively removes VOCs and nitrate from the subsurface and may reduce the volume and mobility of contaminants more rapidly. This alternative relies on monitored natural attenuation to reduce the volume of tritium in ground water. Both alternatives provide a monitoring component to ensure that contaminants in the subsurface are addressed.

2.10.3.5. Short-Term Effectiveness

Since there would be no remediation-related construction occurring under Alternative 1, there would be no short-term impact to human or ecological receptors. Under Alternative 2, there would be minimal impact to onsite workers during monitoring activities. Workers would follow Site 300 operational procedures to mitigate potential risks during monitoring.

A health and safety plan would be developed prior to construction and operation of the extraction and treatment system component of Alternative 3 to protect the health of onsite workers. In addition, workers would follow Site 300 operational procedures and use personal protective equipment and clothing to mitigate potential risks during construction and operation of the treatment system. Biological resource surveys would continue to be conducted prior to any construction activities at Site 300 to ensure there are no impacts to ecological receptors.

Alternative 3 poses additional short-term exposure risks if tritiated water is brought to the surface during ground water extraction. Workers could be exposed during operation and maintenance of the ground water treatment facility.

VOC concentrations may decrease below MCLs within 2-4 years through natural attenuation regardless of other actions taken. Alternative 3 may lessen the time to reach cleanup standards set in the Final ROD. Tritium activities are below the MCL. There is no MCL for perchlorate, but concentrations currently exceed the 18 µg/L State Action Level. Because of the small size of the plume, dispersion alone may decrease the concentration of perchlorate to less than the Action Level within 15 years. Additional monitoring data will be presented in the Remedial Design report to refine this estimate.

2.10.3.6. Implementability

No actions would be necessary to implement Alternative 1. Alternative 2 could be readily implemented by continuing and enhancing the existing ground water monitoring programs and continuing administrative controls to prevent exposure.

Alternative 3 can be readily implemented although additional time, labor and expense would be necessary both in the short- and long-term to construct, operate, and monitor the treatment system. Operation of the treatment system would require meeting Substantive Requirements issued by the RWQCB. In addition, provisions would need to be made to avoid impacting the integrity of the landfill cap during construction, as well as for worker safety during treatment system construction and operation since an active small firearms shooting range is located in the vicinity.

2.10.3.7. Cost

The estimated present worth of the life-cycle costs for the Pit 6 Landfill OU alternatives range from no cost for Alternative 1 to $5,939,000 for Alternative 3. Monitoring, modeling, and risk and hazard management costs were developed for Alternative 2. Capital and O&M costs for the extraction and treatment facility, as well as monitoring, and risk and hazard management costs, were developed for Alternative 3.

Compared to the other alternatives:

- Alternative 1 has no cost as no remedial action would occur.
- Alternative 2 costs $2,376,000, which includes the cost to monitor and model the natural attenuation of contaminants in ground water to document the effectiveness of the remedy in meeting RAOs and determine when cleanup goals are met.
- Alternative 3 costs exceed the costs of Alternative 2 by $3.6 million, which includes the capital and O&M costs for the ground water extraction and treatment system.

2.10.3.8. State Acceptance

The California DTSC and RWQCB provided ARARs and information about requirements that will be evaluated as possible cleanup standards in the Final ROD, which were used as the basis for developing the selected interim remedy. These State agencies reviewed and evaluated the remedial technologies and alternatives, participated in the selection of the interim remedy, and provided oversight and enforcement of state environmental regulations. In addition, the regulatory agencies have monitored and reviewed public acceptance of the selected interim remedy.

2.10.3.9. Community Acceptance

General comments on community acceptance are included at the beginning of the Responsiveness Summary (Section 3). The responding members of the community have general reservations about the use of MNA and whether evidence is sufficient to show actual biochemical breakdown of the VOCs.

2.10.4. Comparative Evaluation of Remedial Alternatives for the HE Process Area OU

This section compares the characteristics of each alternative against the other alternatives presented for remediation of the HE Process Area OU with respect to the EPA/NCP criteria. As a presumptive remedy has been identified for this OU, only one alternative (Alternative 2) has been compared against the no action alternative required by the NCP.

2.10.4.1. Overall Protection of Human Health and the Environment

Alternative 1 (no action) may not protect human health and the environment because no active measures are taken to reduce contaminant concentrations in ground water to health- and environmentally-protective levels. In addition, potential changes in plume concentration and size that could result in impacts to downgradient receptors would not be monitored or detected.

Under Alternative 2, human health is protected from exposure to VOCs volatilizing from subsurface soil at Building 815 through the implementation of construction and/or use of access restrictions. Risk and hazard would be re-evaluated using current data. Alternative 2 also provides measures to prevent exposure to VOCs volatilizing from Spring 5 until concentrations in the spring are reduced to health-protective levels through the extraction and treatment of ground water.

Alternative 2 mitigates risk to human health from potential ingestion of contaminated ground water through extraction and treatment of contaminated ground water at the Building 815, the HE rinsewater lagoon, and the HE Burn Pit source areas, and in the downgradient portion of the plume. This alternative also includes measures to prevent exposure to contamination by human and ecological receptors while contaminant concentrations are being reduced, such as administrative controls to prevent access to contaminated ground water.

Alternative 2 includes measures to reduce contaminant concentrations and mass in ground water and surface water and prevent migration of the contaminant plumes, and therefore would provide long-term and effective protection of human health and the environment.

2.10.4.2. Compliance with ARARs

Under Alternative 1 (no action), concentrations of VOCs, HE compounds, nitrate, and perchlorate may remain above MCLs and any more stringent State requirements that may be established as cleanup ARARs in the Final ROD.

Alternative 2 includes active measures to reduce contaminant concentrations and mass in ground water and surface water to meet all RAOs. The remedial actions described in Alternative 2 can be designed and implemented to comply with action-specific ARARs.

Although permits are not required for meeting the substantive requirements for air discharges, DOE/LLNL has chosen to meet those requirements by obtaining air permits from the SJVUAPCD.

2.10.4.3. Long-Term Effectiveness and Permanence

Alternative 1 (no action) does not provide long-term effectiveness in meeting RAOs or permanently reduce COC concentrations.

Alternative 2 provides long-term effectiveness by permanently reducing contaminant concentrations to meet RAOs through active remediation. This alternative also provides monitoring to determine the long-term effectiveness and permanence of the remedies.

2.10.4.4. Reduction of Toxicity, Mobility, and Volume

Alternative 1 does not remove COCs from the subsurface. Therefore, implementation of this alternative would not reduce the toxicity, mobility, or volume of the COCs.

Under Alternative 2, remedial actions involve removing contaminants from ground water and adsorbing them to carbon. The toxicity of the contaminants would be reduced through the thermal destruction of the contaminants sorbed to GAC. Contaminant volume and mobility in ground water would be reduced irreversibly by source mass removal, contaminant concentration reduction, and plume control.

2.10.4.5. Short-Term Effectiveness

Since there would be no remediation-related construction occurring under Alternative 1, there would be no short-term impact to human or ecological receptors.

In Alternative 2, there would be minimal impact to onsite workers during monitoring activities. Workers would follow Site 300 operational procedures to mitigate potential risks during monitoring.

A health and safety plan would be developed prior to construction and operation of the extraction and treatment system component of Alternative 2 to protect the health of onsite workers. In addition, workers would follow Site 300 operational procedures and use personal protective equipment and clothing to mitigate potential risks during construction and operation of the treatment system. Biological resource surveys would continue to be conducted prior to any construction activities at Site 300 to ensure there are no impacts to ecological receptors.

Ground water and soil vapor extraction will reduce contaminant concentrations. Based on historical trends and expected effectiveness of pump-and-treat technology, it may take between 25 and 30 years for ground water contaminants to fall below MCLs. Detailed modeling with refined cleanup time estimates will be presented in the Remedial Design report.

2.10.4.6. Implementability

No actions would be necessary to implement Alternative 1.

The treatment technologies incorporated into Alternative 2 are well proven and have been identified as presumptive technologies for VOCs in ground water. The implementation of this alternative would require construction and operation of extraction and treatment systems at the Building 815, HE rinsewater lagoon, and HE Burn Pit source areas. The ground water extraction and treatment system at the site boundary to control offsite plume migration is already in place and operating. The operation of the ground water treatment systems for Alternative 2 would require Substantive Requirements from the RWQCB for the discharge of treated effluent.

2.10.4.7. Cost

The estimated present worth of the life-cycle costs for the HE Process Area OU alternatives range from no cost for Alternative 1 to $27,621,000 for Alternative 2. Compared to the other alternative:

- Alternative 1 has no cost as no remedial action would occur.
- Alternative 2 costs exceed those of Alternative 1 by $27.6 million which includes the costs for monitoring, risk and hazard management, and the capital and O&M costs for the extraction and treatment facilities.

2.10.4.8. State Acceptance

The California DTSC and RWQCB provided ARARs and information about requirements that will be evaluated as possible cleanup standards in the Final ROD, which were used as the basis for developing the selected interim remedy. These State agencies reviewed and evaluated the remedial technologies and alternatives, participated in the selection of the interim remedy, and provided oversight and enforcement of state environmental regulations. In addition, the regulatory agencies have monitored and reviewed public acceptance of the selected interim remedy.

2.10.4.9. Community Acceptance

General comments on community acceptance are included at the beginning of the Responsiveness Summary (Section 3). The responding members of the community appear to support the proposed ground water extraction and treatment action, with concerns that the entire plume be captured.

2.10.5. Comparative Evaluation of Remedial Alternatives for the Building 850 Area

This section compares the characteristics of each alternative against the other alternatives for Building 850 with respect to the EPA/NCP criteria.

2.10.5.1. Overall Protection of Human Health and the Environment

Alternative 1 (no action) may not protect human health or the environment because without monitoring of the ground water COC plumes, there would be no means of determining changes in plume size and location that could impact downgradient receptors. Alternative 1 does not meet the RAOs of preventing potential incidental ingestion and direct dermal contact with contaminated surface soils.

Alternatives 2, 3, and 4 all address risk to human health from potential incidental ingestion and direct dermal contact with contaminated surface soils, and ingestion of contaminated ground water. These three alternatives include the same measures to prevent exposure to contamination by human and ecological receptors while contaminant concentrations are being reduced.

Alternatives 2 and 3 both include source control measures and rely on natural attenuation of contaminants in ground water and surface water to health- and environmentally protective levels, as well as to prevent further releases to ground water. Alternative 3 also includes the excavation of soil/bedrock beneath the Building 850 Firing Table. In addition, Alternative 4 includes active extraction and *in situ* treatment of uranium and nitrate to reduce concentrations/activities of these contaminants to levels protective of human health and the environment.

Data indicate that there is a diminishing source of tritium and uranium to ground water and there is no unacceptable risk or hazard associated with tritium and uranium in subsurface soil in the vicinity of the firing table. Therefore, Alternatives 3 and 4 may not significantly increase in the level of protection to human health and the environment posed by contaminated subsurface soil/rock over Alternative 2.

Alternatives 2, 3, and 4 provide similar levels of protection to human health for preventing the ingestion of contaminated ground water as: (1) the tritium and uranium plumes are contained onsite, (2) uranium activities in ground water are below the MCL and within the natural background range, and (3) ground water is not currently used for drinking.

2.10.5.2. Compliance with ARARs

Alternative 1 may meet RAOs, MCLs, or more stringent State requirements that may be established as ground water cleanup ARARs in the Final ROD if natural attenuation reduces contaminant concentrations in ground water as expected. However, without monitoring, there is no means of establishing achievement of these goals. Without cleanup, some COCs in surface soils at the firing table may exceed cleanup standards for the foreseeable future.

Alternatives 2, 3, and 4 all include source control measures to prevent further releases of tritium and uranium to ground water. They all rely on natural attenuation to reduce tritium activities in ground water to meet its MCL and any more stringent State requirements that may be established as cleanup ARARs in the Final ROD. Data indicate that a diminishing tritium source is present at Building 850 and the continuing decay of tritium may result in the attainment of the tritium MCL in a reasonable timeframe.

2.10.5.3. Long-Term Effectiveness and Permanence

The long-term effectiveness and permanence of Alternative 1 relies solely on natural attenuation to reduce contaminant concentrations in ground water. It does not provide long-term or permanent protection of human health as contaminated surface soils are left in place.

Alternatives 2 and 3 provide long-term effectiveness by removing contaminant sources to prevent future releases to ground water, permanently mitigating exposure risk by removing contaminated surface soils, and through natural attenuation of contaminants in ground water. In addition, Alternative 4 provides long-term effectiveness by permanently removing uranium and nitrate from ground water.

Under Alternatives 2, 3, and 4, monitoring would be conducted after cleanup standards established in the Final ROD have been achieved, to ensure long-term effectiveness and permanence.

2.10.5.4. Reduction of Toxicity, Mobility, and Volume

While Alternative 1 does not remove COCs from the subsurface, natural attenuation of contaminants may result in the long-term reduction of toxicity, mobility, and volume of contaminants if further releases do not occur.

The excavation component of Alternatives 3 and 4 would reduce the mobility of the contaminants by removing the waste, thus preventing further leaching of contaminants to the subsurface. It would not reduce the toxicity or volume of the contaminants as the waste would be redeposited at a different location.

Alternatives 2, 3, and 4 rely on monitored natural attenuation of tritium in ground water to achieve a long-term reduction in toxicity, mobility, and volume of tritium in the subsurface. Alternatives 2 and 3 rely on sorption and degradation to reduce the toxicity, mobility, and volume of uranium and nitrate in ground water.

By adding the additional soil/bedrock excavation component, Alternative 3 may additionally reduce contaminant mobility over Alternative 2. However, none of the removal components of Alternative 2 or 3 would reduce contaminant toxicity and volume.

The extraction and treatment of uranium and nitrate in ground water and *in situ* treatment of uranium under Alternative 4 would reduce the volume and mobility of the contaminants in ground water.

2.10.5.5. Short-Term Effectiveness

Since there would be no remediation-related construction occurring under Alternative 1, there would be no impact to human or ecological receptors from this type of activity and therefore it would be effective in the short-term. However, exposure risks from surface soil would remain.

Alternatives 2, 3 and 4 have the potential for short-term exposure for onsite workers during the removal of contaminated soil and the sand pile. Short-term exposure risk may be higher for Alternatives 3 and 4 than for Alternative 2 as workers would be exposed to a much larger volume of contaminated media. The excavation component of Alternatives 3 and 4 is likely to increase the number of exposure pathways, as well as disrupt habitat, increasing the potential for short-term exposure and impacts to the environment.

Alternative 4 also poses short-term and possibly long-term exposure risk to onsite workers as uranium and potentially tritium would be brought to the surface during the extraction of ground water. Workers could be exposed during the installation, operation and maintenance of the treatment systems and the handling and storage of uranium-contaminated resin. This is due to the fact that uranium is removed and concentrated in ion-exchange resins as part of the treatment process. Exposure control measures would be needed to prevent exposure until the uranium is safely disposed.

Alternative 2 would reduce the tritium source rapidly by actively removing surface soil contamination. Ground water data trends indicate that little tritium remains in the vadose zone; hence the excavation of deeper soil and bedrock included in Alternatives 3 and 4 may not reduce activities more rapidly. Without an active source, monitored natural attenuation may reduce tritium activities below MCLs within a few decades. By decay alone (Alternative 2), tritium activities in ground water would decrease to less than MCLs in under 40 years. Other factors (dispersion, dilution) will likely contribute to reducing measured activities more quickly. Detailed modeling with refined cleanup time estimates will be presented in the Remedial Design report.

Under Alternative 4, tritium activities would not be significantly reduced by the ground water extraction for uranium and nitrate. Uranium is already below the MCL.

2.10.5.6. Implementability

No action would be necessary to implement Alternative 1.

The monitoring and exposure control components of Alternatives 2, 3, and 4 can be easily implemented as many of the exposure control methods and most of the monitoring network are already in place. The removal of contaminated soil and sand pile in Alternatives 2, 3, and 4 should be fairly easy to implement but deviations from the estimated volume to be removed would affect the degree of difficulty of implementation. Additional engineering and logistical difficulties are posed by the excavation of subsurface soil in Alternatives 3 and 4. The primary difficulties in excavating beneath the Building 850 Firing Table are: (1) excavating bedrock in areas of steep terrain is extremely difficult, (2) this firing table is currently active and in use for high explosive experiments, and (3) there are a number of subsurface conduits for diagnostic equipment that would have to be avoided or removed/replaced during excavation.

The ground water extraction and treatment portion of Alternative 4 is implementable. However, there are safety concerns related to potential worker exposure to tritiated water. The operation of the *ex situ* ground water treatment system for Alternative 4 would require Substantive Requirements from the RWQCB for the discharge of treated effluent. The implementability of the *in situ* reactive barrier component of Alternative 4 is limited by (1) significant engineering challenges to install the barrier in unconsolidated alluvium and bedrock, and (2) the removal and replacement of spent resins in the subsurface barriers. The *in situ* reactive barrier may require Substantive Requirements designed to ensure that residual materials or by-products protect beneficial uses of ground water.

2.10.5.7. Cost

The estimated present worth of the life-cycle costs for the Building 850 alternatives range from no cost for Alternative 1 to $16,097,000 for Alternative 4, as described below

- Alternative 1 has no cost as no remedial action would occur.

- Alternative 2 costs $4,033,000 and includes: (1) monitoring, (2) exposure controls, (3) monitored natural attenuation, modeling, and risk assessment, and (4) removal of contaminated surface soil and the sand pile.
- Alternative 3 costs $8,246,000 and includes: (1) monitoring, (2) exposure controls, (3) monitored natural attenuation, modeling, and risk assessment, (4) removal of contaminated surface soil and the sand pile, (5) excavation of contaminated subsurface soil/rock, and (6) offsite disposal of waste.
- Alternative 4 costs $16,097,000 and includes: (1) monitoring, (2) exposure controls, (3) monitored natural attenuation, modeling, and risk assessment, (4) removal of contaminated surface soil and the sand pile, (5) excavation of contaminated subsurface soil/rock, (6) offsite disposal of waste, (7) extraction and treatment of nitrate and uranium in ground water, and (8) installation and maintenance of an *in situ* permeable reactive barrier wall to remove uranium from ground water.

2.10.5.8. State Acceptance

The California DTSC and RWQCB provided ARARs and information about other requirements that will be evaluated as possible cleanup standards in the Final ROD, which were used as the basis for developing the selected interim remedy. These State agencies reviewed and evaluated the remedial technologies and alternatives, participated in the selection of the interim remedy, and provided oversight and enforcement of state environmental regulations. In addition, the regulatory agencies have monitored and reviewed public acceptance of the selected interim remedy.

2.10.5.9. Community Acceptance

General comments on community acceptance are included at the beginning of the Responsiveness Summary (Section 3). The responding members of the community have general reservations about the use of MNA and whether the tritium plume is expanding. They also have reservations about the time it will take for tritium to reach what they consider acceptable limits. Members of the community have expressed their concern over potential delays in cleanup at the Pit 7 Complex resulting from its removal from this Interim ROD, and indicated their desire for continued community involvement in the Pit 7 Complex cleanup decision process.

2.10.6. Comparative Evaluation of Remedial Alternatives for the Pit 2 Landfill

This section compares the characteristics of each alternative against the other alternatives for the Pit 2 Landfill with respect to the EPA/NCP criteria.

2.10.6.1. Overall Protection of Human Health and the Environment

Alternative 1 (no action) may protect human health and the environment for the following reasons: (1) no risk or hazard to human health or ecological receptors in the vicinity of the Pit 2 Landfill was identified, (2) ground water has not been impacted by contamination in the Pit 2 Landfill area, and (3) no COCs were identified in any media for the Pit 2 Landfill. Although there is no known risk or hazard associated with the Pit 2 Landfill, potential impacts to ground water would not be monitored or detected under Alternative 1.

Alternatives 2 and 3 both include the same measures to monitor for potential future impacts to ground water and any associated changes in risk or hazard that could affect human health and the environment. Thus, both alternatives would provide long-term and effective protection of human health and the environment.

If characterization data for the Pit 2 Landfill waste indicate that contaminants associated with the waste could impact human health and/or the environment, the capping and/or excavation components of Alternative 3 would provide additional long-term protection for human health and the environment. If the waste characterization results indicate that human health and the environment would not be impacted by contaminants in the landfill waste, Alternative 3 would provide no significant quantifiable health risk benefit compared to Alternative 2.

2.10.6.2. Compliance with ARARs

Alternative 1 (no action) currently meets all MCLs or any more stringent State requirements that may be established as cleanup ARARs in the Final ROD. However, there are no provisions in this alternative to monitor for continued compliance.

Alternatives 2 and 3 both include measures to monitor for continued compliance with MCLs or any more stringent State requirements that may be established as cleanup ARARs in the Final ROD. If Alternative 3 were chosen, all action-specific ARARs would be met.

2.10.6.3. Long-Term Effectiveness and Permanence

Alternative 1 may provide long-term effectiveness in meeting RAOs, MCLs, or any more stringent State requirements that may be established as cleanup standards in the Final ROD, however there are no mechanisms included in this alternative to establish the continued compliance in meeting these goals.

Alternatives 2 and 3 provide monitoring to determine the long-term effectiveness and permanence of the remedies.

If the characterization data for the Pit 2 Landfill waste provide evidence that contaminants associated with the waste could impact human health and/or the environment, the capping and/or excavation components of Alternative 3 would add additional long-term and permanent protection for human health and the environment.

2.10.6.4. Reduction of Toxicity, Mobility, and Volume

Because there are no COCs identified in any media identified for the Pit 2 Landfill area, the criteria for reduction in toxicity, mobility, and volume of contaminants are not applicable unless pit waste characterization indicates the potential for impacts to human health and the environment. Both Alternatives 2 and 3 provide a monitoring component to determine if contaminants in the pit waste impact ground water in the future.

If waste characterization data indicate that contaminants were present in the waste that could impact human health or the environment, the capping and excavation components of Alternative 3 would reduce the mobility of the contaminants in the waste. However, they would not reduce the toxicity or volume of the contaminants. Excavation might increase the potential for airborne releases of volatile or dust-borne contaminants during disruption, but proper disposal should lower long-term mobility. The monitoring component of Alternatives 2 and 3 does not reduce the toxicity, mobility, or volume of contaminants in the waste, but provides a mechanism for detecting the migration of contaminants into ground water.

2.10.6.5. Short-Term Effectiveness

Since there would be no remediation-related construction occurring under Alternative 1, there would be no short-term impact to human or ecological receptors. Under Alternative 2, there would be minimal impact to onsite workers during monitoring activities. Workers would follow Site 300 operational procedures to mitigate risks during monitoring. As there are no contaminants of concern from the Pit 2 landfill, protection of human health and the environment is already achieved.

There would not be a significant difference in the short-term effectiveness of Alternatives 2 and 3 if only the characterization and monitoring components of Alternative 3 were implemented. However, there may be a short-term risk to onsite workers if intrusive methods are necessary to characterize the pit waste associated with uncertainties related to the pit contents. Risk to workers during characterization would be reduced through appropriate procedures and safety programs. The risk of exposure for onsite workers and ecological receptors in the short-term increases if the capping component of Alternative 3 is implemented. The excavation component of Alternative 3 poses the highest short-term risk of exposure and potential impact to human and ecological receptors during implementation of the remedy. Previously buried waste and associated contamination would be brought to the surface, handled, transported, and redeposited at a new location, which increases the number of exposure pathways and may disrupt plant and animal habitat. A high level of exposure control measures would need to be implemented to prevent the exposure of onsite workers, transport personnel, the public, and ecological receptors to contaminants.

2.10.6.6. Implementability

No actions would be necessary to implement Alternative 1. Alternative 2 could be readily implemented by continuing and enhancing the existing ground water monitoring programs and continuing administrative controls to prevent exposure.

The implementability of Alternative 3 would be significantly more difficult than Alternative 2 if the pit capping or waste excavation options are selected. Capping of the landfill presents additional challenges to prevent onsite worker exposure during installation. Excavation of landfill waste would require extensive provisions to prevent exposure and protect the safety of onsite workers, transport personnel, and the public during transport of the waste.

2.10.6.7. Cost

The estimated present worth of the life-cycle costs for the Pit 2 Landfill alternatives range from no cost for Alternative 1 to a maximum of $22,250,000 for Alternative 3. Monitoring costs were developed for Alternative 2. For Alternative 3, costs were developed for: (1) waste characterization, (2) monitoring, (3) installation and maintenance of a pit cap, and (4) total excavation of the pit waste with offsite disposal. The cost to implement Alternative 3 depends on the characterization results and whether a cap or excavation were selected as the remedy.

Compared to the other alternatives:

- Alternative 1 has no cost as no remedial action would occur.
- Alternative 2 costs $515,000. The objectives of this remedy are to monitor for (1) continued compliance with RAOs and cleanup standards to be established in the Final ROD, and (2) potential future releases from the Pit 2 Landfill that could impact ground water.
- The maximum Alternative 3 costs exceed those of Alternative 2 by over $20 million, which includes the costs for: (1) waste characterization, (2) monitoring, (3) total excavation of the pit waste, and (4) offsite disposal. Actual costs could be significantly reduced if only partial excavation is necessary.

2.10.6.8. State Acceptance

The California DTSC and RWQCB provided ARARs and information about other requirements that will be evaluated as possible ARARs in the Final ROD, which were used as the basis for developing the selected interim remedy. These State agencies reviewed and evaluated the remedial technologies and alternatives, participated in the selection of the interim remedy, and provided oversight and enforcement of state environmental regulations. In addition, the regulatory agencies have monitored and reviewed public acceptance of the selected interim remedy.

2.10.6.9. Community Acceptance

General comments on community acceptance are included at the beginning of the Responsiveness Summary (Section 3). The responding members of the community have general reservations about leaving landfills onsite and the degree of characterization of the landfill contents needed to assure long-term release prevention.

2.10.7. Comparative Evaluation of Remedial Alternatives for the Building 854 OU

This section compares the characteristics of each alternative against the other alternatives presented for remediation of the Building 854 OU with respect to the EPA/NCP criteria. As a presumptive remedy has been identified for this OU, only one alternative (Alternative 2) has been compared against the no action alternative required by the NCP.

2.10.7.1. Overall Protection of Human Health and the Environment

Alternative 1 (no action) may not protect human health and the environment because no active measures are taken to reduce contaminant concentrations in the vadose zone or ground water to health- and environmentally-protective levels. In addition, potential changes in plume concentration and size that could result in impacts to downgradient receptors would not be monitored or detected.

Alternative 2 mitigates risk to human health from potential ingestion of contaminated ground water and inhalation of VOC vapors through extraction and treatment of contaminated soil vapor and ground water at the Building 854 source area, and ground water extraction and treatment in the downgradient portion of the plume. This alternative also includes measures to prevent exposure to contamination by human and ecological receptors while contaminant concentrations are being reduced, such as administrative controls to prevent access to contaminated ground water and access restrictions for Springs 10 and 11 if VOC concentrations appear above health protective limits.

Alternative 2 includes measures to reduce contaminant concentrations and mass in ground water and subsurface soil and therefore would provide long-term and effective protection of human health and the environment.

2.10.7.2. Compliance with ARARs

Under Alternative 1 (no action), concentrations of VOCs and nitrate may remain above MCLs or any more stringent State requirements that may be established as cleanup ARARs in the Final ROD.

Alternative 2 includes active measures to reduce contaminant concentrations and mass in ground water and subsurface soil to meet all RAOs and acquire data helpful in meeting cleanup ARARs, which will be established in the Final ROD. The remedial actions described in Alternative 2 can be designed and implemented to comply with all action-specific ARARs.

Although permits are not required for meeting the substantive requirements for air discharges, DOE/LLNL has chosen to meet those requirements by obtaining air permits from the SJVUAPCD.

2.10.7.3. Long-Term Effectiveness and Permanence

Alternative 1 (no action) does not permanently reduce COC concentrations or provide long-term effectiveness in meeting RAOs, MCLs, or more stringent State requirements that may be established as cleanup standards in the Final ROD.

Alternative 2 provides long-term effectiveness by permanently reducing contaminant concentrations to meet MCLs, or more stringent State requirements that may be established as cleanup standards in the Final ROD through active remediation. This alternative also provides monitoring to determine the long-term effectiveness and permanence of the remedies.

2.10.7.4. Reduction of Toxicity, Mobility, and Volume

Alternative 1 does not remove COCs from the subsurface. Therefore, implementation of this alternative would not reduce the toxicity, mobility, or volume of the COCs.

Alternative 2 remedial actions involve removing contaminants from soil and ground water and adsorbing them to carbon. The toxicity and volume of extracted VOCs and perchlorate would be reduced through the thermal destruction of these contaminants sorbed to GAC. The toxicity and volume of nitrate would be reduced through biochemical processes in the bioreactor. Contaminant volume and mobility in ground water would be reduced irreversibly by source mass removal, contaminant concentration reduction, and plume control.

2.10.7.5. Short-Term Effectiveness

Since there would be no remediation-related construction occurring under Alternative 1, there would be no short-term impact to human or ecological receptors.

Under Alternative 2, there would be minimal impact to onsite workers during monitoring activities. Workers would follow Site 300 operational procedures to mitigate potential risks during monitoring.

A health and safety plan would be developed prior to construction and operation of the extraction and treatment systems under Alternative 2 to protect the health of onsite workers. In addition, workers would follow Site 300 operational procedures and use personal protective equipment and clothing to mitigate potential risks during construction and operation of the treatment system. Biological resource surveys will continue to be conducted prior to any construction activities at Site 300 to ensure there are no impacts to ecological receptors.

The ground water and soil vapor extraction of Alternative 2 should reduce TCE concentrations below MCLs. Based on current concentration trends and the known effectiveness of ground water and soil vapor extraction on localized perched aquifers, TCE concentrations may fall below its MCL within 25 years. Detailed modeling with refined cleanup time estimates will be presented in the Remedial Design report.

2.10.7.6. Implementability

No actions would be necessary to implement Alternative 1.

The treatment technologies incorporated into Alternative 2 are well proven and have been identified as presumptive technologies for VOCs. Implementation of this alternative would require the construction and operation of soil vapor and ground water extraction and treatment systems at the Building 854 source area. A ground water extraction and treatment system would also be installed downgradient of Building 854 to control plume migration. Operation of the treatment system for Alternative 2 would require meeting Substantive Requirements issued by the RWQCB and a permit from the local air board.

2.10.7.7. Cost

The estimated present worth of the life-cycle costs for the Building 854 OU alternatives range from no cost for Alternative 1 to $9,167,000 for Alternative 2. Compared to the other alternatives:

- Alternative 1 has no cost as no remedial action would occur.
- Alternative 2 costs exceed the costs of Alternative 1 by $9.2 million, which includes the costs for monitoring, risk and hazard management, and the capital and O&M costs for the extraction and treatment facilities.

2.10.7.8. State Acceptance

The California DTSC and RWQCB provided ARARs and information about other requirements that will be evaluated as possible cleanup standards in the Final ROD, which were used as the basis for developing the selected interim remedy. These State agencies reviewed and evaluated the remedial technologies and alternatives, participated in the selection of the interim remedy, and provided oversight and enforcement of state environmental regulations. In addition, the regulatory agencies have monitored and reviewed public acceptance of the selected interim remedy.

2.10.7.9. Community Acceptance

General comments on community acceptance are included at the beginning of the Responsiveness Summary (Section 3). The responding members of the community appear to support the proposed ground water and soil vapor extraction and treatment action with concerns that the entire plume be captured. This is complicated at the Building 854 area because additional characterization has been slowed by technical and ecological issues.

2.10.8. Comparative Evaluation of Remedial Alternatives for the Building 832 Canyon OU

This section compares the characteristics of each alternative against the other alternatives presented for remediation of the Building 832 Canyon OU with respect to the EPA/NCP criteria. A presumptive remedy has been identified for this OU. Therefore, only one alternative (Alternative 2), has been compared against the no action alternative required by the NCP.

2.10.8.1. Overall Protection of Human Health and the Environment

Alternative 1 (no action) may not protect human health and the environment because no active measures are taken to reduce contaminant concentrations in the vadose zone or surface water to health- and environmentally-protective levels. In addition, potential changes in plume concentration and size that could result in impacts to downgradient receptors would not be monitored or detected.

Alternative 2 mitigates risk to human health from potential future ingestion of contaminated ground water from Buildings 830 and 832 and inhalation of VOC vapors at Building 830 through extraction and treatment of contaminated soil vapor and ground water at the Buildings 830 and 832 source areas, and ground water extraction and treatment in the downgradient portion of the plume. This alternative also includes measures to prevent exposure to contamination by human and ecological receptors while contaminant concentrations are being reduced such as administrative controls to prevent access to contaminated ground water and access restrictions for Spring 3.

Alternative 2 includes measures to reduce contaminant concentrations and mass in ground water and therefore would provide long-term and effective protection of human health and the environment.

2.10.8.2. Compliance with ARARs

Under Alternative 1 (no action), concentrations of VOCs, nitrate, and perchlorate may remain above MCLs or any more stringent State requirements that may be established as cleanup ARARs in the Final ROD.

Alternative 2 includes active measures to reduce contaminant concentrations and mass in ground water and subsurface soil to meet all RAOs and acquire data helpful in meeting cleanup

ARARs, which will be established in the Final ROD. The remedial actions described in Alternative 2 can be designed and implemented to comply with all action-specific ARARs.

Although permits are not required for meeting the substantive requirements for air discharges, DOE/LLNL has chosen to meet those requirements by obtaining air permits from the SJVUAPCD. Air permit N-472-55-2 has been issued for the soil vapor extraction system at Building 832.

2.10.8.3. Long-Term Effectiveness and Permanence

Alternative 1 (no action) does not provide long-term effectiveness in meeting RAOs, MCLs, or other State requirements that may be established as cleanup standards in the Final ROD, or permanently reduce COC concentrations.

Alternative 2 provides long-term effectiveness by permanently reducing contaminant concentrations to meet RAOs and cleanup standards which will be set in the Final ROD, through active remediation. This alternative also provides monitoring to determine the long-term effectiveness and permanence of the remedies.

2.10.8.4. Reduction of Toxicity, Mobility, and Volume

Alternative 1 does not remove COCs from the subsurface. Therefore, implementation of this alternative would not reduce the toxicity, mobility, or volume of the COCs.

Under Alternative 2, remedial actions involve removing contaminants from soil and ground water and absorption to carbon. The toxicity of the contaminants would be reduced through the thermal destruction of the contaminants sorbed to GAC and the biochemical processes in the bioreactor. Contaminant volume and mobility in ground water would be reduced irreversibly by source mass removal, contaminant concentration reduction, and plume control.

2.10.8.5. Short-Term Effectiveness

Since there would be no remediation-related construction occurring under Alternative 1, there would be no short-term impact to human or ecological receptors.

Under Alternative 2, there would be minimal impact to onsite workers during monitoring activities. Workers would follow Site 300 operational procedures to mitigate potential risks during monitoring.

A health and safety plan would be developed prior to construction and operation of the extraction and treatment system component of Alternative 2 to protect the health of onsite workers. In addition, workers would follow Site 300 operational procedures and use personal protective equipment and clothing to mitigate potential risks during construction and operation of the treatment system. Biological resource surveys would continue to be conducted prior to any construction activities at Site 300 to ensure there are no impacts to ecological receptors.

The ground water and soil vapor extraction of Alternative 2 would reduce concentrations to meet RAOs, MCLs, or more stringent State requirements that may be established as cleanup standards in the Final ROD. Based on current concentrations and the known effectiveness of ground water and soil vapor extraction, TCE concentrations may fall below the MCL in about

30 years. Detailed modeling with refined cleanup time estimates will be presented in the Remedial Design report.

2.10.8.6. Implementability

No actions would be necessary to implement Alternative 1.

The treatment technologies incorporated into Alternative 2 are well proven and have been identified as presumptive technologies for VOCs. Implementation of this alternative would require construction and operation of soil vapor and ground water extraction and treatment systems at the Building 830 and 832 source areas. Ground water extraction and treatment systems would also be installed downgradient of Buildings 830 and 832 to control plume migration. For Alternative 2, permitting of the treatment facility discharges would be required.

2.10.8.7. Cost

The estimated present worth of the life-cycle costs for the Building 832 Canyon OU alternatives range from no cost for Alternative 1 to $26,842,000 for Alternative 2. Compared to the other alternatives:

- Alternative 1 has no cost as no remedial action would occur.
- Alternative 2 costs exceed those of Alternative 1 by $26.8 million, which includes the costs for monitoring, risk and hazard management, and the capital and O&M costs for the extraction and treatment facilities.

2.10.8.8. State Acceptance

The California DTSC and RWQCB provided ARARs and information about other requirements that will be evaluated as possible cleanup standards in the Final ROD, which were used as the basis for developing the selected interim remedy. These State agencies reviewed and evaluated the remedial technologies and alternatives, participated in the selection of the interim remedy, and provided oversight and enforcement of state environmental regulations. In addition, the regulatory agencies have monitored and reviewed public acceptance of the selected interim remedy.

2.10.8.9. Community Acceptance

General comments on community acceptance are included at the beginning of the Responsiveness Summary (Section 3). The responding members of the community appear to support the proposed ground water and soil vapor extraction and treatment action with concerns that the entire plume be captured.

2.10.9. Comparative Evaluation of Remedial Alternatives for the Building 801 Dry Well and Pit 8 Landfill, OU 8

This section compares the characteristics of each alternative against the other alternatives for the Building 801 dry well and Pit 8 Landfill with respect to the EPA/NCP criteria.

2.10.9.1. Overall Protection of Human Health and the Environment

Alternative 1 (no action) may not protect human health and the environment if a future release from the landfill occurred and went undetected. In the baseline risk assessment, no unacceptable risk or hazard to human health or ecological receptors posed by VOCs or nitrate in subsurface soil/rock was identified. The Building 801 dry well source was closed in 1981. VOC and nitrate concentrations in ground water in the Building 801 dry well area are near or below State and Federal MCLs and are declining. The water-bearing zone affected by the contamination is not currently a drinking water source. Although the concentrations of these contaminants may be reduced to health- and environmentally-protective levels through natural attenuation, potential changes in plume concentration and size that could result in impacts to downgradient receptors would not be monitored or detected in Alternative 1.

There are no COCs identified in surface soil, subsurface soil/rock, ground water, or surface water in the Pit 8 Landfill area. The baseline human health risk assessment did not identify any unacceptable risk or hazard to human health. The baseline ecological risk assessment identified an HQ greater than 1 for cadmium exposure to individual adult ground squirrels and individual juvenile and adult deer. Surveys indicate no impact on squirrel or deer populations.

Alternative 1 does not provide ground water monitoring to detect potential future releases from the landfill.

Alternatives 2 and 3 both address risk to human health from potential ingestion of contaminated ground water. Alternatives 2 and 3 include measures to reduce contaminant concentrations and mass in ground water and monitor for changes that could impact human health and the environment. Thus, both alternatives would provide long-term and effective protection of human health and the environment. If the characterization data for the Pit 8 Landfill waste indicate that contaminants associated with the waste could impact human health and/or the environment, the capping and/or excavation components of Alternative 3 would provide additional long-term protection for human health and the environment. If the waste characterization results indicate that human health and the environment would not be impacted by contaminants in the landfill waste, Alternative 3 would provide no significant quantifiable additional health risk benefit compared to Alternative 2.

2.10.9.2. Compliance with ARARs

Alternative 1 (no action) meets all MCLs and may meet any more stringent State requirements that may be established as cleanup ARARs in the Final ROD if natural attenuation continues to act to reduce contaminant concentrations as expected. However, there are no provisions in this alternative to monitor contaminant concentrations to determine if these goals are met.

The measures proposed under Alternatives 2 and 3 meet all action-specific ARARs. Data indicate that COC concentrations are naturally diminishing and will be below detection limits in a reasonable timeframe.

2.10.9.3. Long-Term Effectiveness and Permanence

Alternative 1 may provide long-term effectiveness in meeting RAOs, MCLs, or more stringent State requirements that may be established as cleanup standards in the Final ROD by permanently reducing COC concentrations, however there are no mechanisms included in this alternative for establishing achievement of these goals.

Alternative 3 provides long-term effectiveness by permanently reducing contaminant concentrations to health-protective levels and to meet RAOs, MCLs, or more stringent State requirements that may be established as cleanup standards in the Final ROD. Alternative 3 would effectively and permanently reduce contamination in ground water. Alternatives 2 and 3 provide monitoring to determine the long-term effectiveness and permanence of the remedies.

If the characterization data for the Pit 8 Landfill waste gives evidence that contaminants associated with the waste could impact human health and/or the environment, the capping and excavation components of Alternative 3 would add additional long-term and permanent protection for human health and the environment.

2.10.9.4. Reduction of Toxicity, Mobility, and Volume

While Alternative 1 does not remove COCs from the subsurface, natural attenuation of contaminants may result in the long-term reduction of the toxicity, mobility, and volume of contamination in the subsurface. However there are no mechanisms included in this alternative for establishing the achievement of these goals.

Alternative 2 relies on natural attenuation to achieve the long-term reduction of the toxicity, mobility, and volume of contamination in the subsurface. Both Alternatives 2 and 3 provide a monitoring component to ensure that contaminants in the subsurface are addressed.

If the characterization data for the Pit 8 Landfill waste indicate that contaminants associated with the waste could impact ground water, the capping component of Alternative 3 could reduce the mobility of the contaminants in the waste. Excavation might increase the potential for airborne releases of volatile or dust-borne contaminants during disruption, but proper disposal should lower long-term mobility. These components would not reduce the toxicity or volume of the contaminants.

The monitoring component of Alternatives 2 and 3 does not reduce the toxicity, mobility, or volume of contaminants in the waste but provides a mechanism for detecting the migration of contaminants in ground water.

2.10.9.5. Short-Term Effectiveness

Since there would be no remediation-related construction occurring under Alternative 1, there would be no short-term impact to human or ecological receptors. Under Alternative 2, there would be minimal impact to onsite workers during monitoring activities. Workers would follow Site 300 operational procedures to mitigate potential risks during monitoring.

There may not be a significant difference in the short-term effectiveness of Alternatives 2 and 3 if only the characterization and monitoring components of Alternative 3 were implemented. However, there may be short-term risk to onsite workers if intrusive methods are necessary to characterize the pit waste associated with uncertainties related to the pit contents. The risk of exposure for onsite workers and ecological receptors in the short-term increases if the capping component of Alternative 3 is implemented. The excavation component of Alternative 3 poses the highest short-term risk of exposure and potential impact to human and ecological receptors. Previously buried waste and associated contamination would be brought to the surface, handled, transported, and redeposited at a new location which increases the number of exposure pathways and may disrupt plant and animal habitat. A high level of exposure control measures would need to be implemented to prevent the exposure of onsite workers, transport personnel, the public, and ecological receptors to contaminants.

Because there are no identified risks, Alternative 3 does not reduce the time to achieve protection over Alternative 2. As there are no COCs above MCLs in ground water from the Building 801/Pit 8 Landfill area, protection of human health and the environment is already achieved.

2.10.9.6. Implementability

No actions would be necessary to implement Alternative 1. Alternative 2 could be readily implemented by continuing and enhancing the existing ground water monitoring programs.

The implementability of Alternative 3 would be significantly more difficult than Alternative 2 if the pit capping or waste excavation options are selected. Capping of the landfill presents additional challenges to prevent onsite worker exposure during installation. Excavation of landfill waste would require extensive provisions to prevent exposure and protect the safety of onsite workers, transport personnel, and the public during transport of the waste.

2.10.9.7. Cost

The estimated present worth of the life-cycle costs for the Building 801 dry well and Pit 8 Landfill alternatives range from no cost for Alternative 1 to a maximum of $21,612,000 for Alternative 3. Monitoring costs were developed for Alternative 2. For Alternative 3, costs were developed for: (1) waste characterization, (2) monitoring, (3) installation and maintenance of a pit cap, and (4) total excavation of the pit waste with offsite disposal. The cost to implement Alternative 3 is dependent on the characterization results and whether a cap or excavation were selected as the remedy.

Compared to the other alternatives:

- Alternative 1 has no cost as no remedial action would occur.
- Alternative 2 costs $535,000 and the objectives of this remedy are to: (1) monitor the natural attenuation of contaminants in ground water at Building 801 to document the effectiveness of the remedy in meeting RAOs, MCLs, or more stringent State requirements that may be established as cleanup standards in the Final ROD, and determine when these goals are met, and (2) monitor for potential future releases from the Pit 8 Landfill that could impact ground water.
- The maximum Alternative 3 costs exceed those of Alternative 2 by $841,000 for waste characterization and capping to over $21 million for: (1) waste characterization, (2) monitoring, (3) total excavation of the pit waste, and 4) offsite disposal. Actual costs could be significantly reduced if only a cap or partial excavation is necessary.

2.10.9.8. State Acceptance

The California DTSC and RWQCB provided ARARs and information about other requirements that will be evaluated as possible cleanup standards in the Final ROD, which were used as the basis for developing the selected interim remedy. These State agencies reviewed and evaluated the remedial technologies and alternatives, participated in the selection of the interim remedy, and provided oversight and enforcement of state environmental regulations. In addition, the regulatory agencies have monitored and considered public acceptance of the selected interim remedy.

2.10.9.9. Community Acceptance

General comments on community acceptance are included at the beginning of the Responsiveness Summary (Section 3). The responding members of the community have general reservations about leaving landfills onsite and the degree of characterization of the landfill contents needed to assure long-term release prevention.

2.10.10. Comparative Evaluation of Remedial Alternatives for Building 833, OU8

This section compares the characteristics of each alternative against the other alternatives for remediation of the Building 833 area with respect to the EPA/NCP criteria.

2.10.10.1. Overall Protection of Human Health and the Environment

Alternative 1 (no action) may not protect human health and the environment. Although contaminant concentrations may be reduced to health- and environmentally-protective levels through natural attenuation, potential changes in soil concentrations and ground water plume concentration and size that could result in impacts to downgradient receptors would not be monitored or detected.

Alternatives 2 and 3 both address risk to human health from potential ingestion of contaminated ground water and inhalation of ambient air. Both alternatives would provide long-term and effective protection of human health and the environment.

Alternative 3 provides for more rapid contaminant mass removal and concentration reduction through extraction and treatment of contaminated ground water and soil vapor than by the natural attenuation of contaminants in Alternative 2. However, the additional mass removal provided in Alternative 3 would provide no significant quantifiable health risk benefit compared to Alternative 2 because ground water in this area is not used for drinking.

Alternatives 2 and 3 include the same measures to prevent exposure to contamination by human and ecological receptors while contaminant concentrations are being reduced, such as administrative controls to prevent access to contaminated ground water and building use restrictions.

2.10.10.2. Compliance with ARARs

Alternative 1 (no action) may meet all MCLs and any more stringent State requirements that may be established as cleanup ARARs in the Final ROD, if natural attenuation reduces contaminant concentrations. However, there are no provisions in this alternative to monitor contaminant concentrations to determine if these goals are met.

Alternative 3 includes measures to reduce contaminant concentrations and mass in ground water and soil vapor to meet all RAOs and acquire data helpful in meeting cleanup ARARs, which will be established in the Final ROD. Data indicate that VOC concentrations are diminishing and will achieve MCLs in a reasonable timeframe as proposed under Alternative 2. However, concentrations may decrease more rapidly through the active remediation of Alternative 3.

The remedial actions described in Alternative 3 would be designed and implemented to comply with all action-specific ARARs.

2.10.10.3. Long-Term Effectiveness and Permanence

Alternative 1 may provide long-term effectiveness in meeting RAOs, MCLs, and any more stringent State requirements that may be established as cleanup standards in the Final ROD and permanently reduce COC concentrations. However there are no mechanisms included in this alternative for establishing the achievement of these goals.

Under Alternative 3, contaminants would be actively removed from ground water and the vadose zone through extraction and treatment. Alternatives 2 and 3 provide monitoring to determine the long-term effectiveness and permanence of the remedies.

2.10.10.4. Reduction of Toxicity, Mobility, and Volume

While Alternative 1 does not remove COCs from the subsurface, natural attenuation of contaminants may result in the long-term reduction of the toxicity, mobility, and volume of contamination in the subsurface. However there are no mechanisms included in this alternative for monitoring the progress toward or establishing the achievement of these goals.

Alternative 2 relies on natural attenuation to achieve long-term reduction of the toxicity, mobility, and volume of contamination in the subsurface. Alternative 3 actively removes contaminants from the subsurface and would reduce the volume and mobility of contaminants more rapidly. Both alternatives provide a monitoring component to ensure that contaminants in the subsurface are addressed.

2.10.10.5. Short-Term Effectiveness

Since there would be no remediation-related construction under Alternative 1, there would be no short-term impact to human or ecological receptors. Under Alternative 2, there would be minimal impact to onsite workers during monitoring activities. Workers would follow Site 300 operational procedures to mitigate potential risks during monitoring.

A health and safety plan would be developed prior to construction and operation of the extraction and treatment system under Alternative 3 to protect the health of onsite workers. In addition, workers would follow Site 300 operational procedures and use personal protective equipment and clothing to mitigate potential risks during construction and operation of the treatment system. Biological resource surveys would continue to be conducted prior to any construction activities at Site 300 to ensure there are no impacts to ecological receptors.

Whereas Alternative 3 may reduce the time for TCE concentrations to decrease below MCLs, the total mass of contaminants is small and limited in area. Natural processes may decrease TCE concentrations below the MCL in 5 to 10 years. Detailed modeling with refined cleanup time estimates will be presented in the Remedial Design report.

2.10.10.6. Implementability

No actions would be necessary to implement Alternative 1. Alternative 2 could be readily implemented by continuing and enhancing monitoring and the existing administrative controls to prevent exposure.

Alternative 3 can be readily implemented although additional time, labor and expense would be necessary both in the short- and long-term to construct, operate and monitor the treatment system. Operation of the treatment system in Alternative 3 would require meeting Substantive Requirements issued by the RWQCB and air permits from the local air board.

2.10.10.7. Cost

The estimated present worth of the life-cycle costs for the Building 833 alternatives range from no cost for Alternative 1 to $4,256,000 for Alternative 3. Monitoring and risk and hazard management costs were developed for Alternative 2. Capital, O&M costs for the extraction and treatment facility, as well as monitoring, and risk and hazard management costs, were developed for Alternative 3.

Compared to the other alternatives:

- Alternative 1 has no cost as no remedial action would occur.
- Alternative 2 costs $819,000 to monitor contaminants in ground water.
- Alternative 3 costs exceed those of Alternative 2 by $3.4 million, which includes the capital and O&M costs for the ground water and soil vapor extraction and treatment system.

2.10.10.8. State Acceptance

The California DTSC and RWQCB provided ARARs and information about other requirements that will be evaluated as possible cleanup standards in the Final ROD, which were used as the basis for developing the selected interim remedy. These State agencies reviewed and evaluated the remedial technologies and alternatives, participated in the selection of the interim remedy, and provided oversight and enforcement of state environmental regulations. In addition, the regulatory agencies have monitored and reviewed public acceptance of the selected interim remedy.

2.10.10.9. Community Acceptance

General comments on community acceptance are included at the beginning of the Responsiveness Summary (Section 3). The responding members of the community have reservations that the active remedy was not selected.

2.10.11. Comparative Evaluation of Remedial Alternatives for the Building 845 Firing Table and Pit 9 Landfill, OU 8

This section compares the characteristics of each alternative against the other alternatives for the Building 845 firing table and Pit 9 Landfill with respect to the EPA/NCP criteria.

2.10.11.1. Overall Protection of Human Health and the Environment

Alternative 1 (no action) may protect human health and the environment for the following reasons: (1) no unacceptable risk or hazard to human health or ecological receptors posed by HMX or uranium in subsurface soil/rock in the vicinity of the Building 845 firing table was identified, (2) ground water has not been impacted by contamination in either the Building 845 firing table or Pit 9 Landfill areas, and (3) no COCs were identified in any media for the Pit 9 Landfill. Although there is no unacceptable risk or hazard associated with the contaminants in subsurface soil at Building 845 or associated with the Pit 9 Landfill, potential impacts to ground water would not be monitored or detected.

Alternatives 2 and 3 both include the same measures to monitor for potential future impacts to ground water and any associated changes in risk or hazard that could affect human health and the environment. Thus, both alternatives would provide long-term and effective protection of human health and the environment.

If the characterization data for the Pit 9 Landfill waste gives evidence that contaminants associated with the waste could impact human health and/or the environment, the capping and/or excavation components of Alternative 3 would provide additional long-term protection for human health and the environment. If the waste characterization results indicate that human health and the environment would not be impacted by contaminants in the landfill waste, Alternative 3 would provide no significant quantifiable health risk benefit compared to Alternative 2.

2.10.11.2. Compliance with ARARs

Alternative 1 (no action) meets all MCLs and may meet any more stringent State requirements that may be established as cleanup ARARs in the Final ROD. However, there are no provisions in this alternative to monitor contaminant concentrations to assure continued compliance.

Alternatives 2 and 3 both include measures to monitor for continued compliance. If Alternative 3 were chosen, all remedial actions would comply with action-specific ARARs.

2.10.11.3. Long-Term Effectiveness and Permanence

Alternative 1 may provide long-term effectiveness in meeting RAOs, MCLs, and any more stringent State requirements that may be established as cleanup standards in the Final ROD, and permanently reduce COC concentrations in subsurface soil/rock. However, there are no mechanisms included in this alternative for monitoring continued compliance.

Alternatives 2 and 3 provide monitoring to determine the long-term effectiveness and permanence of the remedies.

If characterization data for the Pit 9 Landfill waste provide evidence that contaminants associated with the waste could impact human health and/or the environment, the capping and/or excavation components of Alternative 3 would add additional long-term and permanent protection for human health and the environment.

2.10.11.4. Reduction of Toxicity, Mobility, and Volume

While Alternative 1 does not remove COCs from the subsurface, natural attenuation of contaminants may result in the long-term reduction of toxicity, mobility, and volume of contamination in subsurface soil/bedrock. However, there are no mechanisms included in this alternative for determining if contaminants in subsurface soil/rock impact ground water in the future.

Alternatives 2 and 3 rely on natural attenuation to achieve the long-term reduction of the toxicity, mobility, and volume of contamination in subsurface soil/bedrock. Both Alternatives 2 and 3 provide a monitoring component to determine if contaminants in subsurface soil/rock impact ground water in the future.

If characterization data for the Pit 9 Landfill waste indicate that contaminants associated with the waste could impact ground water, the capping component of Alternative 3 could reduce the mobility of the contaminants in the waste. Excavation might increase the potential for airborne releases of volatile or dust-borne contaminants during disruption, but proper disposal should lower long-term mobility. These components would not reduce the toxicity or volume of the contaminants.

The monitoring components of Alternatives 2 and 3 do not reduce the toxicity, mobility, or volume of contaminants in subsurface soil/rock at Building 845 or for contaminants that may be present in Pit 9 Landfill waste, but both provide a mechanism for detecting any migration of contaminants into ground water.

2.10.11.5. Short-Term Effectiveness

Since there would be no remediation-related construction under Alternative 1, there would be no short-term impact to human or ecological receptors. Under Alternative 2, there would be minimal impact to onsite workers during monitoring activities. Workers would follow Site 300 operational procedures to mitigate potential risks during monitoring.

There would not be a significant difference in the short-term effectiveness of Alternatives 2 and 3 if only the characterization and monitoring components of Alternative 3 were implemented. However, there may be a short-term risk to onsite workers if intrusive methods are necessary to characterize the pit waste associated with uncertainties related to the pit contents. The risk of exposure for onsite workers and ecological receptors in the short-term increases if the capping component of Alternative 3 is implemented. The excavation component of Alternative 3 poses the highest short-term risk of exposure and potential impact to human and ecological receptors during implementation of the remedy. Previously buried waste and associated contamination would be brought to the surface, handled, transported, and redeposited at a new location which increases the number of exposure pathways and may disrupt plant and animal habitat. A high level of exposure control measures would need to be implemented to prevent the exposure of onsite workers, transport personnel, the public, and ecological receptors to contaminants.

Because there are no identified risks, Alternative 3 does not reduce the time to achieve protection over Alternative 2. As there are no COCs in ground water from the Building 845/Pit 9 Landfill area, protection of human health and the environment is already achieved.

2.10.11.6. Implementability

No actions would be necessary to implement Alternative 1. Alternative 2 could be readily implemented by continuing and enhancing the existing ground water monitoring programs.

The implementability of Alternative 3 would be significantly more difficult than Alternative 2, especially if the pit capping or waste excavation options are implemented. Capping of the landfill presents additional challenges to prevent onsite worker exposure during installation. Excavation of landfill waste would require extensive provisions to prevent exposure and protect the safety of onsite workers, transport personnel, and the public during transport of the waste.

2.10.11.7. Cost

The estimated present worth of the life-cycle costs for the Building 845 firing table and Pit 9 Landfill alternatives range from no cost for Alternative 1 to a maximum of $7,065,000 for Alternative 3. Monitoring costs were developed for Alternative 2. For Alternative 3, costs were developed for: (1) waste characterization, (2) monitoring, (3) installation and maintenance of a pit cap, and (4) total excavation of the pit waste with offsite disposal. The cost to implement Alternative 3 depends on the characterization results and whether a cap or excavation were the selected remedy.

Compared to the other alternatives:

- Alternative 1 has no cost as no remedial action would occur.
- Alternative 2 costs $488,000 to monitor for: (1) continued compliance with RAOs and cleanup standards established in the Final ROD and (2) potential future releases from the Pit 9 Landfill which might impact ground water.
- The maximum Alternative 3 costs exceed the costs of Alternative 2 by up to $6.6 million, which includes the costs for: (1) waste characterization, (2) monitoring, (3) total excavation of the pit waste, and (4) offsite disposal. Actual costs could be significantly less if only a portion of the waste is excavated.

2.10.11.8. State Acceptance

The California DTSC and RWQCB provided ARARs and information about other requirements that will be evaluated as possible cleanup standards in the Final ROD, which were used as the basis for developing the selected interim remedy. These State agencies reviewed and evaluated the remedial technologies and alternatives, participated in the selection of the interim remedy, and provided oversight and enforcement of state environmental regulations. In addition, the regulatory agencies have monitored and reviewed public acceptance of the selected interim remedy.

2.10.11.9. Community Acceptance

General comments on community acceptance are included at the beginning of the Responsiveness Summary (Section 3). The responding members of the community have general reservations about leaving landfills onsite and the degree of characterization of the landfill contents needed to assure long-term release prevention.

2.10.12. Comparative Evaluation of Remedial Alternatives for the Building 851 Firing Table, OU 8

This section compares the characteristics of each alternative against the other alternatives for remediation of the Building 851 firing table area with respect to the EPA/NCP criteria.

2.10.12.1. Overall Protection of Human Health and the Environment

Alternative 1 (no action) may protect human health and the environment as there is no risk or hazard posed by contaminants in this area. However, potential changes in uranium activities and plume size that could result in impacts to downgradient receptors would not be monitored or detected.

Alternative 2 provides for the monitoring of uranium in ground water to indicate any changes in plume size or activities and enable the assessment of changes in risk or hazard that could affect human health and the environment. Monitoring for other potential COCs in ground water would determine if soil and rock contaminants impact human health or the environment in the future. For these reasons, Alternative 2 should protect human health and the environment.

Alternative 3 provides additional long-term protection from exposure from ingestion of uranium-contaminated ground water through extraction and treatment of ground water at the Building 851 source area. However, because uranium activities are below the drinking water MCL and ground water is not currently used for drinking, Alternative 3 may not provide a significant quantifiable health risk benefit compared to Alternative 2.

2.10.12.2. Compliance with ARARs

Alternative 1 (no action) meets all MCLs and may meet any more stringent State requirements that may be established as cleanup ARARs in the Final ROD. However, there are no provisions in this alternative to monitor contaminant concentrations to assure compliance.

Alternatives 2 and 3 both include measures to monitor for compliance.

Alternative 3 includes active measures to reduce uranium activities and mass in ground water and subsurface soil to meet all cleanup standards established in the Final ROD. The remedial actions described in Alternative 3 can be designed and implemented to comply with all action-specific ARARs. As active measures are used to reduce uranium activities under Alternative 3, contaminant concentrations may be reduced more rapidly than under Alternative 2.

2.10.12.3. Long-Term Effectiveness and Permanence

Alternative 1 (no action) may provide long-term effectiveness and permanently reduce COC concentrations.

Under Alternatives 2 and 3, monitoring would be conducted to ensure long-term effectiveness and permanence.

Alternative 3 provides long-term effectiveness by permanently reducing contaminant concentrations through active remediation. This alternative also provides monitoring to ensure the long-term effectiveness and permanence of the remedies.

2.10.12.4. Reduction of Toxicity, Mobility, and Volume

Under Alternatives 1 and 2, there would be no impacts on the community or onsite workers. Alternative 2 also provides monitoring which would be conducted to ensure the plumes do not migrate and impact downgradient receptors.

Under Alternative 3, a reduction in contaminant toxicity, volume and mobility in ground water may be achieved more rapidly as active remediation measures are employed. Radioactive decay would reduce the toxicity and volume of extracted uranium in the ion-exchange resins.

2.10.12.5. Short-Term Effectiveness

Since there would be no remediation-related construction under Alternative 1, there would be no short-term impact to human or ecological receptors.

Under Alternative 2, there would be minimal impact to onsite workers during monitoring activities. Workers would follow Site 300 operational procedures to mitigate potential risks during monitoring.

A health and safety plan would be developed prior to construction and operation of the extraction and treatment system component of Alternative 3 to protect the health of onsite workers. In addition, workers would follow Site 300 operational procedures and use personal protective equipment and clothing to mitigate potential risks during construction and operation of the treatment system. Biological resource surveys would continue to be conducted prior to any construction activities at Site 300 to ensure there are no impacts to ecological receptors.

Alternative 3 also poses short-term and possibly long-term exposure risk to onsite workers because uranium would be brought to the surface through ground water extraction. Workers could be exposed during the installation, operation and maintenance of the treatment systems, and the handling and storage of uranium-contaminated resin. This is due to the fact that uranium is removed and concentrated in ion-exchange resins as part of the treatment process. Exposure control measures would be needed to prevent exposure until the uranium is safely disposed.

Because there are no identified risks, Alternative 3 does not reduce the time to achieve protection compared to Alternative 2. Because there are no COCs detected above background concentrations in ground water from the Building 851 area, protection of human health and the environment is already achieved.

2.10.12.6. Implementability

No actions would be necessary to implement Alternative 1. Alternative 2 is readily implementable as ground water is already monitored in the vicinity of the Building 851 firing table.

Implementation of Alternative 3 would require construction and operation of a ground water extraction and treatment system at the Building 851 source area. The implementability of Alternative 3 could be limited by permitting requirements for the long-term storage or disposal of uranium-contaminated resins.

2.10.12.7. Cost

The estimated present worth of the life-cycle costs for the Building 851 firing table alternatives range from no cost for Alternative 1 to $4,198,000 for Alternative 3. Compared to the other alternatives:

- Alternative 1 has no cost as no remedial action would occur.
- Alternative 2 costs exceed those of Alternative 1 by $530,000, which includes the costs of ground water monitoring.
- Alternative 3 costs exceed those of Alternative 2 by $3.7 million, which includes the costs of ground water monitoring, and the capital, and O&M costs for the extraction and treatment facility.

2.10.12.8. State Acceptance

The California DTSC and RWQCB provided ARARs and information about other requirements that will be evaluated as possible cleanup standards in the Final ROD, which were used as the basis for developing the selected interim remedy. These State agencies reviewed and evaluated the remedial technologies and alternatives, participated in the selection of the interim remedy, and provided oversight and enforcement of state environmental regulations. In addition, the regulatory agencies have monitored and reviewed public acceptance of the selected interim remedy.

2.10.12.9. Community Acceptance

General comments on community acceptance are included at the beginning of the Responsiveness Summary (Section 3). The responding members of the community have reservations regarding the lack of a remedy for depleted uranium.

2.11. The Selected Remedies

The following sections describe the principal elements, rationale, cost, and expected outcomes of the selected interim remedies.

2.11.1. Summary of the Rationale for the Selected Remedies

The key factors in selecting the interim remedies for each of the Site 300 OUs addressed in this Interim ROD are described in the following sections. All of the selected alternatives meet the two U. S. EPA threshold evaluation criteria: protecting human health and the environment and complying with ARARs. All of the selected alternatives are also acceptable to the State of California.

2.11.1.1. Building 834 OU

As specified in 40 CFR 300.430(f)(ii)(E), the selected Alternative 2 (soil vapor and ground water extraction and treatment, with monitoring and hazard management) for the Building 834 OU meets the threshold criteria and provides the best balance of trade-offs among alternatives in terms of the balancing criteria. Alternative 2 permanently removes contaminants from the subsurface and reduces the toxicity, mobility, and volume of contaminants through extraction and treatment. Alternative 2 actively remediates soil/bedrock and ground water to restore and protect the beneficial uses of ground water and mitigate VOC inhalation risk inside and in the vicinity of Building 834. Dual-phase ground water and soil vapor extraction and treatment is an established remedial technology, considered by EPA to be a presumptive remedy for the cleanup of VOCs in soil and ground water. In addition, Alternative 2 uses exposure control methods and administrative controls to provide initial protection of human health and to ecological receptors.

Alternative 2 provides long-term effectiveness and permanence by removing contaminant mass from the subsurface. The toxicity and volume of extracted VOCs and nitrate are eliminated by thermal regeneration of GAC and phytoremediation, respectively. Exposure controls during remediation will ensure short-term effectiveness. This alternative is readily implementable as ground water and soil vapor extraction and treatment systems have been operating at Building 834 for a number of years under an Interim ROD for this OU. The implementability of Alternative 3 has not yet been demonstrated, and could even slow the cleanup process by requiring the pumping system to be turned off during the bioremediation process. Risk protection may not be achieved more rapidly under Alternative 3 versus Alternative 2. The estimated present-worth Alternative 2 costs are $2.4 million lower than Alternative 3. A major portion of the capital costs for Alternative 2 have already been incurred.

2.11.1.2. Pit 6 Landfill OU

The selected Alternative 2 for the Pit 6 Landfill OU (MNA with risk and hazard management) meets the threshold criteria and provides the best balance of trade-offs among alternatives in terms of the balancing criteria. Alternative 2 permanently removes contaminants from the subsurface, and reduces the toxicity, mobility, and volume of contaminants through irreversible chemical degradation and radioactive decay (natural attenuation), and provides a mechanism for establishing achievement of these goals in a timeframe comparable to active remediation. The radioactive decay of tritium and degradation of TCE are irreversible and hence effective in the long term and permanent. The toxicity and volume of VOCs and tritium are reduced by natural degradation and decay and there would be no impacts on the community, onsite workers, or ecological receptors from these processes. Alternative 2 is readily implementable. The addition of ground water extraction (Alternative 3) is unlikely to significantly accelerate the attainment of cleanup standards and would provide no significant health risk benefit compared to Alternative 2. The Alternative 2 estimated present-worth costs are $3.6 million lower than Alternative 3.

2.11.1.3. High Explosives Process Area OU

The selected Alternative 2 for the HE Process Area (ground water extraction and treatment with monitoring and risk and hazard management) meets the two threshold criteria and provides the best balance of trade-offs among the balancing criteria. Alternative 2 provides long-term effectiveness by permanently reducing contaminant concentrations through extraction and treatment of ground water. Contaminant toxicity will be reduced through thermal destruction of contaminants sorbed to GAC. Contaminant volume and mobility will be reduced irreversibly by contaminant mass removal and plume control through ground water extraction. Alternative 2 is readily implementable. The treatment technologies incorporated into Alternative 2 are well proven and have been identified as presumptive technologies for VOCs in ground water.

2.11.1.4. Building 850 Firing Table Area

The selected Alternative 2 for the Building 850 Firing Table (soil and sand pile removal, MNA, and risk and hazard management) meets the two threshold criteria and provides the best balance of trade-offs among alternatives in terms of the balancing criteria. Alternative 2 permanently removes contaminants in the soil and sand pile, reduces the toxicity, mobility and volume of contaminants through irreversible radioactive decay (natural attenuation), and provides a mechanism for establishing achievement of these goals in a timeframe comparable to active remediation. The radioactive decay of tritium is irreversible and hence effective in the long term and permanent. The toxicity and volume of tritium are reduced by natural decay and there would be no impacts on the community, onsite workers, or ecological receptors from allowing these processes to occur. Excavation beneath the firing table (Alternative 3) would be very difficult because of the presence of bedrock and ongoing operations in the area, and would provide little if any benefit based on the evidence that the tritium source term in this area is greatly depleted. Installation of a reactive barrier (Alternative 4) could slow the migration of depleted uranium from the area, however uranium concentrations are already well below the MCL. Alternative 2 estimated present-worth costs are $4.2 million lower than Alternative 3 and $12.1 million lower than Alternative 4.

There are currently no cost-effective technologies available to remediate tritiated ground water. In addition, MNA for tritium will prevent incurring short-term exposure risk associated with extracting tritiated ground water and bringing it to the surface for disposal, as would occur under Alternative 4.

2.11.1.5. Pit 2 Landfill

The selected Alternative 2 for the Pit 2 Landfill (monitoring) meets the two threshold criteria and provides the best balance of trade-offs among alternatives in terms of the balancing criteria. No COCs emanating from the Pit 2 Landfill have been identified in any environmental media, and no risk or hazard to human health or ecological receptors was identified in the baseline risk assessment. Monitoring would provide long-term effectiveness and permanence in protecting human health and the environment. Because there are no COCs identified in any media, the criteria for reducing toxicity, mobility, and volume of contaminants do not apply. The alternative is readily implementable because a portion of the monitoring network is already in place. Alternative 2 also provides a mechanism for: (1) demonstrating continued compliance with cleanup standards, which will be established in the Final ROD, and (2) assuring that no releases from the Pit 2 Landfill occur that could pose a risk or hazard to human health or ecological receptors or impact ground water. Alternative 2 estimated present-worth costs are up to $20 million lower than Alternative 3.

2.11.1.6. Building 854 OU

The selected Alternative 2 for the Building 854 OU (soil vapor and ground water extraction and treatment with monitoring and risk and hazard management) protects human health and the environment, complies with action-specific ARARs, and provides the best balance of trade-offs among alternatives in terms of the balancing criteria. Alternative 2 permanently removes contaminants from the subsurface and reduces the toxicity, mobility, and volume of contaminants through the extraction and treatment of soil vapor and ground water. Alternative 2 provides long-term effectiveness by permanently reducing contaminant concentrations through active remediation. The toxicity of contaminants would be reduced through thermal destruction of contaminants sorbed to GAC. Contaminant volume and mobility would be reduced irreversibly by contaminant mass removal and plume control. Alternative 2 is readily implementable and uses technologies that are proven and identified as a presumptive remedy for VOCs in ground water. Soil vapor extraction would also prevent future inhalation of TCE above health-based concentrations in the vicinity of Building 854A and 854F. A ground water extraction system is already operating at Building 854.

2.11.1.7. Building 832 Canyon OU

The selected Alternative 2 for the Building 832 Canyon Area (soil vapor and ground water extraction and treatment with monitoring and risk and hazard management) meets the two threshold criteria and provides the best balance of trade-offs among alternatives in terms of the five balancing criteria. Alternative 2 permanently removes contaminants from the subsurface and reduces the toxicity, mobility, and volume of contaminants through the extraction and treatment of soil vapor and ground water. Alternative 2 provides long-term effectiveness by permanently reducing contaminant concentrations through active remediation. The toxicity of contaminants will be reduced through thermal destruction of contaminants sorbed to GAC. Contaminant volume and mobility will be reduced irreversibly by contaminant mass removal and plume control. Soil vapor extraction would also prevent future inhalation of TCE above health-based concentrations in the vicinity of Building 830.

Alternative 2 is implementable and uses technologies that are well proven and identified as a presumptive remedy for VOCs in ground water and soil. A ground water extraction and treatment system is already operating at Building 832.

2.11.1.8. Building 801 Dry Well and the Pit 8 Landfill

The selected Alternative 2 for Building 801 and the Pit 8 Landfill (monitoring) protects human health and the environment and provides the best balance of trade-offs among alternatives in terms of the balancing criteria. Because there are no COCs identified in any media, the criteria for reducing toxicity, mobility, and volume of contaminants do not apply. The alternative is readily implementable because a portion of the monitoring network is already in place.

Monitoring of contaminants that could potentially be released from the landfill provides a tool for: (1) demonstrating continued compliance with cleanup standards, which will be established in the Final ROD, and (2) assuring that no releases from the Pit 8 Landfill occur that could pose a risk or hazard to human health or ecological receptors or impact ground water.

Monitoring will also provide long-term effectiveness and permanence in protecting human health and the environment.

The estimated Alternative 2 present-worth costs are up to $21 million lower than Alternative 3. Risks to onsite workers are significantly higher under Alternative 3 compared to Alternative 2 if excavation of landfill waste is selected.

2.11.1.9. Building 833

The selected Alternative 2 for the Building 833 area (monitoring and risk and hazard management) meets the two threshold criteria and provides the best balance of trade-offs among alternatives in terms of the balancing criteria. The toxicity, and possibly volume, of contaminants in the subsurface may be reduced by allowing continued reduction of contaminant concentrations in ground water, which may be occurring through dispersion, dilution, and/or irreversible chemical degradation. Data indicate that natural processes should reduce VOC concentrations to MCLs in 5 to 10 years. This alternative is readily implementable because the ground water monitoring network is already in place. Exposure controls during monitoring would ensure short-term effectiveness. Ground water and soil vapor extraction (Alternative 3) would be very ineffective due to the minimal amount of water and small mass of contaminants present. The estimated Alternative 2 present-worth costs are $3.4 million less than Alternative 3.

2.11.1.10. Building 845 and the Pit 9 Landfill

The selected Alternative 2 for the Building 845/Pit 9 Landfill (monitoring) meets the two threshold criteria and provides the best balance of trade-offs among alternatives in terms of the balancing criteria. Because there are no COCs identified in any media, 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. Monitoring will provide long-term effectiveness and permanence in protecting human health and the environment.

The estimated Alternative 2 present-worth costs are up to $6.6 million lower than Alternative 3. Short-term health risks to onsite workers are significantly higher under Alternative 3 compared to Alternative 2 if waste excavation is selected.

2.11.1.11. Building 851 Firing Table

The selected Alternative 2 for the Building 851 Firing Table Area (monitoring) meets the two threshold criteria and provides the best balance of trade-offs among the balancing criteria. Monitoring will be conducted to ensure that the contaminants do not migrate and impact downgradient receptors. The alternative is readily implementable because a portion of the monitoring network is already in place. The estimated present-worth costs of Alternative 2 are $3.7 million lower than Alternative 3.

2.11.2. Descriptions of the Selected Remedies

This section presents detailed descriptions of the elements of the selected remedies for each OU addressed in this Interim ROD. These details are described in a series of tables and figures as follows:

Area	Table number	Figure number(s)
Building 834	**2.11-1**	**2.11-1**
Pit 6 Landfill	**2.11-2**	**–**
High Explosives Process Area	**2.11-3**	**2.11-2, 2.11-3**
Building 850 Firing Table	**2.11-4**	**2.11-4**
Pit 2 Landfill	**2.11-5**	**–**
Building 854	**2.11-6**	**2.11-5**
Building 832 Canyon	**2.11-7**	**2.11-6**
Building 801, Pit 8 Landfill	**2.11-8**	**–**
Building 833	**2.11-9**	**–**
Building 845 Firing Table, Pit 9 Landfill	**2.11-10**	**–**
Building 851 Firing Table	**2.11-11**	**–**

The descriptions of the remedies are conceptual in scope and are not intended to provide design information. DOE will present more detailed information to support the implementation of the selected interim remedies in future documents. That information will include remedial designs, monitoring programs, and contingency plans. Figures are not included for areas where there are no active components to the selected remedy. Contaminant distribution maps for all OUs addressed in this Interim ROD are included as Figures 2.5-2 through 2.5-26.

2.11.3. Estimated Costs of the Selected Remedies

The work required to implement each selected interim remedy was divided into a series of activities and a unit cost was developed for each. The bases of the unit costs are a series of assumptions regarding the resources necessary to complete the activity. The quantity of each resource used for the unit costs is based on contemporaneous experience at LLNL.

The unit cost of labor resources is based on an average for all staff in a category, such as scientists and engineers. For most other resources, the unit cost is based on a current contract, e.g., the hourly cost for drilling rigs used to install monitoring wells. (All LLNL overhead rates and taxes are included in the unit rates. However, Project and Program Management costs are not included.) The base year for all cost estimates is fiscal year 1999.

Summaries of the cost estimates for each selected remedy are provided in Tables 2.11-12 through 2.11-22**.** The information in these cost estimates is based on the best available information regarding the anticipated scope of the remedies. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. This is an order-of-magnitude engineering cost estimate that is expected to be within + 50% to - 30% of the actual project cost.

It is assumed that all costs associated with direct and indirect capital will occur in the first year. The period of performance for all ongoing activities is assumed to be 30 years, except for operation and maintenance of soil vapor extraction and treatment systems, where the period of performance is assumed to be 10 years. For present-worth calculations a discount rate of 5% is assumed.

Site-wide regulatory compliance and management activities are not included in the cost estimates. It is assumed that periodic reports to regulatory agencies will be required and these costs are not included. Similarly, project management and support costs and contingency costs are not included.

All costing was performed following the guidance of the EPA "Remedial Action Costing Procedures Manual", Report No. EPA/600/8-87/049, dated October 1987.

2.11.4. Expected Outcomes of the Selected Remedies

2.11.4.1. Available Land Uses

DOE has no plans to release any portion of LLNL Site 300 for residential or industrial use. Some areas will require long-term management due to the presence of contaminants of concern. This long-term management would primarily affect land use for LLNL programs.

Table 2.11-23 indicates those areas where long-term waste management will be required because: (1) landfills will be left in place, (2) closed landfills are present, or (3) where surface soil or vadose zone contamination will be left in place under a monitoring only remedy.

2.11.4.2. Available Ground Water Uses

Upon achievement of cleanup standards, ground water use will be unrestricted.

2.11.4.3. Cleanup Standards

This ROD is considered interim for three primary reasons: (1) issues related to ground water cleanup standards remain, (2) DOE/LLNL is continuing to evaluate treatment technologies, and (3) further characterization is occurring in some areas of the site. The regulatory agencies have agreed that this Interim ROD will not contain cleanup standards for ground water or VOC-contaminated subsurface soil. This Interim ROD will allow DOE/LLNL to: (1) begin ground water cleanup, (2) gather more information on the feasibility of achieving compliance with various ground water regulatory standards, and (3) implement final remedies at areas not involving contaminated ground water. The following sections contain DOE's assurances that cleanup performed during the interim period will protect human health and the environment.

2.11.4.3.1. Soil at the Building 850 Firing Table Area. At the Building 850 Firing Table area, soil removal and excavation are expected to be completed during the interim cleanup period and will be considered the final remedy for this medium. The soil cleanup standards apply to: (1) PCBs, dioxins, and furans in surface soil adjacent to the Building 850 Firing Table, and (2) tritium in soil in the Building 850 sand pile and any contiguous soil. The cleanup standards are based on risk and hazard to humans or the threat to beneficial uses of ground water, whichever is more protective. Soil cleanup standards to protect ground water from downward migration of contaminants in soil are based on preventing impacts to ground water exceeding MCLs. Potential impacts to ground water in the Building 850 Firing Table area were estimated using NUFT (Nonisothermal Unsaturated-Saturated Flow and Transport) model (Nitao, 1998). Details of the NUFT modeling used to determine soil cleanup standards protective of ground water at Building 850 are presented in *Designated Level Evaluation for Surface Soils and Building 850 Firing Table and Sand Pile* (U.S. DOE, 2000b).

The cleanup standards for soil in the Building 850 Firing Table area are:

1. PCBs: 1.0 mg/kg, the U.S. EPA Region IX industrial Preliminary Remediation Goal (PRG). This standard is more protective than the 1,500 mg/kg concentration of PCBs in surface soil modeled to be protective of ground water.
2. 2,3,7,8-TCDD (tetrachlorodibenzo-p-dioxin): 2.7×10^{-5} mg/kg, the U.S. EPA Region IX industrial PRG. All related dioxin and furan compounds will be converted to an equivalent concentration of 2,3,7,8-TCDD using the Dioxin Toxicity Equivalence Factors and compared to the PRG for 2,3,7,8-TCDD. This standard is more protective than the 3.3×10^{-5} mg/kg concentration of 2,3,7,8-TCDD in surface soil modeled to be protective of ground water.
3. Tritium: 5,000,000 pCi/L as soil moisture in the Building 850 sand pile and any contiguous surface soil to protect ground water. This concentration can also be expressed as 277 pCi/g, assuming a soil moisture content of 10 % and a bulk density of 1.8 g/cm^3. This standard is more protective than the U.S. EPA Region IX commercial PRG of 45,000 pCi/g. If native soil immediately beneath the sand pile exceeds the surface soil cleanup standards, subsurface soil will be excavated and the cleanup standards will be recalculated to account for the resulting decrease in thickness of the unsaturated zone.

EPA Region IX PRGs are risk-based tools for evaluating and cleaning up contaminated sites. They combine current EPA toxicity values with standard exposure factors to estimate contaminant concentrations that are considered protective of humans, including sensitive groups, over a lifetime.

2.11.4.3.2. Ground Water and VOC-Contaminated Subsurface Soil. Soil vapor and ground water extraction and treatment are included in the selected remedies for several areas, but DOE/LLNL does not expect to achieve specific cleanup standards at Site 300 during the interim period. Experience indicates that ground water remediation typically requires several decades to reduce contaminants to the low concentrations typically used as cleanup standards. DOE's selected interim remedies for VOC-contaminated subsurface soil and ground water remediation focus on achieving source control and reducing the mass and concentration of contaminants. The conceptual designs of these remedies are based upon achieving ground water cleanup standards at least as protective as MCLs and are intended to be consistent with remedies and cleanup standards anticipated to be selected in the Final ROD.

DOE makes the following specific assurances for the cleanup of ground water and VOC-contaminated subsurface soil:

1. During the period between the Interim ROD and Final ROD, DOE/LLNL will evaluate compliance with California State Water Resources Control Board (SWRCB) Resolution 92-49, including the feasibility of achieving background ground water quality or some concentration between background and the applicable water quality objectives. The results of the evaluations will be presented in the Remediation Evaluation Summary Report currently scheduled for 2005. See Appendix C.
2. Cleanup standards for ground water and VOC-contaminated subsurface soil will be included in the Final ROD, scheduled for completion in 2007.
3. DOE/LLNL will not discontinue operation of any ground water or soil vapor extraction and treatment system before the Final ROD without the notification and approval of the

regulatory agencies. During the interim cleanup period, DOE/LLNL will prepare soil vapor extraction system shutdown criteria to be used in the interim cleanup period, if necessary. The schedule to develop the shutdown criteria will be included in the RDWP for Site 300.

4. The actions DOE/LLNL will undertake under the Interim ROD will be consistent with the Remedial Action Objectives (RAOs) for Site 300, which include remediating ground water to protect human health and the environment and restoring beneficial uses of ground water.
5. In the post-Interim ROD Remedial Design (RD) documents, DOE/LLNL will provide the details and specifications of the extraction and treatment systems that will be implemented during the interim cleanup period. These RD documents will include flexible system designs capable of remediating contaminant concentrations in ground water to non-detectable or background levels.

2.11.4.3.3. Ambient Air. At several areas, contaminants volatilizing from the subsurface into indoor or outdoor ambient air may result in an unacceptable carcinogenic risk or noncarcinogenic hazard. The cleanup standard for the ambient air exposure pathway is a risk of 1×10^{-6} and a hazard quotient of 1. Modeling will be conducted periodically to re-evaluate changes in inhalation risk and hazard levels resulting form remediation and progress toward meeting the cleanup standards. Details will be included in the Risk and Hazard Management Plan portion of the CMP.

2.12. Principal Threat Waste

The NCP establishes an expectation that the lead agency will use treatment to address the principal threats posed by a site wherever practicable. Identifying principal threat wastes combines concepts of both hazard and risk. In general, principal threat wastes are those source materials considered to be highly toxic or highly mobile which generally cannot be contained in a reliable manner or would present a significant risk to human health or the environment should exposure occur. Conversely, non-principal threat wastes are those source materials that generally can be reliably contained and that would present only a low risk in the event of exposure. The manner in which principal threat wastes are addressed generally will determine whether the statutory preference for treatment as a principal element is satisfied. Contaminated ground water is not usually considered a principal threat waste.

Table 2.12-1 summarizes source materials, affected media, and human health risks, and describes how principal threat wastes are addressed by the selected remedies.

2.13. Statutory Determinations

Under CERCLA Section 121 and the NCP, DOE must select remedies that protect human health and the environment, comply with ARARs, are cost-effective, and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. In addition, CERCLA includes a preference for remedies that employ treatment that permanently and significantly reduce the volume, toxicity or mobility of hazardous wastes as a principal element and a bias against offsite disposal of untreated wastes. Sections 2.13.1 through 2.13.6 discuss how the Site 300 selected interim remedies meet these statutory requirements.

2.13.1. Protection of Human Health and the Environment

Sections 2.13.1.1 through 2.13.1.11 describe how the selected remedies for each OU addressed in this Interim ROD will protect human health and the environment.

2.13.1.1. Building 834 OU

The selected Alternative 2 for the Building 834 OU (ground water and soil vapor extraction and treatment with monitoring and risk and hazard management) protects human health and the environment through active remediation. The only identified human health risks at Building 834D are possible ingestion of ground water with contaminants at concentrations exceeding MCLs and inhalation of VOC vapors above health-based concentrations in and around Building 834D. Alternative 2 uses active remediation to reduce contaminant concentrations and mass at the Building 834 source area and at several locations downgradient through dual-phase ground water and soil vapor extraction. The selected Alternative 2 addresses risk to human health from potential inhalation of VOC vapors above health-based concentrations by reducing soil vapor VOC concentrations through soil vapor extraction.

Alternative 2 also includes measures to prevent exposure to contamination while contaminant concentrations are being reduced through ground water and soil vapor extraction, including administrative controls to prevent access to contaminated ground water. Thus, Alternative 2 provides long-term protection of human health and restores beneficial uses of ground water.

The calculated human cancer risk from VOC vapors at Building 834D is 1×10^{-3} with an HI of 36. A human cancer risk of 6×10^{-4} and an HI of 21 was calculated for inhalation of TCE by workers outside of Building 834D. The Building 834 baseline ecological risk assessment identified a potential risk from TCE, PCE and cadmium for ground squirrels, deer and kit fox, with an HI and HQ exceeding 1. However, site-wide population surveys and area-specific presence/absence surveys found no current adverse impact to these receptors.

Soil vapor and ground water extraction and treatment under Alternative 2 will reduce the calculated risks to human health and the environment to levels within or below the EPA 1×10^{-4} to 1×10^{-6} target risk range and HIs below 1. There is no existing exposure to contaminated ground water. Fate and transport modeling indicate that contaminants from the Building 834 Complex would not significantly impact offsite water-supply wells.

There are no short-term risks that cannot be controlled associated with Alternative 2 and no adverse cross-media impacts (such as transferring contaminants from ground water to air) are expected from the selected interim remedy.

2.13.1.2. Pit 6 Landfill OU

The selected Alternative 2 for the Pit 6 Landfill OU (MNA and risk and hazard management) protects humans from potential ingestion of contaminated ground water by natural attenuation of contaminants. It also prevents exposure to contamination by human and ecological receptors while contaminant concentrations are being reduced by using administrative controls to prevent access to contaminated ground water. Alternative 2 also relies on monitored natural attenuation to reduce contaminant concentrations and mass in ground water, thus providing long-term and effective protection of human health and the environment.

An inhalation risk of 5×10^{-6} for onsite workers was identified for VOCs volatilizing from subsurface soil in the vicinity of the Pit 6 Landfill. A landfill cap was installed in 1997 that prevents exposure to VOCs vaporizing from the landfill, mitigating this risk. An inhalation risk of 4×10^{-5} and an HI of 1.5 for onsite workers were also identified for VOCs volatilizing from Spring 7 to ambient air. Alternative 2 includes risk management measures to protect onsite workers. Natural attenuation has reduced VOC concentrations about 20-fold at the spring sampling point since the baseline risk calculation. There is no current human exposure to contaminated ground water.

The Pit 6 Landfill baseline ecological assessment determined a potential risk from VOCs for ground squirrels and kit fox, with an HI exceeding 1. However, site-wide population surveys and area-specific presence/absence surveys found no current adverse impact. In addition, the landfill cap was designed to prevent burrowing, and thus exposure to animals, to the pit contents.

MNA and risk and hazard management under the selected Alternative 2 and the previously installed landfill cap will reduce cancer risk to the EPA 1×10^{-4} to 1×10^{-6} target risk range or below and reduce the onsite worker HI below 1. There are no short-term risks that cannot be controlled associated with Alternative 2 and no adverse cross-media impacts are expected from the selected interim remedy.

2.13.1.3. High Explosives Process Area OU

Under the selected Alternative 2 (ground water extraction and treatment, monitoring, and risk and hazard management), risk to human health from potential ingestion of contaminated ground water is mitigated through extraction and treatment of contaminated ground water at the Building 815, HE rinsewater lagoon, and HE Burn Pit source areas and in the downgradient portion of the plumes. Alternative 2 also includes measures to prevent exposure to contamination by human and ecological receptors while contaminant concentrations are being reduced, including administrative controls to prevent access to contaminated ground water.

Under Alternative 2, human health is also protected by preventing exposure to VOCs volatilizing from subsurface soil at Building 815 through construction and/or use restrictions. In addition, Alternative 2 provides measures to prevent exposure to VOCs volatilizing from Spring 5 until concentrations in the spring are reduced to health-protective levels through extraction and treatment of ground water.

Since Alternative 2 includes measures to reduce contaminant concentrations and mass in ground water and surface water and prevent migration of the contaminant plumes, it provides long-term and effective protection of human health and the environment.

An excess human cancer risk from inhaling VOC vapors in the Building 815 vicinity was calculated as 5.1×10^{-6}. An excess cancer risk of 1×10^{-5} was calculated for onsite workers potentially inhaling VOC vapors from surface water at Spring 5. The HE Process Area baseline ecological assessment determined a risk from copper and cadmium for aquatic organisms, ground squirrels and deer, with a toxicity quotient (TQ) and hazard quotient (HQ) exceeding 1.

However, site-wide population surveys and area-specific surveys found no current adverse impact to these receptors.

Under Alternative 2 ground water extraction and treatment and risk and hazard management using administrative controls will further reduce cancer risk to the 1×10^{-4} to 1×10^{-6} EPA target risk range or below. Risk and hazard management using administrative controls will prevent exposure until the risk is reduced to acceptable levels. There are no short-term risks that cannot be controlled associated with Alternative 2, and no adverse cross-media impacts are expected from the selected interim remedy.

2.13.1.4. Building 850 Firing Table

Under the selected Alternative 2 (soil and sand pile removal, MNA, and risk and hazard management) for the Building 850 Firing Table area, removal of the tritium-contaminated sand pile will eliminate the potential for tritium to impact ground water. Thus, Alternative 2 provides long-term protection of human health and restores beneficial uses of ground water.

A risk of 5×10^{-4} has been calculated for potential inhalation/ingestion of resuspended particulates and direct dermal exposure to PCBs in surface soil. In addition, a risk of 1×10^{-4} was calculated for potential inhalation/ingestion of suspended particulates and direct dermal contact with CDDs and CDFs in surface soil. The Building 850 baseline ecological assessment determined a risk from copper, zinc, cadmium, and PCBs/CDDs/CDFs for aquatic organisms, ground squirrels, kit fox and deer, with a TQ and HQ exceeding 1. However, site-wide and area-specific surveys found no current adverse impact.

Under Alternative 2 removal of contaminated surface soil and the sand pile, monitored natural attenuation, and risk and hazard management by administrative controls will reduce cancer risk to the 1×10^{-4} to 1×10^{-6} EPA target risk range or below. There are no short-term risks that cannot be controlled associated with Alternative 2 and no adverse cross-media impacts are expected from the selected interim remedy.

2.13.1.5. Pit 2 Landfill

No contaminants of concern emanating from the Pit 2 Landfill have been identified in any environmental media and thus no unacceptable risk or hazard to human health or the environment was identified in the baseline risk assessment.

Monitoring conducted under the selected Alternative 2 will protect human health and the environment for the following reasons:

1. No unacceptable risk or hazard to human health or ecological receptors was identified in the vicinity of the Pit 2 Landfill,
2. Ground water has not been impacted by contamination in the Pit 2 Landfill area, and
3. No COCs were identified in any media for the Pit 2 Landfill.

Thus, monitoring for changes that could affect human health and the environment under Alternative 2 will provide long-term and effective protection of human health and the environment.

2.13.1.6. Building 854 OU

The selected Alternative 2 (ground water and soil vapor extraction and treatment with monitoring and risk and hazard management) for the Building 854 OU mitigates risk to human health from potential ingestion of contaminated ground water and inhalation of VOC vapors through extraction and treatment of contaminated soil vapor and ground water at the Building 854 source area, and ground water extraction and treatment in the downgradient portion of the VOC plume. This alternative also includes measures to prevent exposure to contamination by human and ecological receptors while contaminant concentrations are being reduced, including administrative controls to prevent access to contaminated ground water. Alternative 2 includes measures to reduce contaminant concentrations and mass in ground water and thus provides long-term and effective protection of human health and the environment.

A risk of 7×10^{-5} has been calculated for onsite workers for potential incidental ingestion and direct dermal contact with PCB-contaminated soil. Risks of 5×10^{-6} and 1×10^{-6} were calculated for onsite adult workers from inhalation of VOCs in air inside Buildings 854F and 854A, respectively. This PCB risk is based on the report of two PCBs in a soil sample from one borehole. That borehole was located in a small sump-like area, which is being investigated further. If PCBs are found during further investigation, action will be taken to mitigate this risk, most likely by excavating the contaminated soil.

A risk of 1×10^{-5} was also calculated for inhalation of VOCs in air outside Building 854F. No unacceptable hazard to ecological receptors in the Building 854 area has been identified.

Soil vapor and ground water extraction and treatment under Alternative 2 will further reduce the calculated risks to human health and the environment to the 1×10^{-4} to 1×10^{-6} EPA target risk range or below. There are no short-term risks that cannot be controlled associated with Alternative 2 and no adverse cross-media impacts are expected from the selected interim remedy.

2.13.1.7. Building 832 Canyon OU

The selected Alternative 2 (ground water and soil vapor extraction and treatment with monitoring and hazard management) mitigates risk to human health from potential ingestion of contaminated ground water from Buildings 830 and 832 and inhalation of VOC vapors at Building 830 through extraction and treatment of contaminated soil vapor and ground water at the Building 830 and 832 source areas, and ground water extraction and treatment in the downgradient portion of the plume. This alternative also includes measures to prevent exposure to contamination by human and ecological receptors while contaminant concentrations are being reduced, including administrative controls to prevent access to contaminated ground water and access restrictions for Spring 3. Because Alternative 2 includes measures to reduce contaminant concentrations and mass in ground water, it will provide long-term and effective protection of human health and the environment.

A cancer risk of 3×10^{-6} was calculated for inhalation of VOCs by onsite workers inside Building 830. A risk of 1×10^{-5} was calculated for onsite workers inhaling VOCs in air outside Building 830 and a cancer risk of 3×10^{-6} was calculated for inhalation of dichloropropane by onsite workers inside Building 832. In addition, a cancer risk of 6×10^{-5} for onsite adult workers was calculated for TCE and PCE volatilizing from surface water at Spring 3 to ambient air. No unacceptable impacts from VOCs to ecological receptors at Building 830 and 832 have been identified.

Soil vapor and ground water extraction and treatment under Alternative 2 will further reduce the calculated risks to human health and the environment to the 1×10^{-4} to 1×10^{-6} EPA target risk range or below. There are no short-term risks that cannot be controlled associated with Alternative 2 and no adverse cross-media impacts are expected from the selected interim remedy.

2.13.1.8. Building 801 Dry Well and Pit 8 Landfill Area (OU 8)

There are no COCs identified in surface soil, subsurface soil/rock, ground water, or surface water in the Pit 8 Landfill area. The baseline risk assessment did not identify any unacceptable risk or hazard to human health. The baseline ecological assessment found potential risk from cadmium to ground squirrels and deer with HQs greater than 1. However, site-wide and area-specific surveys found no current adverse impact.

The selected Alternative 2 for the Building 801 Dry Well and Pit 8 Landfill area addresses potential risk to human health from potential ingestion of contaminated ground water by monitoring for changes that could impact human health and the environment. Thus, it provides long-term and effective protection of human health and the environment.

2.13.1.9. Building 833 Area (OU 8)

The selected Alternative 2 for the Building 833 area addresses risk to human health from potential ingestion of contaminated ground water by monitoring for changes that could impact human health and the environment, and by managing risk and hazard.

An excess human cancer risk of 1×10^{-6} was calculated for inhalation of VOCs evaporating from subsurface soil inside Building 833. Natural processes will continue to reduce this risk below 1×10^{-6}. The Building 833 baseline ecological assessment determined that contaminants in the area do not pose an unacceptable threat to plants or animals.

2.13.1.10. Building 845 Firing Table and Pit 9 Landfill Area (OU 8)

Monitoring for changes that could impact human health under the selected Alternative 2 for the Building 845 Firing Table and Pit 9 Landfill area effectively protects human health and the environment because:

1. There is no unacceptable risk or hazard to human health or ecological receptors posed by COCs in subsurface soil/rock in the vicinity of the Building 845 firing table,
2. Ground water has not been impacted by contamination in either the Building 845 firing table or Pit 9 Landfill areas, and
3. No COCs were identified in any media for the Pit 9 Landfill.

No unacceptable risk or hazard associated with contaminants in surface soil, or subsurface soil or bedrock were identified in the Building 845 firing table or Pit 9 Landfill area in the baseline ecological assessment.

2.13.1.11. Building 851 Firing Table Area (OU 8)

No unacceptable risk or hazard associated with contaminants in surface soil and subsurface soil/bedrock was identified in this area in the baseline risk assessment. The selected Alternative 2 for the Building 854 firing table area protects human health and the environment by monitoring COCs in ground water for changes that could affect human health. The baseline ecological assessment found risk from cadmium to ground squirrels and deer with HQs greater than 1. However, site-wide and area-specific surveys found no current adverse impact.

2.13.2. Compliance with ARARs

The selected remedies in this Interim ROD comply with the ARARs identified for Site 300. Table 2.13-1 summarizes how the selected remedies comply with the Site 300 Federal, State and local ARARs. In conjunction with the ARARs for surface discharge of treated ground water, the effluent limitations and other invariable provisions that will be included in Substantive Requirements issued by the RWQCB are provided in Appendix B. DOE will comply with all prohibitions, limitations, specifications and provisions specified in the Substantive Requirements and Monitoring and Reporting Program issued by the RWQCB. The Monitoring and Reporting Program will be replaced and superceded by the Site-Wide CMP when it is finalized.

2.13.3. Cost-Effectiveness

In DOE’s judgement, the selected remedies for the OUs addressed in this Interim ROD are cost-effective and represent a reasonable value for their cost. In making this determination, the following definition was used: “A remedy shall be considered cost-effective if its costs are proportional to its overall effectiveness.” [NCP 300.450(f)(1)(ii)(D)]. This was accomplished by evaluating the “overall effectiveness” of those alternatives that satisfied the threshold criteria (i.e., protect human health and the environment and comply with ARARs). Overall effectiveness was evaluated by assessing three of the five balancing criteria in combination (long-term effectiveness and permanence, reduction in toxicity, mobility and volume through treatment, and short-term effectiveness). Overall effectiveness was then compared to estimated present-worth costs to determine cost-effectiveness. The relationship of the overall effectiveness of the selected remedial alternatives was determined to be proportional to their costs and hence they represent reasonable value.

The cost-effectiveness of the selected remedies for each of the OUs addressed in this Interim ROD is summarized in Tables 2.13-2 through 2.13-12.

2.13.4. Utilization of Permanent Solutions and Alternative Treatment Technologies to the Maximum Extent Practicable

DOE and the regulatory agencies have determined that the selected remedies for the Site 300 OUs addressed in this Interim ROD represent the maximum extent to which permanent solutions and treatment technologies can be utilized in a practicable manner at the site. Of those alternatives that protect human health and the environment and comply with ARARs, DOE and the regulatory agencies have determined that the selected interim remedies provide the best balance of trade-offs in terms of the EPA/NCP five balancing criteria and two modifying criteria. The selected interim remedies also consider the statutory preference for treatment as a principal element and a bias against offsite treatment and disposal, and State and community acceptance.

The ways in which the selected interim remedies utilize permanent solutions and alternative treatment technologies to the maximum extent practicable and provide the best balance of trade-offs are described for each OU in sections 2.13.4.1 through 2.13.4.11.

2.13.4.1. Building 834 OU

The selected Alternative 2 for the Building 834 OU (ground water and soil vapor extraction and treatment with monitoring and risk and hazard management) provides the best balance of trade-offs among the EPA/NCP balancing and modifying criteria. Alternative 2 is effective in the long term and permanently removes VOC source area and plume mass through ground water and soil vapor extraction, while Alternative 1 (no action) does not.

Alternative 2 reduces contaminant toxicity, mobility and volume by extracting and treating VOCs using GAC and by thermal GAC regeneration which destroys the VOCs. Under Alternative 2, the mobility of TBOS/TKEBS in ground water will be reduced by ground water extraction, but disposal offsite will not reduce their mobility or volume. The toxicity and mobility of nitrate will be reduced by phytoremediation under Alternative 2. Since the rate of degradation through enhanced *in situ* bioremediation under Alternative 3 is unknown, reduction in contaminant toxicity, mobility compared to Alternative 2 is not certain.

Alternative 2 is effective in the short term. Alternative 1 would have no construction-related impacts, although Alternative 2 effectively mitigates such impacts by using Site 300 standard operating procedures (SOPs) and Health and Safety Plans. It is unlikely that risk protection would be achieved significantly faster under Alternative 3 than Alternative 2. Alternative 2 is readily implementable since the majority of the extraction and treatment system is already operating. The implementability of enhanced *in situ* bioremediation under Alternative 3 is limited by permitting requirements for fluid injection and potential difficulty finding suitable enhancing materials.

Alternative 2 estimated present-worth costs are $2.4 million lower than Alternative 3. The State of California has expressed acceptance of Alternative 2.

2.13.4.2. Pit 6 Landfill OU

The selected Alternative 2 for the Pit 6 Landfill OU (MNA with monitoring and risk and hazard management) provides the best balance of trade-offs among the EPA/NCP balancing and modifying criteria. Alternative 2 will effectively and permanently reduce contamination in ground water through irreversible chemical degradation and radioactive decay (natural attenuation). Alternative 1 would not halt natural attenuation but does not include the monitoring to establish achievement of cleanup standards, which will be established in the Final ROD. Alternative 2 relies on natural attenuation to achieve long-term reduction of the toxicity, mobility, and volume of contamination in the subsurface, while Alternative 3 actively removes VOCs and nitrate from the subsurface through ground water extraction and may reduce the volume and mobility of these contaminants more rapidly.

Since there would be no remediation-related construction occurring under Alternative 1, there would be no short-term impact to human or ecological receptors. Under Alternative 2, there will be minimal impact to onsite workers during monitoring activities. Workers will follow Site 300 operational procedures to mitigate potential risks during monitoring. Alternative 3 poses additional short-term exposure risks if tritiated water is brought to the surface during ground water extraction, since workers could be exposed during the operation and maintenance of the ground water treatment facility.

Alternative 2 can be readily implemented by continuing and enhancing the existing ground water monitoring programs and continuing administrative controls to prevent exposure. Alternative 3 could be readily implemented, although additional time, labor and expense would be necessary both in the short- and long-term to construct, operate and monitor the treatment system. Operation of the treatment system would also require meeting Substantive Requirements issued by the RWQCB. In addition, provisions would need to be made to avoid impacting the integrity of the landfill cap during construction, as well as for worker safety during treatment system construction and operation since an active small firearms shooting range is located in the vicinity.

Alternative 2 estimated present-worth costs are $3.6 million lower than Alternative 3. The State of California has expressed acceptance of Alternative 2.

2.13.4.3. High Explosives Process Area OU

The selected Alternative 2 for the High Explosives Process Area (ground water extraction and treatment with monitoring and risk and hazard management) provides the best balance of trade-offs among the EPA/NCP balancing and modifying criteria. Alternative 2 will be effective in the long-term by permanently reducing contaminant concentrations through ground water extraction. This alternative also includes monitoring to determine the long-term effectiveness and permanence of the remedy. Alternative 1 (no action) does not actively reduce contaminant concentrations.

Under Alternative 2, contaminants will be removed from ground water and sorbed to carbon. The toxicity of the contaminants will be eliminated through the thermal regeneration the GAC. Contaminant volume and mobility in ground water will be reduced irreversibly by source mass removal, contaminant concentration reduction, and plume control. Alternative 1 would not actively reduce contaminant toxicity, mobility or volume.

Since there would be no remediation-related construction occurring under Alternative 1, there would be no short-term impact to human or ecological receptors. Under Alternative 2, there will be minimal, easily controllable impact to onsite workers during monitoring activities. Workers will follow Site 300 operational procedures to mitigate potential risks during monitoring.

Alternative 2 treatment technologies are well-proven and are presumptive technologies for VOCs in ground water. Implementation of this alternative will require the construction and operation of extraction and treatment systems at the Building 815, HE rinsewater lagoon, and HE Burn Pit source areas. The ground water extraction and treatment system at the site boundary to control offsite plume migration is already in place and operating. The operation of the ground water treatment systems for Alternative 2 will require meeting Substantive Requirements issued by the RWQCB for the discharge of treated effluent.

Alternative 2 estimated present-worth costs exceed those of Alternative 1 by $27.6 million. The State of California has expressed acceptance of Alternative 2.

2.13.4.4. Building 850 Firing Table

The selected Alternative 2 for the Building 850 Firing Table (MNA, removal of contaminated soil and the sand pile adjacent to the firing table, monitoring, and risk and hazard management) provides the best balance of trade-offs among the EPA/NCP balancing and modifying criteria. Alternative 2 provides long-term effectiveness by removing contaminant sources to prevent future releases to ground water, permanently mitigating exposure risk by removing contaminated surface soils, and through natural attenuation of contaminants in ground water.

Alternatives 2, 3, and 4 rely on the monitored natural attenuation of tritium in ground water to achieve a long-term reduction in toxicity, mobility, and volume of tritium in the subsurface. Alternatives 2 and 3 rely on degradation and decay to reduce the toxicity, mobility, and volume of uranium and nitrate in ground water. The soil removal component of Alternatives 2, 3, and 4 will reduce the mobility of the contaminants by removing the soil and sand pile, thus preventing further leaching of contaminants to the subsurface. It will not reduce the toxicity or volume of the contaminants as the soil and sand will be removed to a different location. Alternative 1 does not actively reduce contaminant toxicity, mobility and volume.

Alternatives 2, 3, and 4 have the potential for short-term exposure for onsite workers during the removal of contaminated soil and the sand pile. Short-term exposure risk may be higher for Alternatives 3 and 4 than for Alternative 2 as workers would be exposed to a much larger volume of previously buried contaminated media. Alternative 4 also has short-term exposure risks associated with bringing tritium to the surface, as the center of the uranium contamination where ground water would be extracted also contains tritium above the MCL. The excavation component of Alternatives 3 and 4 is likely to increase the number of exposure pathways, as well as disrupt habitat, increasing the potential for short-term exposure and impacts to the environment. Alternative 2 will rapidly reduce the source of contamination by removal, thereby actively reducing the tritium activities. Ground water data trends indicate that little tritium remains in the vadose zone; therefore, excavation of deeper soil and bedrock included in Alternative 3 and 4 may not reduce activities more rapidly compared to Alternative 2.

The removal of contaminated soil and the sand pile in Alternatives 2, 3, and 4 should be fairly easy to implement, but deviations from the estimated volume to be removed would affect the degree of difficulty of implementation. Additional engineering and logistical difficulties are posed by the excavation of subsurface soil in Alternatives 3 and 4.

Alternative 2 estimated present-worth costs are $4.2 million lower than Alternative 3 and over $12 million lower than Alternative 4. The State of California has expressed acceptance of Alternative 2.

2.13.4.5. Pit 2 Landfill

The selected Alternative 2 for the Pit 2 Landfill (monitoring) provides the best balance of trade-offs among the EPA/NCP balancing and modifying criteria. Alternatives 2 and 3 use monitoring to determine the long-term effectiveness and permanence of the remedies. Alternative 1 may provide long-term effectiveness and comply with cleanup standards, which will be established in the Final ROD; however there are no mechanisms included to establish continued compliance with these goals.

Because there are no COCs identified in any media for the Pit 2 Landfill area, the criteria for reduction in toxicity, mobility, and volume of contaminants are not applicable. Both Alternatives 2 and 3 use monitoring to determine if contaminants in the pit waste impact ground water in the future.

Since there would be no remediation-related construction occurring under Alternative 1 (no action), there would be no short-term impact to human or ecological receptors. Under Alternative 2, there will be minimal, easily mitigable impact to onsite workers during monitoring activities. Workers will follow Site 300 operational procedures to mitigate risks during monitoring.

There would not be a significant difference in the short-term effectiveness of Alternatives 2 and 3 if only the characterization and monitoring components of Alternative 3 were implemented. The excavation component of Alternative 3 poses the highest short-term risk of exposure and potential impact to human and ecological receptors during implementation of the remedy. Previously buried waste and associated contamination would be brought to the surface, handled, transported, and redeposited at a new location, which increases the number of exposure pathways and may disrupt plant and animal habitat. A high level of exposure control measures would need to be implemented to prevent the exposure of onsite workers, transport personnel, the public, and ecological receptors to contaminants.

No actions would be necessary to implement Alternative 1. Alternative 2 is readily implemented by continuing and enhancing the existing ground water monitoring programs and continuing administrative controls to prevent exposure. The implementability of Alternative 3 would be significantly more difficult than Alternative 2 if the pit capping or waste excavation options were implemented.

The Alternative 2 estimated present-worth cost is up to $20 million lower than Alternative 3 depending on the amount of waste excavated. The State of California has expressed acceptance of Alternative 2.

2.13.4.6. Building 854 OU

The selected Alternative 2 for the Building 854 OU (ground water and soil vapor extraction and treatment with monitoring and risk and hazard management) provides the best balance of trade-offs among the EPA/NCP balancing and modifying criteria. Alternative 1 (no action) does not provide long-term effectiveness or permanently reduce COC concentrations. Alternative 2 provides long-term effectiveness by permanently reducing contaminant concentrations through active remediation. Alternative 1 does not remove COCs from the subsurface; therefore, implementation of this alternative would not reduce the toxicity, mobility, or volume of the COCs.

In contrast to Alternative 1, Alternative 2 removes contaminants from soil and ground water, which will be sorbed to carbon. The toxicity and volume of extracted VOCs and perchlorate will be reduced through thermal GAC regeneration. The toxicity and volume of nitrate will be reduced through biochemical processes in the bioreactor under Alternative 2. Contaminant volume and mobility in ground water will be reduced irreversibly by source mass removal, contaminant concentration reduction, and plume control. There will also be minimal impact to onsite workers during monitoring activities since workers will follow Site 300 operational procedures to mitigate risks.

Alternative 2 treatment technologies are well-proven and are presumptive technologies for VOCs. Implementation of Alternative 2 requires construction and operation of soil vapor and ground water extraction and treatment systems at the Building 854 source area. A ground water extraction and treatment system will also be installed downgradient of Building 854 to control plume migration. Operation of the treatment systems for Alternative 2 would require meeting Substantive Requirements issued by the RWQCB and a permit from the local air board.

Alternative 2 estimated present-worth costs are $9.1 million higher than Alternative 1. The State of California has expressed acceptance of Alternative 2.

2.13.4.7. Building 832 Canyon OU

The selected Alternative 2 for the Building 832 Canyon OU (ground water and soil vapor extraction and treatment with monitoring and risk and hazard management) provides the best balance of trade-offs among the EPA/NCP balancing and modifying criteria. Alternative 2 provides long-term effectiveness by permanently reducing contaminant concentrations through active ground water and soil vapor extraction. Alternative 1 (no action) does not provide long-term effectiveness or permanently reduce COC concentrations. Under Alternative 2, contaminants will be removed from soil and ground water and sorbed to carbon. The toxicity of the contaminants will be destroyed by thermal regeneration of the GAC, and the biochemical processes in the bioreactor. Contaminant volume and mobility in ground water will be reduced irreversibly by source mass removal, contaminant concentration reduction, and plume control. Alternative 1 does not actively reduce contaminant toxicity, mobility or volume.

Alternative 2 will have minimal impact to onsite workers during monitoring activities as workers will follow Site 300 operational procedures to mitigate risks.

Alternative 2 treatment technologies are well-proven and are presumptive technologies for VOCs. Implementation of this alternative will require construction and operation of soil vapor and ground water extraction and treatment systems at the Buildings 830 and 832 source areas. Ground water extraction and treatment systems will also be installed downgradient of Buildings 830 and 832 to control plume migration. Operation of the treatment systems for Alternative 2 would require meeting Substantive Requirements issued by the RWQCB and a permit from the local air board.

The selected Alternative 2 estimated present-worth costs are $26.8 million higher than the no action Alternative 1. The State of California has expressed acceptance of Alternative 2.

2.13.4.8. Building 801 and Pit 8 Landfill

The selected Alternative 2 for the Building 801 and Pit 8 Landfill (monitoring) provides the best balance of trade-offs among the EPA/NCP balancing and modifying criteria. Alternative 2 and Alternative 3 (monitoring and landfill waste characterization) both provide long-term effectiveness by reducing contaminant concentrations to health-protective levels. Alternative 2 would effectively and permanently reduce contamination in ground water by allowing continued reduction which may be occurring through dispersion, dilution, and/or irreversible chemical degradation. Alternative 1 (no action) may provide long-term effectiveness in meeting cleanup standards, which will be established in the Final ROD, by permanently reducing COC concentrations. However, there are no measures to establish achievement of these goals.

Alternative 2 relies on natural attenuation to achieve long-term reduction of the toxicity, mobility, and volume of contamination in the subsurface. Both Alternatives 2 and 3 use monitoring to establish continued compliance with cleanup standards, which will be established in the Final ROD.

Since there would be no remediation-related construction under Alternative 1, there would be no short-term impact to human or ecological receptors. Under Alternative 2, there will be minimal impact to onsite workers during monitoring activities since workers will follow Site 300 operational procedures to mitigate potential risks. There would not be a significant difference in the short-term effectiveness of Alternatives 2 and 3 if only the characterization and monitoring components of Alternative 3 were implemented. Because there are no identified risks, Alternative 3 does not reduce the time to achieve human health protection compared to Alternative 2.

Alternative 2 is readily implemented by continuing and enhancing the existing ground water monitoring programs. The implementability of Alternative 3 would be significantly more difficult than Alternative 2 if the pit capping or waste excavation options were implemented.

The cost of Alternative 2 is up to $21.1 million lower than Alternative 3 depending on the amount of waste excavated. The State of California has expressed acceptance of Alternative 2.

2.13.4.9. Building 833

The selected Alternative 2 for the Building 833 (monitoring with risk and hazard management) provides the best balance of trade-offs among the EPA/NCP balancing and modifying criteria. Alternatives 2 and 3 both provide long-term effectiveness by permanently reducing contaminant concentrations. Alternative 2 effectively and permanently reduces contamination in ground water through irreversible chemical degradation. Under Alternative 3, contaminants would be actively removed from ground water through extraction and treatment. Alternative 1 may provide long-term effectiveness and permanently reduce COC concentrations; however there are no mechanisms for establishing the achievement of these goals.

Alternative 2 relies on natural attenuation to achieve the long-term reduction of the toxicity, mobility, and volume of contamination in the subsurface. Alternative 3 actively removes contaminants from the subsurface and would reduce the volume and mobility of contaminants more rapidly.

Since there would be no remediation-related construction under Alternative 1, there would be no short-term impact to human or ecological receptors. With Alternative 2, there will be minimal impact to onsite workers during monitoring activities. Whereas Alternative 3 may reduce the time for contaminant concentrations to decrease below MCLs, the total mass of contaminants is small and limited in area. Natural processes may decrease VOC concentrations below MCLs in 5 to 10 years.

Alternative 2 is readily implemented by continuing and enhancing the existing ground water monitoring programs and continuing administrative controls to prevent exposure. Alternative 3 could be readily implemented, although additional time, labor and expense would be necessary both in the short- and long-term to construct, operate and monitor the treatment system. Alternative 3 would also require meeting Substantive Requirements issued by the RWQCB and air permits from the local air board for the treatment system.

The estimated present-worth cost of Alternative 2 is $3.4 million lower than Alternative 3. The State of California has expressed acceptance of Alternative 2.

2.13.4.10. Building 845 Firing Table and Pit 9 Landfill

The selected Alternative 2 for the Building 845 Firing Table and Pit 9 Landfill (monitoring) provides the best balance of trade-offs among the EPA/NCP balancing and modifying criteria. Alternatives 2 and 3 use monitoring to determine the long-term effectiveness and permanence of the remedies. Under Alternative 3, if the characterization data for the Pit 9 Landfill waste were to provide evidence that contaminants associated with the waste could impact human health and/or the environment, the capping and/or excavation components of Alternative 3 would add additional long-term and permanent protection for human health and the environment. Alternative 1 does not include mechanisms to establish achievement of cleanup standards, which will be established in the Final ROD.

Alternatives 2 and 3 rely on natural attenuation to achieve long-term reduction of the toxicity, mobility, and volume of contamination in subsurface soil/bedrock. If characterization data for the Pit 9 Landfill waste were to indicate that contaminants associated with the waste could impact ground water, the capping component of Alternative 3 could reduce the mobility of the contaminants in the waste. However, excavation might increase the potential for airborne releases of volatile or dust-borne contaminants during disruption.

There would not be a significant difference in the short-term effectiveness of Alternatives 2 and 3 if only the characterization and monitoring components of Alternative 3 were implemented. The risk of exposure for onsite workers and ecological receptors in the short-term increases if the capping component of Alternative 3 is implemented. The excavation component of Alternative 3 poses the highest short-term risk of exposure and potential impact to human and ecological receptors during implementation of the remedy. Because there are no identified risks, Alternative 3 does not reduce the time to achieve human health protection over Alternative 2.

Alternative 2 is readily implemented by continuing and enhancing the existing ground water monitoring programs. The implementability of Alternative 3 would be significantly more difficult than Alternative 2 if pit capping or waste excavation were implemented. Excavation of landfill waste would require extensive provisions to prevent exposure and protect the safety of onsite workers, transport personnel, and the public during transport of the waste.

The estimated present-worth cost of Alternative 2 is up to $6.6 million lower than Alternative 3 depending on the amount of waste excavated. The State of California has expressed acceptance of Alternative 2.

2.13.4.11. Building 851 Firing Table

The selected Alternative 2 for the Building 851 Firing Table (monitoring) provides the best balance of trade-offs among the EPA/NCP balancing and modifying criteria. Alternative 1 (no action) may be effective in the long-term in meeting RAOs, MCLs, or any more stringent State requirements that may be established as cleanup standards in the Final ROD, and permanently reduce COC concentrations. However, no mechanism is included to establish compliance. Under Alternatives 2 and 3, monitoring would be conducted to ensure long-term effectiveness and permanence. Alternative 3 provides long-term effectiveness by permanently reducing contaminant concentrations through active remediation (ground water extraction and treatment) to meet RAOs, MCLs, or any more stringent State requirements that may be established as cleanup standards in the Final ROD.

With Alternatives 1 and 2, the toxicity and volume of depleted uranium is reduced by natural decay and there would be no impacts on the community or onsite workers from allowing this process to occur. Under Alternative 3, reduction in contaminant toxicity, volume, and mobility in ground water may be achieved more rapidly via active remediation. Radioactive decay would reduce the toxicity and volume of extracted uranium in the ion-exchange resins.

Under Alternative 2, there will be minimal impact to onsite workers during monitoring activities because workers will follow Site 300 operational procedures to mitigate risks. Alternative 3 poses short-term and possibly long-term exposure risk to onsite workers as uranium would be brought to the surface through ground water extraction. Because there are no identified risks, Alternative 3 does not reduce the time to achieve human health protection over Alternative 2.

Alternative 2 is readily implementable because ground water is already monitored in the vicinity of the Building 851 firing table. The implementability of Alternative 3 could be limited by permitting requirements for the long-term storage or disposal of uranium-contaminated resins.

The estimated present-worth costs of Alternative 2 are $3.7 million lower than Alternative 3. The State of California has expressed acceptance of Alternative 2.

2.13.5. Preference for Treatment as a Principal Element

By using soil vapor extraction and treatment by GAC to treat contaminated soil, ground water extraction and treatment by GAC to treat contaminated ground water, ground water extraction and treatment by biotreatment and/or ion exchange, and thermal regeneration of GAC, the selected interim remedies for these OUs address the principal threats through the use of treatment technologies. By using treatment as a significant portion of the Site 300 remedies for the OUs addressed in this Interim ROD, the statutory preference for remedies that employ treatment as a principal element is satisfied.

2.13.6. Five Year Review Requirements

Because the remedies for the Site 300 OUs addressed in this Interim ROD will result in hazardous substances remaining onsite above levels allowable for unlimited use and unrestricted exposure, a statutory review will be conducted within five years after initiation of remedial action to ensure that the remedy is, or will be, protective of human health and the environment.

2.14. Documentation of Significant Changes

The Site 300 Proposed Plan was released for public comment on April 20, 2000. The Proposed Plan identified the Preferred Alternatives for the Site 300 OUs addressed in this Interim ROD. DOE and the regulatory agencies reviewed all written and verbal comments submitted during the public comment period. It was determined that no significant changes to the interim remedies as originally identified in the Proposed Plan were necessary or appropriate.

3. Responsiveness Summary

This section responds to public comments directed to DOE/LLNL, U. S. EPA, and the State of California regarding the *Final Proposed Plan for Environmental Cleanup at Lawrence Livermore National Laboratory Site 300*, dated April 20, 2000. Responses to community comments and questions are incorporated into this Interim ROD.

The 30-day public comment period on the Proposed Plan began on April 20 and ended on May 20, 2000. On May 4, 2000, DOE/LLNL and the regulatory agencies held a public meeting at the Tracy Community Center, California to present the proposed remediation plans and receive public questions and comments on the preferred remedial alternatives. At the meeting, representatives from DOE and LLNL summarized information from the Feasibility Study and Proposed Plan. Following the presentations, four members of the public read their comments into the formal public record. One letter was received during the comment period. This letter, from Tri-Valley Communities Against a Radioactive Environment (CAREs), reiterated and expanded upon comments made verbally at the public meeting. The meeting transcript and a copy of the written comments are available to the public at the LLNL Visitors Center and the Tracy Public Library.

Community acceptance was measured by both the magnitude and substance of comments received. In addition to the formal written comments provided in this Section, numerous verbal discussions have helped DOE/LLNL interpret the issues of importance to the responding interested parties.

The interested public at Site 300 is made up of a small number of residents who live within about a mile of the Site, the nearby community of Tracy (approximately 8 miles from the northeast boundary of the Site) and the local environmental community represented primarily by Tri-Valley Communities Against a Radioactive Environment (CAREs).

Public meetings have typically attracted a few (1–4) nearby residents, several Tracy residents (5–15) and mostly members of Tri-Valley CAREs and their affiliates (8–20). Individuals in these groups have routinely expressed reservations about future land use assumptions, inclusion of community input, assurances that commitments are met, and about continued funding of the cleanup. There have also been general concerns over the application of monitored natural attenuation, risk and hazard management techniques, leaving landfills onsite, treatment options for radionuclides, cleanup standards, and whether site characterization is (and will be) adequate for effective remedial design.

Specific areas of support, reservations or opposition are listed under the Community Acceptance Sections in Section 2.10.

3.1. Organization of the Responsiveness Summary

Section 3.2 of this Responsiveness Summary responds to the questions and comments received at the May 4 public meeting and recorded in the transcript of that meeting. Section 3.3 responds to the Community Acceptance Criteria referenced in both the verbal and written comments submitted by Tri-Valley CAREs and Section 3.4 responds to the letter from Tri-

Valley CAREs received on May 20. Responses to similar questions or comments are cross-referenced.

DOE/LLNL, EPA, and the State of California have consulted on the following responses and agree on their content.

3.2. Public Meeting (May 4, 2000, in Tracy, CA)

Verbal comments from the transcript of public comments.

Robert Sarvey—26139 Corral Hollow Road, Tracy, California.

Mr. Sarvey comment #1*: I'd like to see anybody raise their hands that's in attendance from the city, officials or staff. Do we have anybody? Okay. I just wanted to establish for the record that we have no city officials present, and we do need some sort of help in that area.*

Response: A representative of the City of Tracy's Community Development Department was present throughout the presentations, but left before Mr. Sarvey made his comments. DOE/LLNL encourages involvement by local government in the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) process and welcomes their participation. DOE/LLNL has invited local government officials to all meetings and workshops regarding remediation activities at Site 300 in accordance with the LLNL Community Relations Plan.

To meet the objectives of the Community Relations Plan, DOE/LLNL has provided copies of Site 300 restoration documents to the City to: (1) provide an open dialogue on planned and ongoing remedial activities, and (2) increase their level of understanding of the Site 300 cleanup process. Comments on such documents are solicited from City officials. In addition, briefings have been presented to City staff on the cleanup project to provide accurate and timely information.

Mr. Sarvey comment #2*: One of my main concerns here is that the risks or the hazard assessments do not reflect a use of the land other than for the site for high-explosives and testing. And it's been said to the contrary that it is, but I don't see any information in the pamphlets that I've received that it is.*

Response: Site 300 is a federally-owned facility. DOE plans for LLNL Site 300 to function as an experimental test facility to support the Department mission of research, development, and testing of high explosives materials. In the Interim Record of Decision (ROD), DOE reiterates the commitments that it intends to maintain Site 300 for its current purposes. Section 28 of the Federal Facility Agreement (FFA) states: "The Department of Energy shall retain liability in accordance with CERCLA, not withstanding any change in ownership of the real property interests... shall not transfer any real property interests ... except in compliance with Section 120 (h) of CERCLA...". This provision ensures that DOE will not transfer lands with unmitigated contamination that could cause potential harm. The relevant provisions of CERCLA Section 120 have been added to the Interim ROD, Section 2.6.2.

Additionally, the 5-year review process and the Site-Wide Compliance Monitoring/Contingency Plan (CM/CP) specifically evaluate changes that have either occurred or can be foreseen for the future, including potential changes in land use.

Mr. Sarvey comment #3*: Another thing: In the risk assessment, I don't see any considerations for earthquakes, wildfires, or excessive rainfalls. There's no consideration in any of the information that I've read that these things have been considered, and they're things that do occur on a regular basis that, obviously, we cannot predict.*

Response: During the baseline risk assessment and in all remedial engineering designs, DOE/LLNL considers factors that could impact the preferred alternatives and result in contaminant disturbance; thereby, increasing potential risk to human health and the environment. For example:

Earthquakes: None of the contaminants at Site 300 are in a form that could be rapidly released in event of an earthquake. The engineered pit caps have been designed to withstand the maximum anticipated earthquake for the site. However, even if the cap over a landfill were ruptured, the only potential risk would be that of additional infiltration passing through the landfill when the next heavy rains occurred. In the upcoming Site 300 CM/CP DOE/LLNL will include regular and post-earthquake inspections of landfill covers and repair of any damage. Currently, the landfill caps are monitored and inspected on an annual basis as specified in the Post-Closure Monitoring Plans for Pit 6 and Pits 1 & 7. LLNL must comply with stringent seismic design criteria requirements for all remediation facilities. The details of seismic preparedness will be covered in the remedial design documents and in the CM/CP.

Wildfires: Existing practices at Site 300 include an extensive fire management program which burns off excess vegetation on a regular basis (controlled burns). Furthermore, none of the contaminants that will remain on the surface are subject to further spread by wildfire. The only items that could possibly have such potential are the polychlorinated biphenyls (PCBs) and associated contaminants in the Building 850 area, which are planned for removal. No other contamination is of a type that would be affected by wildfire.

Excessive rainfall: DOE/LLNL employs engineering controls to prevent deleterious effects of increased rainfall and consequent surface runoff. None of the landfill pits addressed in this Interim ROD are subject to subsurface inundation by rising ground water caused by excessive rainfall—they are all far above the water table.

Mr. Sarvey comment #4: *I also feel that the balancing criteria should not include the costs of the cleanup. When we look at the cost of the cleanup as opposed to the Lab budget, we see a pretty big discrepancy there, and I'd like to see the cost taken out of the consideration of what we're doing to clean this mess up that we've created.*

Response: EPA and the National Contingency Plan set the evaluation procedures, which include cost as one of the Balancing Criteria. Cost was only one of five Balancing Criteria considered, in addition to: (1) short-term effectiveness, (2) ability to reduce toxicity, mobility and volume of contaminants, (3) implementability, and (4) long-term effectiveness and permanence. The preferred alternatives represented the best balance of trade-offs with respect to those criteria. The following discussion demonstrates that the role of cost was not overemphasized in the analysis.

In every case, the selected alternatives protect human health and the environment and meet all applicable or relevant and appropriate requirements (ARARs), i.e., the Threshold Criteria. This is by design, in that DOE did not choose any alternatives that would not do so. In some cases the more expensive options would create new risks by disturbing and possibly spreading contamination that might otherwise never present a risk (failing in the category of 'short-term effectiveness'), while others are not practically implementable. Each area at Site 300 addressed in the Proposed Plan is discussed below with regard to benefit of additional expenditures.

- Building 834: The effectiveness of enhanced bioremediation has not been demonstrated for this situation. Effectiveness could be reduced by incompatibilities with the ground water and soil vapor extraction portion of the alternative. Field tests indicate a complete loss of detectable microbial degradation of VOCs in the Building 834 Core Area during SVE system operation. DOE will continue to investigate alternative technologies to optimize remediation.
- Pit 6 Landfill: Although ground water extraction could theoretically reduce the time for cleanup, data indicate that contaminants could fall below maximum contaminant levels (MCLs) without the ground water extraction remedy component before the Final ROD is prepared. Treatment of such low concentrations of VOCs is very inefficient. In addition, there is no risk to human health or the environment posed by these contaminants under current or projected conditions. Hence, the preferred remedial alternative provides the best balance of trade-offs with respect to the balancing criteria. If at a later time, concentrations have not declined below MCLs or more stringent State requirements that may be established as cleanup ARARs in the Final ROD, the CM/CP will provide for re-examination of more active remediation.
- HE Process Area: The single active alternative considered is a presumptive remedy, meets remedial action objectives and can achieve MCLs or more stringent cleanup standards that may be established in the Final ROD.
- Building 850 Firing Table: The more expensive alternatives are not expected to clean up the site more rapidly. There are no effective technologies to clean up tritium in ground water. Excavation of contaminants in the bedrock beneath the firing table area is essentially unimplementable because of hard, competent bedrock beneath active facilities, and likely to increase risks to human health far greater than those of leaving them in place. An *in situ* barrier might prevent movement of uranium in ground water, but uranium is already well below its MCL. It would also be difficult to install such a barrier without encountering and potentially releasing some tritium to the air, increasing risks to onsite workers. The construction itself might also disrupt wildlife. The low uranium activities (already within the general range of background activities in California) will not migrate far because of low solubility and propensity to sorb onto the native rock and soil.
- Pit 2 Landfill: There is no ground water contamination or evidence of a release from the Pit 2 Landfill. The pit is not likely to be inundated by ground water since it is well above the local water table. Hence, there is no measurable benefit of additional expenditure.
- Building 854: The single active alternative considered is a presumptive remedy, meets remedial action objectives and can achieve MCLs or more stringent cleanup standards that may be established in the Final ROD.
- Building 832 Canyon: The single active alternative considered is a presumptive remedy, meets remedial action objectives and can achieve MCLs or more stringent cleanup standards that may be established in the Final ROD.

- Building 801 Dry Well/Pit 8 Landfill: VOCs from the dry well are already below MCLs and continue to decrease. There is no evidence of a release from the Pit 8 Landfill and it is not likely to be inundated by ground water since it is well above the local water table. Hence, there is no measurable benefit of additional expenditure.
- Building 833: The extremely small volume and isolation of VOCs suggest that they will not migrate out of the immediate area or cause any human or ecological exposure. The wells in that area produce so little water that it is doubtful whether active ground water extraction could significantly accelerate the cleanup. (See section 2.10.10 for additional discussion.)
- Building 845 Firing Table/Pit 9 Landfill: There is no ground water contamination or evidence of a release from the Pit 9 Landfill. The pit is not likely to be inundated by ground water since it is well above the local water table. Hence, there is no measurable benefit of additional expenditure.
- Building 851 Firing Table: There is no ground water contamination above the MCL. Although a signature of depleted uranium has been detected, the total uranium activity is at the low end of natural background. Hence, there is no measurable benefit of additional expenditure.

Mr. Sarvey comment #5*: I also think—and this is addressed to the EPA—that we need a citizens review committee. It's been said before that people from Tracy have been polled. And I've been to every single one of these meetings, and no one's ever asked me to participate in a citizens review committee.*

And I think that we need a member of the city council, the planning commission, a member of the staff and several citizens to establish a commission to oversee this cleanup and make sure it's being done properly.

Response: DOE/LLNL has an ongoing public participation process, as defined in LLNL's Community Relations Plan, to involve members of the public and local government in its cleanup projects. This Plan exceeds the requirements of Federal regulations. The Plan is reviewed on a regular basis to assure its objectives are met. As required by the Plan, information repositories have been established to allow public access to Site 300 environmental documents to provide accurate and timely information to interested members of the community. In addition, Tracy city officials receive DOE/LLNL reports regarding cleanup of Site 300. Site data have also been provided to the City of Tracy for use in its environmental documents.

U.S. EPA has established a Technical Assistance Grant (TAG) to provide technical advice to all of the community regarding environmental cleanup activities. Recognizing that the TAG recipient works most closely with Tri-Valley CAREs, DOE would entertain requests from other citizen groups interested in following the restoration project at Site 300, and would be willing to discuss a way to satisfy their needs. The local community is provided with, and will continue to receive access to, information by way of local repositories, public notices, newsletters, and public workshops.

Four public workshops and one public meeting are already scheduled to take place before the Final ROD is signed in 2007. After the ROD has been finalized, DOE/LLNL will update its

Community Relations Plan and interview nearby residents to re-assess the desire and usefulness of forming a Community Work Group.

Mr. Sarvey comment #6*: Another thing: The budget for this cleanup must be increased. Once again, we're spending millions, perhaps billions, of dollars at the Lab, but we're spending very little money here to clean this up, and I think that's a great mistake.*

Response: Site 300 cleanup expenditures are currently about $10,000,000 annually. Budgets for DOE environmental restoration activities are formulated through project baselines and are constrained by the Federal budgetary process. Specifically, Congress provides separate funding allocations for Defense Programs and Environmental Management. Neither DOE nor LLNL can shift money between these allocations without Congressional approval. Citizens are encouraged to participate in the Federal budget process through their elected representatives.

Mr. Sarvey comment #7*: Another thing that's important to me and that's never mentioned is: There's several private sites located around Site 300, and there never is any mention of them, the contamination there.*

I spoke with the State Department of Toxic Substances. I understand they're doing limited testing at these sites. But the Department of Energy is responsible, no matter who the ownership of these sites belongs to, is responsible to clean these sites up. And this all should be coordinated in one thing. It should not be done separately.

Once again, like I said, private site cleanup and Site 300 should be coordinated together. We're planning on building right up to the edge of the old Primex site. And, as far as I know, there's very little testing that's been done.

Response: DOE is not liable for the condition nor any potential contamination on nearby private land that is non-DOE related. The Proposed Plan and Interim ROD address the environmental restoration at LLNL Site 300 only. Each parcel of private land must follow its own regulatory processes under Federal and State regulations to address contamination, if any.

The following information, was obtained from the DTSC to describe the background and status of each of the nearby private sites.

SRI International, Corral Hollow Experimental Site: This facility has been addressed by DTSC under RCRA. DTSC held a 30-day comment period on a closure plan for an open air detonation unit in January and February 1992. DTSC approved the closure certification plan for the open air detonation unit on October 30, 1992. Sampling and analysis performed during the closure of the unit showed no residual contamination. DTSC completed a RCRA Facility Assessment (RFA) for the facility in June 1993. The RFA concluded that there was no evidence of release of hazardous wastes to the environment and recommended no further action.

Primex Technologies: This facility is also being addressed by DTSC under RCRA. A RCRA Facility Investigation (RFI) has been completed. DTSC approved the RFI Report on March 13, 2000. As part of the RFI, soil sampling was performed at five areas identified in a 1993 DTSC report including: 1) former test areas, 2) a former fuel storage area, 3) the site of a diesel fuel release, 4) a former container storage area, and 5) the site of a petroleum product release. A total of 85 shallow (depths not exceeding 18 inches below ground surface) soil samples were collected. Based on the results of the RFI, a Corrective Measures Study Workplan has been prepared which describes the proposed corrective measures to remediate soil containing elevated levels of petroleum hydrocarbons at two locations. The Corrective Measures Study Workplan will be made available for public comment in the near future.

Mr. Sarvey comment #8*: One thing I would also request: Since we don't have the money to clean this up, let's stop messing it up. Let's stop contributing to the waste. Let's stop contributing. Let's stop testing up there. Let's do something else with this site. We should no longer continue to contaminate a site that we can't afford to clean up.*

Response: DOE/LLNL has been actively cleaning up Site 300 for some time, and remediation activities are underway in some areas. DOE has also developed a life-cycle baseline that allocates budgets for the entire cleanup operation at Site 300. This assures funding needs for Site 300 cleanup are well understood from the present through the future achievement of all cleanup standards that will be set in the Final ROD. DOE operations at LLNL are conducted in compliance with all applicable State and Federal regulatory requirements. See response to Mr. Sarvey's comment #6 for more information about the budget process.

Operations have improved significantly since the early 1980s. Accidental releases to the environment have been much reduced due to the improved procedures. For instance, a Contained Firing Facility is under construction, and most of the future explosive tests will take place inside an environmentally controlled facility to minimize environmental releases from these tests.

René Steinhauer – community organizer for Tri-Valley CAREs.

Mr. Steinhauer comment #1: *I would like to shorten my remarks by saying that I echo everything that Bob Sarvey has said. I think a good overall view of the situation, as careful and detailed as you have been, is in a very unscientific way.*

Response: See responses above.

Mr. Steinhauer comment #2: *You assume there are going to be no drastic changes or variations in the model with which we have been working with. Extensive rainfall, other things are a problem, and, as we know—just as one example, we know that at a particular location, when rain is very severe, the ground table rises. It rises to the level where there are contaminants near the surface, and then it brings down some of the contaminants with it as the groundwater level falls. And then that groundwater is then there and moving toward other areas.*

Response: The only location where increased rainfall (and the resulting rise in the ground water table) is believed to have a potential to release additional contamination is at the Pit 7 Complex, which is not covered by the Proposed Plan and Interim ROD. DOE/LLNL, the State, and EPA have decided that the Pit 7 Complex will have its own focused Remedial Investigation/Feasibility Study to evaluate a wider range of technologies than previously presented. The public will have an opportunity to review and comment on decisions regarding the Pit 7 Complex in separate CERLCA documents and at a public meeting.

Mr. Steinhauer comment #3: *And especially as new development comes up, there is an increased—"pressure" is probably the wrong word, but the increased usage of some of the water facilities moves that material even quicker than it was moving before.*

So I'm not satisfied that enough contingencies have been taken into account. It is as if we are looking at a scene that is going to stand still throughout time. And to imagine that a place *like this will stand still for the next two to three decades is not very reasonable. It's not a very scientific assumption. So I would like to see more done in that regard.*

Response: Ground water pumping outside of the Site 300 boundary should not have any impact on the migration of onsite contaminant plumes. The aquifers are not well connected hydraulically, and the formations contain significant layers of silts and clays which impede the movement of ground water.

Nonetheless, such eventualities will be addressed in the CM/CP and re-examined during the 5-year reviews required by CERCLA. In general, all impacts of increased offsite pumping can be mitigated through minor modifications to onsite remediation activities. Whenever such a potential deviation from expectations arises, mitigating actions will be discussed with the regulatory community. Any significant and/or fundamental changes to the remedies will be subject to public review and comment.

Mr. Steinhauer comment #4: *Tri-Valley CAREs has in previous months, almost a year ago, prepared a small insert to one of our regular monthly newsletters. It's called the "Livermore Lab's Site 300 Cleanup: Community Acceptance Criteria." And there are copies of it available back there in this kind of yellow color.*

Unfortunately, there's another item there about the same color. In it, we prepared 12 criteria items to be mindful of. And I'm not going to read this sheet, but I would like to read the 12 topic headings, if I may, if I can separate this sheet from my paper. Is this microphone on?

So I'm just going to read the sections because a good deal has been made about the nine criteria. Tri-Valley CAREs prepared 12 criteria to be mindful of, and, actually, Peter will be discussing perhaps a third point, a more overriding kind of general concept. But I'm just going to read the titles of these to be— to remind the public of things to be concerned about.

Number 1 was, "Complete the cleanup project in a timely manner."

2. "Cleanup levels should support multiple uses for the property." And we've addressed this at some length already.

3. "Cleanup levels should be set to the strictest state and federal government levels." And we've heard some on that.

4. "Remedies that actively destroy contaminants are preferable."

5. "Radioactive wastes and the tritium-polluted underwater plume should be controlled immediately in order to prevent further releases to the environment."

6. "Radioactive substances should be isolated from the environment."

7. "The ecosystem should be protected and balanced against the cleanup remedies." There's a distinction there.

8. "Decisions should not rely on computer modeling." And I think some of this we have a good deal of.

9. "Additional site characterization is needed and therefore must be adequately included in budget planning." And also, earlier remarks have been made about money that's allocated for it. And although I've not looked at the figures, if I recall correctly, about one percent of the budget is really being directed towards the cleanup. And when you consider all the millions and *billions of dollars that go into projects that the Lab conducts, a one-percent cleanup is a very paltry amount, and it shows really—it shows how much emphasis, how much importance the Lab places on cleanup.*

10. "A contingency plan should be completed and subject to public review."

11. "The public should be involved in the cleanup decisions," and,

12. "Cleanup should be given priority over further weapons development." And that might be one way that we can begin to balance some of the costs that are involved in here.

Response: See separate responses to the full text of the Community Acceptance Criteria provided at the meeting in Section 3.3.

Mr. Steinhauer comment #5: *In connection with that, when we ran that little—that little insert, there was a section in there where people could sign in; they could indicate, "I support the Community Acceptance Criteria listed above," or, "I am sending additional comments on the Site 300 cleanup."*

And because it was just an insert in one of our newsletters, I would like to present you with some 50-plus—I think there's about 60 or just under that here of people that cared enough to sign. If they had been here today, this room would be a little bit more full than it is here today, which is rather a disappointment.

But I would like to present that to you, Bert, if I may, just for the record. And at the same time, I give you a clean, yellow copy in there that has the full text of the statement so that it may be appropriately incorporated into the remarks that are here.

Response: The referenced material contained no comments other than those listed above and addressed in Section 3.3.

Mr. Steinhauer comment #6: *And so the other thing that I would just like to say is that I do believe that a lot of people here are working in good faith, but sometimes that good faith is—is slightly out of focus because of individual concerns and target dates and expenditure tallies and things of that sort.*

But we're dealing with a very serious situation in here and with the Lawrence Livermore Lab, both at the Main Site and here at Site 300, we have two Superfund sites; we have some terrible contamination going on; we have very little money being allocated. And to the degree that it's possible, there's been very little general public involvement.

And I know that you've done your best in a sense in publishing it in the newsletters, but we have to find a way to break out of this and all of us work together as a community.

At the back table, I have other copies of this document that I just presented to Bert. I have a Spanish translation of that, which somehow took more space than the English version, and a few other fact sheets on the Site 300 to which you are all invited to help yourselves to.

Response: DOE/LLNL understands the public concerns regarding the presence of contamination at Site 300. To that end, DOE has formulated and funded a restoration project for Site 300 intended to clean up contamination resulting from past operations to protect human health and the environment and restore beneficial uses of natural resources in a cost-effective, efficient, and compliant manner.

DOE/LLNL-sponsored public workshops (which DOE offers, even though they are not required by CERCLA) are an attempt to share information and hear the concerns and priorities of the community. This open dialogue between DOE/LLNL, the public, and local governments is considered in the technical work scope for ongoing and planned Site 300 restoration activities.

Sally Light—825 Kains, Avenue, Albany, California 94706.

Ms. Light comment #1: *I also just got back from New York. We cover a lot of ground at Tri-Valley CAREs. We were all at the Non-Proliferation Treaty Review Conference at the UN, and so we—we do a lot.*

I made notes to myself before coming here tonight, and I'm one of the people who actually regularly attend the meetings that we have quarterly with the folks—the cleanup folks at the Lab, both Main Site and Site 300, along with the regulators and as part of our TAG grant.

These are not required meetings. It's just a really nice thing that we are able to all get together.

And I can tell you that the cleanup people are really working in good faith, in my opinion. I'm very convinced of that, and I'm really impressed with them.

In terms of the weapons work, we're clearly adversaries of the Lab and DOE, but when it comes to cleanup, we're really more of a team. And I want that clearly on the record.

Response: Thank you, DOE/LLNL appreciates the compliment.

Ms. Light comment #2: *However, I am very concerned about money. And I'm more and more thinking that money is driving a lot of the things we're seeing in terms of the process, the remedies that are—then become the preferred alternatives and so forth and so on.*

And all day today I've had to deal with reporters calling me about Tri-Valley CAREs' position or statement concerning the Department of Energy's press conferences today and yesterday having to do with the National Ignition Facility and weapons work, all the incredible inflated figures that have come up as part of what DOE wants for its weapons part of the budget.

And it's—if those inflated figures—we're talking about from 750 million up to a billion dollars—for the NIF on top of what the request has gone through, if that actually goes through—and who knows what will happen—that money has to come out of somewhere. And I worry that it will come out of cleanup as it has in the past.

Response: Please see responses to Mr. Sarvey's comments #6 and #8.

Ms. Light comment #3: *And so there's a whole history of this. And it gets to, again, the priorities that Department of Energy sets for weapons over cleanup. So it's very much the driver, in my opinion.*

And when I looked in detail at the supporting documents months ago for Site 300 alternatives and the preferred one chosen, again and again I personally came up that the personal conclusion, looking at what I was seeing, that despite the fact that tonight we've had somebody respond that cost wasn't a primary factor, I really think it is.

Response: Please see the response to Mr. Sarvey's comment #4.

Ms. Light comment #4: *As Rene said earlier, historically, Livermore Lab's annual budget is about 99 percent for weapons and 1 percent for cleanup. And it can't get any worse than that. Because I know that the folks here use their cleanup budget to the maximum. They do a really, really good job at using what they have.*

Response: See responses to Mr. Sarvey's comments #6 and #8. DOE's budget for cleanup at Site 300 is approximately $10 million per year.

Ms. Light comment #5: *But without that money, how can you thoroughly characterize Site 300? And that is still—has to happen. Most of Site 300 hasn't been characterized.*

And for people who want to know what that term means, it's a CERCLA term, I guess. And it means actually discovering what you have in terms of the hydrogeology in the contaminants and where they're going. And that has not happened.

So how can you have a reasonable cleanup plan without knowing what you have, both in terms of the contaminants and in terms of the very rugged geology up there?

Response: DOE/LLNL believes that the areas addressed in this Interim ROD are adequately characterized to select a conceptual clean up approach and begin implementing the cleanup. The U.S. EPA and State of California regulatory agencies concur with this statement by their acceptance of the preferred alternatives for environmental cleanup in the Proposed Plan. These agencies reviewed and evaluated the remedial technologies and alternatives and participated in the selection of the interim remedy. As more is learned about the site during cleanup, the cleanup strategy and its technical approach can be adjusted to optimize cleanup accordingly. Any significant or fundamental changes to the selected interim remedies based on these adjustments will be subject to public review and comment.

The Site 300 Federal Facility Agreement contains milestones for characterizing those areas not addressed in this Interim ROD, and that characterization is underway.

Regarding the adequacy of funds, see response to Mr. Sarvey's comment #6.

Ms. Light comment #6: *So this is, again, budget driven, I think, because if there had been adequate funds, really adequate funds, that would all be known now, and you wouldn't be in the position of having to carry on characterization while at the same time you're coming up with your Proposed Interim Plan and your Final Plan and so forth and so on. It's getting the cart before the horse or somewhere in between there.*

Response: See responses to Mr. Sarvey's comment #6 and Ms. Light's comment # 5.

Ms. Light comment #7: *Also, this has—something that I want to bring up right now that bothers me is the cleanup in a relationship for long-term stewardship. And long-term stewardship is—DOE has historically sort of bifurcated the two and said that long-term stewardship is not really related to cleanup.*

But I know that Congress is looking at how the Department of Energy has used its cleanup budgets for all of its facilities. How have they used it?

In order to come up with projected costs for long-term stewardship, which is how—which is the phrase having to do with dealing with the long-term problems of radioactive waste, primarily, in the Department of Energy facilities around the country after those facilities have basically ended their life cycle because radioactive materials go on for many thousands of years.

So if that is really true, if Congress is looking to how the cleanup budgets have been used and the cleanup budgets are inadequate to meet the task, this means that we're very much likely to run into the same problem that we have had all along, and that is: Since the Department of Energy doesn't give a fig about cleanup that it does about weapons, ultimately will DOE just walk away from these sites, including Site 300 and Main Site, ultimately, without having anything adequate in the plan in terms of the stewardship of these properties?

And I think that that is a very big problem here, and I think that Site 300 might very well become a model for a long-term stewardship projection because we know the Department of Energy right now is doing two studies: One site-specific and one programmatic that is national over long-term stewardship. And they have to come up with their data from somewhere.

Response: Congressional actions are beyond the scope of the Interim ROD. Please see response to Mr. Sarvey's comment #2, which states that DOE will not transfer lands with unmitigated contamination that could cause potential harm. DOE believes that LLNL will be able to clean up Site 300 within a reasonable timeframe given the understanding of contaminants present and technologies available to remediate those contaminants in the environment.

The Congressionally-mandated long-term stewardship initiative is intended to promote rigorous planning for the operation and maintenance of treatment facilities to ensure remedies meet cleanup standards. The initiative demonstrates that Congress is increasingly aware that DOE's liability will not be eliminated when "cleanup" is complete, and are interested in understanding the estimated size of that liability. As such, long-range planning is being refined to ensure adequate funding is allocated in the outyears to address residual contamination and ensure cleanup is achieved.

Ms. Light comment #8: *I know that our technical expert will be going into more detail, but one thing I want to say and that is: The monitored natural attenuation, it seems to me looking at the documents that I have reviewed, is being relied on overly because of cost-driven factors. And I don't feel happy with that.*

I think there were a lot of times—a lot of choices delineated in the documents that I saw where there were a lot of other choices besides that that could have been added in. But it's much cheaper to go with MNA. I'm sure Peter will get into that if he chooses.

Response: There are only two places where MNA is selected as DOE's preferred alternative. At the Pit 6 Landfill, there is evidence that chemical degradation has been occurring that will bring the concentrations of VOCs below MCLs within two to four years (see discussion under Mr. Sarvey's comment #4).

The other location is the Building 850 Firing Table, where MNA is recommended for tritium only. Tritium has a well-established half-life of 12.3 years. Therefore, by decay alone, the highest tritium activities currently measured will decline to the drinking water MCL of 20,000 pCi/L within 30 years. Taking into account that the exact highest concentration may not have been detected and that the tritium source has diminished, DOE gives a conservative estimate of 40 years, strictly by decay. During that time span, the plume will not migrate offsite, based on fate and transport modeling, and there is no risk of human exposure. In contrast, all more active methods of trying to clean up the site more rapidly pose some risk of human exposure.

Peter Strauss—technical advisor to Tri-Valley CAREs, 317 Rutledge Street, San Francisco 94110.

Mr. Strauss introductory remark: *First, I want to thank everybody on the podium. And I think—I thank you for your openness and your willingness to provide information and your enthusiasm. I really think that there is an enthusiastic bunch here trying to do something that's—you know, trying to do the best thing.*

Response: Thank you.

Mr. Strauss comment #1: *I agree with Sally almost entirely about budget constraints as an important driver in this process.*

Response: See response to Mr. Sarvey's comments #4, #6, and #8, and Mr. Steinhauer's comment #6.

Mr. Strauss comment #2: *Today, I prepared a draft copy of the comments that we will be submitting, and I will be providing these to Marylia at Tri-Valley CAREs. They will edit them and then send it to—to the people on the podium. But I want to point out some of the important points that I think are—are needed, and I hope I'm not going to be too long.*

First, Sally just left off with monitored natural attenuation. I know that there's only a few of the operable units where this applies. It's very important for—from Tri-Valley CAREs' perspective, that when John explained the processes by which a contaminant is—diminishes in a groundwater sample that— that we do not rely on dispersion and dilution; we rely on real degradation.

And I think that that has to be shown in some way. And I'm not sure that you've given that—that that burden has—you've proven that burden.

Obviously, for radioactive substances, we know half-lives, and so we know that. But for some of the other compounds, we don't know that. And I would like to see a little bit more fleshed out in these studies.

Another thing to consider being the—in monitored natural attenuation is, "What is an acceptable time frame?" And I do not think that that's laid out in the Proposed Plan, and I think it should be.

Response: The only place where non-radiological MNA is being recommended is at the Pit 6 Landfill, where DOE/LLNL expects the VOC concentrations to decline below MCLs within about 4 years. See discussion under Ms. Light's comment #8 and Mr. Sarvey's comment #4.

EPA's guidance and the Proposed Plan state that a reasonable timeframe for MNA is one that is *comparable* to that of other viable alternatives.

Mr. Strauss comment #3: *There are—there was a whole list of–I guess as the icon—John had the icon of the wall for exposure controls. And these are–where elevated—in areas where elevated risks or hazards are identified. And it seems like they were growing in perpetuity.*

And from Tri-Valley CAREs' perspective, that's not acceptable. We do not believe that permanent exposure control should be part of the remedy unless—unless it's absolutely clear to us that it can't be cleaned up in any other way.

Response: DOE/LLNL's intent is to use exposure controls to supplement, not replace, other remedial actions. These will be employed where cleanup is progressing but has not yet reduced all risk or hazard to levels protective of human health and the environment. There are some landfills where there is no evidence of a current release, but it may be appropriate to continue access controls for a longer period.

Mr. Strauss comment #4: *One of the problems that we've had is that the Proposed Plan and the Interim ROD will not contain cleanup standards except for—to the—what's termed the MCL. The Final ROD is not scheduled until 2007.*

We're concerned about ineffective performance during this seven-year period. And we would recommend that cleanup goals be established to the most stringent goals, and that would be background levels, and after which in 2007 DOE can tell us whether they can meet those goals or not.

It might be the same—actually the same remedy, but it might push you a little harder. And the burden of proof is shifted to you to prove why you can't meet the background rather than just meeting the MCLs.

So I would propose that the cleanup—at least goals should be established as the—to the most stringent as possible.

Response: DOE/LLNL, the State, and EPA believe the most expeditious way to begin cleanup is the use of an Interim ROD to initiate cleanup activities employing the selected alternatives. It is understood that the burden of proof regarding achievement of whatever cleanup standards that may be established in the Final ROD resides with DOE. The evaluation of the practicality and feasibility of cleanup standards below MCLs will be presented to the regulatory agencies after additional environmental data are collected and modeling based on active remediation is conducted. As agreed with the regulatory agencies, the ground water cleanup standards will be set in the Final ROD and during the interim period remediation systems will be designed with the capability of reaching concentration levels that may be established as ARARs in the Final ROD. Soil removal and construction activities during the interim period will meet the RAOs. DOE has also added an assurance to not discontinue operation of any ground water or soil vapor extraction and treatment system before the Final ROD without notification and approval of the regulatory agencies.

Mr. Strauss comment #5: *I think we've talked about the major—that Tri-Valley CAREs is recommending that, that the possible mission change or change in ownership of the site should be considered in remedy selection. We've suggested in the past that DOE change its assumption that it will forever hold onto this site and change it to control it for 20 to 30 years.*

We've been told that there's been a procedure in the Federal Facilities Agreement which calls for revisiting this if there is a change in land use. I would like to see that explicit in the Proposed Plan.

Response: See response to Mr. Sarvey's comment #2. The Proposed Plan is already Final, and states: [Sec 5.2] "CERCLA and the Federal Facility Agreement for Site 300 include provisions for assuring cleanup if ownership were to change. All remedies would be reevaluated if any transfer of ownership or change in land use is anticipated." DOE has also included a further explanation of its commitment with regards to any transfer of land ownership in the Interim ROD.

Mr. Strauss comment #6: *I'm going to reiterate something that Rene's saying, but for the last two years in conversation with DOE, Livermore staff, and regulators, Tri-Valley CAREs has recommended that something be done to prevent the continued release of tritium from Pits 3 and 5 to the groundwater.*

Now, I know that the—that section has been taken out of this Proposed Plan, but I really would like to see something on the order of an emergency action done that contains those—at least stops the migration of—of tritium.

This year we've had—I guess we didn't have such a rainy season, but last year we did. I think the year before we did. And every time the water level rises, it saturates those pits and carries with it the tritium.

Response: As you state, the Pits 3 and 5 Landfills in the Pit 7 Complex area are not covered in the Proposed Plan or Interim ROD. The Pit 7 Complex will have a separate focused Remedial Investigation/Feasibility Study to evaluate a wider range of technologies than previously presented. Preventing further releases from the Pit 3 Landfill has been discussed between DOE and the regulators. While DOE and the regulators are collectively evaluating what could be done, the interim conclusions are that more evaluation is necessary to find a viable remedy and that there are no imminent threats that require action before further evaluation is complete.

Mr. Strauss comment #7: *Marylia would hit me if I didn't say this, if I didn't make this comment. In almost all Superfund projects, commitments and milestones concerning the cleanup performance—that means the timing of cleanup, how much contaminant will be removed—are disregarded in the Record of Decision and even in the Proposed Plan.*

That—I know that the Lab has an idea; they have models. The Plan does not have a measurable schedule for performance damage for which the community can measure its progress.

And there's a five-year review that's going to come up. And in that review, we won't know if the Lab has met its goals or not unless we have this information right on— in this Proposed Plan.

So we suggest that for each OU the Lab spell out the mass of contaminant in the soil and groundwater and lay out a conservative timetable for cleaning that up. I mean, that would give the community some idea about how long this is going to take.

John, if you—you mentioned before that—you said that maybe it's going to take 20 years. Well, boy, I would— if we could hold you to that, that would be great.

Response: The Federal Facility Agreement contains milestones for installation of treatment facilities and several other remedial actions. DOE considers all Federal Facility Agreement milestones to be performance measures. However, the estimates of time to reach MCLs are not based explicitly on modeling that gives mass removal rates. Such information would be more difficult to predict and DOE/LLNL has not performed modeling to predict mass removal rates. One of the purposes of the Interim ROD is to gather data from which such predictions can be more readily made. The post-Interim ROD design documents will have schedules and specific extraction locations, etc., which are necessary input to such estimates. Throughout this process, DOE/LLNL will continue to work with the regulators to develop appropriate performance measures. DOE/LLNL will attempt to provide new estimates of the residual contaminant mass and projected rates of mass removal in the Remedial Design documents.

Mr. Strauss comment #8*: Leslie spent a lot of time—a good deal of time on risk assessment, explaining how that was done. And I want to counter with that, that the geology of Site 300 is extremely complex. There are synclines and anticlines; there's faults; there are many strata of different formations, one that, if I—if I'm—if I'm not mistaken, was just discovered in a—in a recent investigation in the Pit 7 complex.*

This makes characterization of contamination difficult and modeling the movement of contaminants through these formations even more difficult.

Response: See response to TVC's Community Criteria # 8 (as numbered in Mr. Steinhauer's comment #4). Although the geology at Site 300 is complex, a considerable amount of subsurface hydrogeologic data has been collected and tools are available to apply models to achieve specific practical objectives.

Mr. Strauss comment #9: *I was at a DOE seminar on risk assessment about four years ago, and I came away with the feeling that risk assessment is like saying the moon is made out of blue cheese.*

Now, I know that we have to, as—as a scientific community, have to feel that—have to have a number or have to feel that you want to have a number.

Now, Tri-Valley CAREs and a number of environmental groups have come together and advocated something called a precautionary principle. And in part, this principle states,

"We believe existing environmental regulations and other decisions, particularly those based on risk assessment, have failed to protect adequately human health and the environment. We believe that there is compelling evidence that damage to humans in the worldwide environment is of such a magnitude of seriousness that new principles for conducting human activities are necessary. While we believe that human activity may involve hazards, people must provide more—must proceed more carefully than has been the case in recent history. When an activity raises threats of harm to human health or the environment, precautionary measures should be taken even in—if some cause-and-effect relationships are not fully understood. In this context, the proponent of activity rather than the public should bear the burden of proof."

And I think it's very important for—for the regulators and the DOE and staff there to recognize this and keep that in the back of your mind, that that's very important from our perspective and from the environmental community in general.

Response: All cleanup activities are specifically planned to reduce risk and there are no approaches selected that are not well understood, based on many applications in similar situations. In fact, presumptive remedies and/or technologies were incorporated into the alternatives where appropriate. All preferred alternatives ensure overall protection of human health and the environment and compliance with all applicable or relevant and appropriate requirements. Precautionary principles are built into the procedures and laws governing environmental cleanup.

Mr. Strauss comment #10: *There was one thing that Rene mentioned in the Community Acceptance Criteria that I wanted to explain a little bit. Leslie had talked about protecting the* *plants and animals. And one of the things that, as in my experience, is that the remedy could actually harm the plants and animals.*

You can extract water, and you can dry up springs. And the kit fox can—you know, is drinking from that spring, and that kit fox no longer has a niche. So it's very important to balance that out. So I wanted to explain that, too.

Response: No kit fox have ever been sighted at Site 300. Ecological issues will be addressed in the National Environmental Policy Act (NEPA) document that will be issued prior to the Final Interim ROD. There are a limited number of springs that could potentially be affected by proposed pumping of ground water for cleanup. These are described below, by operable unit:

- <u>Building 834</u>: There are no springs in this area.
- <u>Pit 6 Landfill</u>: The only two 'springs' downgradient from the landfill do not currently have any surface flow. Since no ground water pumping in this area is proposed, there is no likelihood of impacts.
- <u>HE Process Area</u>: Two springs exist in this general area, Spring 14 and Spring 5. Spring 14 is not contaminated and is far enough away from any planned pumping that it is unlikely to be affected. Spring 5 currently has no surface flow, so the presence of surface water in the area will be unaffected. Treated ground water from the area would be discharged to the surface, potentially creating an additional resource for wildlife.
- <u>Building 850 Firing Table</u>: The only spring in the area is Well 8 Spring, which has low flow and some standing water. No ground water pumping is proposed for this area, and thus the spring will be unaffected.
- <u>Pit 2 Landfill:</u> Spring 6 is downgradient from this area. However, no ground water pumping is proposed for this area and the spring will not be affected.
- <u>Building 854</u>: Two springs are downgradient from the contaminant plume, Spring 11 and Spring 10. Spring 11 has minimal seepage during the wet season and does not constitute a significant resource for wildlife. Spring 10, at the bottom of the canyon, has low flow and some standing water. This spring probably drains a very large area of surrounding hillside. Because ground water pumped from the area upgradient is localized and treated water will be discharged to the ground, little if any impact is expected. Spring flow will be monitored.
- <u>Building 832 Canyon</u>: Spring 3 is the only spring in the area that could potentially be affected. Treated ground water will be returned to the drainage, such that little, if any impact is expected. Spring flow rates will also be monitored.
- <u>Operable Unit 8 (remainder of site)</u>: No other areas covered in the Proposed Plan or Interim ROD either have springs or have planned ground water extraction.

Mr. Strauss comment #11: *And I'm close to wrapping up.*

For the—the area that's called OU-5 or Building 850 where there's a tritium plume, Tri-Valley CAREs believes strongly that hydraulic control must be part of the remedy instead of just leaving it to migrate and leaving it in the ground, essentially.

And we do not believe that the remedy is adequate unless the tritium plume is contained and brought under hydraulic control.

Response: All evidence indicates that the source of tritium contamination in the Building 850 Firing Table area is diminishing. Because tritium is an excellent tracer of ground water movement, DOE/LLNL also has a good history of the movement of the plume, including migration rate and activity levels. Figure 6-2 in the Site-Wide Feasibility Study (attached here as Figure 3.2-1) shows that the tritium plume above the MCL is shrinking, and that the highest activities have decreased substantially. The highest tritium activity in 1999 was 96,500 pCi/L, compared to the highest measured ground water activity of 562,000 pCi/L, in 1985. Well 8 Spring was monitored much earlier and indicated that the major release occurred even earlier, in that the highest tritium activity recorded in spring water was in 1972 (770,000 pCi/L).

The flow model along the plume pathway is well calibrated by over 15 years of observation. Therefore, there is a high level of confidence that tritium from the Building 850 plume will not reach the site boundary at greater than 1,000 pCi/L, and will likely be below the normal detection level.

Hydraulic control will not decrease the total tritium activity in the ground. Its only purpose would be to prevent movement of the plume to locations where human or environmental exposure might occur. Since exposure is extremely unlikely if the tritium is allowed to decay in place, there is no benefit of hydraulic control. In fact, if tritiated water from near the downgradient end of the plume were withdrawn and injected back at the source of the plume, ground water gradients would be affected and plume migration could be accelerated. Furthermore, it is not clear how to hydraulically control the plume without creating a new possible exposure pathway for workers, where none exists now.

Based on the above, DOE/LLNL does not feel that any additional use of resources to hydraulically control the plume is necessary or appropriate at this time. One of the facets of MNA is that monitoring will continue to assess the remaining contamination to determine whether cleanup standards set in the Final ROD are being met. If MNA does not achieve the objectives or any new threat has appeared, the appropriateness of MNA will be re-evaluated.

3.3. Tri-Valley CAREs Community Acceptance Criteria, as Submitted at the Community Meeting

#1. Complete the cleanup project in a timely manner. *Set a schedule for cleanup activities and adhere to it. The goal should be to complete cleanup ten years after the DOE's last scheduled ROD, with up to 30 years after for monitoring of residual contamination. As part of the plan, schedule milestones addressing total mass removal, and trends toward achievement of cleanup goals should be established and committed to by the Dept. of Energy, which is the Lab's parent agency. Areas at Site 300 that will still be contaminated after ten years should be identified up front and the reasons stated.*

Response: DOE/LLNL strives to complete the cleanup project in a timely manner. The goal is to accomplish the cleanup as quickly as reasonably achievable in a cost-effective and compliant manner, with the resources available. DOE/LLNL cannot predict the funding levels that will be made available by Congress nor the competing priorities within DOE accurately enough to produce a definitive schedule for the complete project. However, a project management system for environmental restoration activities exists to define current and future work scope, schedule and costs (i.e., cleanup strategy) to achieve remediation and meet regulatory milestones. A change control process is used to document changes in the project management system and impacts on the cleanup project. The immediate priority is to reduce exposure or potential risk as rapidly as possible. In some cases the rates of physical, chemical, and hydrogeologic processes will limit the speed of the actual cleanup.

Schedules will continue to be negotiated with the regulators and will be included in other documents (such as the Remedial Design Work Plan, following the Interim ROD), as appropriate. The timeframe for monitoring after cleanup will also be negotiated with the regulators and input from the community will be considered.

#2. Cleanup levels should support multiple uses for the property. *Those uses should be unrestricted by environmental contamination. The Lab's current assumptions about land-use need to be altered. As we can see, residential development is beginning to take place adjacent to the site boundary. Therefore, assumptions should include the possibility of large residential communities relying on the regional aquifer for drinking water, thus speeding up groundwater movement. Second, we do not believe that Site 300 will necessarily always remain in DOE's custody. The "need" for testing nuclear weapons and components (particularly of new and modified designs) is a political decision, not a technically necessary mandate, and, in our opinion this testing should cease. We recommend that Site 300 future land use assumptions include mixed residential, recreational, ecological preserve and industrial activities. Without full cleanup to standards appropriate for all of the above-listed uses, substantial residual contamination may remain in soil and groundwater and restrict any non-military use of the property.*

Response: Remedial action objectives (RAOs) for ground water include both protection of drinking water supplies beyond the site boundary and restoration of beneficial uses of ground water everywhere onsite. The interim ground water cleanup actions will meet the RAOs and during the interim period, DOE/LLNL will evaluate the feasibility of reaching MCLs and more stringent State requirements that may be established as ARARs in the Final ROD.

No persons offsite are currently being exposed to contaminated ground water from the site, and DOE/LLNL will use best-proven and cost-effective technologies to assure that they never are. The integrity of regional aquifers and local drinking water supplies is of the highest priority to LLNL and DOE, and the selected interim remedies are designed to ensure their protection.

Some of the current onsite landfills will remain intact, since the potential for future releases can be appropriately controlled and mitigated. None of those considered in this Interim ROD are currently release sites. Monitoring will continue to assure that they do not contaminate the environment in the future, but those locations may continue to require administrative access controls.

#3. Cleanup levels should be set to the strictest state and federal government levels. *We believe that the strictest cleanup levels should be met in cleaning up the site. Federal and state Maximum Contaminant Levels (MCLs) for all groundwater (on-site and off-site) should be the "bottom line below which the cleanup will not fall." In many cases the technology exists (and/or can be developed) that will clean up contamination to "background" levels—that is to the level that existed in nature at the site before Livermore Lab took over in 1955 and began polluting it.*

In all cases where this can be achieved, it should be. In this regard, Tri-Valley CAREs concurs with a strict interpretation of the CA Regional Water Quality Control Board's non-degradation policy for groundwater. Migration of pollutants into pristine waters must be halted.

Response: DOE/LLNL and the regulatory agencies have agreed that the Interim ROD will not contain any cleanup standards for ground water or VOC-contaminated subsurface soil. The interim ground water cleanup actions will meet the RAOs and during the interim period, DOE/LLNL will evaluate the feasibility of reaching MCLs and more stringent State requirements that may be established as ARARs in the Final ROD. Experience during the first few years of remediation will help determine the speed with which contaminant concentrations can be reduced and how cost effective different levels of cleanup might be. Prevention of the migration of contaminants into pristine waters is a major goal of the cleanup effort.

Currently, no person is exposed to cancer risks greater than 1 in 1 million or hazard indices of greater than 1. Risks reported in the Baseline Health Risk Assessment were calculated based on possible exposures, which are preventable using risk and hazard management. In most cases, contaminant concentrations are now substantially less than those used in the baseline assessment, and potential risks and hazards will continue to fall under the selected interim remedies.

#4. Remedies that actively destroy contaminants are preferable. *In order of preference, Tri-Valley CAREs recommends the following types of cleanup measures: a) remedies that destroy contaminants (i.e. by breaking them down into non hazardous constituents), such as by ultra-violet light/hydrogen peroxide, permeable barriers, or biodegradation; b) active remedies that safely treat or remove contaminants from the contaminated media; c) monitored natural attenuation in so far as it relies on natural degradation (and not further dispersion of the pollution) within a reasonable time frame. What is called "risk and hazard management" (i.e., restrictions on land use, fencing, signs and institutional controls), while potentially useful for reducing short-term risks, is not a valid cleanup in our eyes and should only be used as an interim measure. In no case do we think that "point of use cleanup" (e.g., merely placing filters on off-site drinking water wells) is appropriate. When soil excavation takes place, it should be properly controlled to minimize releases of contaminated soil into the air, and onto adjacent properties.*

Response: DOE and LLNL also prefer remedies that destroy contaminants. In many cases, it may be most cost effective for the destruction to take place offsite, such as in a facility that regenerates granular activated carbon (GAC). However, investigations of innovative technologies, such as phytoremediation, will continue so that remedy components may be identified that can lead to contaminant destruction. Radioactive elements, of course, cannot be destroyed, except by natural decay.

The preliminary criteria for applying MNA relies on evidence of natural degradation or decay, even though EPA guidance allows consideration of dispersion and dilution. DOE/LLNL may find, however, that at very low concentrations evidence is difficult to document and observations of concentrations dropping below detection limits must be considered adequate.

The Proposed Plan and Interim ROD do not suggest that risk and hazard management substitutes for active cleanup. "Point-of-use cleanup" is not a selected remedy. DOE and LLNL are committed to risk and hazard management for minimizing risks and hazards, both for existing contamination and as a matter of safety policy. This includes minimizing potentially hazardous releases to the air during cleanup operations.

#5 Radioactive wastes and the tritium-polluted underwater plume should be controlled immediately in order to prevent further releases to the environment. *The tritium plume, nearly two miles long and growing, cannot be cleaned up in the traditional sense of the word, since it is not feasible to separate the radioactive hydrogen (tritium) from the water. Therefore, Tri-Valley CAREs recommends the following: a) isolation of the tritium contaminated wastes in the unlined dumps at site 300 to prevent further and continuing contamination of the groundwater; b) hydraulic control of the underground water plume to prevent further migration; c) aggressive monitoring to ensure no migration occurs over time while the tritium decays (at a rate of 5.5% per year); and, d) a stringent contingency plan in case these methods fail. As it currently stands, groundwater rises into the unlined waste dumps during heavy rainfall and, once that water mixes with the radioactive wastes there, it picks up additional tritium contamination. Isolation of the wastes may be accomplished by means of drains, by capturing groundwater upstream from the dump sites before it is inundated, or removing the tritium-contaminated solid debris from the dumps and storing it above ground in a monitored storage facility. This latter method has the highest likelihood of actually preventing further tritium contamination.*

Response: DOE/LLNL agrees that control of the tritium source is very important and has considered the options suggested by Tri-Valley CAREs in developing the cleanup approach.

The Building 850 tritium plume, as defined by the 20,000 pCi/L MCL contour, is shrinking. At the Building 850 tritium source area there is strong evidence from over 15 years of monitoring that the source has significantly diminished. This provides evidence that most of the tritium has already decayed or been leached from the surface soil and unsaturated zone.

Part of the selected MNA remedy for Building 850 is to monitor for any changes in tritium activities. Monitoring results will be a continuing discussion topic with the regulators, and if any results warrant re-evaluation of the remedy, other possible actions will be considered with the regulators.

While DOE and the regulators are collectively evaluating what could be done to prevent further releases from the Pit 7 Complex, the interim conclusions are that more evaluation is necessary to find a viable remedy and that there are no imminent threats that require action before completion of further evaluation.

#6. Radioactive substances should be isolated from the environment. *As is the case with tritium (discussed above), there are several underground plumes containing uranium 238. Technology exists to separate this contaminant from the groundwater. We recommend that this radioactive waste be stored in above ground monitored facilities after separation from groundwater.*

Response: Uranium activities in areas addressed in the Interim ROD are close to or within the range of natural background. All uranium activities in ground water in these areas are below the 20 pCi/L MCL.

The Site-Wide Feasibility Study and Proposed Plan considered technologies for separating uranium from ground water and disposing of the resulting waste. However, because of the low activity levels and low mobility of uranium in the subsurface, no benefit was identified to balance the considerable cost of exercising that option.

#7. The ecosystem should be protected and balanced against the cleanup remedies. *Site 300 sits on 11 square miles of land, including a series of steep hills and canyons, covered by grasslands. Seven major plant communities occur at Site 300, including: coastal sage scrub, native grassland, introduced grassland, oak woodland and three types of wetland. Twenty species of reptiles and amphibians, 70 species of bird, and 25 species of mammals also live there. Special and rare and endangered species include the burrowing owl, San Joaquin Kit Fox and the Large-Flowered Fiddleneck. Ecological risks should be no greater than those for humans. The Lab should update its ecological assessment of 1994, as there are more complete data now. Moreover clean-up activities should not inadvertently destroy unique habitat.*

Response: The Proposed Plan indicated DOE/LLNL will continue surveys to monitor rare and endangered species at Site 300. No kit fox have ever been sighted at Site 300. All significant additions to the findings in the 1994 ecological assessment are described in the Site-Wide Feasibility Study. DOE/LLNL works closely with the U.S. Fish and Wildlife Service and California Department of Fish and Game and will make every effort to minimize the impact of remediation activities on unique habitat, such as that for the Large-Flowered Fiddleneck. The National Environmental Policy Act review associated with the Interim Record of Decision also addresses these issues.

#8. Decisions should not rely on computer modeling. *The draft SWFS points out just how complex the hydrogeology of the site is, and how little it is understood by the "experts". Given this, Tri-Valley CAREs believes that over-reliance on modeling to predict the fate and transport of pollution is not a good idea. Computer modeling should be used as a tool only, and continually updated by field testing.*

Response: DOE/LLNL agrees that contaminant fate and transport models should not be solely relied upon for critical decisions without field calibration. DOE/LLNL understands that validation and calibration are very important aspects of modeling. In cases of projecting future risks, very conservative assumptions are used. When engineering actual cleanup, however, 'best estimates' are more appropriate and useful for design purposes.

Numerical models were primarily used as screening tools. The screening level approach requires very conservative assumptions and input parameters in the model.

Modeling results were not the primary factors in making cleanup decisions, but were used as a tool to help support decisions and indicate where more data may be needed.

#9. Additional site characterization is needed and therefore must be adequately included in budget planning. *It is also apparent from the draft SWFS and other documents that additional characterization (e.g. of soil, groundwater, unlined waste dumps etc.) is necessary, and will have to be budgeted for many years to come.*

Response: The Site-Wide Feasibility Study mentioned 3 areas (Building 812, Building 865, and the Sandia Test Site) that are not addressed in the Proposed Plan because additional characterization was necessary to determine if contaminants have been released and whether cleanup is necessary. The Pit 7 Complex area was added to the list of areas requiring further characterization and withdrawn from the Proposed Plan because of its complexity. DOE believes that the areas addressed in the Interim ROD are adequately characterized to select a conceptual cleanup approach and begin implementing the cleanup. The U.S. EPA and State of California regulatory agencies concur with this statement by their acceptance of the preferred alternatives for environmental cleanup in the Proposed Plan. These agencies reviewed and evaluated the remedial technologies and alternatives and participated in the selection of the interim remedies.

See response to Mr. Sarvey's verbal comment #8 regarding the DOE budget process.

#10. A contingency plan should be completed and subject to public review. *We recommend that a site wide contingency plan be part of the SWFS, or part of the upcoming Remedial Action Plan. This is needed because the cleanup of a few sites is not scheduled for some years to come and there are many uncertainties regarding the effectiveness of cleanup. For example, innovative technologies that have not been fully evaluated will be used (because exotic bomb testing activities created a "toxic stew" of contaminants).*

Response: DOE/LLNL expects a draft of the CM/CP to be available by March 2002, at which time the public will have the opportunity to review and comment. In addition, a public workshop is scheduled for April 16, 2002, at which the Draft CM/CP will be presented. There may be additional OU-specific contingencies that could be identified during development of subsequent remedial design documents. DOE/LLNL will consider other appropriate mechanisms for public participation during the remedial design and implementation phases. No unproven technologies will be used to clean up the relatively straightforward contamination found at Site 300.

#11. The public should be involved in cleanup decisions. *As it now stands, public involvement takes place through Tri-Valley CAREs and at Lab-sponsored public meetings and hearings which could end altogether after "sign-off" is obtained on the cleanup remedies. Instead, the Lab should commit to keeping the public informed and getting public feed-back on a regular basis.*

Response: The public will remain involved and be informed of DOE's environmental activities, including plans for long-term stewardship at the site. Presently, the basic cleanup approaches and other technical details set forth in the Proposed Plan and Interim ROD have all now undergone public review and comment.

DOE/LLNL has an ongoing public participation process, as defined in its Community Relations Plan, to involve members of the public and local government officials in its cleanup projects. The Plan is reviewed on a regular basis to assure its objectives are being met. As required by the Plan, information repositories have been established to allow public access to Site 300 environmental documents and provide accurate and timely information to interested members of the community. In addition, Tracy city officials receive DOE/LLNL reports regarding cleanup of Site 300. Site data have also been provided to the City of Tracy for use in its environmental documents.

U.S. EPA has established a Technical Assistance Grant (TAG) to provide an independent vehicle for technical advice to all of the community regarding environmental cleanup activities. Recognizing that the TAG recipient works most closely with Tri-Valley CAREs, DOE/LLNL would entertain requests from other unrelated groups interested in following the restoration project at Site 300, and would be willing to discuss a way to satisfy their needs. The local community is provided, and will continue to receive access to, information by way of local repositories, public notices, newsletters, media reports, and public workshops.

Four public workshops and one public meeting are already scheduled before the Final ROD is signed in 2007. After the ROD has been finalized, DOE/LLNL will update its Community Relations Plan and interview nearby residents to re-assess the desire and usefulness of forming a Community Work Group.

#12. Cleanup should be given priority over further weapons development. *Perhaps most important of all, Tri-Valley CAREs insists that cleanup of site 300 be given a priority over further bomb-creating enterprises, and that adequate, stable, long-term funding be assured in order the cleanup may be done right. The current allocation of approximately one percent of Livermore Lab's annual budget to cleanup at Site 300 (and only another 1 % of Livermore Lab's annual budget to cleanup the Lab's main site) is insufficient. Moreover, ongoing and planned weapons activities must not be allowed to continue to pollute the site.*

Response: Issues of priority of weapons work versus cleanup are beyond the scope of the Proposed Plan, Interim ROD, or the CERCLA process. These are Departmental issues and should be addressed through normal political channels. Public input can always be provided through public agencies and elected representatives.

Ongoing activities at all LLNL sites are designed to minimize hazardous releases to the environment. Activities have changed significantly since LLNL began operation 40 years ago, with experiments now designed with a much better understanding of environmental protection and safety. Compliance with the Resource Conservation and Recovery Act (RCRA) and several other regulations (such as the Clean Air and Clean Water Acts) helps ensure that future harmful releases do not occur. LLNL has extensive environmental protection procedures in place which are designed to prevent any additional contamination. Those preventive and mitigating activities and monitoring for any releases are reported in the Site Annual Environmental Report. Current operations at Site 300 are overseen by several environmental regulatory agencies and are conducted in compliance with their regulations to prevent future releases that could be detrimental to human health and the environment.

The Site Annual Environmental Report provides information on releases and background environmental conditions around LLNL's sites; it can be found at www-envirinfo.llnl.gov/ or obtained through Bert Heffner, Manager, Environmental Community Relations, (925) 424-4026.

3.4. Tri-Valley CAREs Written Comments, Submitted on May 20, 2000

General Comments

#1. ***There is a statement in the Fact Sheet that nitrates are not harmful to humans.*** *This is incorrect. There are several suspected negative health effects in humans including spontaneous abortion, non-Hodgkin's lymphoma and stomach cancer. Related to this comment, the MCL for nitrate is 10 mg/l, not 45 (which is the CA standard). Hopefully, this will be corrected in the Proposed Plan, and remedies addressing nitrate will be adjusted accordingly.*

Response: The Fact Sheet statement that nitrate is not toxic to adults was based on the IRIS database posted by the U.S. EPA, which cites no definitive studies showing adverse health effects for adults. DOE/LLNL acknowledges that there may be additional studies that indicate possible negative health effects to adults that have not been included by EPA in the IRIS database. The statement has not been repeated in other documents and is not included in the Interim ROD.

The MCL for nitrate, when reported as NO_3, is 45 mg/L. Where EPA has reported it as 10 mg/L, that refers to nitrate when expressed as N (personal communication, Dr. Stan Smucker, U.S. EPA, Region 9). These two concentrations are equivalent. DOE/LLNL has, with one exception, used the appropriate MCL when expressing nitrate analytical results. The exception is that DOE/LLNL erred in the calculation on Table 1-19 of the SWFS by comparing the 10 mg/L PRG of nitrate as N to the measured values of NO_3, thereby suggesting risks 4.5 times higher than are actually present. This error and others will be reported in an Errata for the SWFS to be provided later. Due to the use of these higher values (greater conservatism) in risk calculations, interim remedies addressing nitrate do not need to be re-evaluated.

*#2. **In the Fact Sheet, you should include dioxins and furans as contaminants.** The more toxic of these compounds has health effects in the parts per trillion range.*

Response: The Fact Sheet was much condensed compared to the Proposed Plan and necessarily contained less detail. The dioxins and furans were mentioned in the Proposed Plan and are included in the Interim ROD. DOE notes in the Interim ROD that its proposed interim remedies remove these contaminants and disposes of them in a licensed offsite facility.

*#3. **New research on degradation of PCBs indicates that as these compounds naturally degrade they become more mobile in the environment.** We suggest that DOE investigate how this affects the groundwater models and any risk analysis. In addition, as PCBs are predominately found in surficial soils, volatilization of PCB breakdown products is of some concern.*

Response: The selected interim remedy will remove PCBs and dispose of them in a licensed offsite facility. PCBs have not been found in the ground water and the removal of soils contaminated with PCBs from the Building 850 Firing Table area should prevent future migration to ground water or volatilization of breakdown products.

*#4. **If MNA is chosen for any OU, we feel very strongly that a reasonable time frame for cleanup that is acceptable to stakeholders must be established prior to the signing of the ROD.** DOE responded to our question regarding how a reasonable time frame would be established by stating that it would be established in the Site 300 ROD (we assume final ROD) and subsequent contingency plan, "in consort with the regulatory agencies". While Tri-Valley CAREs has an amenable relationship with the regulatory agencies, we believe that DOE must speak and receive input directly from the entire community. Furthermore, MNA as a remedy is controversial, and the time frame in which it is accomplished is one of its most important facets. Establishing it in the post interim ROD contingency plan is not acceptable to us. We recommend that this Proposed Plan lay out the guidelines of how an acceptable time frame will be established so that there is room for public debate.*

Further, we note that MNA is not an acceptable "remedy" if dispersion of contamination is included in the definition on MNA. Establishing that actual chemical and/or biological degradation is occurring (and not dispersion) is an early and key criterion for considering the appropriateness of selecting MNA as a remedy.

In addition, before MNA should be considered for certain contaminants, it is important that breakdown products and their risks are identified. There is no information in any of the primary documents about breakdown of High Explosive (HE) compounds and the toxicity of daughter products. Further, the Proposed Plan should also address the more commonly known breakdown products, such as vinyl chloride, where appropriate.

Response: Please see responses to verbal comments: Mr. Strauss' comment #2, Ms. Light's comment #8, Mr. Strauss' comment #11, and Tri-Valley CAREs' Community Acceptance Criteria #5 (as numbered in Mr. Steinhauer's comment #4). Reiterating the main points, MNA is only proposed at two sites: (1) Pit 6 Landfill, for VOCs, and (2) Building 850 Firing Table, for tritium.

At the Pit 6 Landfill, the presence of the degradation product cis-1,2-DCE plus the rapid declines in TCE concentration provide good evidence of chemical breakdown. Vinyl chloride has never been detected. Not all degradation modes of TCE produce vinyl chloride.

At the Building 850 Firing Table, DOE/LLNL have not been able to devise any faster cleanup method to remediate the tritium plume than natural decay. Decay will reduce the activities below the MCL in no more than 40 years, without any human exposures.

#5. ***Exposure controls in areas where elevated risks or hazards are identified will sometimes have to run in perpetuity.*** *We do not believe that permanent exposure controls should be part of the remedy, unless it is in areas that absolutely cannot be cleaned up. Moreover, any process for making that determination must be a public one.*

Response: Please see response to Mr. Strauss' verbal comment #3. There are no areas where risk has been identified that will not be reduced through implementation of the preferred interim remedies.

#6. ***To clarify, in past discussions DOE has said that it will achieve cleanup levels between background and MCL.*** *In the objectives this is not stated, but should be. In previous discussions, there were recommendations by the water board that the first Remedial Action Objective clean up "possibly to levels exceeding the protection proved by MCLs/WQOs." Additionally, for the Remedial Action Objectives (RAOs), it was "assumed that cleanup standards for contaminant concentration will be between MCLs and background". However, the RAO do not state this. We support cleaning up to background wherever feasible. Again, this should be the goal of cleanup, and it should be so stated.*

Response: DOE/LLNL and the regulatory agencies have agreed that the Interim ROD will not contain any cleanup standards for ground water or VOC-contaminated subsurface soil. Please see responses to verbal comments: Mr. Strauss' comment #4 and Tri-Valley CAREs' Community Acceptance Criteria #3 (as numbered in Mr. Steinhauer's comment #4).

#7. ***Tri-Valley CAREs strongly reiterates that State Water Resource Control Board Resolution (SWRCB) 68-16 (i.e., the non-degradation policy) applies to groundwater at this site, not merely to discharges of treated water.*** *This resolution applies to discharges: either underground or above ground discharges as is commonly understood by the general term discharge. While some believe that Resolution 92-49, paragraph III.G may be the more stringent of ARARs for setting in-situ cleanup standards, other Sections of 92-49 are also relevant, including paragraph III. F. Specifically, this paragraph cites that cleanup and abatement*

activities shall conform to the provisions of Resolution 68-16. In addition, in response to a comment, DOE states that it is "abhorrent" to re-inject contaminated water in a pristine area. We agree wholeheartedly with this sentiment. However, allowing the vadose zone to contaminate the groundwater or the plume to be diluted through advection and migrate to pristine waters is sanctioning the same abhorrent effect. This is precisely why we think SWRCB Resolution 68-16 applies to this site.

Response: DOE/LLNL and the regulatory agencies have agreed that the Interim ROD will not contain any cleanup standards for ground water or VOC-contaminated subsurface soil. Please see response to Tri-Valley CAREs' Community Acceptance Criteria #3 (as numbered in Mr. Steinhauer's comment #4).

#8. ***The Proposed Plan and the interim ROD will not contain cleanup standards (according to agency decisions thus far).*** *Since the final ROD is not scheduled until 2007, we are concerned about ineffective performance during the seven-year interval. We recommend that interim cleanup goals be set at the most stringent levels. DOE will have an opportunity in 2007 to amend them, so long as it can prove why they cannot be met.*

Response: Please see response to Mr. Strauss' verbal comment #4.

#9. ***One of the major points that TVC is recommending is that a possible mission change or change in ownership of the site should be considered in remedy selection.*** *If in the future DOE wants to dispose of the property, the remedy that is chosen today should not limit tomorrow's land-use decisions. DOE maintains that it will control the site indefinitely. Cleanup should support multiple uses for the property. Because the Bay Area is growing so rapidly, and residential growth is beginning to occur in Tracy and near Site 300, it would be unfortunate if the cleanup levels decided in 2000 dictate how this 11 square mile site will be used in the future. A possible mission change or change in ownership of the site should be considered in remedy selection. Just recently, DOE did make a step in turning over a small portion of the site to the U.S. Fish and Wildlife Service, for the purpose of protecting a rare and endangered plant. We recommend that the remedy by compatible with this use, and with other potential, perhaps similar, uses.*

Response: Please see responses to verbal comments by Mr. Sarvey (comment #2) and Mr. Strauss (comment #5). To clarify, DOE has not turned over ownership of any part of Site 300 to the U.S. Fish and Wildlife Service. It has only provided additional authority for the U.S. Fish and Wildlife Service to protect the *Amsinckia grandiflora* within its potential range at Site 300. No new types of activities will be conducted on the site as a result of the additional authority provided.

#10. ***We recommended in our earlier comments on the Draft Proposed Plan that DOE change its assumption regarding indefinite control to 20-30 years.*** *We have been told in response that there is a procedure for revisiting land transfers or changes in use in the Federal Facilities Agreement (FFA). Tri-Valley CAREs recommends that this be made explicit in the ROD. Furthermore, addressing the change of future use of the facility is not difficult. However, we note that addressing this contingency (i.e., future transfer of property from the US Government to a private or state entity) has been incorporated by the Navy in two recent RODs at Moffett Field. We recommend that DOE look at recent RODs in this EPA Region.*

Response: We have added in Section 2.6.2 a more complete description of the constraints and safeguards involved in the transfer of federal lands on the NPL.

Also please see responses to Tri-Valley CAREs' Community Acceptance Criteria #2 (as numbered in Mr. Steinhauer's verbal comment #4). The situation for military facilities is considerably different, in that Congress has mandated the Department of Defense (DoD) to prepare and submit land-use transfer plans for base closures which include returning lands back to other uses. Congress has not requested DOE to prepare similar plans for its sites undergoing remediation.

*#11. **Industrial standards are used for Site 300 to set interim risk levels.** While we recognize that residential standards may not be feasible in a few small places, on the whole, residential standards should be used. In the future, this would allow DOE to more easily dispose of the property and limit its liability. Also, because the Bay Area is growing so rapidly, and, as mentioned, residential growth is beginning to occur in Tracy and near Site 300, it would be unfortunate if the cleanup levels decided in 2000 dictate how this 11 square mile site will be used in the future.*

Response: Please see response to Tri-Valley CAREs' Community Acceptance Criteria #2 (as numbered in Mr. Streinhauer's verbal comment #4) and the responses to Mr. Sarvey's comment #2 and Mr. Strauss' comment #5.

*#12. **A Contingency Plan that addresses how cleanup will be modified in "the event of future changes in land use at Site 300, or if a transfer of site ownership is anticipated" should be done in conjunction with this document, not in 2002.***

Response: The date for submittal of the CM/CP is set by the Site 300 Federal Facility Agreement Schedule of Deliverables. This schedule was prepared by mutual agreement with the regulatory agencies. The current schedule will allow DOE/LLNL to better understand the potential situations that may warrant contingency plans. There is a public workshop scheduled for April 16, 2002, at which the Draft CM/CP will be presented for review and comment.

*#13. **For at least two years in conversation at various forums with DOE, LLNL staff and regulators, Tri-Valley CAREs has recommended that something be done to prevent the continued release of tritium from Pits 3 and 5 to the groundwater.** With the rainy season just ending, no action was taken to mitigate this problem. While these Pits have been separated from the Proposed Plan to conduct further study, we request that an interim action be done to protect the groundwater and soil near these pits.*

Response: Please see response to Mr. Strauss' verbal comment # 6.

*#14. **Tri-Valley CAREs recognizes that often in Superfund cleanup projects, commitments and milestones concerning the cleanup performance (e.g. timing of cleanup, how much contaminant will be removed) are disregarded in Records of Decision.** We regard this lack as a fundamental problem with the government's approach to CERCLA enforcement.*

Thus, we view this as a weakness, not as a guideline for how things should be done. In this regard, we note a significant deficiency in that the Proposed Plan does not have a measurable schedule or performance standards by which the community can measure progress. The Proposed Plan does not even specify when the Lab will contain certain plumes. We are very concerned that broad commitments as to the timing of cleanup activities are not spelled out: e.g., *the timing of plume capture and the timing of percentages of contaminant mass reduction are examples of commitments that the plan should contain. We suggest that for each OU the Lab spell out the mass in the soil and groundwater and lay out a conservative timetable of performance milestones. These milestones should include the amount of contaminant mass that is removed from the soil and groundwater within an expected time period, regulatory milestones such as achieving cleanup standards, performance trends and achievement of plume control and plume capture. This timetable would then be used to monitor the performance of cleanup, and provide interested parties with an idea how cleanup will progress. Furthermore, in the Lab' s first Five-Year Review for the Site 300, there should be a comparison between expected results and observed performance.*

We also think that long-term funding for clean up should be a major commitment. Cutbacks in funds only delay inevitable expenditures, and may make cleanup more costly. Therefore, DOE and LLNL should make all attempts to ensure stable, future funding. If funds are cut, however, the public should be involved in helping to establish priorities for areas of cleanup.

Response: Please see response to Mr. Strauss' verbal comment #7 (regarding performance measures), response to Mr. Sarvey's verbal comment #6 (regarding budgetary commitments), and response to Tri-Valley CAREs' Community Acceptance Criteria #11 (as numbered in Mr. Steinhauer's comment #4; regarding citizen participation).

*#15. **The geology of Site 300 is extremely complex.** There are "synclines" and "anticlines", a number of faults, and many strata of different formations. This makes characterization of the contamination difficult, and modeling the movement of contaminants through these formations even more difficult.*

While DOE may feel that the baseline risk assessment for Site 300 uses conservative assumptions, we point out that it does not account for synergistic relationships among contaminants, nor does it account for hormone disruption caused by exposure to many of the chlorinated compounds. We are reminded that the risk assessment is an imperfect science, and decisions, while taking risk assessment into consideration, should not rely on it. Instead, we advocate using the Precautionary Principle. In part, this principle states:

"We believe existing environmental regulations and other decisions, particularly those based on risk assessment, have failed to protect adequately human health and the environment…. We believe there is compelling evidence that damage to humans and the worldwide environment is of such magnitude and seriousness that new principles for conducting human activities are necessary.

While we realize that human activities may involve hazards, people must proceed more carefully than has been the case in recent history. Corporations, government entities, organizations, communities, scientists and other individuals must adopt a precautionary approach to all human endeavors.

When an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically. In this context the proponent of an activity, rather than the public, should bear the burden of proof."

Response: Please see response to Mr. Strauss' verbal comment #9.

*#16. **Referring to Section 5.10 "Future Work", this appears to be a good list.** Please indicate if there is there a budget for it, and if any of the additional work is scheduled. Additionally, provide details on how the public will be involved after the Site-Wide ROD.*

Response: Activities identified as "Future Work" will be incorporated in the appropriate fiscal year work plan to define the technical work scope, schedule, and cost. DOE has developed a life-cycle baseline that allocates budgets for the entire cleanup operation at Site 300. This assures funding needs for Site 300 cleanup are defined from the present through the future achievement of all cleanup goals. Please see the responses to Mr. Sarvey's verbal comments #6 and #8, regarding budgets. Please see the response to Mr. Sarvey's verbal comment #5 regarding public involvement after the Site-Wide ROD.

*#17. **Characterization should not be included as a cost component of remedy selection.** Characterization should take place in the remedial investigation phase, and amended as new information becomes available. It is important that LLNL specifies a budget for further characterization, and that this is brought up in the context of developing short and long-term budget priorities.*

Response: The only 'characterization' costs included in the interim remedy selection analysis for the areas addressed in the Proposed Plan and Interim ROD were those associated with detailed characterization of landfill contents. Such characterization would not be necessary if the pit contents are not being considered for removal. Removal and disposal of the contents require a level of waste characterization beyond that necessary to characterize a site and determine if a landfill poses a threat if <u>not</u> disturbed.

*#18. **Tri-Valley CAREs believes that one object of the Site Wide OU is to consolidate information that has been collected over the life of the cleanup project into the SWROD and other Site-Wide Documents.** By not updating the health-related information, or relying on a re-calculation of risks in the Five-Year Review (which may not happen in five years if a final ROD is scheduled at the same year), this objective is not met.*

Response: During a qualitative review of the human health risks presented in earlier documents, DOE/LLNL did not find any area where a new risk assessment is expected to show higher risks. In addition, as part of the Site-Wide Feasibility Study, DOE/LLNL conducted a re-evaluation of the baseline risk assessment to evaluate risk associated with any contaminants identified subsequent to the baseline evaluation. Therefore, remediation based on those data already available is conservative and protects the public. DOE/LLNL agrees that many of the numbers could be revised, and is confident that most of the resulting risks would be much less than previously calculated. DOE/LLNL expects the updated risk assessment will be conducted before the Final ROD is issued.

*#19. **Referring to DOE response to Tri-Valley CAREs' comment 24 on the DFSWFS, we do not agree with DOE that newer samples are not called for (i.e., referring to Table 1-27, spring samples are from 1994. Please indicate more recent data, especially the last two El Nino rain seasons).** There have been significant changes in the hydrological regime since 1994. Furthermore, in your response you state that bioassays will be conducted every five years. Since the last bioassay was taken during the summer of 1994, new data should be available.*

Response: The following reviews the 'springs' shown on Draft SWFS Table 1-27 (which became Table 1-22 in the Final SWFS):

GEOCRK – This spring is located offsite and has relevance only to the GSA Operable Unit, which was addressed separately in the GSA ROD.

Spring 5 – This spring currently has no surface flow. Bioassay tests results will only be reported if surface flow can be sampled.

Spring 6 – This spring has no contaminants of concern and is not believed to have been affected by any of the releases addressed in the Proposed Plan or Interim ROD.

NC2-23 – These are not surface waters and their only relevance is as a water source zone for Spring 6, discussed above.

The original response was intended to explain why additional bioassays are not warranted for NC2-23 and Spring 5. That reasoning is still valid, as they are not surface waters and those locations continue to be monitored like all other ground water samples. The re-sampling of GEOCRK and Spring 6 was not conducted in 1999. Those samples have now been taken but bioassay test results are not yet available.

*#20. **In all areas where there is a suspected contamination by DNAPL, LLNL should continue efforts to remove contaminant mass from the groundwater and soil and locate the source of DNAPL.** Tri-Valley CAREs encourages innovative technologies where appropriate.*

Response: The only area at Site 300 included in this Interim ROD where DNAPLs were identified is the Building 834 area. Ground water and soil vapor extraction and treatment are continuing in this area. The remediation process itself also provides the best evidence for the presence or absence of DNAPLs. Based on the concentrations now being found in the area, DOE/LLNL may have already removed the last of the DNAPL. Should DNAPLs reappear, the remedial design addresses them as a major target of the remediation.

Specific Comments

B-834

*#1. **It is not clear why the enhanced bioremediation is not used.** Rejection in the Proposed Plan is based on the premise that the contaminated water table is perched and time is not an important element. However, this has not been demonstrated with any degree of certainty, considering that for years there have been unknown sources of contamination in the B-832 Canyon area. Years back, this led Lab personnel to speculate that contamination from this area had migrated to B-832. We also don't think that DOE has made a convincing argument regarding time. In our opinion, additional remediation coming from enhanced bioremediation only helps clean up this area in a timely manner. Since this area has one of the greater risks at Site 300, cleanup time should be accelerated.*

Response: Please see the response to Mr. Sarvey's verbal comment #4, which explains why enhanced bioremediation was not selected at this time. DOE/LLNL continues to evaluate ways to effectively use enhanced bioremediation at Building 834.

Considerable characterization in the Building 834 area shows that the contamination is primarily found within the shallow Tps formation, and that it is perched above an unsaturated zone. There is no continuous saturated pathway from the perched water-bearing zone or underlying perching horizon at Building 834 to the Building 832 Canyon.

Soil vapor data collected from GoreSorbers in 1999 from locations between Building 834 and Building 832 Canyon were below the detection limit for TCE, further establishing the separation of these areas. Data from numerous boreholes drilled and sampled in the vicinity of Buildings 830 and 832, where TCE was also used as a heat exchange fluid in experiments similar to those conducted at Building 834, indicate that these buildings are the source of ground water contamination in the Building 832 Canyon.

Pit 6

#2. ***Referring to Sections 6.2.2 and 6.2.7, it is important that wherever MNA is a chosen remedy, that the proposed plan identifies the lines of evidence that are used to prove the occurrence.*** *Tri-Valley CAREs does not accept natural attenuation unless it can be shown that there is a documented loss of contaminant mass through biological or chemical decay, or laboratory data indicating degradation. Dispersion and dilution are not acceptable. This holds true for all applications of MNA at Site 300.*

Response: Please see the responses to verbal comments by Ms. Light (#8) and Mr. Strauss (#2).

#3. ***Referring to Section 6.2.2, is there any indication of eco-receptors using contaminated surface water from Spring 7?***

Response: No. Spring 7 has no surface flow and does not seem to be a suitable water source for any of the sensitive species at Site 300.

#4. ***Referring to Section 6.2.4, please indicate the distance from the landfill that one would have to be to have the risk reduced to one in one million.***

Response: DOE/LLNL believe that the capping of the Landfill in 1998 reduced all risks from subsurface soil inhalation below one in one million.

HE Process Area

#5. ***Referring to Section 6.3.7, please provide a better description of the stepped approach that is taken concerning controlling and treating the groundwater plumes at Building 815.*** *Also, is the cost for the previous removal action (both capital and operating) included in the cost for Alternative 2? There is also a need to discuss contingencies, and cleanup levels of all HE compounds found, including those that do not yet have an MCL (e.g., perchlorate), but do have a PRG.*

Response: The first step of installing a ground water extraction and treatment system at the leading edge of the plume began in 1999, when treatment facility B815-DSB was installed and extraction began from well W-35C-04. (See Appendix A for a description of the new convention for naming treatment facilities and correlations between old and new designations.) A second well, W-6ER, is being connected in 2000. Extraction at these wells should prevent any of the plume from migrating offsite. No HE compounds or perchlorate have been found in this portion of the plume.

The next step is to begin extracting and treating ground water from the source area. Treatment facility B815-SRC is currently being tested, with particular emphasis on ensuring that all contaminants of concern in the area are adequately treated. A full-scale treatability study is expected to begin later in 2000.

The costs of removal actions at Building 815 completed before the SWFS are not included in the costs presented in the SWFS and Proposed Plan. Costs of the treatment systems described above, which were not built at the time of the SWFS preparation, were included; whether considered removal actions, treatability studies, or part of the interim remedy.

Cleanup standards are not being set for ground water or VOC-contaminated subsurface soil in the Interim ROD.

OU 5

*#6. **It is important to designate where excavated material from the Building 850 sand pile be deposited.** This pile contains tritium, explosives, depleted uranium, PCBs and dioxins.*

Response: Materials excavated from the Building 850 area will be disposed of at an offsite facility licensed to receive all contaminants in the materials. Testing at the time of excavation will determine the category(ies) of waste involved. The Nevada Test Site is a likely location for disposal of low-level waste.

*#7. **Referring to Section 6.5.7, Tri-Valley CAREs strongly believes that hydraulic control must be part of the remedy.** Leaving large amounts of tritium and other contaminants to migrate in the groundwater is unacceptable. We do not believe that the remedy is adequate unless the tritium plume is contained and brought under hydraulic control.*

Response: There is no Section 6.5.7 in the Final Proposed Plan, and it is assumed this comment applies to the Building 850 area. Please see response to Mr. Strauss' verbal comment #11.

*#8. **All U-238 contamination should be addressed in the contingency plan concerning changes in land use.** There should be no action taken that would be irreversible, if the uranium needs to be removed at a later time.*

Response: Natural uranium is found throughout Site 300 in soil and rock. Natural uranium also contains 99.3% uranium-238. Please see the portions of the response to Mr. Sarvey's verbal comment #4 regarding the Building 850 and 851 areas. The low uranium activities in ground water at both areas are already within the general range of background activities in California. It is only because precision isotopic analysis can determine that some portion of the uranium in those areas is slightly enriched in depleted uranium that DOE/LLNL has noted their presence. There are no identified risks associated with uranium in these areas. The area of uranium surface soil contamination near the Building 850 Firing Table is planned for removal.

*#9. **For many years in conversation at various fora with DOE, LLNL staff and regulators, Tri-Valley CAREs has recommended that something be done to prevent the continued release of tritium from Pits 3 and 5 to the groundwater.** With the impending rainy season upon us, this has not been done. Instead, you are proposing another study to determine whether or not to remove material from the pits. We request that an interim action be done to protect the groundwater and soil near these pits.*

Response: Please see response to Mr. Strauss' verbal comment #6.

*#10. **The remedial alternative selection for Pit 2 is not logical.** Here, under Alternative 2, DOE would monitor for continued compliance. Alternative 3 is a contingency measure in case the pit was found to contain contaminants that would impact human health. Why not combine*

Alternatives 2 and 3 as the preferred measure, rather than excluding Alternative 3? This remedy also raises questions in our minds about how much additional characterization is necessary for Pit 2. It is Tri-Valley CAREs' position that more than monitoring is needed for Pit 2. Further, a modified cap that prevents surface exposure and retards infiltration would be appropriate.

Response: Please refer to the response to your General Comment #17, above, for discussion of the different types of characterization required for different purposes. DOE believes that characterization of the Pit 2 Landfill area is sufficient to establish that there are no releases from the landfill that could cause harm to human health or the environment. Although DOE does not expect this condition to change, monitoring will continue. The landfill has an earthen cover.

OU 8 (Other Sites)

#11. ***The Alternative selected for B-851 contains monitoring to "determine if the uranium plume is migrating or expanding.*** *While this is necessary, isn't it also necessary to scope out the actions (e.g., hydraulic control) that would be needed if the plume was in fact expanding?*

Response: The ground water uranium activities in the Building 851 area are in the low range of background activities. Although DOE does not expect this condition to change, it has agreed to continue to monitor for uranium. Migration of uranium is extremely slow in ground water due to low solubility and propensity to sorb onto soil and rock particles, and there would be considerable time to evaluate and effect a remedy if activities were to rise to levels warranting action. The evaluation of potential actions to respond to future contingencies will be done in the CM/CP, scheduled for 2002.

#12. ***Referring to DOE's response to Tri-Valley CAREs' comment on the Draft-final SWFS (#4), we continue to believe that it is necessary for describing in the SWFS why the four additional sites (i.e., B-812 Dry Well, B-812 Firing Table, B-865, and Sandia Test Site) are potential release sites.*** *This is to make the document as a comprehensive stand-alone compendium. We do not expect that you go into the amount of detail as the SWRI, but the reasons for the additional sites should be summarized. In this same comment, we noted that adjacent landowners had expressed concern about continued releases from operations, and asked that DOE provide the practices and controls in place to prevent further releases to the environment. DOE's response only addressed the four areas cited above: the comment was intended to cover all operations at the site.*

Response: The SWFS is Final and will not be revised further. There will be separate documents to report information about those areas not covered in this Proposed Plan and Interim ROD.

Operational practices that led to contamination have ceased or have been modified to prevent future releases that may contaminate the environment. Operations are not part of the CERCLA process and can be addressed by other persons at DOE and LLNL. In general, there are thousands of operational procedures, all of which comply with laws and regulations regarding environmental releases. The Operations and Regulatory Affairs Division of LLNL's Environmental Protection Department provides expertise in accomplishing that goal and monitors for actual releases. The Site Annual Environmental Report documents their findings each year. If you wish further information, please contact Bert Heffner, Environmental Community Relations Manager, (925) 424-4026, heffner1@llnl.gov.

Community Acceptance Criteria (these are slightly expanded (and renumbered) from the original draft due to additional public comments received by Tri-Valley CAREs)

#1. Complete the cleanup project in a timely manner. *Set a schedule for cleanup activities and adhere to it. The goal should be to complete cleanup ten years after the DOE's last scheduled ROD, with up to 30 years after that point for monitoring of residual contamination. As part of the plan, schedule milestones addressing total mass removal and trends toward achievement of clean-up goals should be established and committed to by the DOE. Areas that will still be contaminated should be identified. It is important for the community that the Final SWFS and the Proposed Remedial Action Plan contain a measurable schedule and performance standard that can be verified. Broad commitments as to the timing of cleanup activities can and should be spelled out. We recognize that cleanup in 10 years after the last ROD will be difficult to achieve in some small areas. Also, because of the nature of tritium, California drinking water standards will not be attained for that contaminant in the near future, though source control and containment can be achieved for the tritium plume(s).*

Response: Please see response to Tri-Valley CAREs' Community Acceptance Criteria in Section 3.3.

#2. DOE must be held accountable for contamination of LLNL Site 300, and cleanup agreements that it has entered into with the State of California and EPA should not be altered. *Federal Facility Agreements (FFA) that DOE has signed are binding documents. They are the only mechanisms by which surrounding communities, local governments, and the states can hold DOE accountable for cleanup. If alterations are made in the FFA schedule, the committed levels of cleanup must remain the same, and the community should be informed and should have the opportunity to participate in the discussion. (In the case of the schedule for completing a final feasibility study, as mentioned in Comment 1 above, Tri-Valley CAREs thinks that the regulators and the Lab should revise the FFA schedule slightly to include additional commitments).*

Response: DOE and LLNL are working in good faith to meet all agreements and milestones established with the regulators in the FFA. Minor changes to the FFA schedule have been made over its history for a variety of reasons, such as changing priorities and unforeseen technical difficulties. These modifications have not changed the resolve to clean up the site as safely and rapidly as possible with the resources available.

#3. Cleanup levels should support multiple use of the property that is unrestricted by environmental contamination. *Assumptions about land-use need to be altered. As we can see, residential development is beginning to take place adjacent to the site boundary. Any modeling assumptions should assume large residential communities relying on the regional aquifer for drinking water, thus speeding up groundwater movement. Second, we do not believe that Site 300 will necessarily always remain in DOE's stewardship. The "need" for testing nuclear weapons and components (particularly of new and modified designs) is a political decision, not a technically necessary mandate, and, in our opinion this testing should cease. We recommend that Site 300 future land use assumptions include mixed residential, recreational, ecological preserve and industrial land uses. Yet as it now stands, DOE assumes that Site 300 will remain under its stewardship in perpetuity. As such, risks are calculated for adult onsite workers and people living nearby who consume drinking water from a well located at the site boundary. We recommend that Site 300 be assumed to include mixed residential, recreational, ecological* *preserve and industrial land uses. Without full cleanup to standards appropriate for residential use, the residual contamination will restrict the future use of the property. In addition, where cleanup is not expected to occur in a timely manner, or where there are contaminants present that prohibit multiple use, these areas should be designated in the SWFS.*

Response: Please see response to Tri-Valley CAREs' Community Acceptance Criteria in Section 3.3.

#4. Cleanup levels should be set to the strictest state and federal government levels. *We believe that the strictest cleanup levels should be met in cleaning up the site. Federal and state Maximum Contaminant Levels (MCLs) for all groundwater (on-site and off-site) should be the "bottom line below which the cleanup will not fall." In many cases the technology exists (and/or can be developed) that will clean up contamination to "background" levels -- that is to the level that existed at the site before Livermore Lab took over in 1955 and began polluting it. In such cases where "background" cleanup levels that are more protective of human health and the environment can be achieved, they should be achieved. In this regard, Tri-Valley CAREs concurs with a strict interpretation of the California Regional Water Quality Control Board's non-degradation policy for groundwater. It believes that the strictest cleanup levels should be met. MCLs for all groundwater should be the objective, and as soon as possible, migration of contaminants into pristine waters should be halted. At a minimum, the standard of 1 in 1 million excess cancer deaths should be adhered to, as well as meeting a hazard index of less than 1 (non-cancer health effects).*

Response: Please see response to Tri-Valley CAREs' Community Acceptance Criteria in Section 3.3.

#5. Remedies that actively destroy contaminants are preferable. *In order of preference, Tri-Valley CAREs recommends the following types of cleanup measures: a) remedies that destroy contaminants (i.e. by breaking them down into non hazardous constituents), such as by ultra-violet light/hydrogen peroxide, permeable barriers, or biodegradation; b) active remedies that safely treat or remove contaminants from the contaminated media; c) monitored natural attenuation in so far as it relies on natural degradation (and not further dispersion of the pollution) within a reasonable time frame. What is called "risk and hazard management" (i.e., restrictions on land use, fencing, signs and institutional controls), while potentially useful for reducing short-term risks, is not a valid cleanup in our eyes and should only be used as an interim measure. In no case do we think that "point of use cleanup" (e.g., placing filters on off-site drinking water wells) is appropriate. In all cases, hydraulic control should be established to halt migration of contaminant plumes to pristine waters. When soil excavation takes place, it should be properly controlled to minimize releases of contaminated soil into the air, and onto adjacent properties.*

Response: Please see response to Tri-Valley CAREs' Community Acceptance Criteria in Section 3.3.

#6. The tritium source and plume(s) should be controlled at the earliest possible time in order to prevent further releases to the environment. *The main tritium plume, nearly two miles long and growing, cannot be cleaned up in the traditional sense of the word, since it is not feasible to separate the radioactive hydrogen (tritium) component from the water. Therefore, Tri-Valley CAREs recommends the following: a) isolation of the tritium contaminated wastes in* *the unlined dumps to prevent further and continuing contamination of the groundwater; b) hydraulic control of the plume to prevent further migration; c) aggressive monitoring to ensure no migration while the tritium decays (at a rate of 5.5% per year); and, d) a stringent contingency plan in case these methods fail. As it currently stands, groundwater rises into the waste dumps during heavy rainfall and picks up additional tritium contamination. Isolation of the wastes may be accomplished by means of drains, capturing groundwater upstream from the pits before it is inundated, or removing the tritium-contaminated debris from the pits and store it above ground in an above-ground monitored* storage facility.

Response: Please see response to Tri-Valley CAREs' Community Acceptance Criteria in Section 3.3.

#7. Radioactive substances should be isolated from the environment. *As is the case with tritium, there are several plumes containing uranium 238 (U238). Technology exists to separate this contaminant from the groundwater. Tri-Valley CAREs recommends that this contaminant be stored in above ground monitored facilities after separation from groundwater.*

Response: Please see response to Tri-Valley CAREs' Community Acceptance Criteria in Section 3.3.

#8. The ecosystem should be protected and balanced against the cleanup remedies. *Site 300 sits on 11 square miles of land about 30 miles east of San Francisco. It sits on a series of steep hills and canyons, covered by grasslands. Seven major plant communities occur at Site 300, including: coastal sage scrub, native grassland, introduced grassland, oak woodland and three types of wetland. 20 species of reptiles and amphibians, 70 species of bird, and 25 species of mammals also occur. Included may be special and rare and endangered species including the burrowing owl and the San Joaquin Kit Fix and the Large-Flowered Fiddleneck (recently protected in one 160 acre area of Site 300). In order to protect the ecosystem, ecological risks should be no greater than those for humans (i.e., a Hazard Index of less than one for selected species, based on recent data). This involves updating the ecological assessment that was completed in 1994, as there are more complete data developed recently. It also involves making sure that clean-up activities do no inadvertently destroy unique habitat. This could occur from too quickly pumping groundwater, with the effect of destroying natural springs, or by capping large areas and replacing the vegetation with non-native species.*

Response: Please see response to Tri-Valley CAREs' Community Acceptance Criteria in Section 3.3.

#9. Decisions should not rely on modeling alone. *The SWFS points out just how complex the hydrogeology of the site is, and how little is known about it. Given this, Tri-Valley CAREs believes that over reliance on modeling to predict the fate and transport of contaminants is not a good idea. Computer modeling should be used as a tool only, and continually updated by field testing as that information becomes available. We believe that if it should, for some reason we can't now fathom, become necessary to base decisions primarily on modeling, the most conservative assumptions should be used.*

Response: Please see response to Tri-Valley CAREs' Community Acceptance Criteria in Section 3.3.

#10. Use the Precautionary Principle. *The geology of Site 300 is extremely complex. There are "synclines" and "anticlines", a number of faults, and many strata of different formations. This makes characterization of the contamination difficult, and modeling the movement of contaminants through these formations even more difficult.*

While DOE may feel that the baseline risk assessment for Site 300 uses conservative assumptions, we point out that it does not account for synergistic relationships among contaminants, nor does it account for hormone disruption caused by exposure to many of the chlorinated compounds. We are reminded that the risk assessment is an imperfect science, and decisions, while taking risk assessment into consideration, should not rely on it. Instead, we advocate using the Precautionary Principle. In part, this principle states:

"We believe existing environmental regulations and other decisions, particularly those based on risk assessment, have failed to protect adequately human health and the environment…. We believe there is compelling evidence that damage to humans and the worldwide environment is of such magnitude and seriousness that new principles for conducting human activities are necessary.

While we realize that human activities may involve hazards, people must proceed more carefully than has been the case in recent history. Corporations, government entities, organizations, communities, scientists and other individuals must adopt a precautionary approach to all human endeavors.

When an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically. In this context the proponent of an activity, rather than the public, should bear the burden of proof."

Response: Please see responses to verbal comments #8 and #9 by Mr. Strauss.

#11. Additional site characterization is needed and must be budgeted for over many years. *It is also apparent from the SWFS that additional characterization (e.g. of soil, groundwater, waste dumps etc.) is necessary, and will have to be budgeted for many years to come. In this regard, we note that some recent additional characterization efforts at Site 300 yielded the discovery of a new groundwater lens, contaminated with high concentrations of tritium, near the pits 3 and 5 area. Further characterization of this and many other areas at Site 300 is necessary for cleanup to succeed at this site.*

Response: Please see response to Tri-Valley CAREs' Community Acceptance Criteria in Section 3.3.

#12. A contingency plan should be completed and subject to public review prior to the signing of a ROD. *Tri-Valley CAREs recommends that a site-wide contingency plan be part of this document, or part of the draft Remedial Action Plan. This is needed because (a) the cleanup of a few sites is put off until the future, (b) there are many uncertainties, (c) innovative technologies will be used, and (d) contingent actions should be part of the cleanup plan and thus incorporated into the site wide Record of Decision (ROD).*

Response: Please see response to Tri-Valley CAREs' Community Acceptance Criteria in Section 3.3.

#13. The public should be involved in cleanup decisions. *As it now stands, public involvement takes place through the Technical Assistance Grant (TAG) with Tri-Valley CAREs and at public meetings and hearings. After the ROD is signed, there are no mandatory public hearings or workshops. We recommend that a written commitment from the Lab be incorporated. In consultation with the regulators and the public, DOE and LLNL would commit to developing a mechanism for regularly involving the community in decision-making. As a start, we suggest: A public record of cleanup activities should be updated regularly, maintained and made accessible at a local public library. Summaries, at least, should be available in Spanish as well as in English. Public workshops should be held periodically after the last ROD to discuss problems and progress. The Community Work Group at the LLNL Main Site may be a model for establishing a mechanism for public input at Site 300.*

Response: Please see response to Tri-Valley CAREs' Community Acceptance Criteria in Section 3.3.

#14. Cleanup should be given priority over further weapons development. *Perhaps most important of all, Tri-Valley CAREs insists that cleanup of Site 300 be given a priority over further bomb-creating enterprises, and that adequate, stable, long-term funding be assured in order that the job may be done right. The current allocation of approximately one percent of Livermore Lab's annual budget to cleanup at Site 300 (and only another 1 percent to cleanup at the Lab's main site) is insufficient. All attempts should be made by DOE and LLNL to ensure long-term, stable funding. A cut back in funds only delays inevitable expenditures in the future, and may make the cleanup more expensive. If funds are cut, however, the public should be involved in helping to establish priorities for areas of cleanup.*

Response: Please see response to Tri-Valley CAREs' Community Acceptance Criteria in Section 3.3.

#15. Any ongoing activities at Site 300 should be designed to prevent releases to the environment. *Releases to soil, air, groundwater and surface water from weapons testing, high-explosives manufacture and other activities at Site 300 are no longer acceptable. Any activities, if they must occur, should take all necessary precautions to avoid any releases to the environment of chemicals of concern.*

Response: Ongoing activities at all LLNL sites are designed to minimize hazardous releases to the environment. Activities have changed significantly since LLNL began operation 40 years ago, with experiments now designed with a much better understanding of environmental protection and safety. Compliance with the Resource Conservation and Recovery Act (RCRA) and several other regulations (such as the Clean Air and Clean Water Acts) helps ensure that future harmful releases do not occur. LLNL has extensive environmental protection procedures in place which are designed to prevent any additional contamination. Those preventive and mitigating activities and monitoring for any releases are reported in the Site Annual Environmental Report. Current operations at Site 300 are overseen by several environmental regulatory agencies and are conducted in compliance with their regulations to prevent future releases that could be detrimental to human health and the environment.

The Site Annual Environmental Report provides information on releases and background environmental conditions around LLNL's sites; it can be found at www-envirinfo.llnl.gov/ or obtained through Bert Heffner, Manager, Environmental Community Relations, (925) 424-4026.

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5. Glossary

Aquifer: Underground rock or sediment that can store and supply usable quantities of water to wells or springs for agricultural, industrial, and domestic use.

Applicable or Relevant and Appropriate Requirements (ARARs): Federal or state standards, criteria or limitations that are relevant to the proposed cleanup.

Baseline Risk Assessment: An assessment of the potential for adverse health effects of human and non-human species to environmental hazards.

Carcinogen: A cancer-causing substance or agent.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund): A law passed in 1980 that authorized the federal government to respond directly to releases of hazardous substances that may endanger human health or the environment.

Contaminant: A chemical that degrades the natural quality of a substance or environmental media such as ground water, surface water, soil or air.

Cumulative Risk: A total cancer risk that is calculated by adding all of the individual risks for each chemical of concern through all realistic exposure pathways.

Depleted Uranium: Uranium that has had the fissile isotope, U-235, removed. See definition of Uranium-238.

Downgradient direction: The direction of ground water flow.

Dry well: A shallow dry borehole, usually filled with gravel, used to dispose process fluids.

Exposure route: The means by which a chemical may enter the body. The three main exposure routes generally evaluated are ingestion (eating or drinking), inhalation (breathing), and dermal contact (absorbed through the skin).

Federal Facility Agreement: A document that specifies the required actions at a federal facility like LLNL Site 300 as agreed upon by various federal and state agencies.

Firing table: An area next to building or bunker where high explosives are detonated for experimental purposes.

Fissile: Refers to an elemental isotope (form) whose nucleus can split into two new elements of lesser mass by a low-energy neutron (an uncharged particle of the nucleus). Fissile material can sustain a chain reaction and is used in reactor fuel or weapons. The isotope U-235 is the only naturally occurring fissile material.

Granular activated carbon: A well-established technology that is generally effective for removing volatile organic compounds and some inorganic compounds from fluids such as water or air.

Ground water extraction: The process of removing ground water from the ground, usually accomplished by pumping from wells. It can be used to remove dissolved contaminants, lower the water table and/or control ground water movement.

Half-life: The time necessary for a substance to lose half of its radioactivity by the process of radioactive decay.

Hazard Index (HI): The sum of Hazard Quotients for a given exposure pathway or group of pathways. A Hazard Index above 1 indicates the potential for adverse health effects.

Hazard Quotient (HQ): The HQ is the ratio of calculated exposure to accaptable exposure values, as determined by the U.S. EPA and State Agencies. It is a measure of the estimated maximum chronic daily intake of a chemical that is used to determine whether adverse health effects other than cancer may result.

HMX: A high explosive compound called High Melting Explosive, also known as octogen or homocyclonate.

Ion Exchange: A proven technology for removing certain charged substances, such as metals, from water.

Maximum additional cancer risk: The maximum risk of developing cancer in addition to the one in three risk for Californians from other causes.

Maximum Contaminant Level (MCL): The maximum allowable concentration of a contaminant in drinking water. MCLs are set by the Federal and State governments.

Parts per billion (ppb): A way to report the concentration of a substance in the surrounding material. For example, one billion liters (946,400,000 gallons) of water containing one gram of TCE has a concentration of one part per billion. This may be compared to one penny in ten million dollars or one inch in 16,000 miles.

Parts per million (ppm): A way to report the concentration of a substance in the surrounding material. For example, one thousand liters (946,400 gallons) of water containing one gram of TCE has a concentration of one part per million. This may be compared to one penny in ten thousand dollars or one inch in 16 miles.

Perched water-bearing zone: Soil or rock containing ground water that is above the regional water table. Water moving downward through the ground collects (is "perched") above a layer (such as clay) that does not allow water to pass through, creating the perched zone.

PicoCurie (pCi): A unit of measure of radioactivity. A Curie is the amount of a radionuclide which has a decay rate of 2.22×10^{12} disintegrations per minute (3.7×10^{10} disintegrations per second), which is the decay rate of about 1 gram of pure radium. One picoCurie is one trillionth (1×10^{-12}) of a Curie.

PicoCuries per liter (pCi/L): The number of picoCuries in one liter (1.06 quarts) of water.

PicoCuries per liter of soil moisture (pCi/L_{sm}): The number of picoCuries in one liter (1.06 quarts) of water from the pore spaces of unsaturated soil or rock.

Plume: A well defined area of contamination in ground water.

Present-worth cost: A method to evaluate the total costs for projects that vary in duration by discounting all costs to a common base year (1999) to adjust for the time value of money (interest and inflation). The present-worth cost is the amount of money, if invested in the initial year (1999) of the Site 300 remedial action and dispersed over the life of the project (30 years), that would be sufficient to cover all associated costs. The discount rate is based on the anticipated difference between income return and inflation. A discount rate of 5% was used calculate the present-worth costs of the Site 300 remedial alternatives.

Presumptive Remedy: Cleanup technologies, such as dual-phase extraction, that are preferred by the U.S. EPA because they have been repeatedly selected and have proven effective at cleanup sites with similar contaminants and conditions. Use of presumptive remedies accelerates the remedy selection process.

Presumptive Technology: Technologies, such as granular activated carbon for treatment of contaminants dissolved in ground water, that are preferred by U.S. EPA because they have proven effective for certain contaminants. Use of presumptive technologies simplifies the remedy selection process.

Record of Decision (ROD): A document prepared under CERCLA (Superfund) that documents the selection of a remedial alternative and the strategy for its implementation. Responses to all comments received on the Proposed Plan are included in the Responsiveness Summary of the ROD.

Regional aquifer: The primary aquifer that supplies water to a particular region.

RDX: A high explosive compound called Research Department Explosive, also known as cyclonite or hexogen.

Siphon: Removing ground water from the subsurface using its natural pressure or elevation difference without using a pump.

Soil vapor: Air (or other vapor) in the pore spaces of soil or rock in the unsaturated zone.

Soil vapor extraction: Removing soil vapor from the ground, usually by applying a vacuum to one or more wells. Typically used to cleanup chemicals that readily evaporate that are present in soil or rock above the water table.

Superfund: The common name used for the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980.

Toxicity Quotient: The ratio between a measured concentration of an ecological contaminant in environmental media, such as surface water, to a standard, such as ambient water quality criteria. A ratio above 1 indicates potential for an adverse ecological effect.

Unsaturated zone: The region in the ground above the water table where the pore spaces in soil and rock are only partially filled with water. Also called the vadose zone.

Uranium-238 (U-238): The most abundant natural isotope (form) of uranium. Natural uranium is composed of approximately 99.3% uranium-238, 0.7% uranium-235, and 0.006% uranium-234. Uranium-235 is the fissile component (that which can sustain a chain reaction) and is removed during processing for use in either reactor fuel or weapons. The residue after separation is known as depleted uranium. The uranium used at Site 300 contains less than 0.2% uranium-235 and over 99.8% uranium-238. Uranium is usually measured by isotope, so it is possible to estimate the percentage of uranium that is natural and that portion that has been added from the use of depleted uranium. Because over 99% of all uranium is U-238, the text of this Proposed Plan uses U-238 to represent uranium activities.

Vadose zone: See unsaturated zone.

Volatile organic compounds (VOCs): Organic compounds that evaporate easily at room temperature. Examples are solvents, gasoline, paint thinner and nail polish remover. Trichloroethylene (TCE) is a VOC.

Water table: The level to which a shallow well screened in the uppermost water-bearing zone would fill with water.

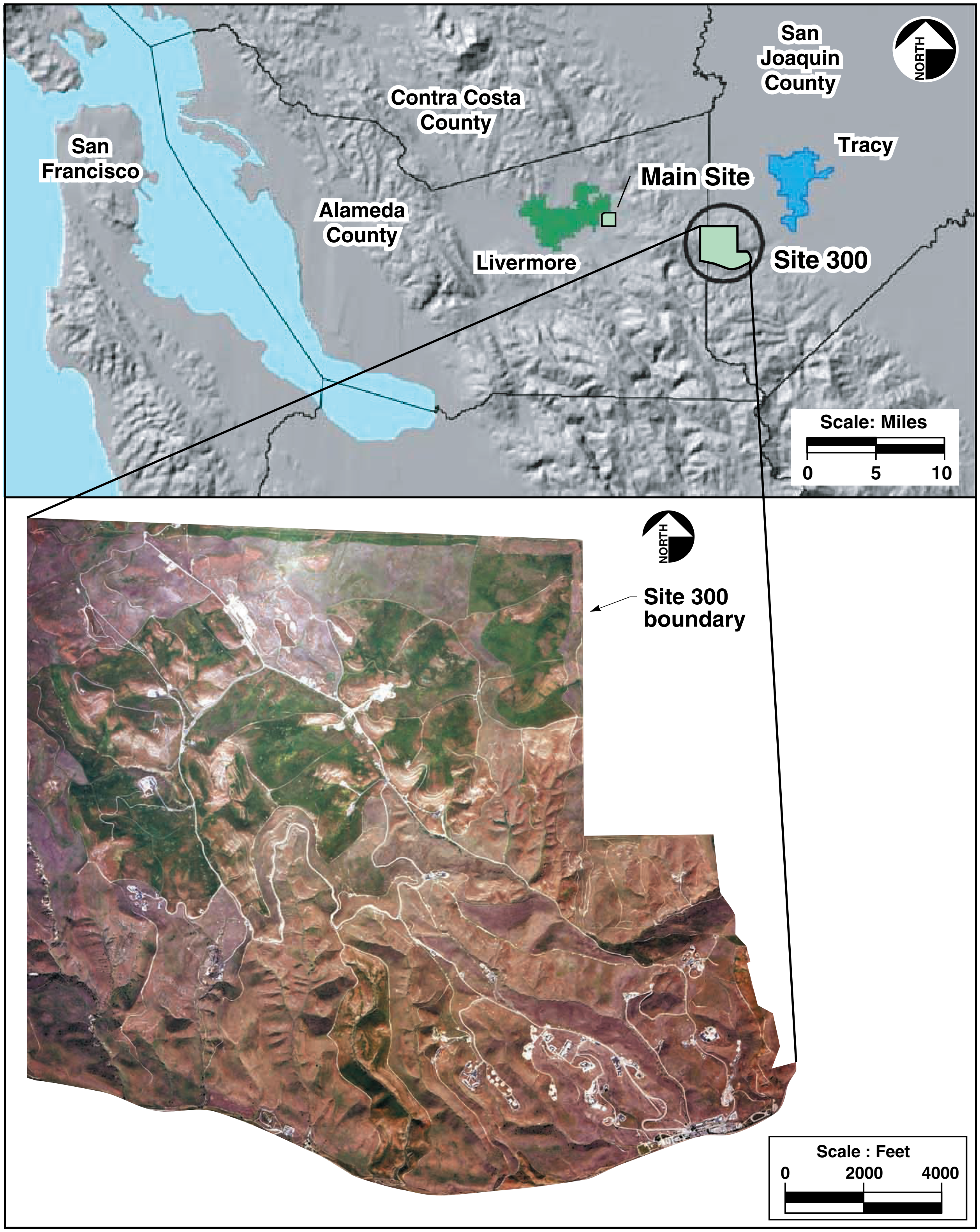
6. Acronyms and Abbreviations

1×10^{-3}	One in one thousand
1×10^{-4}	One in ten thousand
1×10^{-5}	One in one hundred thousand
1×10^{-6}	One in one million
1,1-DCE	1,1-Dichloroethylene
ARARs	Applicable or relevant and appropriate requirements
bgs	below ground surface
CDDs	Chlorinated dibenzo-p-dioxins
CDFs	Chlorinated dibenzofurans
CDI	Chronic daily intake
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR	Code of Federal Regulations
CMP	Compliance Monitoring Plan
COC	Contaminant of Concern
CP	Contingency Plan
CRP	Community Relations Plan
1,1-DCA	1,1-Dichloroethane
DOE	Department of Energy
DNAPL	Dense non aqueous phase liquid
DNT	Dinitrotoluene
DTSC	Department of Toxic Substances Control
EFA	East Firing Area
EPA	U. S. Environmental Protection Agency
FFA	Federal Facility Agreement
FS	Feasibility Study
GAC	Granular activated carbon
gpm	gallons per minute

GSA	General Services Area
HE	High explosives
HI	Hazard index
HMX	High melting explosive
HQ	Hazard quotient
Kgv	Cretaceous Great Valley Sequence
LLNL	Lawrence Livermore National Laboratory
LNAPL	Light non aqueous phase liquid
MCL	Maximum contaminant level
MDL	Method detection limit
µg/L	micrograms per liter
Mg/Kg	Milligrams per Kilogram
mi^2	square miles
MNA	Monitored Natural Attenuation
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NEPA	National Environmental Policy Act
O&M	Operations and maintenance
OU	Operable unit
OSWER	Office of Solid Waste and Emergency Response
PCE	Perchloroethylene, also known as tetrachloroethylene
PCB	Polychlorinated biphenyl
pCi/L	Picocuries per liter
PRGs	Preliminary Remediation Goals
Qal	Quaternary alluvium
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act
RD	Remedial design
RDX	Research department explosive
RfD	Reference dose
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision

RWQCB	Regional Water Quality Control Board
SARA	Superfund Amendments and Reauthorization Act
SJVUAPCD	San Joaquin Valley Unified Air Pollution Control District
SVC	Soil vapor extraction
SVRA	State Vehicle Recreation Area
SWFS	Site-Wide Feasibility Study
SWRI	Site-Wide Remedial Investigation
TBOS/TKEBS	Tetra-butyl-orthosilicate/tetra-kis-2-ethylbutylorthosilicate
TCA	Trichloroethane
TCE	Trichloroethylene
Tmss	Miocene Cierbo formation
Tn	Miocene Neroly formation
$Tnbs_1$	Neroly formation lower blue sandstone
$Tnbs_2$	Neroly formation upper blue sandstone
$Tnsc_1$	Neroly formation lower siltstone/claystone
Tps	Pliocene nonmarine unit
Tpsg	Pliocene nonmarine gravel
TQ	Toxicity quotient
UCRL	University of California Radiation Laboratory
USGS	United States Geological Survey
VOCs	Volatile organic compounds
WFA	West Firing Area
WQO	Water quality objective

Figures



ERD-LSR-00-0065

Figure 2.1-1. Location of LLNL Site 300.

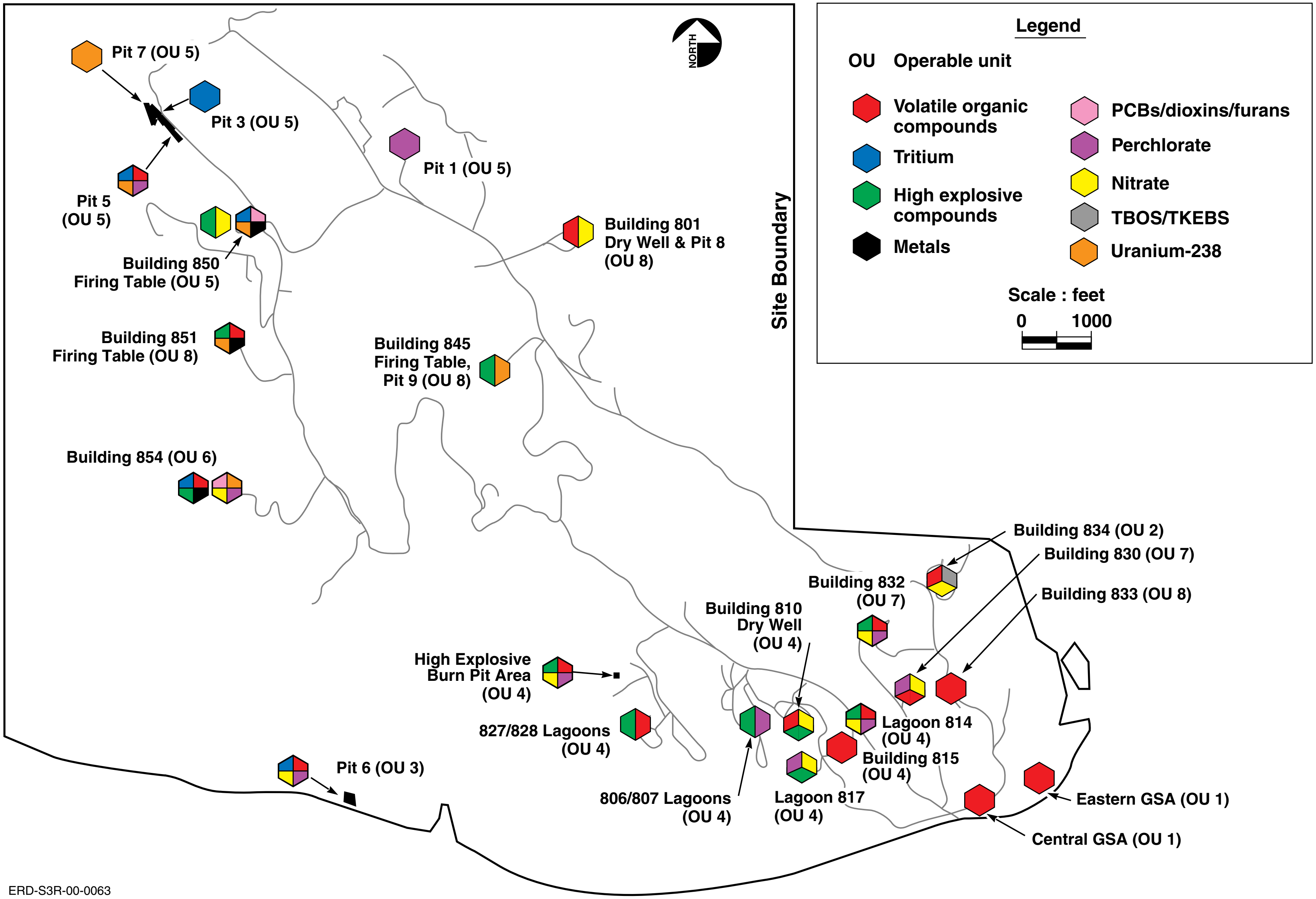


Figure 2.4-1. Site 300 contaminant release sites.

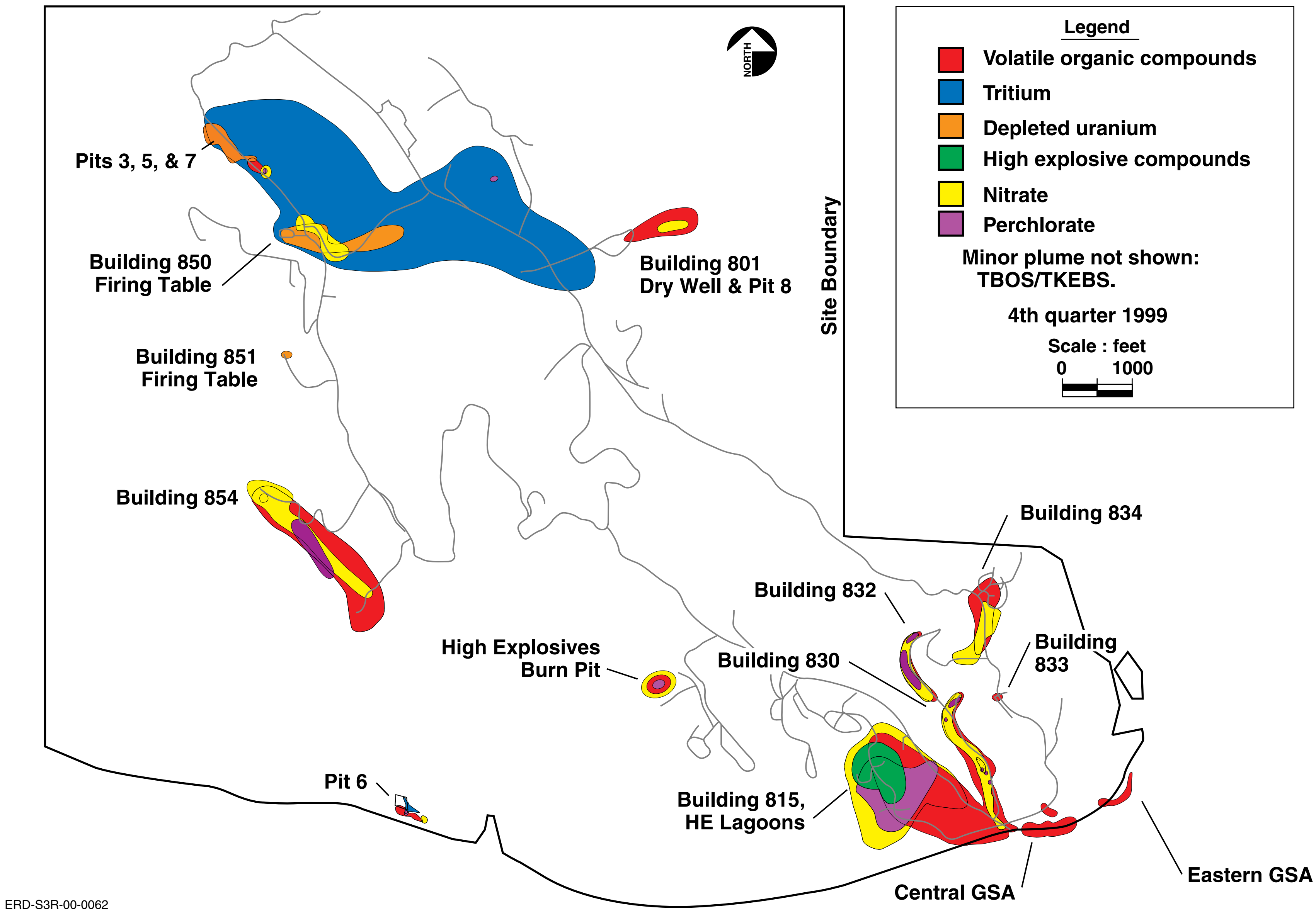


Figure 2.4-2. Site 300 ground water contaminant plumes.

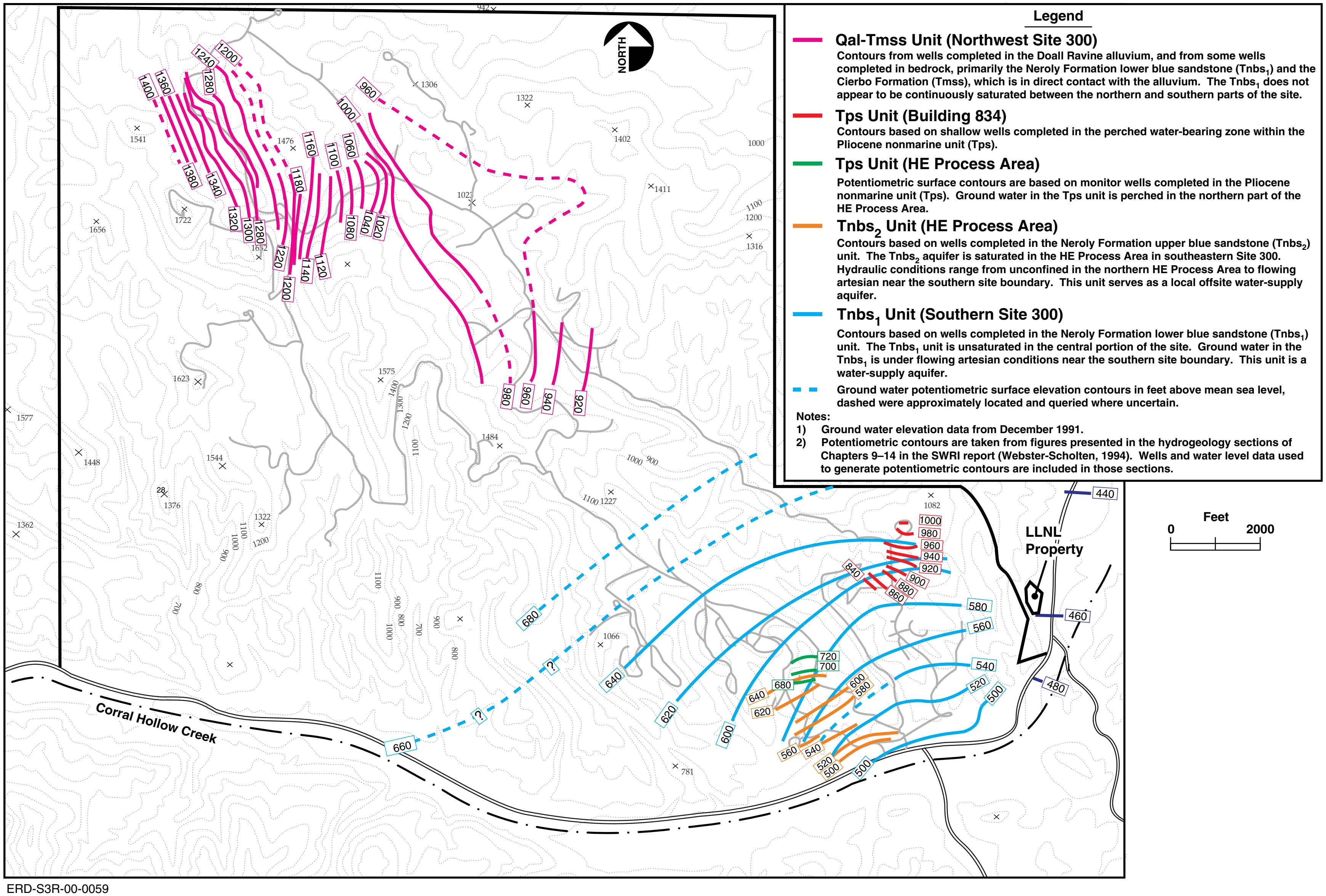
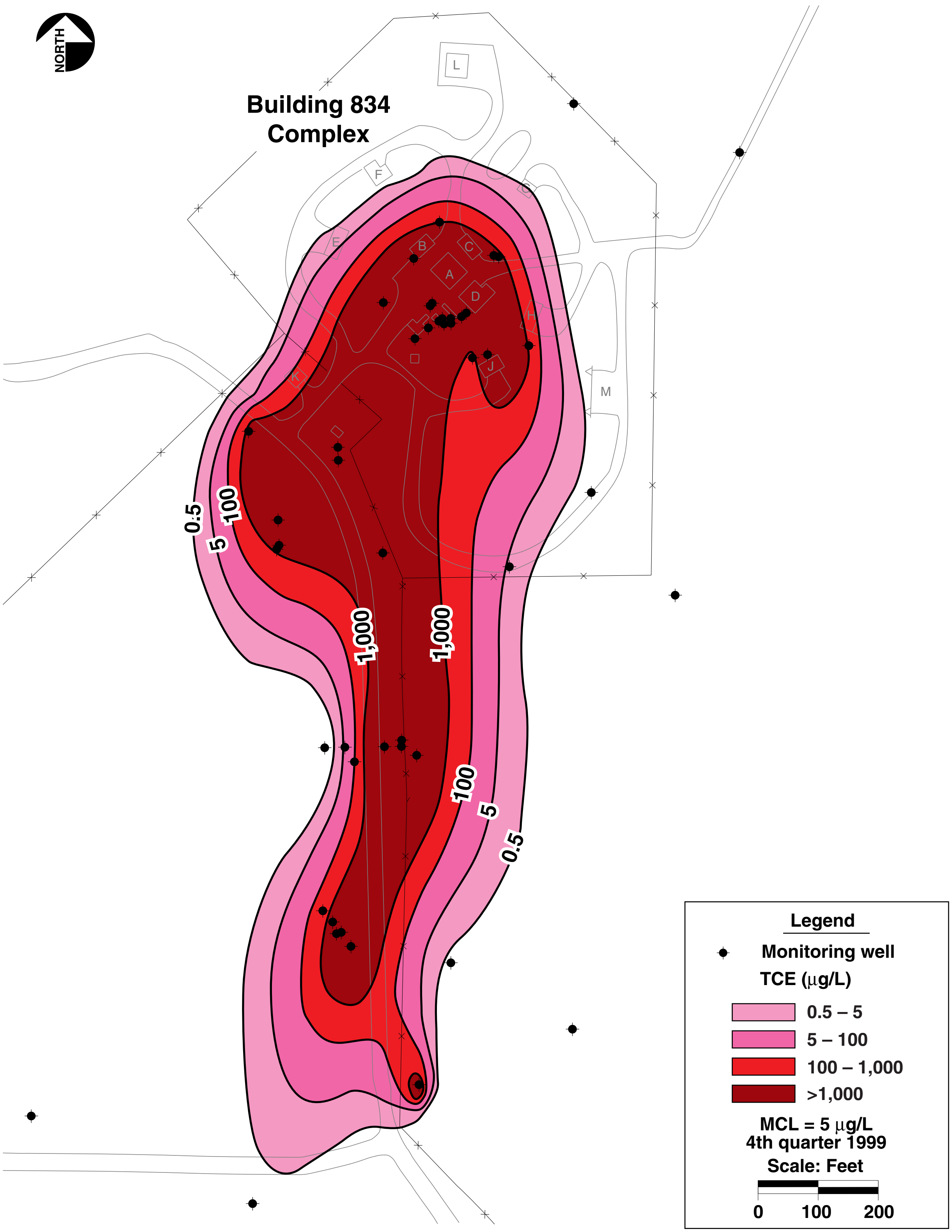


Figure 2.5-1. Potentiometric surface elevation map of major water-bearing units at Site 300.



ERD-S3R-00-0056

Figure 2.5-2. Distribution of TCE in perched water-bearing zone in the Building 834 area, OU2.

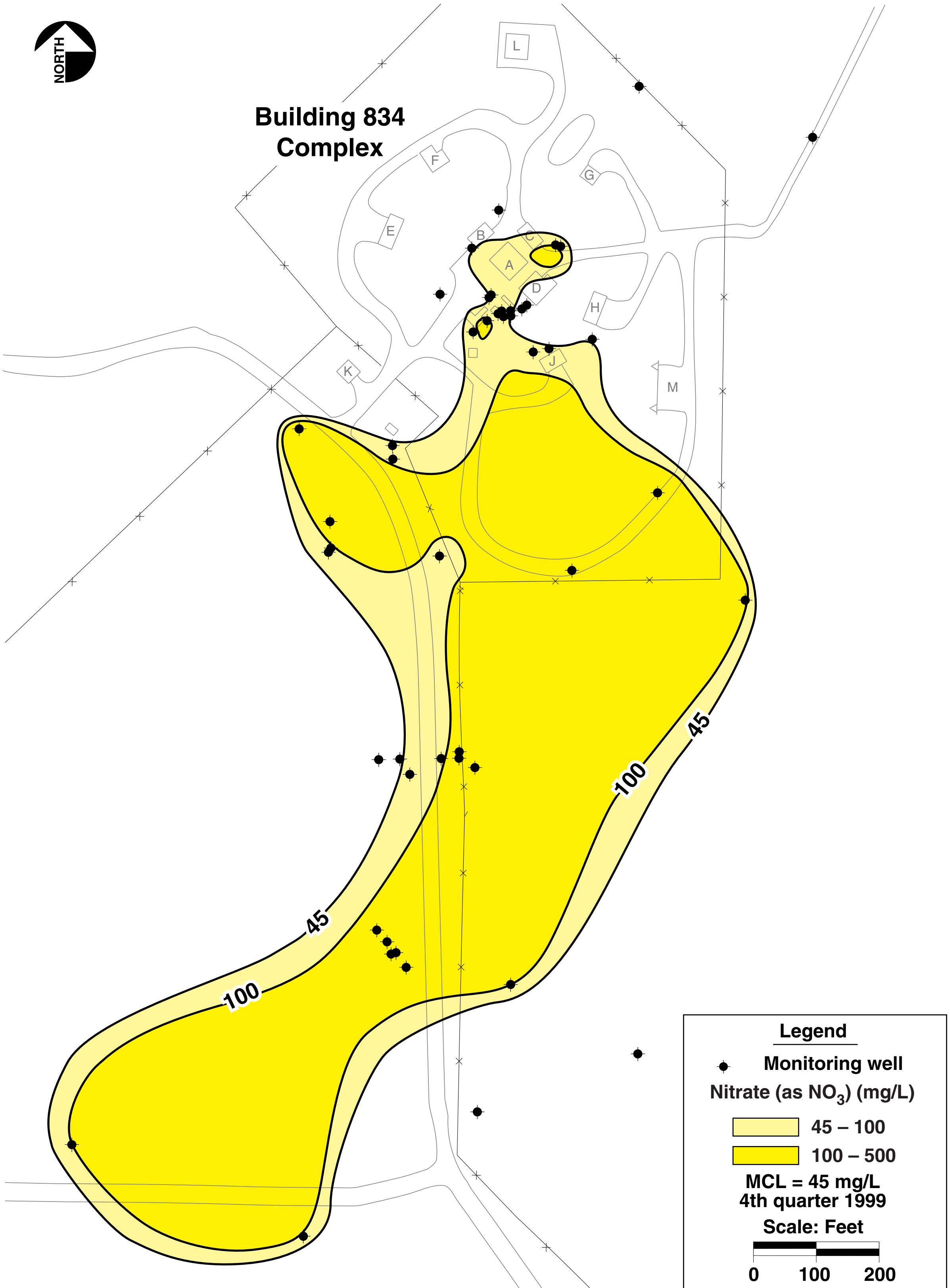


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Figure 2.5-3. Distribution of nitrate in perched water-bearing zone in the Building 834 area, OU2.

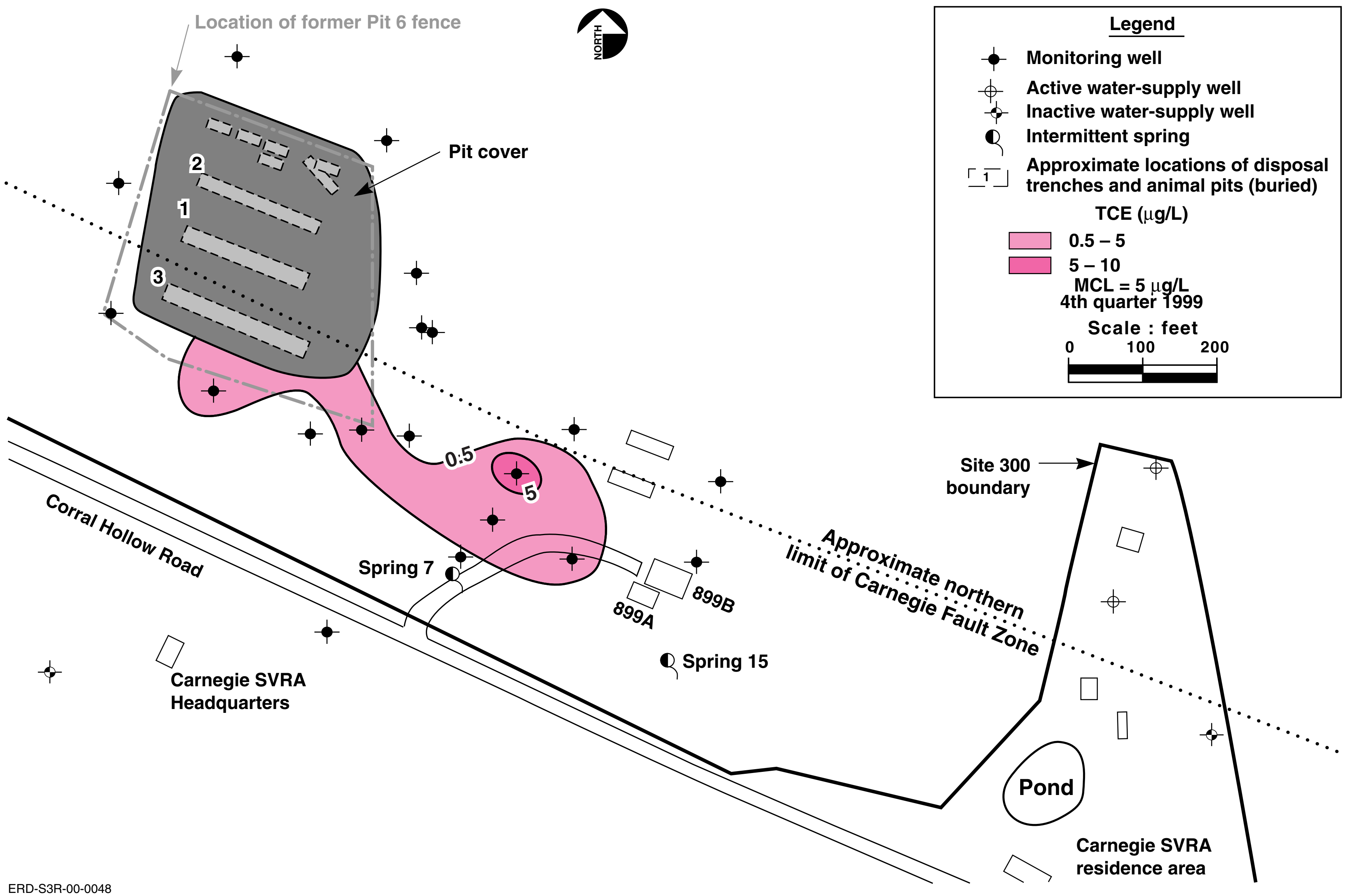


Figure 2.5-4. Distribution of TCE in ground water at the Pit 6 Landfill, OU3.

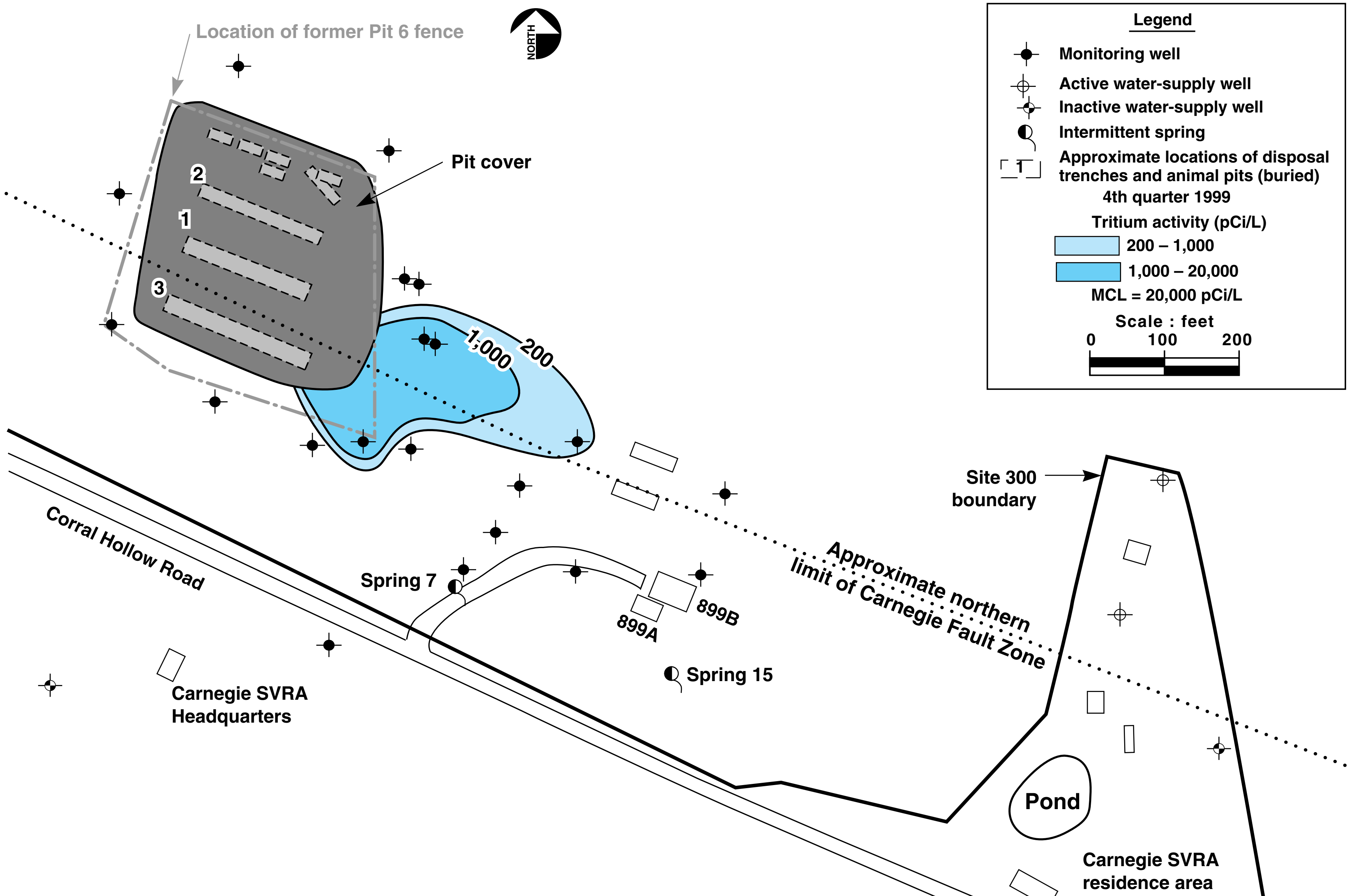


Figure 2.5-5. Distribution of tritium in ground water at the Pit 6 Landfill, OU3.

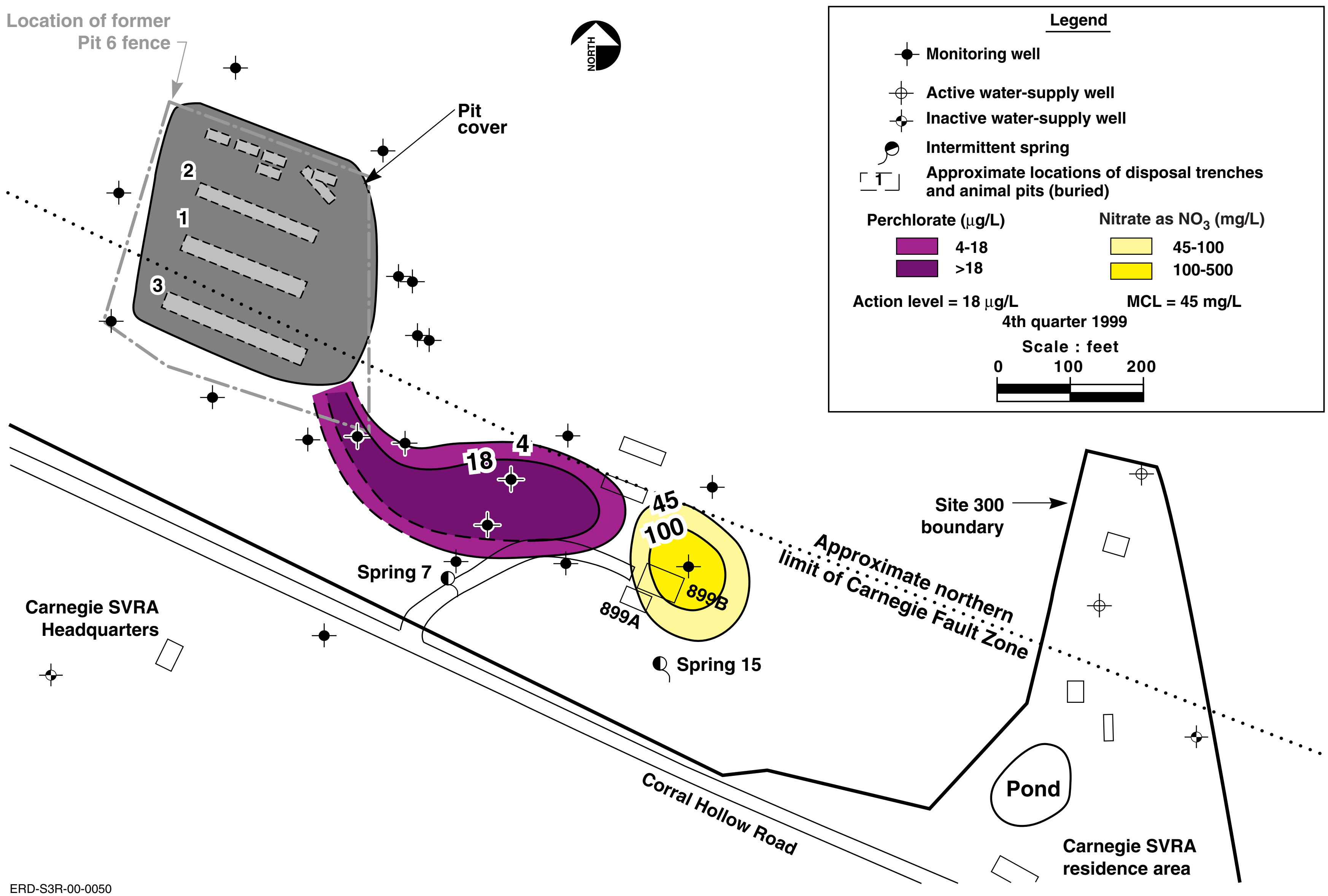
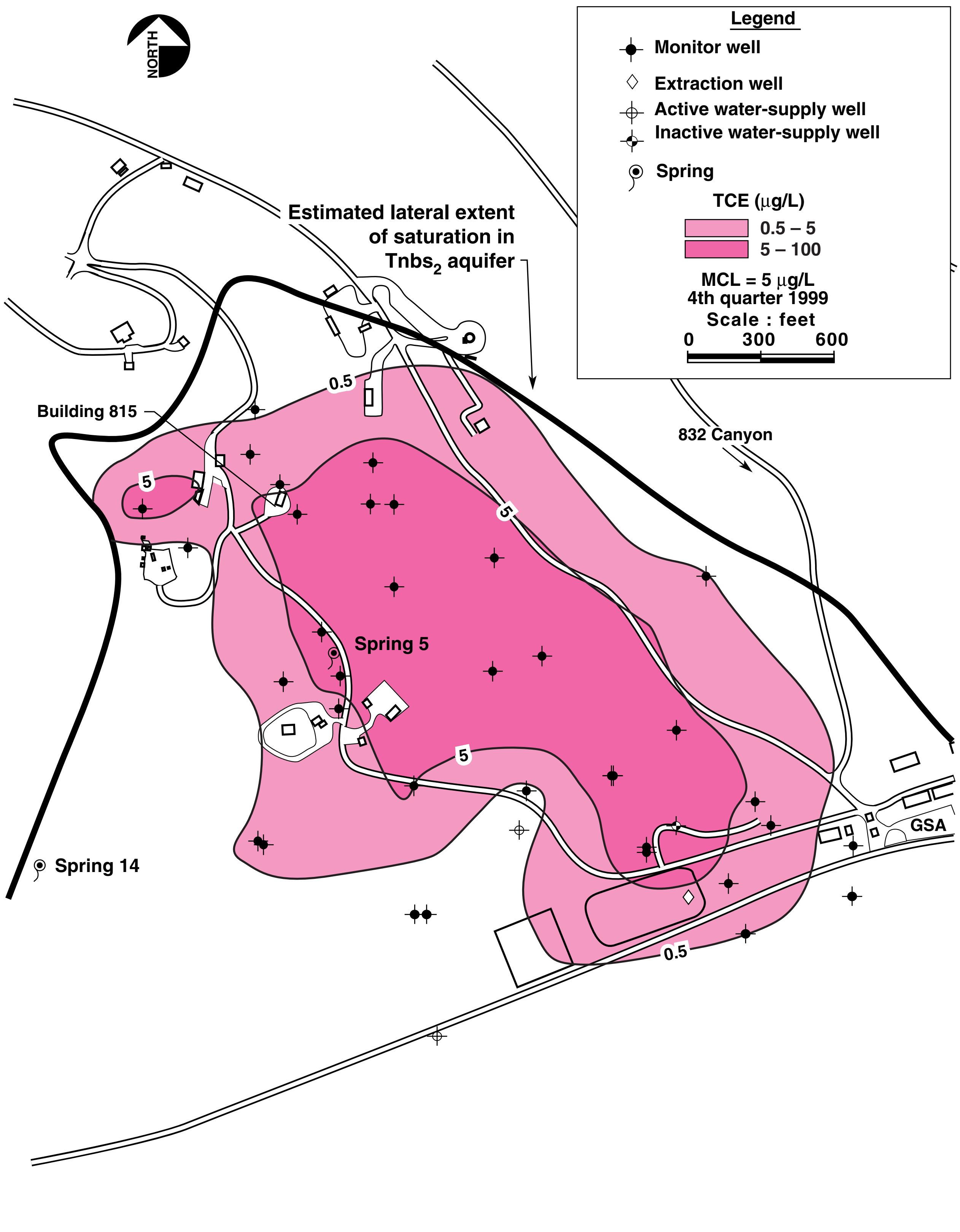
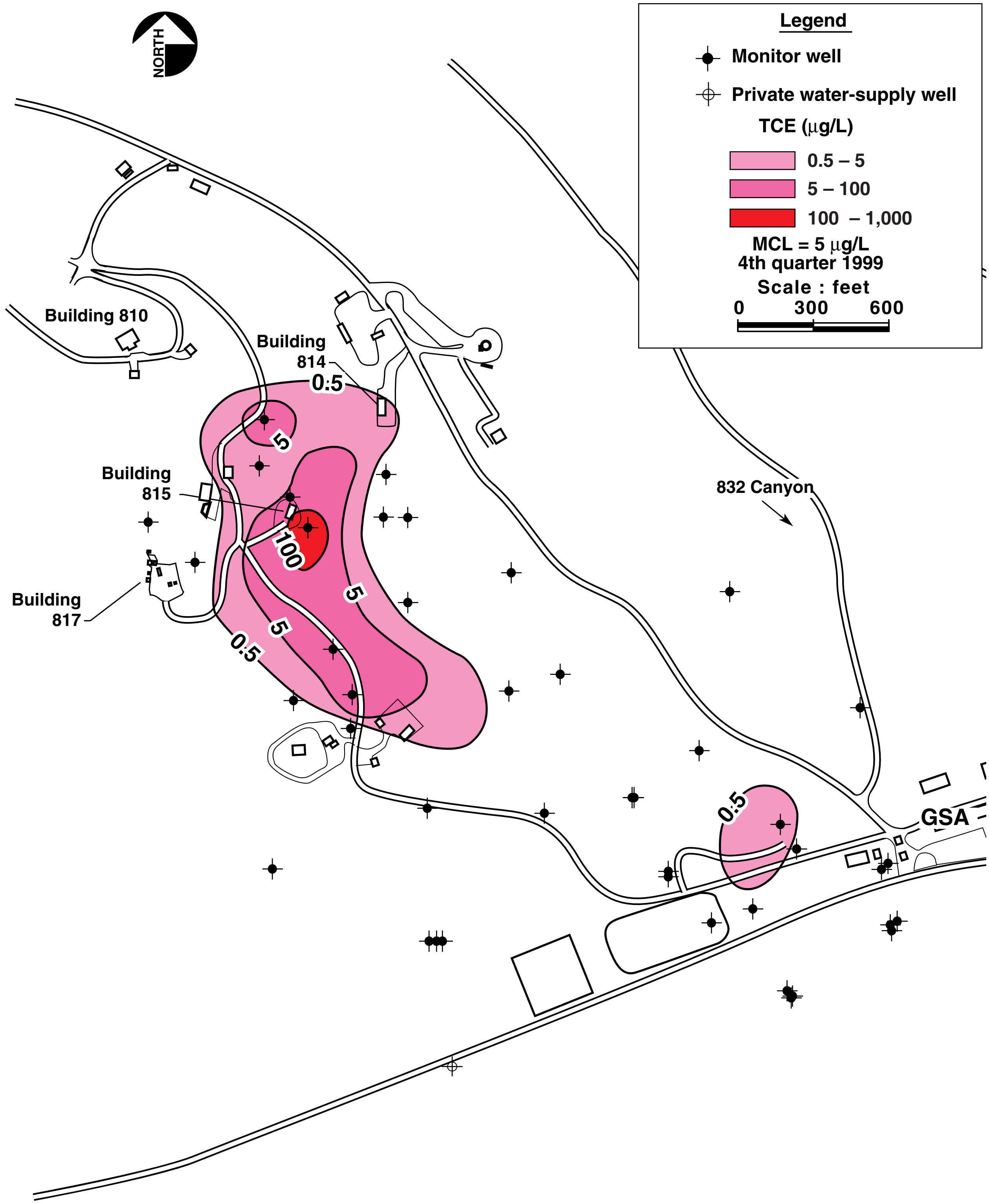


Figure 2.5-6. Distribution of perchlorate and nitrate in ground water at the Pit 6 Landfill, OU3.



ERD-S3R-00-0042

Figure 2.5-7. Distribution of TCE in the $Tnbs_2$ aquifer at the HE Process Area, OU4.



ERD-S3R-00-0057

Figure 2.5-8. Distribution of TCE in the Tps perched water-bearing zone at the HE Process Area, OU4.

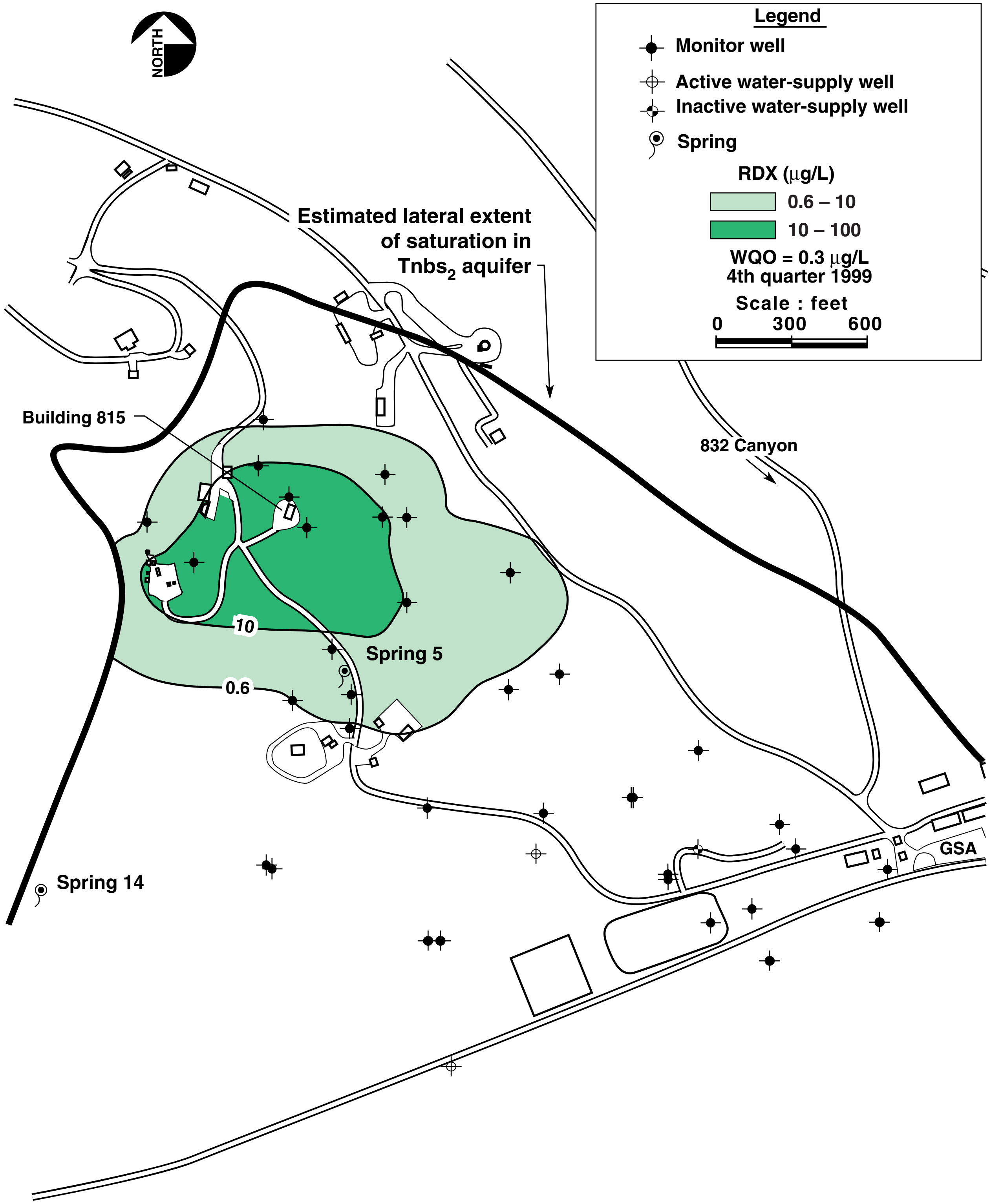


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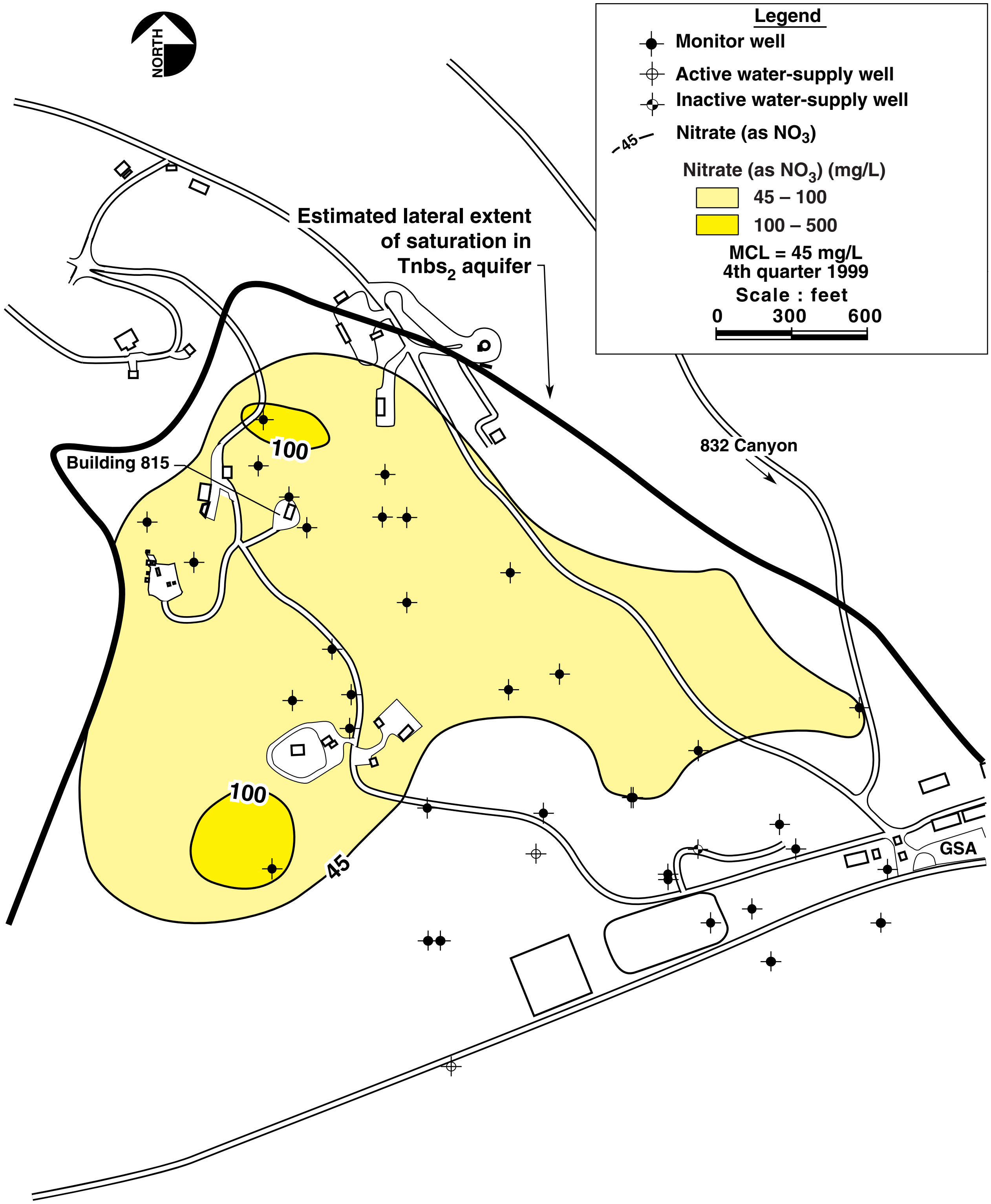
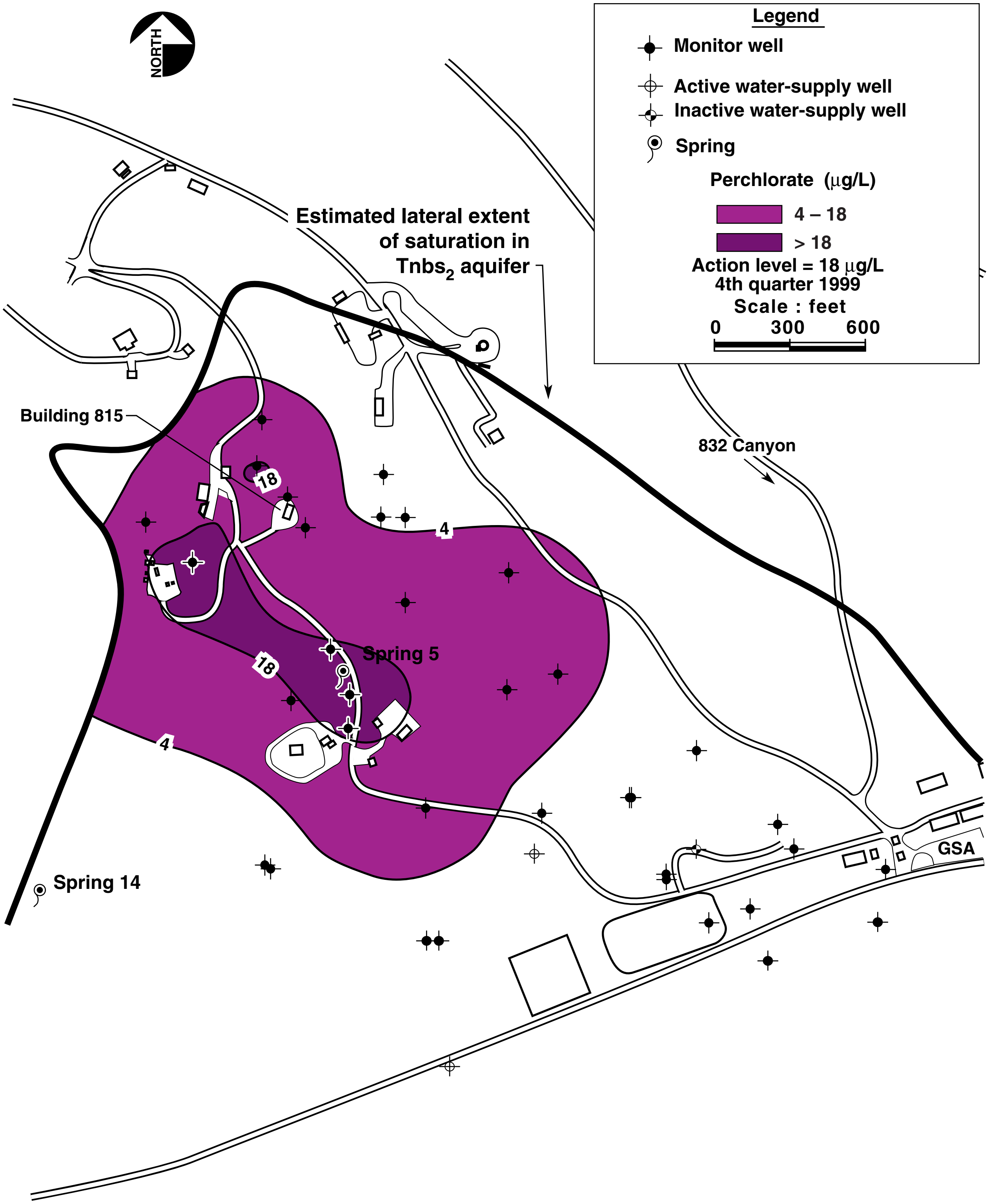
Figure 2.5-9. Distribution of RDX in the $Tnbs_2$ aquifer at the HE Process Area, OU4.



ERD-S3R-00-0045

Figure 2.5-10. Distribution of nitrate in the $Tnbs_2$ aquifer at the HE Process Area, OU4.



ERD-S3R-00-0044

Figure 2.5-11. Distribution of perchlorate in the $Tnbs_2$ aquifer at the HE Process Area, OU4.

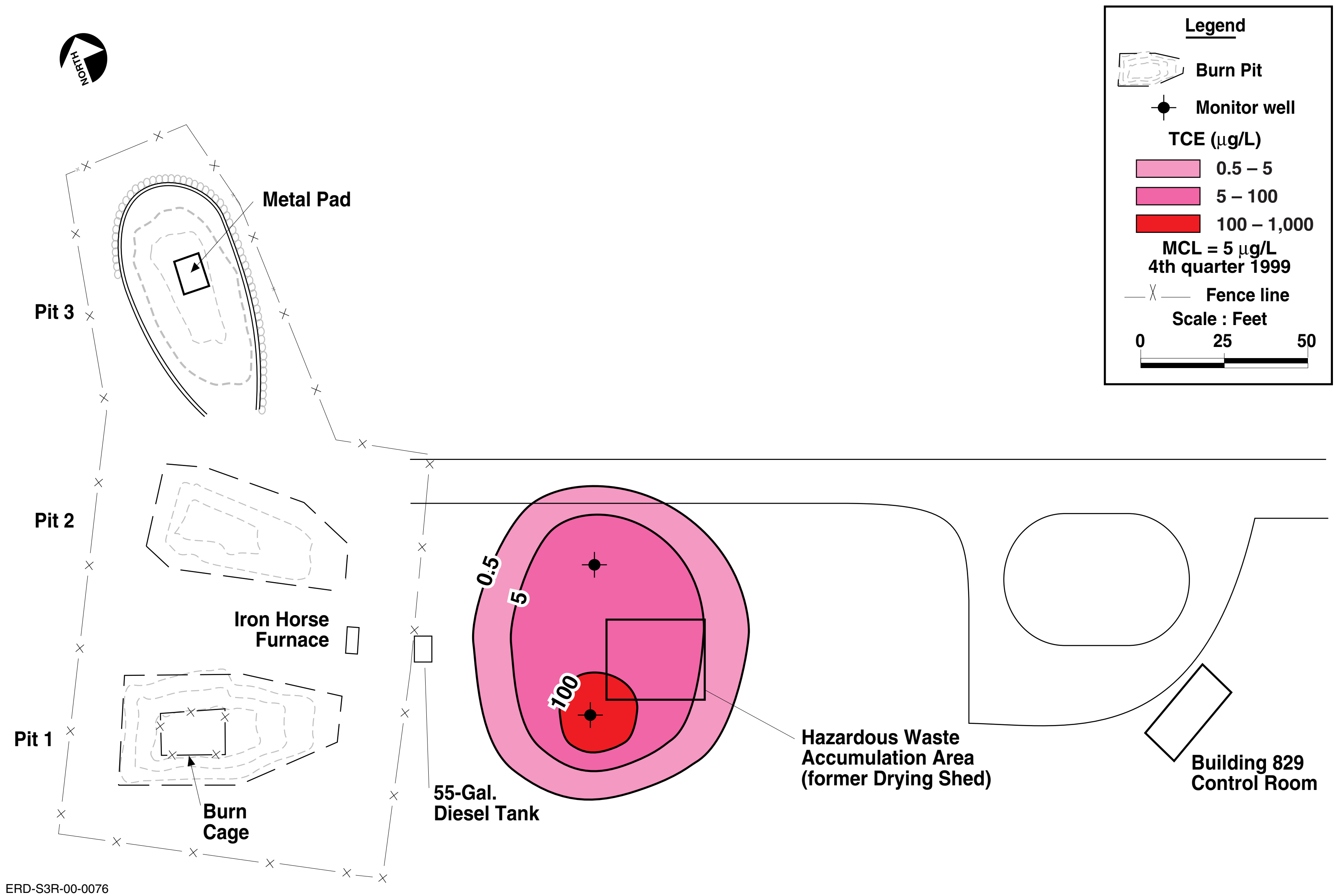


Figure 2.5-12. Distribution of TCE in the $Tnsc_1$ perched water-bearing zone in the HE Burn Pit portion of the HE Process Area, OU4.

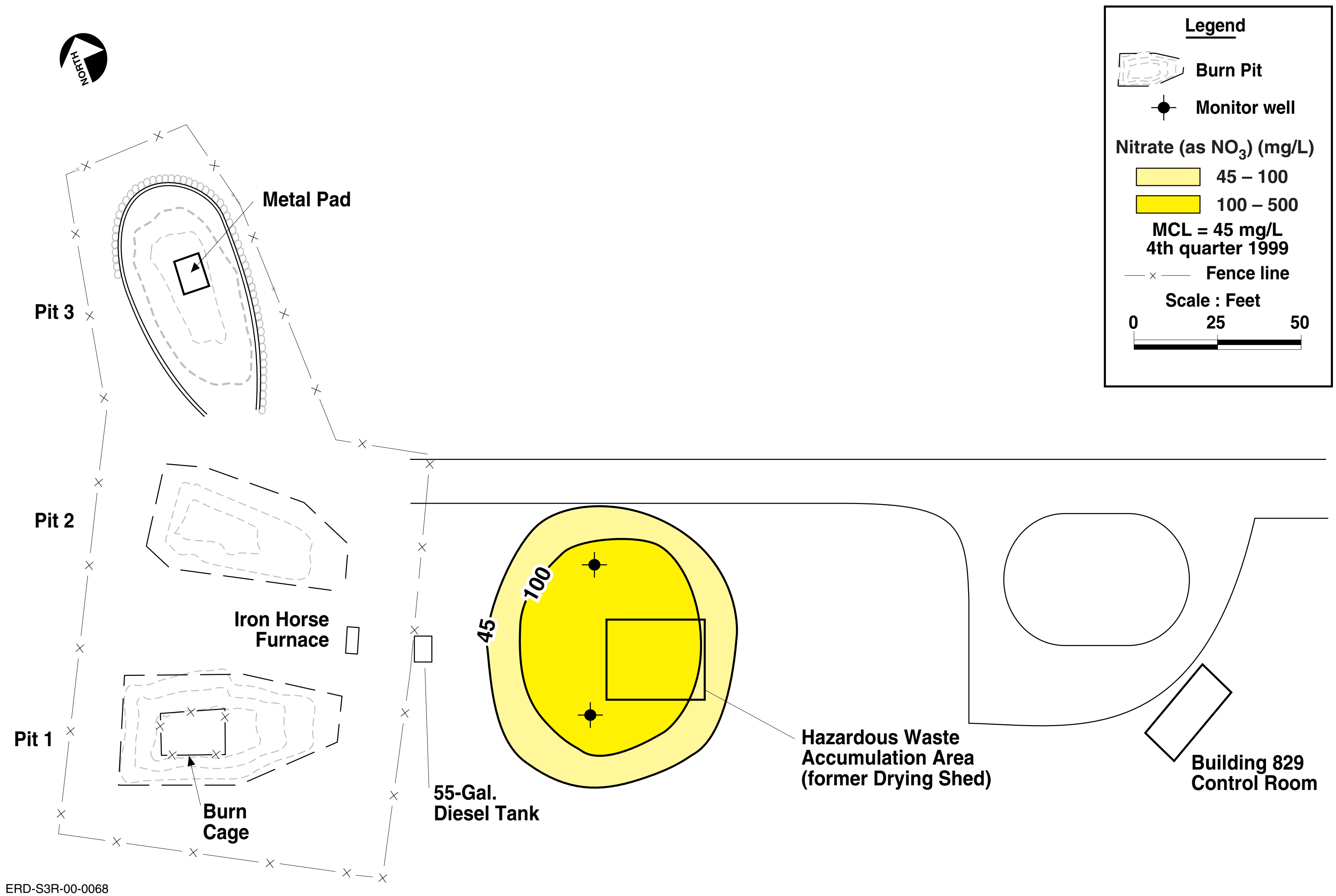


Figure 2-5-13. Distribution of nitrate in the $Tnsc_1$ perched water-bearing zone in the HE Burn Pit portion of the HE Process Area, OU4.

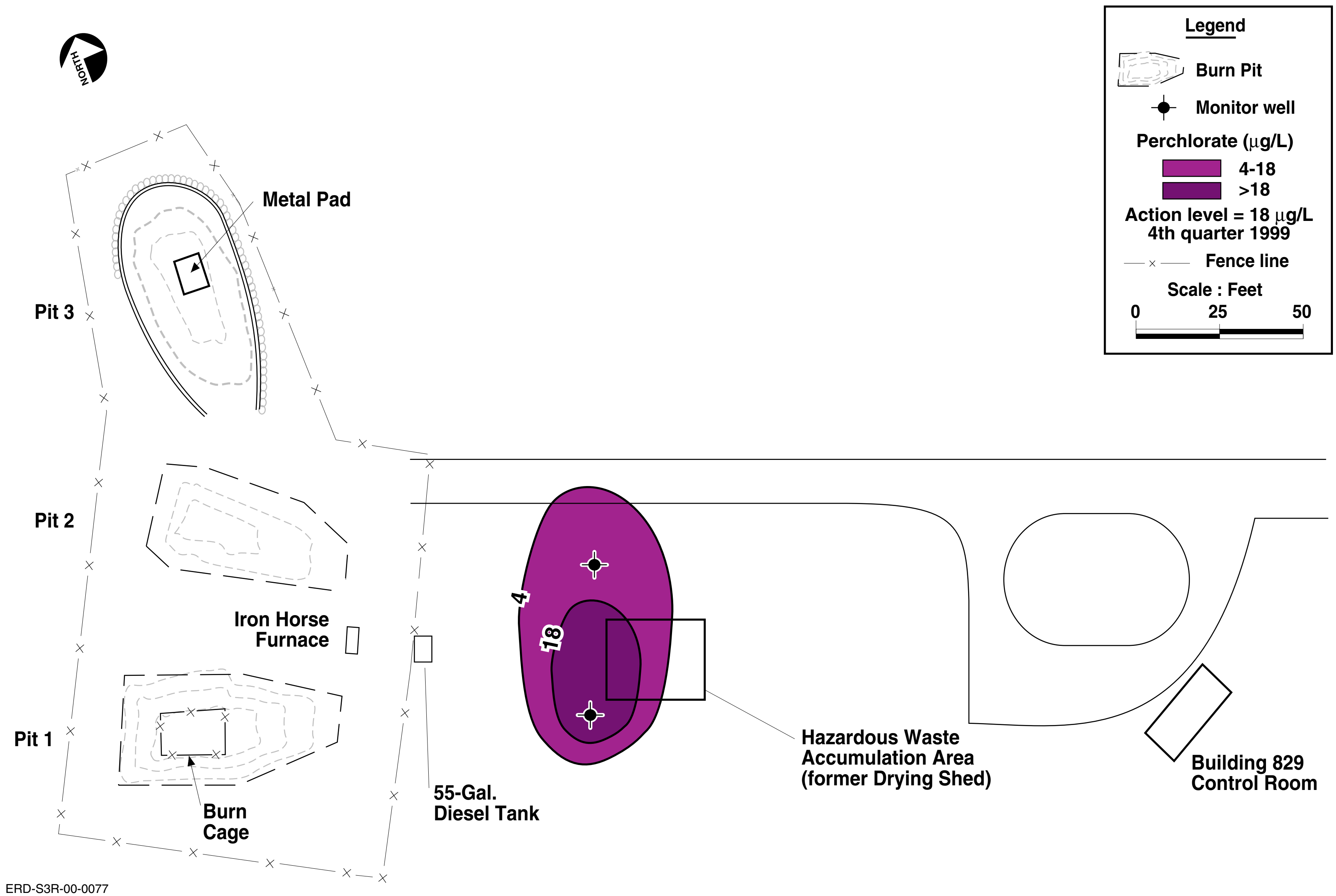
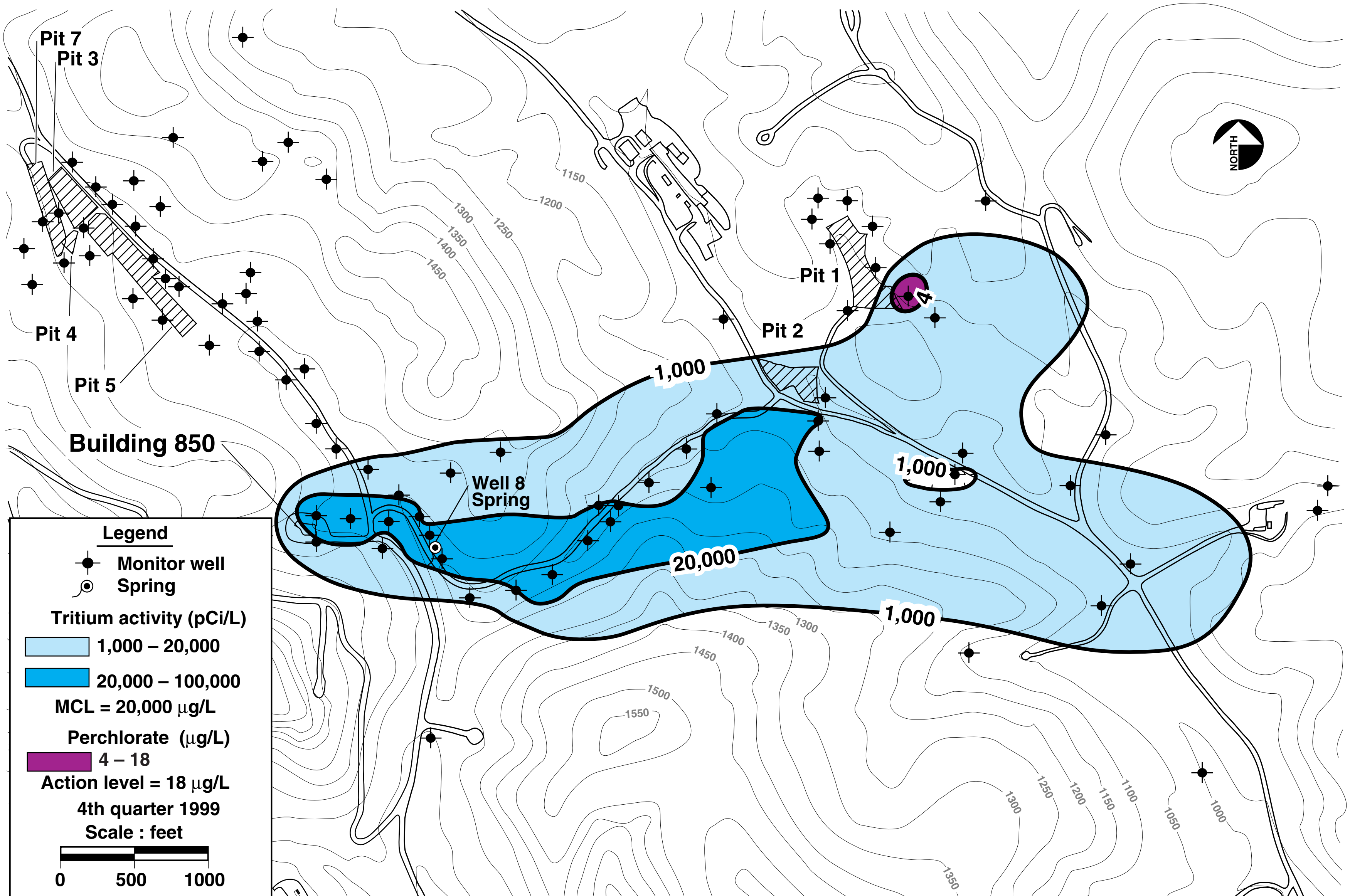
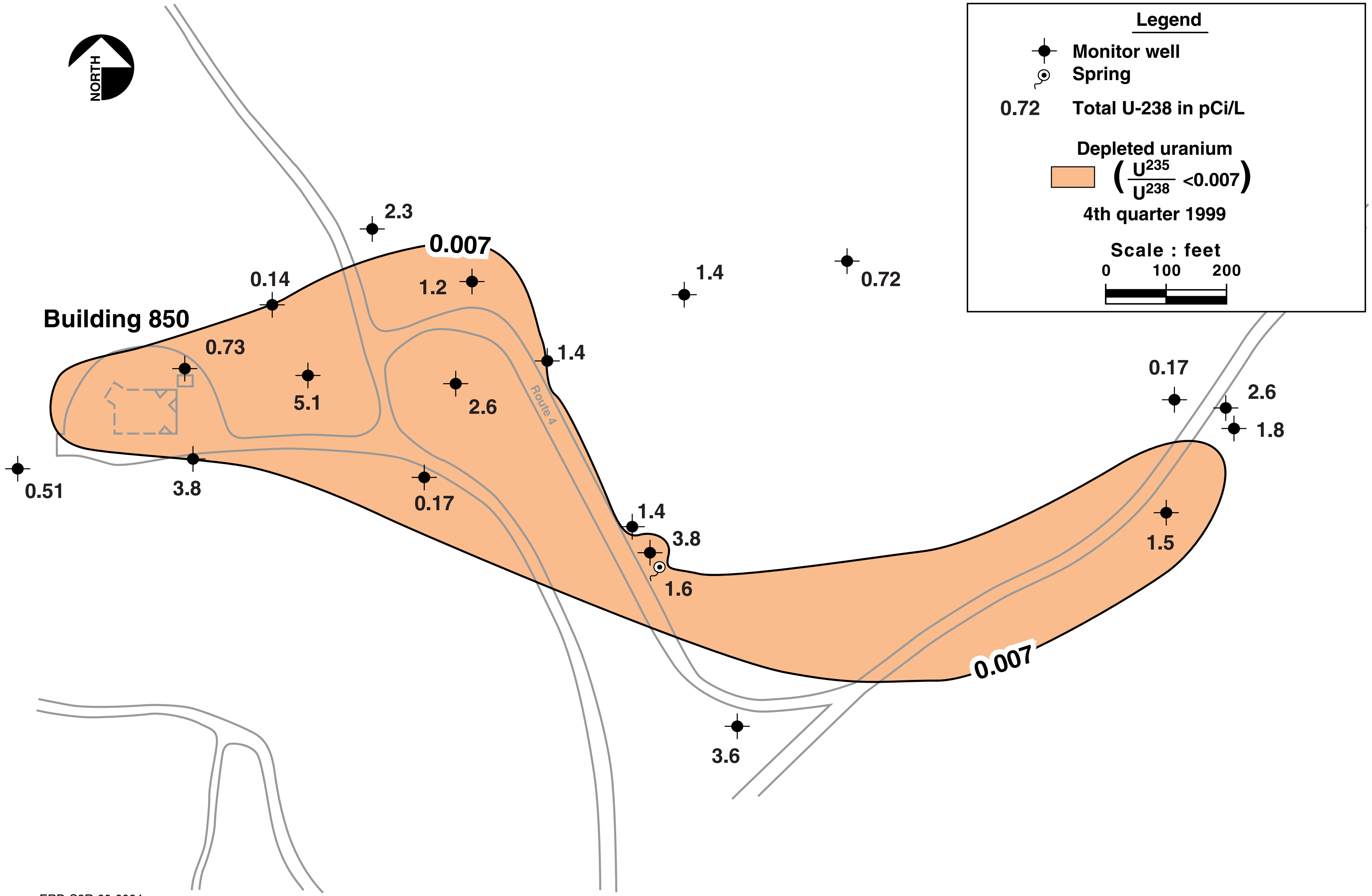


Figure 2.5-14. Distribution of perchlorate in the $Tnsc_1$ perched water-bearing zone in the HE Burn Pit portion of the HE Process Area, OU4.



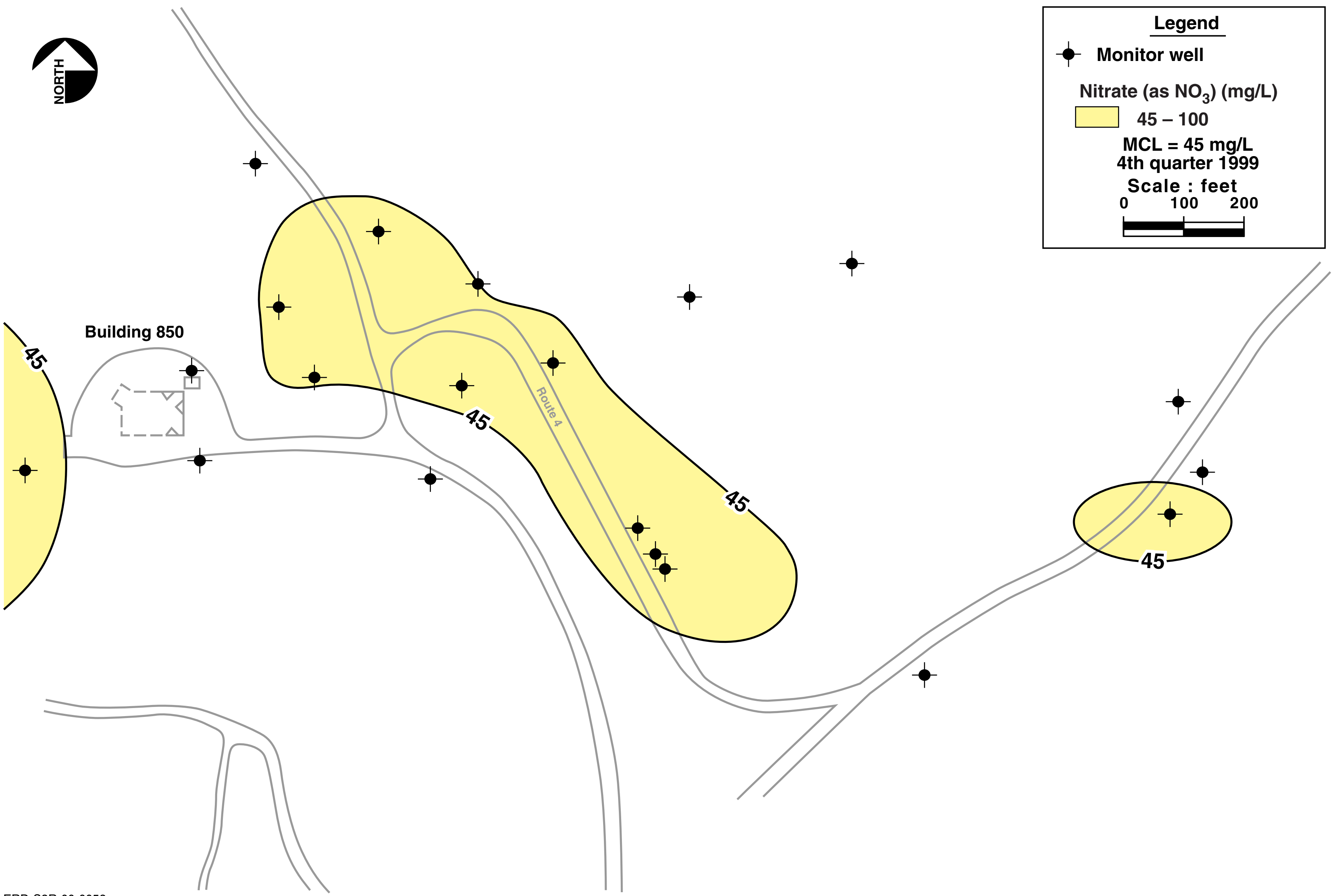
ERD-S3R-00-0060

Figure 2.5-15. Distribution of tritium in alluvium and the lower $Tnbs_1$ water-bearing zone from the Building 850 area and perchlorate near the Pit 1 Landfill, OU5. (Tritium from Pit 7 Complex not shown.)



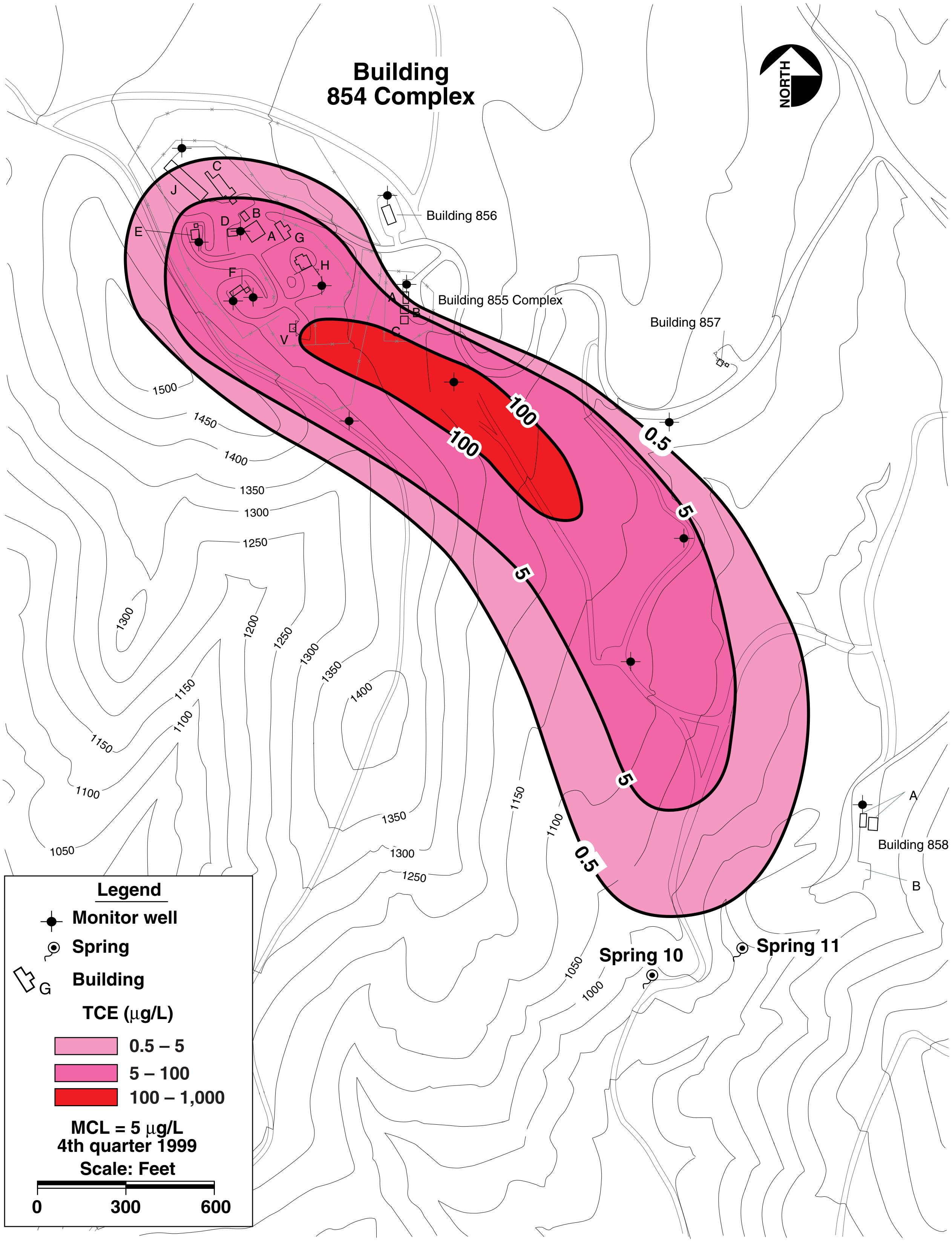
ERD-S3R-00-0064

Figure 2.5-16. Distribution of depleted uranium in alluvium and the lower $Tnbs_1$ water bearing zone and location of the monitoring network in the Building 850 area, OU5. Total uranium-238 values include both naturally occuring uranium and depleted uranium added from LLNL operations. (MCL is 20 pCi/L.)



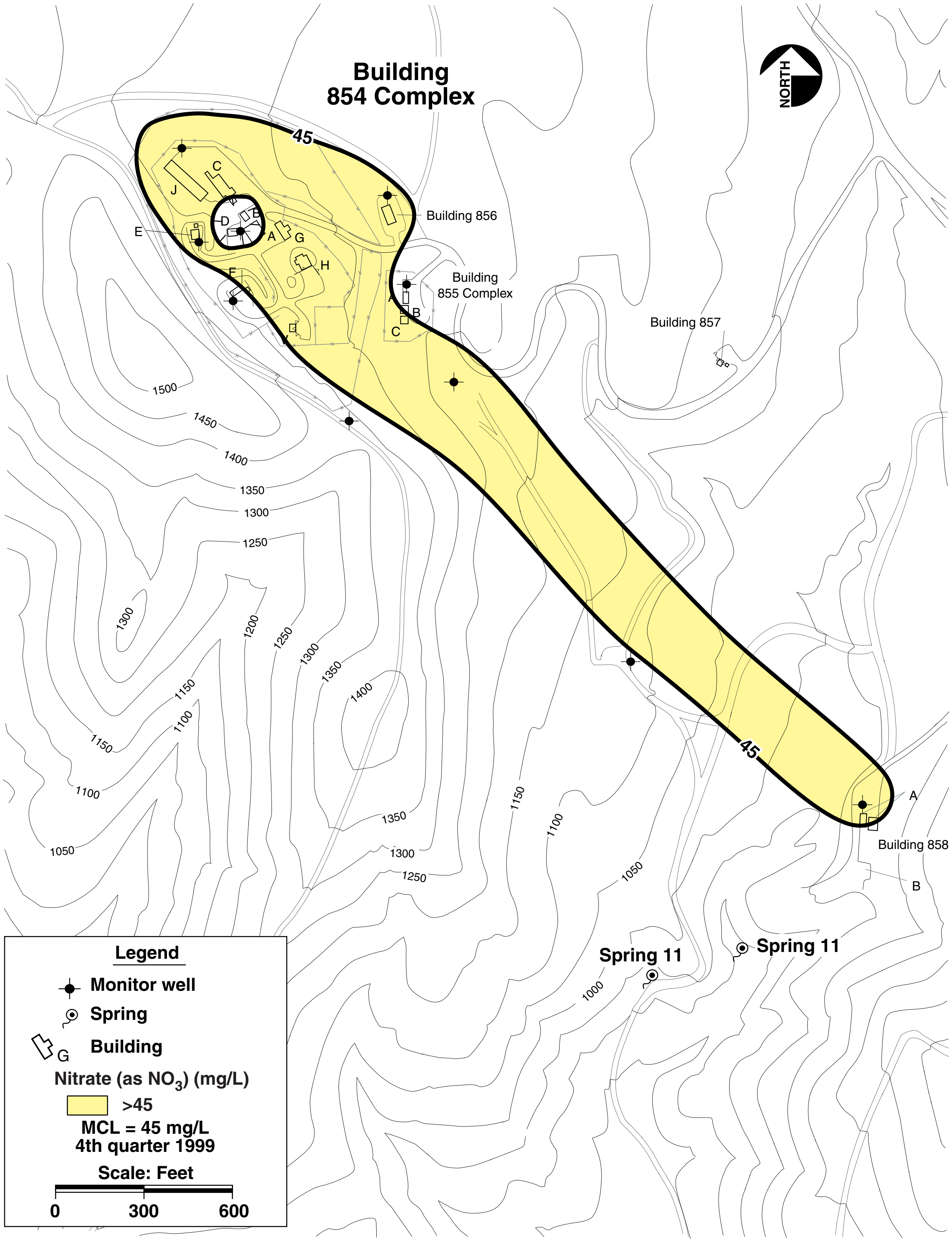
ERD-S3R-00-0058

Figure 2.5-17. Distribution of nitrate in alluvium and the lower Tnbs$_1$ water bearing zone in the Building 850 area, OU5.



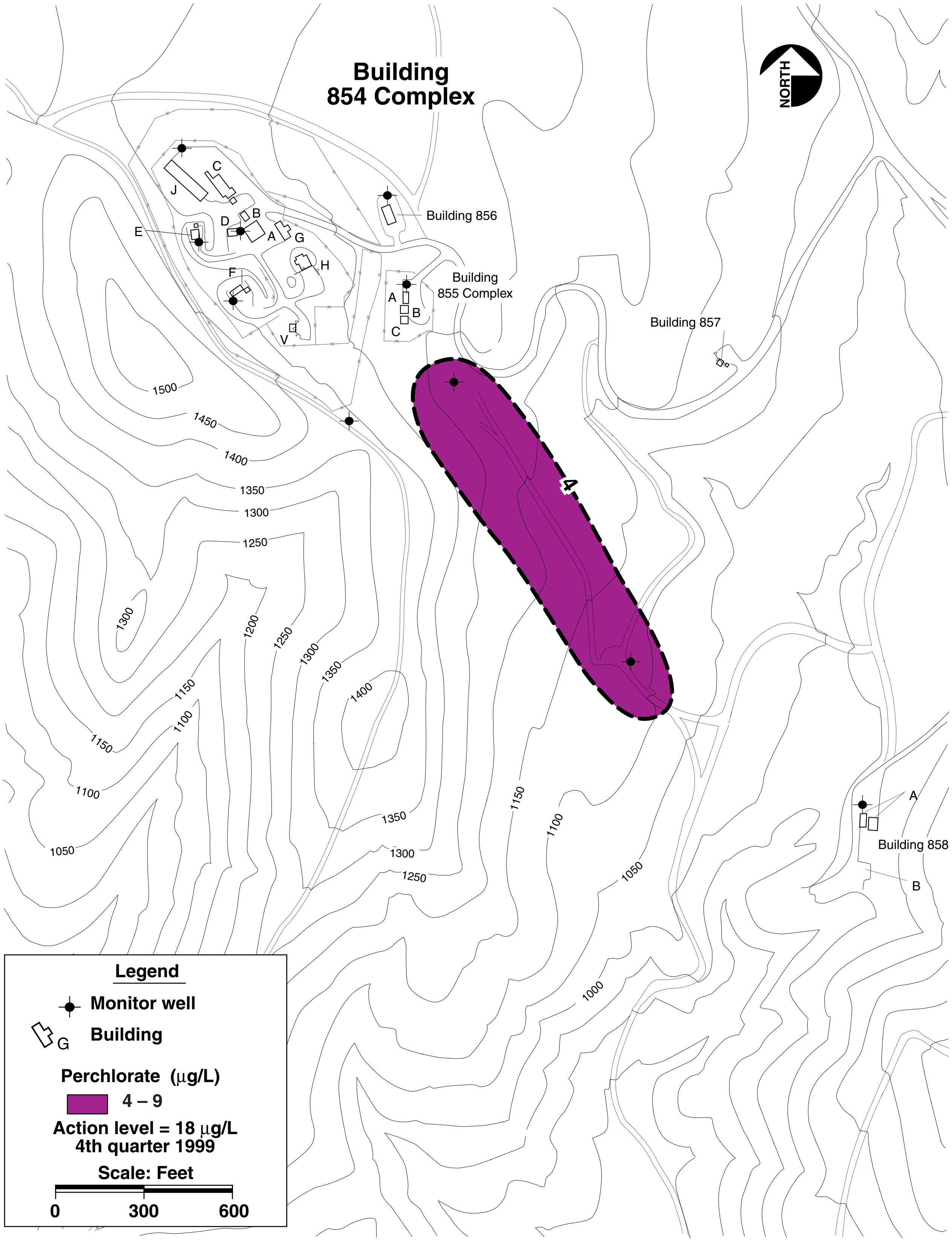
ERD-S3R-00-0052

Figure 2.5-18. Distribution of TCE in the lower $Tnbs_1$ water-bearing zone in the Building 854 area, OU6.



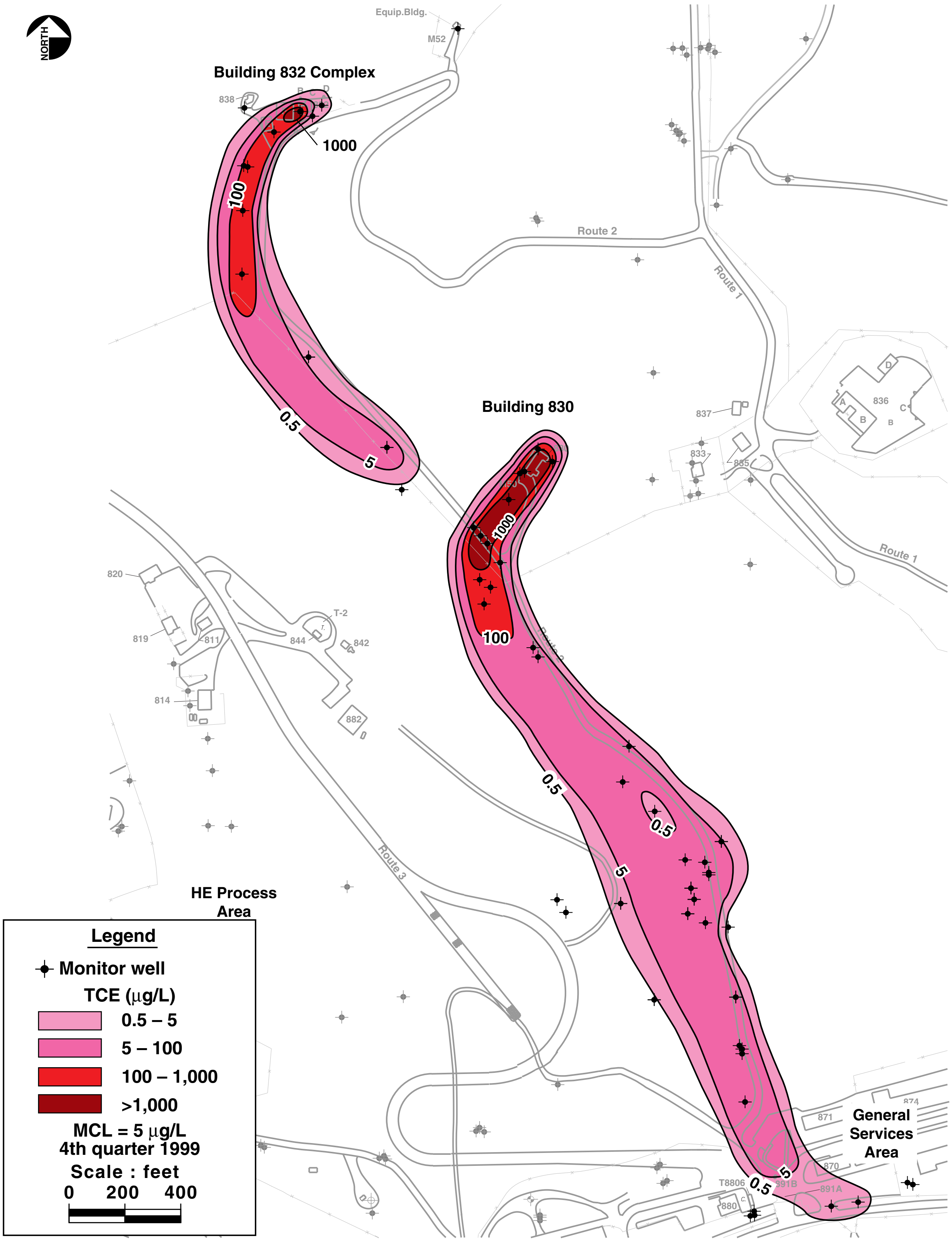
ERD-S3R-00-0054

Figure 2.5-19. Distribution of nitrate in the lower Tnbs$_1$ water-bearing zone in the Building 854 area, OU6.



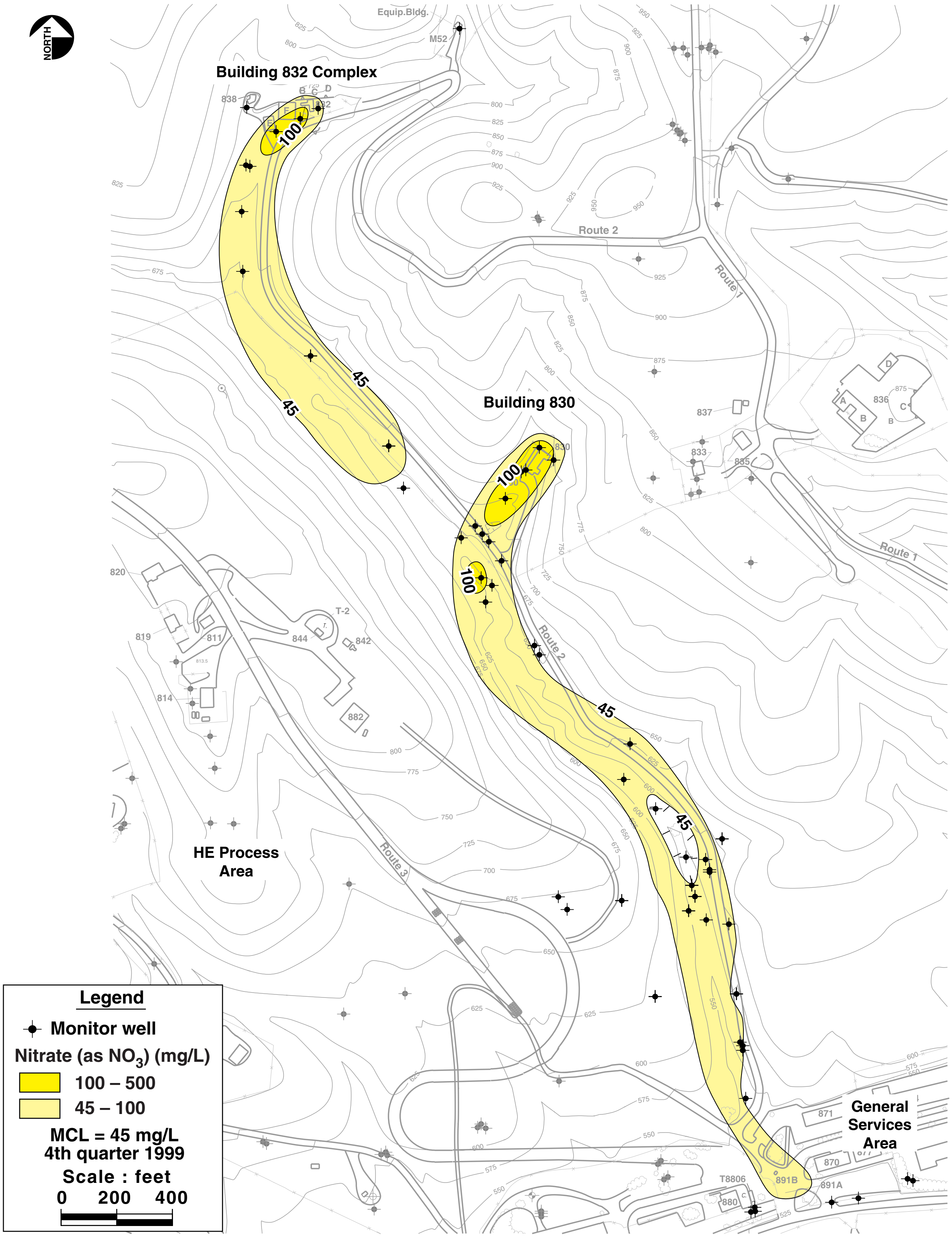
ERD-S3R-00-0053

Figure 2.5-20. Distribution of perchlorate in the lower $Tnbs_1$ water-bearing zone in the Building 854 area, OU6.



ERD-S3R-00-0039

Figure 2.5-21. Distribution of TCE in ground water in the Building 832 Canyon, OU7.



ERD-S3R-00-0041

Figure 2.5-22. Distribution of nitrate in ground water in the Building 832 Canyon, OU7.

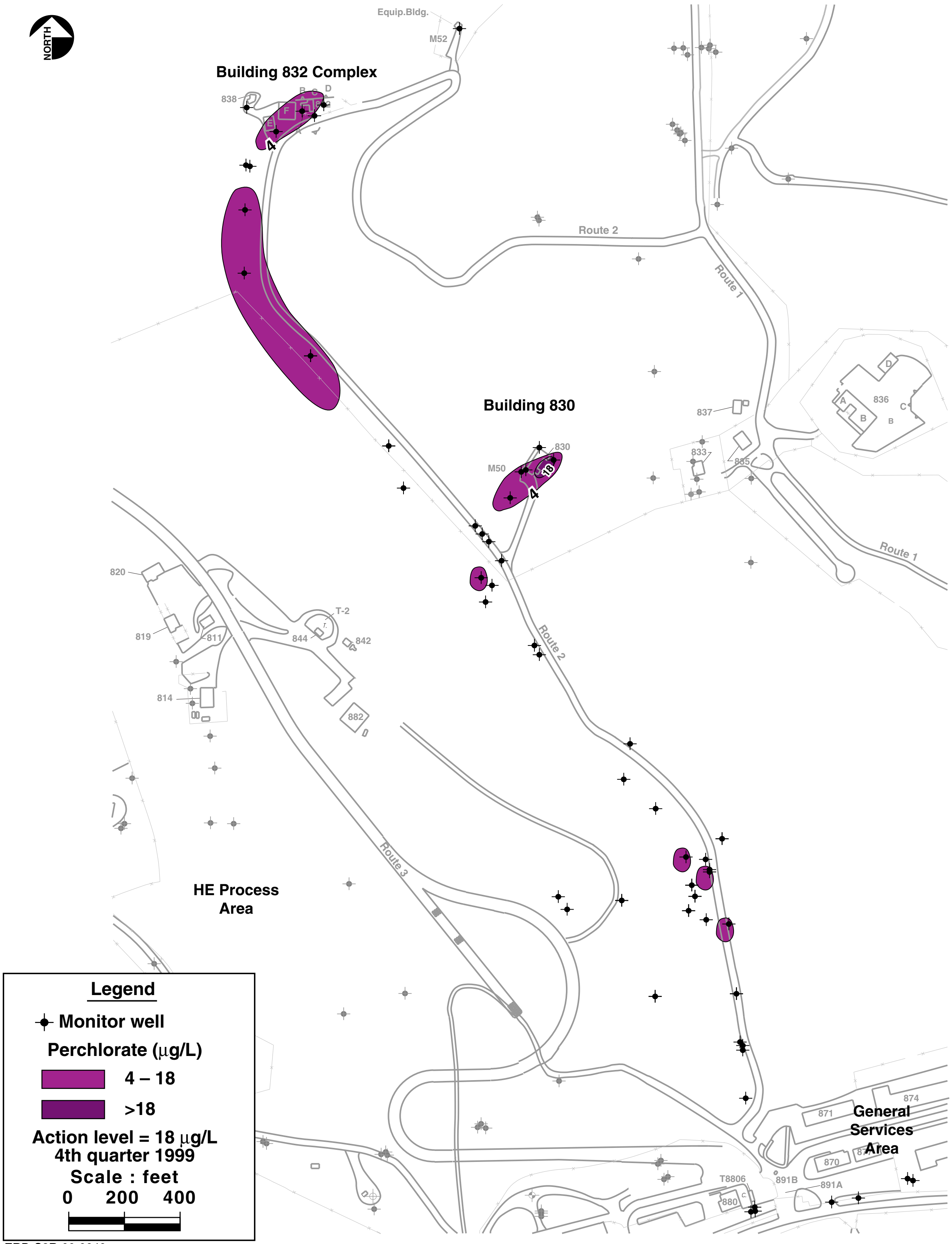


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Figure 2.5-23. Distribution of perchlorate in ground water in the Building 832 Canyon, OU7.

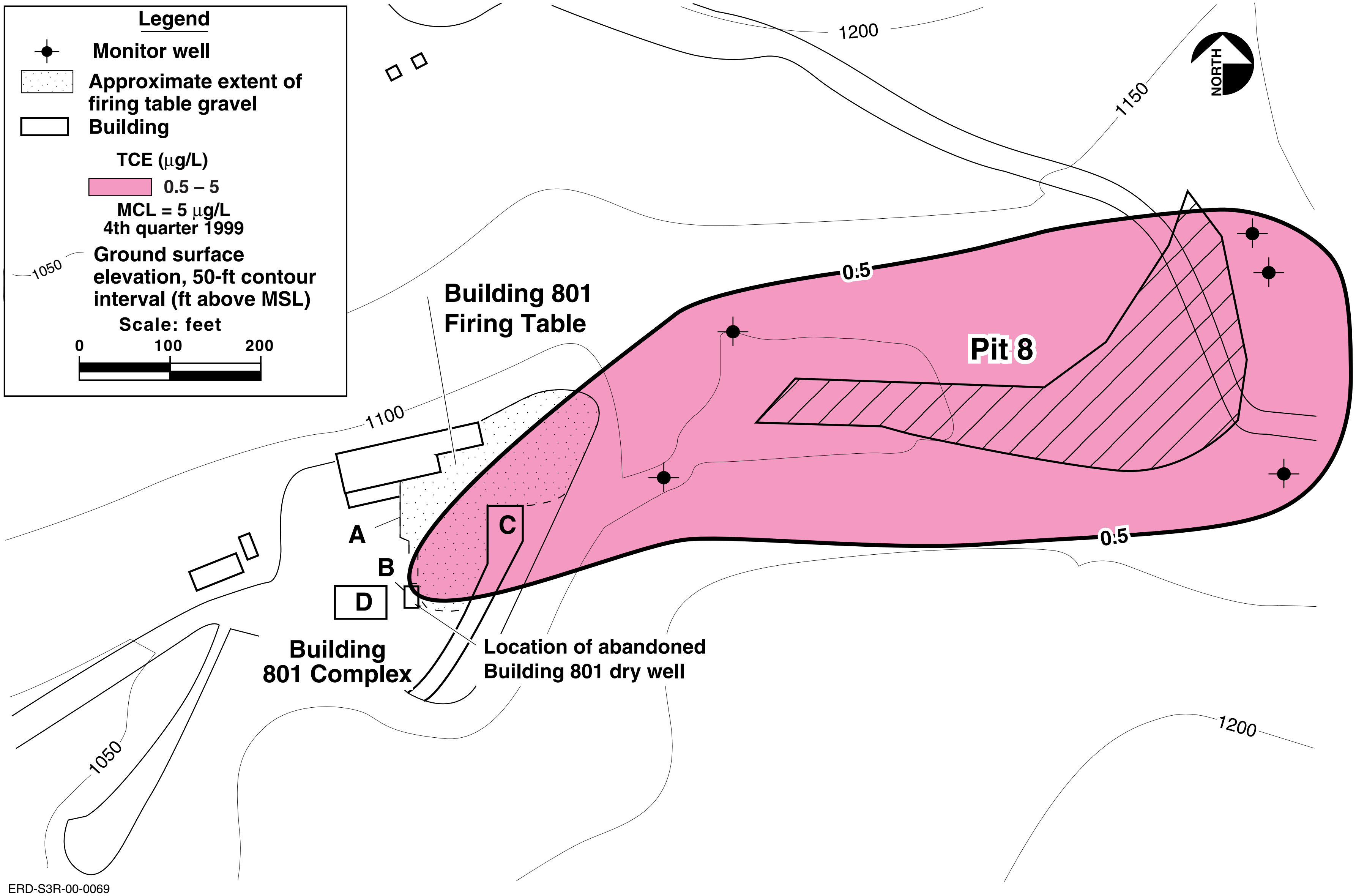
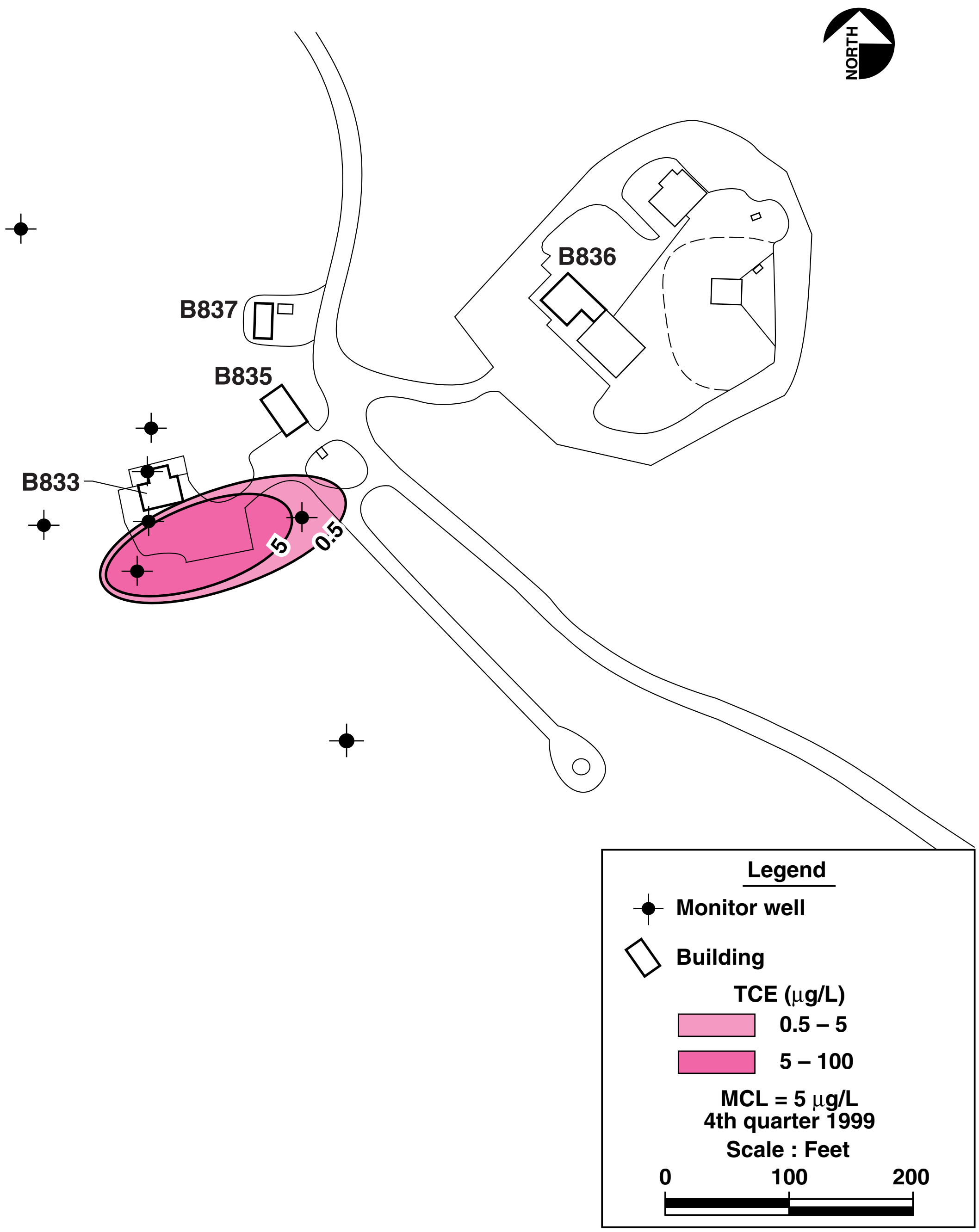


Figure 2.5-24. Distribution of TCE in ground water in the Building 801 and Pit 8 Landfill area, OU8.

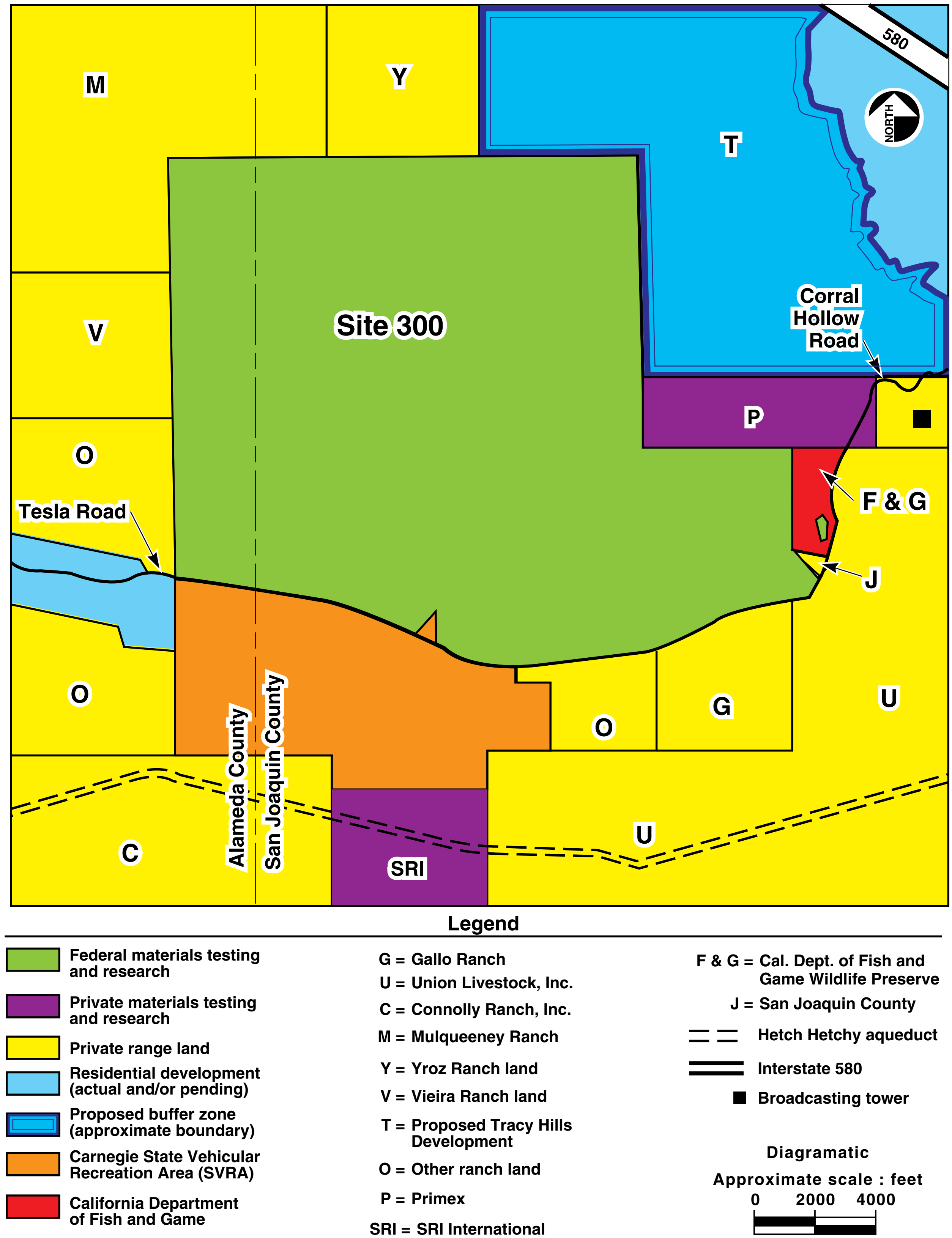


ERD-S3R-00-0067

Figure 2.5-25. Distribution of TCE in the perched Tps water-bearing zone in the Building 833 area, OU8.

ERD-S3R-00-0061

Figure 2.5-26. Distribution of depleted uranium in ground water in the Cierbo Formation at the Building 851 Firing Table area, OU8. Total uranium-238 values include both naturally occuring uranium and depleted uranium added from LLNL operations. (MCL is 20 pCi/L.)



ERD-S3R-00-0066

Figure 2.6-1. Land use in the vicinity of Site 300.

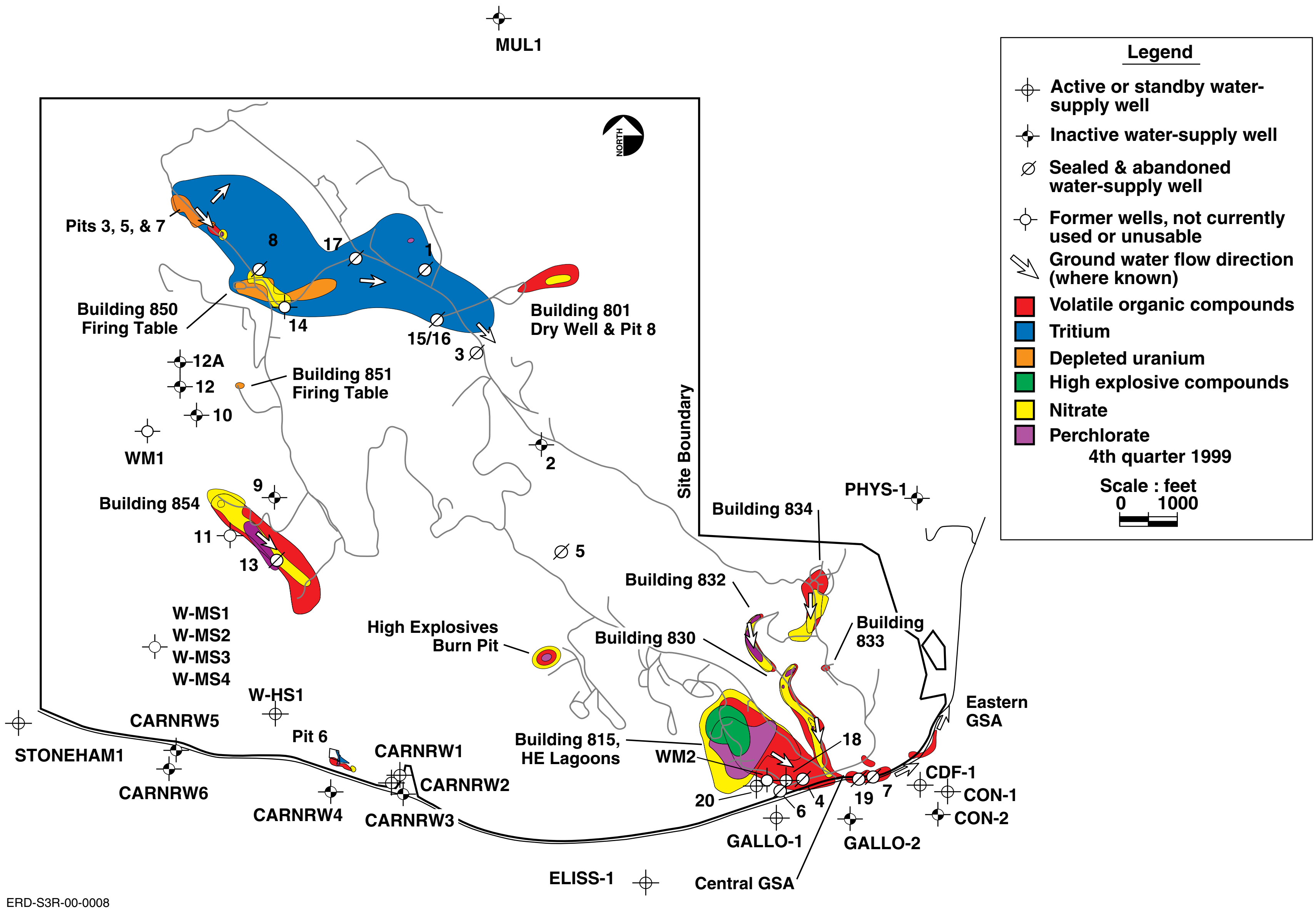
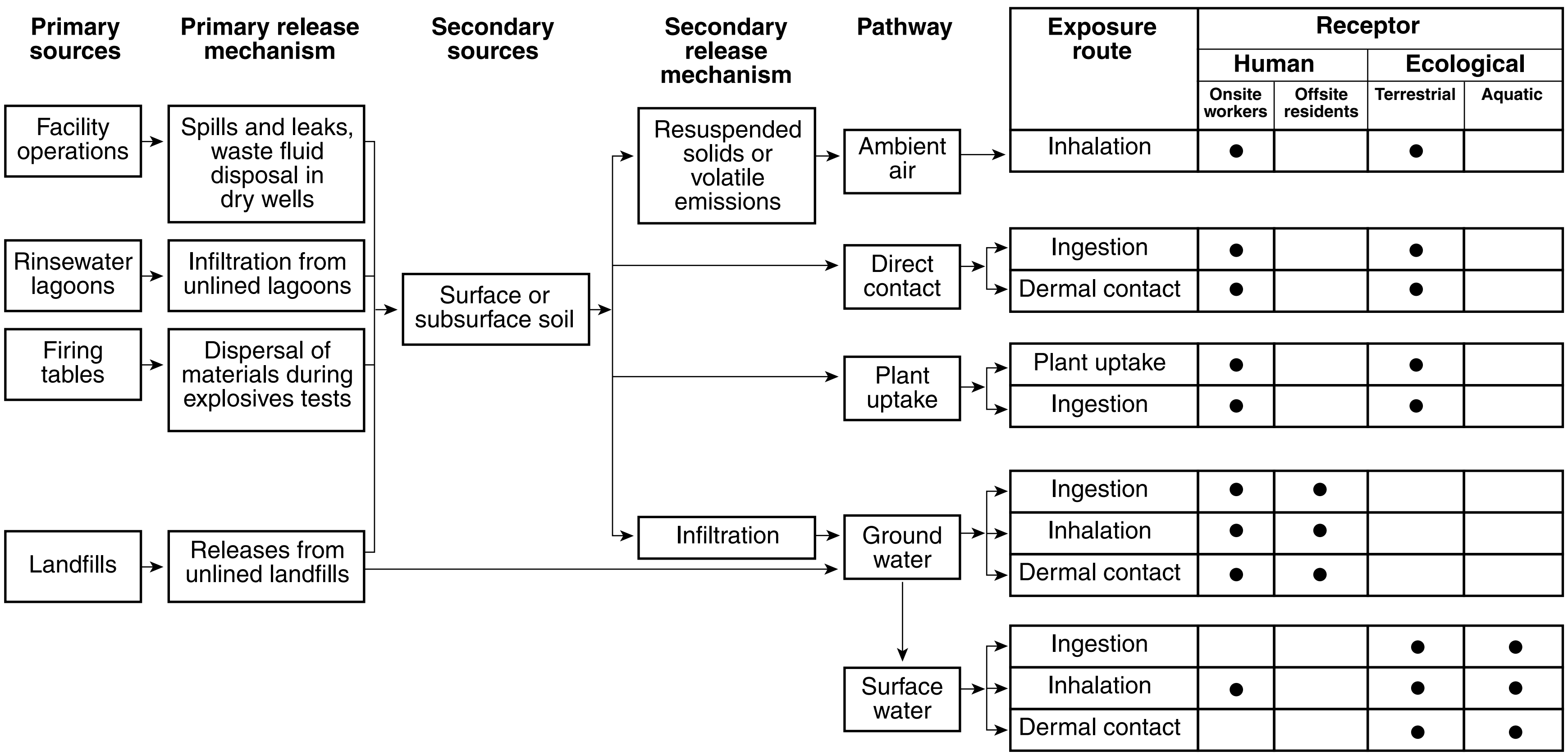


Figure 2.6-2. Water-supply wells in relation to Site 300 ground water contaminant plumes.



ERD-S3R-00-0009

Figure 2.7-1. Conceptual site risk and hazard evaluation model.

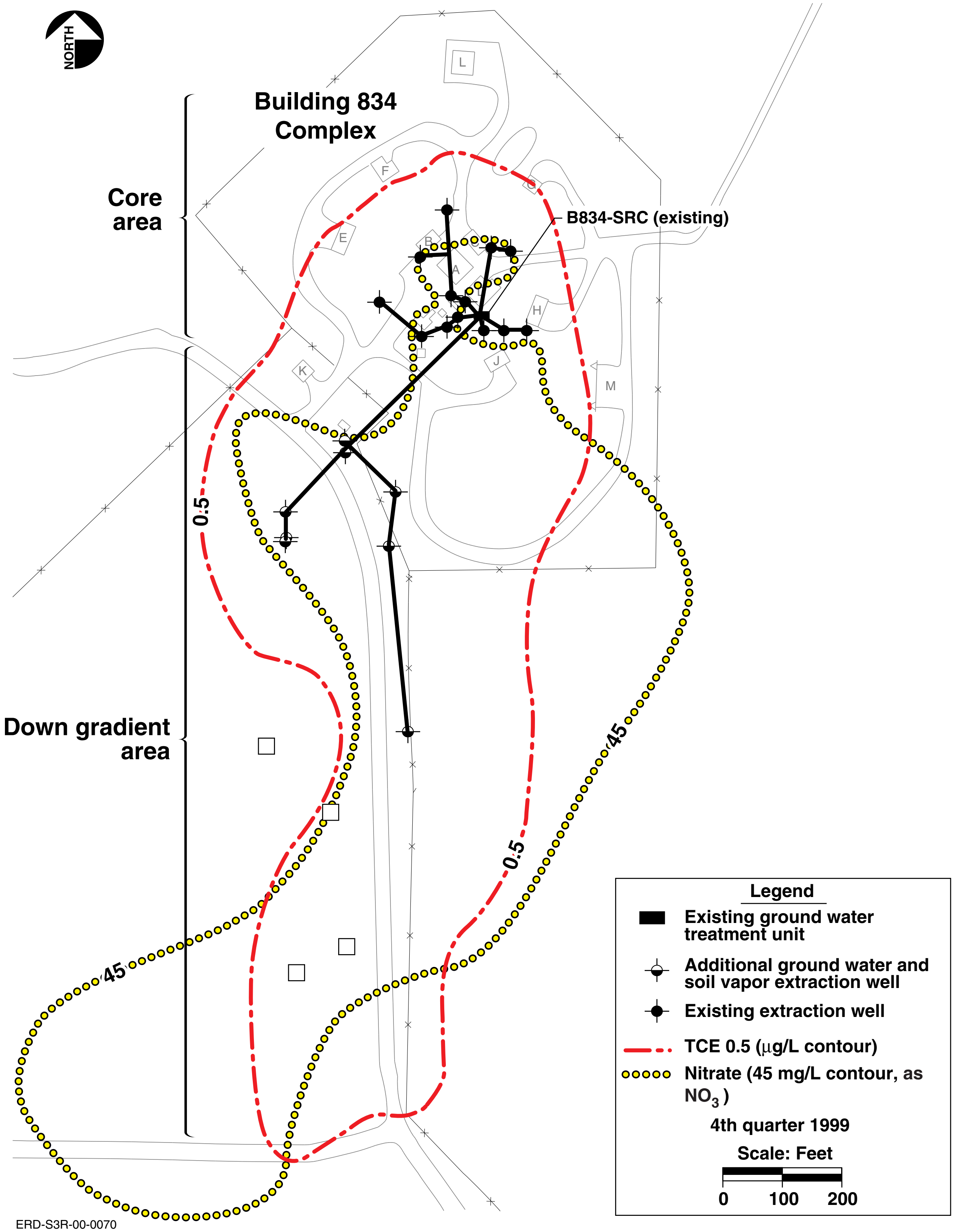


Figure 2.11-1. Locations of the ground water plumes and the components of the selected remedy for Building 834, OU2.

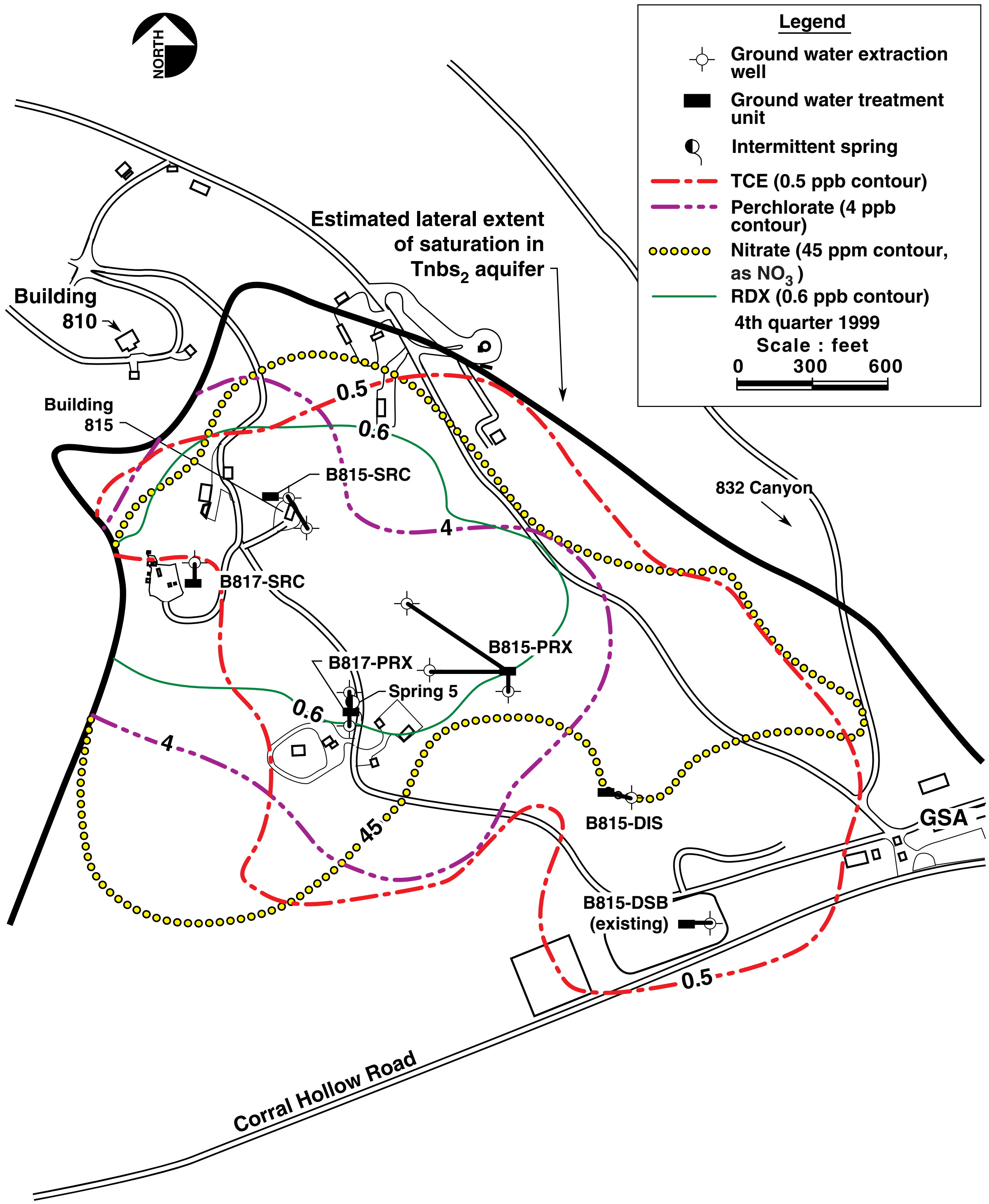


Figure 2.11-2. Locations of the ground water plumes and the components of the selected remedy for the HE Process Area, OU4.

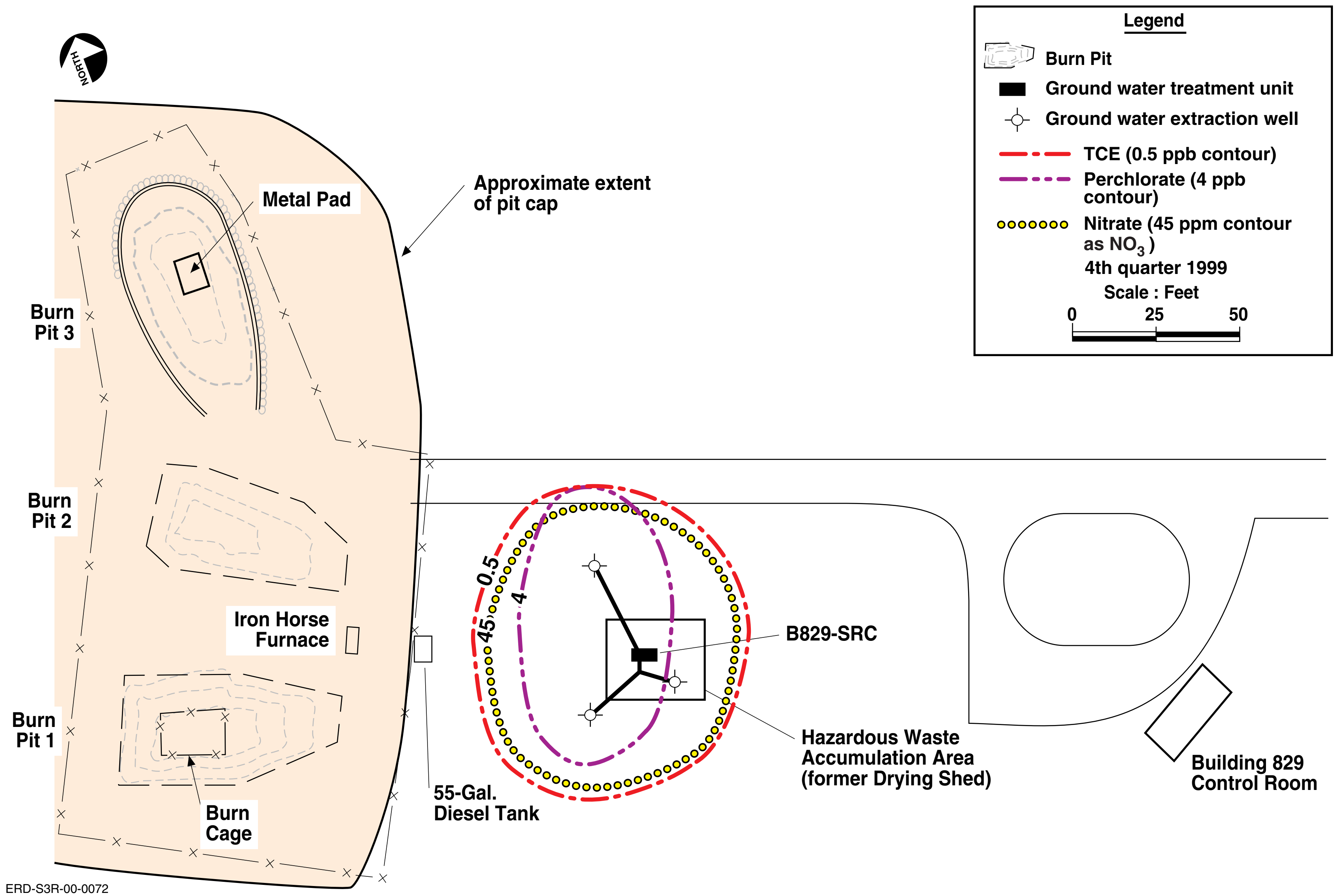


Figure 2.11-3. Locations of the ground water plumes and the components of the selected remedy for the HE Burn Pit portion of the HE Process Area, OU4.

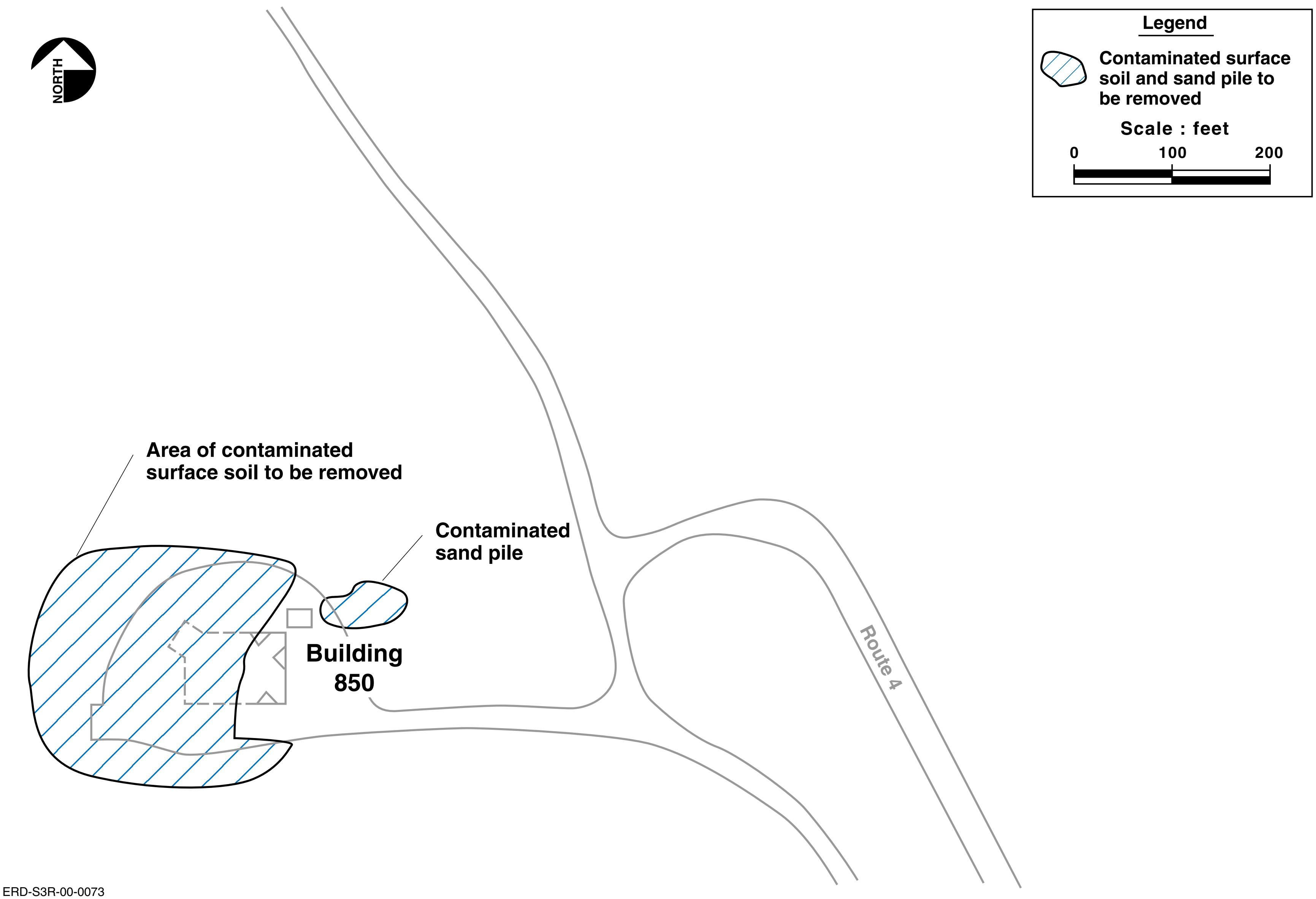
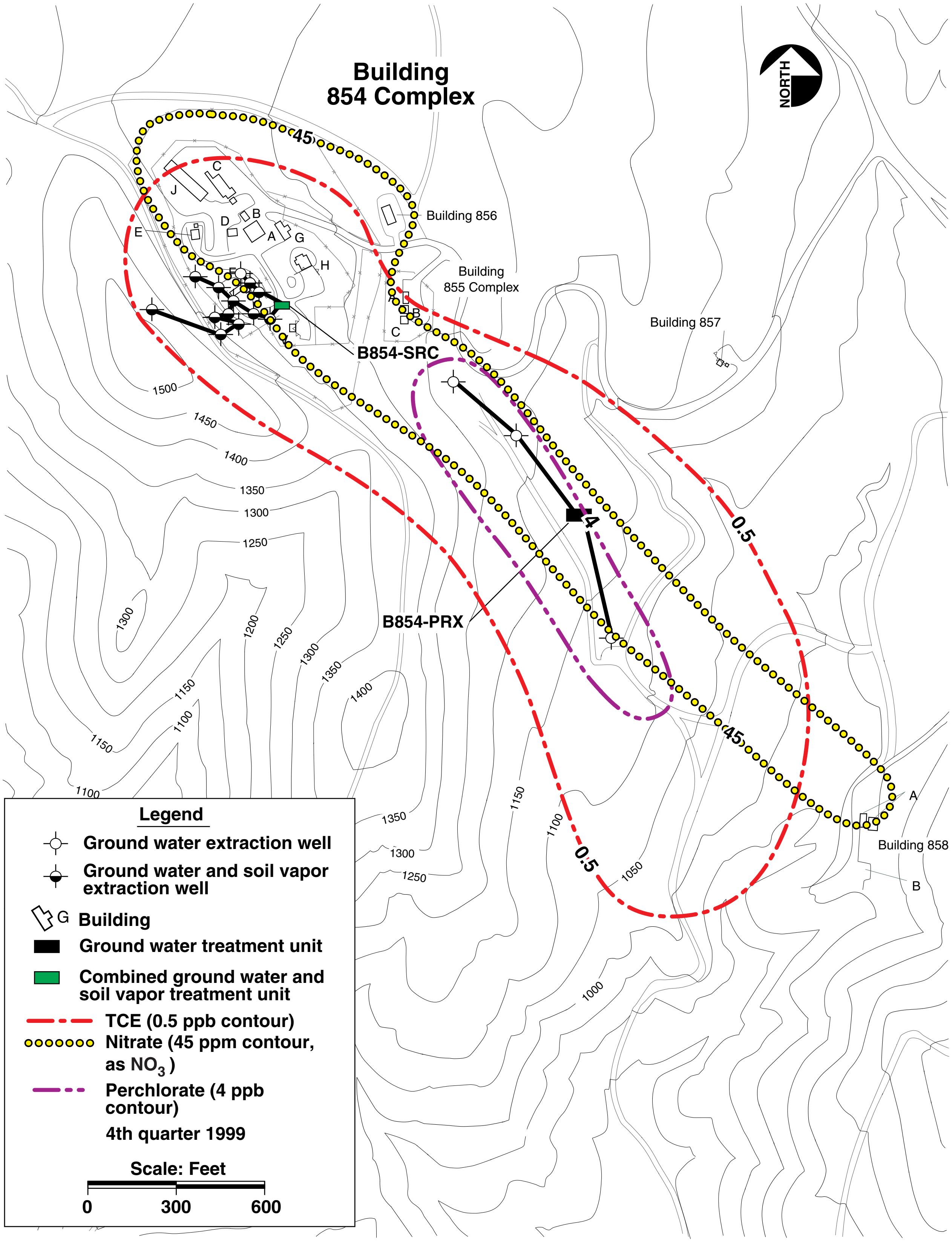
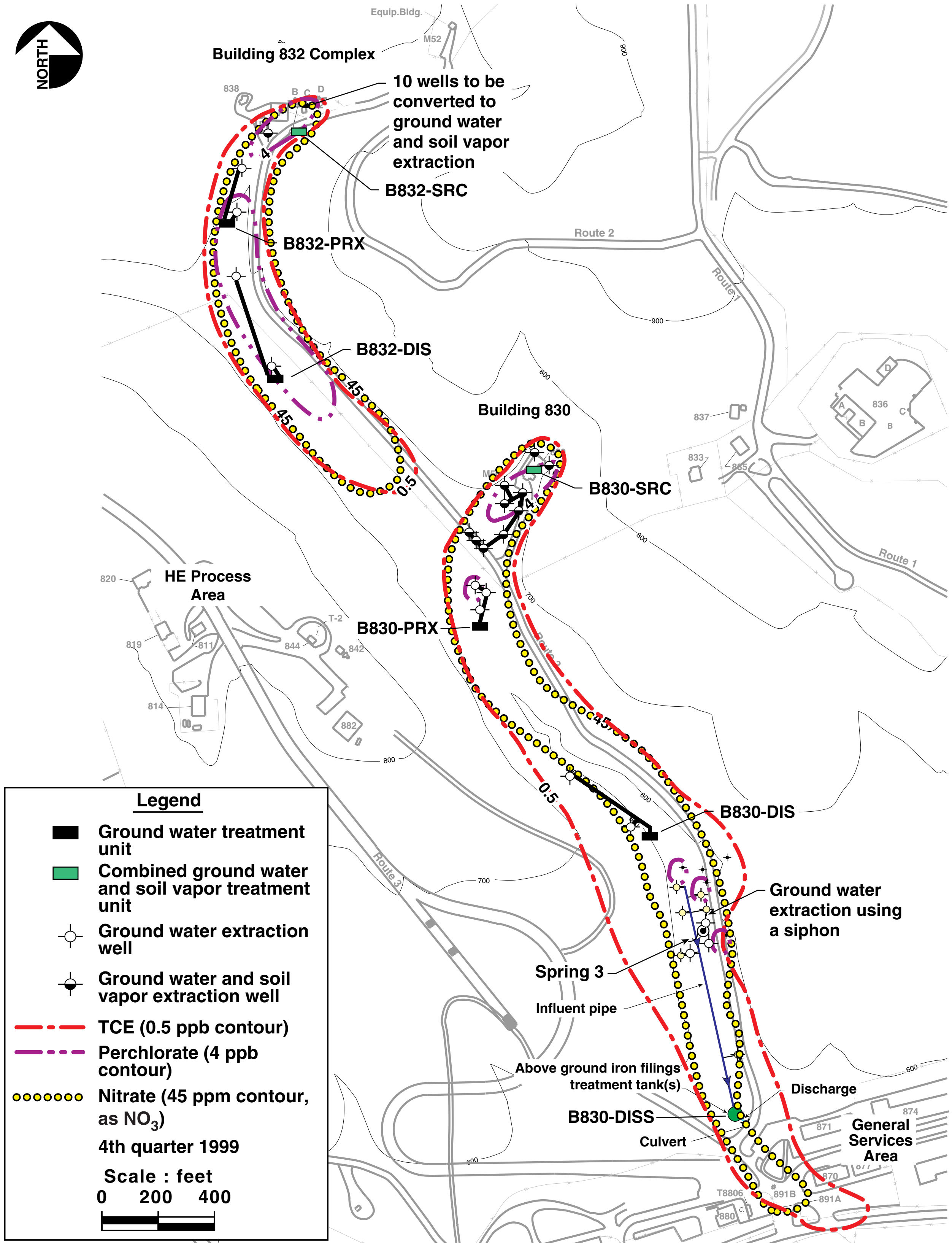


Figure 2.11-4. Location of contaminated material to be removed for the Building 850 firing table (OU5) selected remedy.



ERD-S3R-00-0074

Figure 2.11-5. Locations of the ground water plumes and the components of the selected remedy for the Building 854 area, OU6.



ERD-S3R-00-0075

Figure 2.11-6. Locations of the ground water plumes and the components of the selected remedy for the Building 832 Canyon area, OU7.

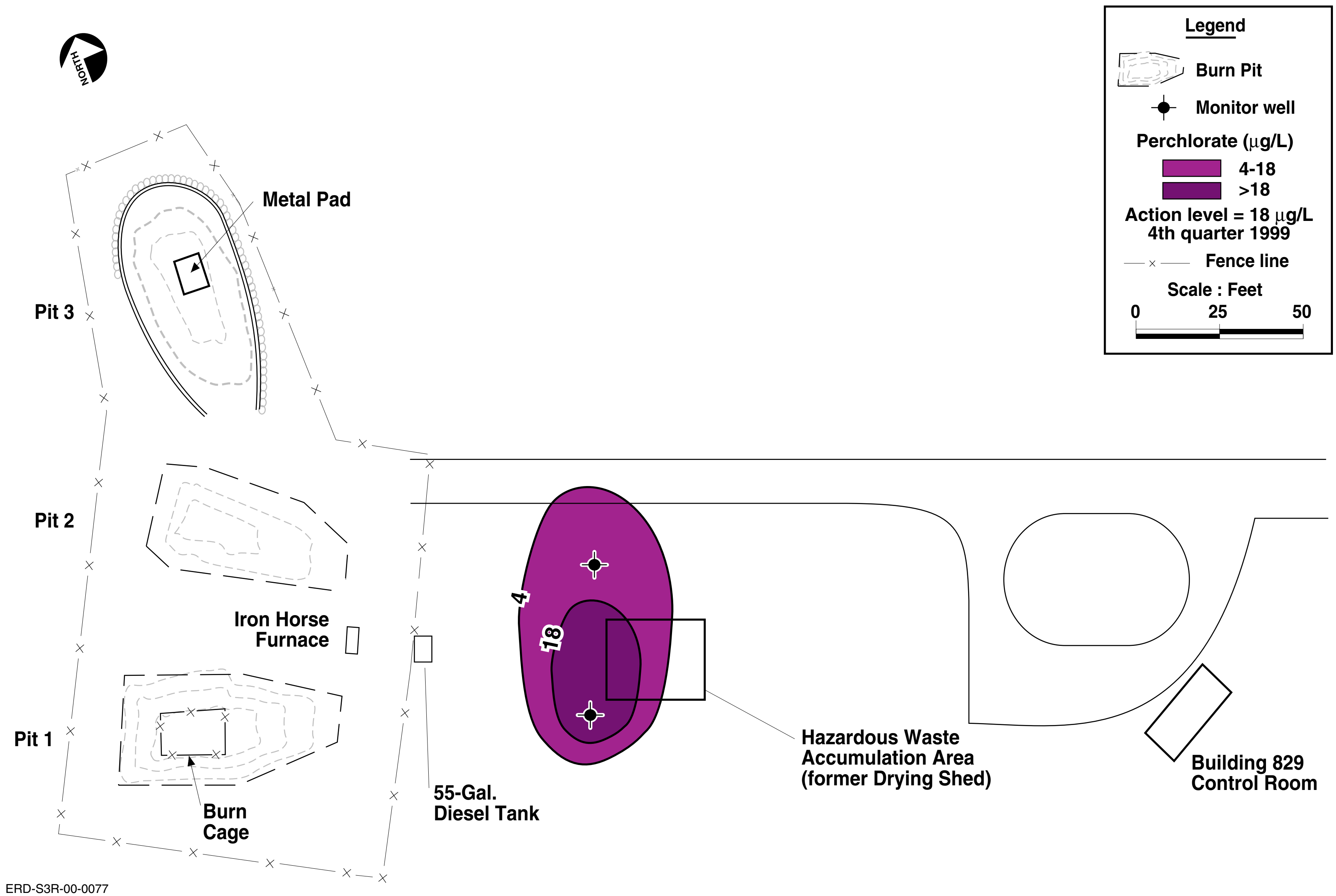


Figure 2.5-14. Distribution of perchlorate in the $Tnsc_1$ perched water-bearing zone in the HE Burn Pit portion of the HE Process Area, OU4.

Tables

Table 1.4-1. Technologies comprising the selected remedies for LLNL Site 300.

Technology	Building 834	Pit 6 Landfill	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
Monitoring	√	√	√	√	√	√	√	√	√	√	√
Risk and hazard management	√	√	√	√		√	√		√		
Monitored natural attenuation		√		√							
Ground water extraction	√		√			√	√				
Soil vapor extraction	√					√	√				
Removal of surface soil and sand pile adjacent to firing tables				√							
Estimated 30-year cost	$12.1M	$2.4M	$27.6M	$4.0M	$0.5M	$9.2M	$26.8M	$0.5M	$0.8M	$0.5M	$0.5M

Table 2.4-1. Overall site cleanup plan for LLNL Site 300.

Area	Past and ongoing responses	Responses proposed in this Interim ROD
General Services Area	Ongoing ground water and soil vapor extraction as documented in the Final GSA OU ROD (1997).	None. Final OU ROD signed in 1997.
Building 834	Ongoing ground water and soil vapor extraction and treatment (since 1995) Excavation of VOC-contaminated soil (1983). Surface water drainage diversion (1998).	Continued ground water extraction and treatment of VOCs, TBOS/TKEBS, and nitrate (ongoing since 1995). Continued soil vapor extraction and treatment of VOCs (ongoing since 1995). Exposure control through risk and hazard management. Monitoring.
Pit 6 Landfill	Exhumed waste containing depleted uranium (1971). Capped landfill as a CERCLA removal action (1997).	Monitored natural attenuation of VOCs and tritium in ground water. Exposure control through risk and hazard management. Monitoring.
High Explosives Process Area	Ground water extraction and treatment underway, initiated in 1999. Closed HE Rinsewater Lagoons under RWQCB oversight (1985-1989). Sealed and abandoned water-supply wells 4 (1990) and 6 (1989). Capped HE Burn Pits under RCRA (1998).	Ground water extraction and treatment of: (1) VOCs and nitrate at the leading edge of the B815 TCE plume, (2) VOCs, HE compounds, nitrate, and perchlorate from B815 and HE rinsewater lagoons, and (3) VOCs, nitrate, and perchlorate from the HE Burn Pit. No further action for: (1) VOCs in soil and bedrock at the HE rinsewater lagoons, and (2) VOCs and HMX/RDX in soil and bedrock at the HE Burn Pits. Exposure control through risk and hazard management. Monitoring.

Table 2.4-1. Overall site cleanup plan for LLNL Site 300. (Cont. page 2 of 3)

Area	Past and ongoing responses	Responses proposed in this Interim ROD
Building 850 Firing Tab1e	Removed PCB-contaminated debris from vicinity of Building 850 Firing Table (1998). Removed/replaced contaminated gravel from Building 850 Firing Table (1988).	Monitored natural attenuation of tritium in ground water. Removal of contaminated sand pile and contaminated soil adjacent to Building 850 firing table. Exposure control through risk and hazard management. Monitoring.
Pit 2 Landfill	Landfill covered (1960).	Enhanced monitoring. Surface water reengineering.
Building 854	Excavated TCE-contaminated soil at Buildings 854H and 854F (1983). Ground water extraction initiated as a treatability study (1999).	Ground water extraction and treatment of VOCs, perchlorate, and nitrate. Soil vapor extraction and treatment of VOCs. Exposure control through risk and hazard management. No further action for metals, HMX, PCBs, and tritium in surface soil. Monitoring.
Building 832 Canyon	Ongoing ground water and soil vapor extraction treatability studies.	Ground water extraction and treatment of VOCs, perchlorate, and nitrate at Buildings 830 and 832. Downgradient ground water extraction using siphon with *ex situ* treatment of VOCs by iron filings. Soil vapor extraction and treatment of VOCs at Buildings 830 and 832. Exposure control through risk and hazard management. No further action for: (1) HMX in surface soil and nitrate in subsurface soil and bedrock at B830, and (2) HMX and nitrate in soil and bedrock at Building 832. Monitoring.

Table 2.4-1. Overall site cleanup plan for LLNL Site 300. (Cont. page 3 of 3)

Area	Past and ongoing responses	Responses proposed in this Interim ROD
Building 801/Pit 8 Landfill	Removed/replaced firing table gravel periodically since 1988. Sealed dry well 801D (1981).	No further action for VOCs in subsurface soil at the B801 dry well. Enhanced monitoring.
Building 833	None.	Exposure control through risk and hazard management. Monitoring.
Building 845 Firing Table/ Pit 9 Landfill	Removed/replaced firing table gravel periodically since 1988.	No further action for HMX and uranium in soil and bedrock. Enhanced monitoring.
Building 851 Firing Table	Removed/replaced firing table gravel periodically since 1988.	No further action for VOCs and uranium in soil and bedrock and for RDX and uranium in surface soil. Monitoring.

Table 2.5-1. Summary of Site 300 operable units and release sites.

OU2: Building 834				
The Building 834 OU contains Buildings 834A, B, C, D, E, F, G, H, J, K, L, M, and O and contamination in perched ground water downgradient of the facility. Historical information and analytical data indicate that contaminants were released to the environment at release sites at the core of the Building 834 Complex between the early 1960s and mid-1980s. Approximately 550 gallons of TCE, used as a heat transfer media at Building 834, were released through leakage from pipes, pumps, and valves, and from surface spills between 1962 and 1978 (Olsen, 1982). TCE was also released to the septic tank prior to 1978. TCE has been identified as the primary chemical of concern and was present in shallow perched water-bearing zone as a dense non-aqueous phase liquid (DNAPL). Other VOCs have also been detected in ground water, surface soil, and the vadose zone. TBOS/TKEBS, silicon-based lubricants used in the TCE heat transfer system, were released to ground water as a light non-aqueous phase liquid (LNAPL). The regional aquifer ($Tnbs_1$) has not been impacted. VOC concentrations in perched ground water have decreased with TCE decreasing from a historical maximum of 800,000 μg/L to 94,000 μg/L in 1999. Concentrations of TBOS/TKEBS and nitrate have shown a similar decrease over time. These concentration reductions are likely attributable in part to the on-going active ground water and soil vapor remediation at Building 834.				
Release sites: Pump Station 834B, Pump Station 834C, Pump Station 834D, Test Cell 834E, Test Cell 834F, Test Cell 834H, Test Cell 834J, and Septic System Effluent.				
Media of concern	Units affected	Contaminants of concern (COCs)/Highest historical concentration	Estimated volume of contaminated media[a]	Estimated contaminant volume
Ground water	Perched gravels and gravelly sands (Tpsg) of the Qt-Tpsg hydrologic unit. Flow direction: southward Average ground water velocity: 0.1 to 1 ft/day	VOCs: Chloroform (950 μg/L) cis-1,2-Dichloroethylene (540,000 μg/L) Tetrachloroethylene (10,000 μg/L) 1,1,1-TCA(33,000 μg/L) TCE (800,000 μg/L) TBOS/TKEBS (7,300,000 μg/L) Nitrate (480 mg/L)	TCE: 1,770,000 ft^3 TBOS/TKEBS: 3,710 ft^3 Nitrate: 569,000 ft^3	TCE: 28 gal TBOS/TKEBS: 1.74 gal
Vadose zone	Stratigraphic unit affected: Tpsg	VOCs: PCE (0.09 mg/kg) Toluene (0.052 mg/kg) TCE (970 mg/kg)	VOCs: 590,000 ft^3	VOCs: 270 gal
Surface soil	NA	None	NA	NA
Surface water	None	None	NA	NA
Corrective Actions: Some excavation of VOC-contaminated soil was performed in 1983. Ground water and soil vapor extraction and treatment were initiated in 1995 and are ongoing. Testing of innovative technologies including surfactant injection was performed under an Interim Record of Decision which was signed in 1995. A drainage diversion project was completed in 1998 as a source control measure to prevent infiltration of rainwater into contaminated media at Building 834 release sites.				

Note:

a = Volume based on background concentrations and most up-to-date plume maps available for preparation of the SWFS.
NA = Not applicable.

Table 2.5-1. Summary of Site 300 operable units and release sites. (Cont. page 2 of 13)

Media of concern	Units affected	Contaminants of concern (COCs)/Highest historical concentration	Estimated volume of contaminated media[a]	Estimated contaminant volume
OU3: Pit 6 Landfill				
The Pit 6 Landfill OU consists of the former waste disposal area (Pit 6) and its related ground water contaminant plume. From 1964 to 1973, approximately 1,900 yd^3 of waste was placed in nine unlined debris trenches and animal pits in the Pit 6 Landfill. The buried waste included laboratory and shop debris and biomedical waste. Data indicate that the chlorinated solvent TCE and trace concentration of other VOCs were released to the subsurface from buried debris in the Pit 6 Landfill. VOC concentrations in ground water have naturally attenuated by almost two orders of magnitude over the past few years and are below or close to MCLs in all wells. Activities of tritium are above background but below the MCL in several monitor wells, indicating a possible localized release.				
Release sites: Shipment cell 55 (Tritium) and trench 3 (VOCs).				
Ground water	Terrace alluvium (Qt) and shallow bedrock ($Tnbs_1$) units of the hydrologic unit. Flow direction: south to southeast. Average ground water velocity: 0.08 ft/day	VOCs TCE (250 μg/L) PCE (3.2 μg/L) cis-1,2-DCE (9.8 μg/L) Trans-1,2-DCE (33 μg/L) 1,1,1- TCA (13 μg/L 1,2-DCA (1.7 μg/L) Chloroform (14 μg/L Nitrate (228 mg/L) Perchlorate (65.2 μg/L) Tritium (2,520 pCi/L)	VOCs: 1,250,000 ft^3 Tritium: 705,000 ft^3	VOCs: 0.021 gal Tritium: Insufficient data
Vadose zone	NA	None	NA	NA
Surface soil	NA	None	NA	NA
Surface water	Spring 7	VOCs TCE (110 μg/L) cis-1,2-DCE (12 μg/L) trans-1,2-DCE (33 μg/L) PCE (1.4 μg/L)	NA (Spring 7 has been dry since 1992)	NA
Corrective Actions: Waste contaminated with uranium was exhumed in 1971. The landfill was capped as a removal action in 1997.				

Notes:
a = Volume based on background concentrations and most up-to-date plume maps available for preparation of the SWFS.
NA = Not applicable.

Table 2.5-1. Summary of Site 300 operable units and release sites. (Cont. page 3 of 13)

OU4: High Explosives (HE) Process Area

The HE Process Area OU consists of Building 815, Building 810, the HE lagoons, the HE Burn Pits, and related downgradient ground water plumes. Building 815 served as a central steam plant for the HE Process Area from 1958 to 1986. Surface spills at the drum storage and dispensing area for the former Building 815 steam plant, where TCE was used to clean pipelines, resulted in releases of TCE to the ground surface. In addition, from 1959 to 1985, waste fluids were discharged to dry well 810A resulting in the release of VOCs to the subsurface. From the mid-to-late 1950s to 1985, wastewater containing HE compounds, nitrate, and perchlorate was discharged to former unlined rinsewater lagoons. These lagoons are believed to have been the primary source of HE compounds, nitrate, and perchlorate in ground water. VOC concentrations in ground water in the Building 815 area have decreased over time with TCE decreasing from a historical maximum of 1,000 μg/L to 160 μg/L in 1999. The concentration reductions are likely attributable to natural attenuation. In the HE Lagoon area, HMX and RDX have generally shown decreasing concentration trends in ground water. Excavation and capping of these lagoons, which was completed in 1989, should prevent further releases of HE compounds and associated constituents (e.g., nitrate and perchlorate). The regional aquifer has not been impacted. Three RCRA-regulated burn pits were located in the vicinity of Building 829 in which HE particulates and cuttings, explosive chemicals, and explosives-contaminated debris were burned. Reportedly nearly 150 kg/month of explosives, reactive chemicals, and explosives-contaminated combustible waste were destroyed at this facility. The facility was operational from the late 1950s until 1998 when the burn pits were capped and closed under RCRA. Historical information and analytic data indicate that HE compounds and VOCs were released to the environment in the vicinity of the HE Burn Pits. Soil analytic data indicate that low levels of HE compounds are present in the upper 10 ft in the vicinity of the burn pits and only sporadic, trace VOCs may be present. Ground water analytic data indicate that a water-bearing zone in the $Tnsc_1$ hydrogeologic unit at the Burn Pits was impacted with TCE concentrations up to 1,000 μg/L.

Release sites: Building 815 TCE Hardstand (VOCs), Building 810 Dry Well (VOCs), HE Lagoon 806/807, HE Lagoons 807A, 807B, 814, 817, 825, 826, 827C/D827E, and 828 (HE compounds, nitrate, and perchlorate), HE Burn Pits (VOCs, nitrate and perchlorate).

Media of Concern	Units affected	Contaminants of concern (COCs)/Highest historical concentration	Estimated volume of contaminated media[a]	Estimated contaminant volume
Ground water	B815: Clays and silts (Tps) and shallow bedrock ($Tnbs_2$ and $Tnsc_1$) HE Lagoons: Clays and silts (Tps) and shallow bedrock ($Tnbs_2$) HE Burn Pits: Bedrock ($Tnbc_1$) Flow direction: to south-southeast. Average ground water velocity: Approx. 1 ft/day ($Tnbs_2$)	B815 VOCs: Chloroform (5.8 μg/L) 1,1-DCE (4.7 μg/L) cis-1,2-DCE (3.3 μg/L) TCE (450 μg/L) HE Lagoons RDX (350 μg/L) HMX (67 μg/L) 4-Amino-2,6-dinitrotoluene (24 μg/L) Nitrate (583 mg/L) Perchlorate (50 μg/L) HE Burn Pits VOCs: cis-1,2-DCE (12 μg/L) TCE (1,000 μg/L) Nitrate (230 mg/L) Perchlorate (24 μg/L)	TCE: Tps: 1,010,000 ft^3 $Tnbs_2$: 994,000,000 ft^3	TCE: Tps: 0.37 gal $Tnbs_2$: 3.25 gal

Table 2.5-1. Summary of Site 300 operable units and release sites. (Cont. page 4 of 13)

OU4: High Explosives (HE) Process Area (Cont.)				
Media of Concern	**Units affected**	**Contaminants of concern (COCs)/Highest historical concentration**	**Estimated volume of contaminated media**	**Estimated contaminant volume**
Vadose zone	**Stratigraphic unit affected: Tps**	**VOCs:** **Benzene (0.9 mg/kg)** **Chloroform (0.4 mg/kg)** **cis-1,2-DCE (0.026 mg/kg)** **Ethylbenzene (0.0006 mg/kg)** **Freon 113 (0.0031 mg/kg** **Freon 12 (0.0024 mg/kg)** **Methylene chloride (0.013 mg/kg)** **PCE (0.0034 mg/kg)** **Toluene (0.003 mg/kg)** **TCE (33 mg/kg)** **Total xylenes (0.0021 mg/kg)** **RDX (3.25 mg/kg)** **HMX (21 mg/kg)**	**TCE: 550,000 ft^3**	**TCE: 0.23 gal**
Surface soil	**NA**	**RDX (0.18 mg/kg)** **HMX (4.0 mg/kg)**	**Insufficient data**	**Insufficient data**
Surface water	**Spring 5 (sampled at well W-817-03A)**	**VOCs:** **cis-1,2-DCE (3.3 μg/L)** **TCE (150 μg/L)**	**NA (No surface flow)**	**NA**
Corrective Actions: Ground water extraction was initiated in 1999 as a removal action to control offsite VOC plume migration from Building 815. Building 810 dry well was taken out of service in 1989 and no longer receives contaminated waste water. Lagoon closures completed in 1985–1989. In 1990 and 1989, two former water-supply wells 4 and 6, respectively, were sealed and abandoned to prevent contamination from migrating between aquifers. The HE Burn Pits were capped and closed under RCRA in 1998.				

Note:

a = Volume based on background concentrations and most up-to-date plume maps available for preparation of the SWFS.

NA = Not applicable.

Table 2.5-1. Summary of Site 300 operable units and release sites. (Cont. page 5 of 13)

OU5: Building 850 (B850)				
The Building 850/Pits 3 & 5 OU includes the B850 firing table and sand pile, ground water plumes originating at B850 release sites, the Pit 2 Landfill and Pits 3, 4, 5, and 7 Landfills (Pit 7 Complex). The Pit 7 Complex will be the subject of a subsequent ROD amendment and is not discussed further. Tritium was used primarily between 1963 and 1978 in hydrodynamic experiments at the B850 firing table. In addition, the experimental test assemblies sometimes contained depleted uranium and metals. Leaching of contaminants from the firing table gravel has resulted in tritium and uranium contamination of ground water, and subsurface soils. As a result of the dispersion of contaminated shrapnel during explosives testing, surface soil was contaminated with various metals, HMX, and depleted uranium. PCB-bearing shrapnel was also present in this area. During the period from 1962 to 1972, a large volume of sand was stockpiled near the B850 firing table and was periodically used and reused during large experiments, gradually becoming contaminated with tritium. Leaching from this sand pile resulted in release of tritium to ground water and the vadose zone. Tritium activities at Well 8 Spring have decreased from a maximum of 770,000 pCi/L to a 1999 maximum of 38,500 pCi/L. Tritium activities in ground water the vicinity of the B850 firing table have been decreasing from a historical maximum of 471,000 pCi/L to 96,500 pCi/L in 1999, which is likely attributable to natural decay. The Pit 2 Landfill operated from 1956 to 1960 and was used to dispose of firing table waste from Buildings 801 and 802. VOCs were reported in ground water in 1989, but have not been detected since. Although tritium has been detected in subsurface soil/rock near the Pit 2 Landfill, the depths indicate that it results from the transport of tritium in ground water from the Building 850 area.				
Release sites: Building 850 Firing Table (HMX, PCBs, tritium, and depleted uranium), Building 850 Sand pile (tritium).				
Media of concern	**Units affected**	**Contaminants of concern (COCs)/ Highest historical concentration**	**Estimated volume of contaminated media[a]**	**Estimated contaminant volume**
Ground water	**Quaternary alluvium (Qal) and sandstone/ claystone bedrock ($Tnbs_1$ and Tmss) of the Qal-Tmss hydrogeologic unit** **Flow direction: east-northeast** **Average ground water velocity: 0.4 ft/day in alluvium; 0.05 to 1 ft/day in bedrock**	**<u>B850 Firing Table and Sandpile</u>** **Tritium (471,000 pCi/L)** **Uranium-238 (18.4 pCi/L)** **Nitrate (140 mg/L)**	**<u>B850</u>** **Tritium: 113,000,000 ft^3** **Uranium-238: 960,000 ft^3**	**Not calculated**
Vadose zone	**Statigraphic units affected (Qal & $Tnbs_1$)**	**<u>B850 Firing Table and Sandpile</u>** **Tritium (11,000,000 pCi/L_{sm})** **Uranium-238 (28.2 pCi/g)**	**<u>B850</u>** **Tritium: 261,000 ft^3**	**Not calculated**
Surface soil	**NA**	**<u>B850 Firing Table and Sandpile</u>** **Metals:** **Beryllium (15 mg/kg)** **Cadmium (8.6 mg/kg)** **Copper (1,000 mg/kg)** **HMX (2.4 mg/kg)** **PCB 1254 (180 mg/kg)** **CDDs (0.0096 mg/kg)** **CDFs (0.057 mg/kg)** **Uranium-238 (24 pCi/g)**	**Not calculated**	**Not calculated**

Table 2.5-1. Summary of Site 300 operable units and release sites. (Cont. page 6 of 13)

OU5: Building 850 (B850) (Cont.)				
Media of concern	**Units affected**	**Contaminants of concern (COCs)/ Highest historical concentration**	**Estimated volume of contaminated media**	**Estimated contaminant volume**
Surface water	Well 8 Spring	Tritium (770,000 pCi/L)	NA	Not calculated
Corrective Actions: Gravel was removed from the Building 850 firing table in 1988. PCB-contaminated firing table debris was removed from the vicinity of the Building 850 firing table in 1998. Pit 1 was closed under RCRA in 1992 through pit capping.				

Notes:

a = Volume based on background concentrations and most up-to-date plume maps available for preparation of the SWFS.
NA = Not applicable.

Table 2.5-1. Summary of Site 300 operable units and release sites. (Cont. page 7 of 13)

OU6: Building 854 (B854)				
In 1967, two TCE brine systems were installed at B854. The primary loop connected Buildings 854B and 854G and the secondary loop connected Buildings 854 C, 854D, 854E, and 854F. TCE has been released to subsurface soil in the B854 OU through leaks and discharges of TCE-based heat exchange fluid from the secondary TCE brine system, primarily from outdoor valve stations and from piping between buildings. Both loops were extensively used until 1986, infrequently used after 1986, and removed in 1989. Most spills are believed to have occurred between 1967 and 1984 (Stupfel, 1992). Test equipment in B854H was connected to the TCE brine system via outdoor piping, The valve station at B854H is located in the basement with a catch basin (sump). The sump discharged to the ground surface east of the building at the drain outfall. Discharge at the B854H drain outfall resulted in releases to TCE to the ground surface. VOC concentrations in ground water in the Building 854 area have decreased with TCE decreasing from a historical maximum of 2,900 μg/L to 270 μg/L in 1999. The concentration reductions are likely attributable to natural attenuation.				
Release sites: Building 854D (TCE), Building 854E (TCE), Building 854F (TCE), Building 854H Drain Outfall (TCE).				
Media of concern	**Units affected**	**Contaminants of concern (COCs)/ Highest historical concentration**	**Estimated volume of contaminated media[a]**	**Estimated contaminant volume**
Ground water	Quaternary landslide deposits (Qls) and sandstone bedrock ($Tnbs_1$) of the Qls-Tmss hydrogeologic unit Ground water flow: east-southeast Flow rate: To be determined.	VOCs: TCE (2,900 μg/L) Nitrate (200 mg/L) Perchlorate (16 μg/L)	VOCs: 6,000,000 ft^3	2.73 gal
Vadose zone	Statigraphic units affected: Qls & $Tnbs_1$	TCE (30.7 mg/kg)	VOCs: 8,790,000 ft^3	13.1 gal
Surface soil	NA	HMX (150 mg/kg) Metals: Lead (98 mg/kg) Zinc (1,400 mg/kg) PCBs (52 mg/kg) Tritium (317 pCi/L_{sm})	Not calculated.	NA
Surface water	Springs 10, 11	None	NA	NA
Corrective Action: TCE-contaminated soil was excavated in 1983 in the vicinity of the Building 854H drain outfall. Surface soil was removed at the northeast corner of Building 854F. The TCE brine systems were removed in 1989. Ground water extraction in the source area began in 1999, as a treatability study.				

Notes:

a = Volume based on background concentrations and most up-to-date plume maps available for preparation of the SWFS.

NA = Not applicable.

Table 2.5-1. Summary of Site 300 operable units and release sites. (Cont. page 8 of 13)

OU7: Building 832 Canyon

The Building 832 Canyon OU consists of Buildings 830 and 832 release sites and related ground water contaminant plumes. Starting in the late 1950s and early 1960s, facilities at Buildings 830 and 832 were used to test the stability of weapons and weapon components. The use of Buildings 830 and 832 for testing was discontinued in the late 1970s and 1985, respectively. Contaminants, primarily VOCs, were released from Buildings 830 and Building 832 through piping leaks and surface spills where TCE was used as a heat exchange fluid as part of testing activities. Rinse water containing HE compounds was disposed via floor drains in Building 832 leading to a surface discharge outside the building. As a result, HMX has been detected in soil and bedrock. However, no HE compounds have been detected in ground water. Nitrate contamination of ground water in the OU is believed to be the result of a combination of HE-related testing and some septic system releases. Although rinsewater containing HE compounds was likely discharged to one or more small disposal lagoons or dry wells near Building 830, no HE compounds have been detected in any media in this area. However the HE compounds released may have degraded and migrated downward as nitrogenous compounds. Although the source of perchlorate contamination is not known at this time, it is suspected that perchlorate was a component of HE test assemblies. VOC concentrations in ground water in the Building 830 area have decreased, with TCE decreasing from a historical maximum of 30,000 μg/L to 8,400 μg/L in 1999. Surface water VOC concentrations at Spring 3 have also decreased from a maximum of 200 μg/L to 21 μg/L in 1999. The concentration reductions are likely attributable to natural attenuation.

Release sites: Building 830 (B830) and Building 832 (B832).

Media of concern	Units affected	Contaminants of concern (COCs)/Highest historical concentration	Estimated volume of contaminated media[a]	Estimated contaminant volume
Ground water	VOCs and nitrate: Alluvium (Qal), and sandstone and siltstone/ claystone bedrock ($Tnbs_2$, $Tnsc_1$, $Tnbs_1$). Perchlorate: Qal and siltstone/ claystone bedrock ($Tnsc_1$). Flow direction: south to southeast. Average ground water velocity: Approx. 0.1 to 1 ft/day.	Building 830 VOCs: Acetone (41 μg/L) Chloroform (30 μg/L) cis-1,2-DCE (1.4 μg/L) PCE (10 μg/L) TCE (30,000 μg/L) Nitrate (501 mg/L) Perchlorate (51 μg/L) Building 832 VOCs: cis-1,2-DCE (8.6 μg/L) TCE (1,800 μg/L) Nitrate (177 mg/L) Perchlorate (17 μg/L)	TCE (4,670,000 ft^3) Nitrate (4,280,000 ft^3) Perchlorate (60,000 ft^3)	TCE (5 gal)

Table 2.5-1. Summary of Site 300 operable units and release sites. (Cont. page 9 of 13)

OU7: Building 832 Canyon (Cont.)				
Media of concern	**Units affected**	**Contaminants of concern (COCs)/Highest historical concentration**	**Estimated volume of contaminated media[a]**	**Estimated contaminant volume**
Vadose zone	VOCs, HE compounds, tritium, nitrate: Qal and $Tnsc_1$.	Building 830 VOCs: Freon 113 (0.0016 mg/kg) Methylene chloride (0.0099 mg/kg) TCE (6.3 mg/kg) Nitrate (13.5 mg/kg) HMX (0.2 mg/kg) <u>Building 832</u> TCE (0.16 mg/kg)	TCE (3,640,000 ft^3) HE compounds (96,000 ft^3)	TCE (0.4 gal)
Surface soil	NA	HMX (0.2 mg/kg)	NA	Not calculated
Surface water	Spring 3	TCE (200 μg/L)	NA	Not calculated
Corrective Action: Treatability Study is underway to evaluate ground water and soil vapor extraction.				

Note:
a = Volume based on background concentrations and most up-to-date plume maps available for preparation of the SWFS.
NA = Not applicable.

Table 2.5-1. Summary of Site 300 operable units and release sites. (Cont. page 10 of 13)

OU8: Building 801 (B801) dry well and Pit 8 Landfill

Since 1955, explosives testing has been conducted on the B801 firing table. Dispersal of firing table debris has resulted in metal and uranium contamination of surface soils. A dry well, located under B801D was active from the late 1950s to about 1984 (Lamarre et al., 1989). The decommissioned dry well was once connected to a sink in the machine shop at B801B. Waste fluid discharges to the dry well beneath B801D resulted in contamination in subsurface soil and ground water. VOC concentrations in ground water in the Building 801 dry well area have decreased slightly with TCE decreasing from a historical maximum of 6 μg/L to 4.6 μg/L in 1999. The concentration reductions are likely attributable to natural attenuation. Pit 8 Landfill is unlined and was constructed in 1958 northeast of the Building 801 Complex (Taffet, 1989). Debris from the Building 801 firing table was disposed of in Pit 8 until 1974 when an earthen cover was installed. The total estimated volume of material disposed of in Pit 8 is about 24,700 yd^3.

Release site: Building 801 Dry Well (VOCs).

Media of concern	Units affected	Contaminants of concern (COCs)/Highest historical concentration	Estimated volume of contaminated media[a]	Estimated contaminant volume
Ground water	Qal and $Tnbs_1$ of the Qal-Tmss hydrologic unit Flow direction: eastward Average ground water velocity: 0.4 ft/day	VOCs: Chloroform (2.4 μg/L) 1,2-DCA (5 μg/L) TCE (6 μg/L) Nitrate (47 mg/L) Perchlorate (4.1 μg/L)	VOCs: Insufficient data	VOCs: Insufficient data
Vadose zone	Stratigraphic units: Qal and $Tnbs_1$	TCE (0.057 mg/kg)	VOCs: 2,830 ft^3	VOCs: 0.0008 gal
Surface soil	NA	None	NA	NA
Surface water	None	None	NA	NA

Corrective Actions: 1,087 yd^3 of gravel was removed from the firing table in 1988. Some soil beneath the firing table gravel was also removed and disposed of in Pit 7. From 1988 to 1998, the firing table gravel was periodically replaced and the gravel and debris removed was temporarily stored in transfer containers until permitting was approved for shipment to the Nevada Test Site (Sator, 1992). In 1998, use of this firing table was discontinued. Firing table gravel and surface soil in the vicinity of the firing table were removed. The dry well was filled with concrete and closed in 1981.

Notes:

a = Volume based on background concentrations and most up-to-date plume maps available for preparation of the SWFS.
NA = Not applicable.

Table 2.5-1. Summary of Site 300 operable units and release sites. (Cont. page 11 of 13)

OU8: Building 833				
Building 833 was used from 1959 to 1982 to conduct thermal and mechanical tests on various mixtures of HE compounds. TCE served exclusively as the heat-transfer fluid at Building 833. Surface discharge of waste fluids occurred through spills, building washdown, rinsewater from the test cell and settling basin, and rinsewater disposal in a disposal lagoon adjacent to Building 833. As a result of these releases, VOC contamination of surface and subsurface soil, and ephemeral perched ground water occurred. VOC concentrations in ground water in the Building 833 area have decreased with TCE decreasing from a historical maximum of 2,100 μg/L to 30 μg/L in 1999. The regional aquifer has not been impacted. The concentration reductions are likely attributable to natural attenuation.				
Release sites: Building 833 Disposal Lagoon, Area north of Building 833, Building 833 Test Cell and Settling Basin.				
Media of concern	Units affected	Contaminants of concern (COCs)/Highest historical concentration	Estimated volume of contaminated media[a]	Estimated contaminant volume
Ground water	Terrace alluvium (Qt) and shallow clay and silt (Tps) of the Qt-$Tnsc_{12}$ hydrologic unit (shallow ephemeral perched ground water present mainly after periods of precipitation)	VOCs: cis-1,2-DCE (58 μg/L) TCE (2,100 μg/L)	TCE: 36,000 ft^3	TCE: 0.1 gal
Vadose zone	Shallow clay and silt (Tps)	TCE (1.5 mg/kg)	TCE: 1,180,000 ft^3	TCE: 0.1 gal
Surface soil	NA	None	NA	NA
Surface water	None	None	NA	NA
Corrective Action: Monitoring-only remedy accepted at December 8, 1993 RPM meeting.				

Note:
a = Volume based on background concentrations and most up-to-date plume maps available for preparation of the SWFS.
NA = Not applicable.

Table 2.5-1. Summary of Site 300 operable units and release sites. (Cont. page 12 of 13)

OU8: Building 845 firing table and Landfill Pit 9

Explosives experiments were conducted at Building 845 from 1958 to 1963. The Building 845 firing table was used for high-explosives experiments that may have occasionally contained tritium and uranium. Leaching of contaminants from the firing table debris has resulted in the contamination of subsurface soil with uranium, tritium, and HMX. The Pit 9 Landfill was used prior to 1968 for the disposal of approximately 500-800 lb of firing table debris generated at the Building 845 firing table. No contamination in ground water has been detected.

Release site: Building 845 Firing Table.

Media of concern	Units affected	Contaminants of concern (COCs)/Highest historical concentration	Estimated volume of contaminated media	Estimated contaminant volume
Ground water	NA	None	NA	NA
Vadose zone	Shallow silty clay, silt and gravels (Qls) and shallow bedrock ($Tnbs_1$)	Uranium-238 (1.2 pCi/g) HMX (0.054 mg/kg)	Not calculated	Not calculated
Surface soil	NA	None	NA	NA
Surface water	None	None	NA	NA

Corrective Action: In 1988, a total of 1,942 yd^3 of 845 firing table gravel and 390 yd^3 of soil from the 845 firing table berm were removed and disposed of in Pit 1 (Lamarre and Taffet, 1989).

Note:
NA = Not applicable.

Table 2.5-1. Summary of Site 300 operable units and release sites. (Cont. page 13 of 13)

OU8: Building 851 firing table				
The Building 851 firing table has been used to conduct experimental high explosives research for weapons and radiography of explosive devices during destructive testing, since 1962. These explosives experiments at the Building 851 firing table have resulted in the release of cadmium, copper, zinc, RDX, tritium, and uranium to surface soil surrounding the Building 851 firing table. Depleted uranium isotopic signatures have been detected in four wells in the vicinity of the firing table.				
Release site: Building 851 Firing Table.				
Media of concern	**Units affected**	**Contaminants of concern (COCs)/Highest historical concentration**	**Estimated volume of contaminated media**	**Estimated contaminant volume**
Ground water	Qls and $Tnbs_1$ of the Qls-Tmss hydrologic unit Flow direction: southeast Average ground water velocity: To be determined.	Uranium-238 (1.3 pCi/L)	Not calculated	Not calculated
Vadose zone	Stratigraphic units: Qls and $Tnbs_1$	VOCs: cis-1,2-DCE (0.012 mg/kg) TCE (0.0003 mg/kg) Uranium-238 (11 pCi/g)	Not calculated	Not calculated
Surface soil	NA	RDX (0.131 mg/kg) Metals: Cadmium (9 mg/kg) Copper (79 mg/kg) Zinc (360 mg/kg) Uranium-238 (14.1 pCi/g)	Not calculated	Not calculated
Surface water	NA	None	NA	NA
Corrective Action: Firing table gravel was removed in 1988 and replaced periodically afterward.				

Note:
NA = Not applicable.

Table 2.5-2. Screening out of contaminants of potential concern (COPCs) in ground and surface water.

OU	Contaminant of potential concern	No. of detections/ No. of samples	Maximum concentration	Rationale for screening out contaminant
OU2: Building 834	Acetone	1 of 15	55 μg/L	Acetone only reported once (in 1989) and new analyses in 1999 show non-detect.
	Toluene	7 of 348	61 μg/L	Only one detection since 1989, and that (0.9 ppb) has been followed by numerous non-detects.
OU3: Pit 6 Landfill	Bis (2-ethylhexyl) phthalate	7 of 79	70 μg/L	Phthalates reported in upgradient well. Potential lab contaminant. Concentration less than 10 times (10X) multiple of blank (EPA 10X Rule).
	Butylbenzyl-phthalate	2 of 47	78 μg/L	Phthalates reported in upgradient well. Potential lab contaminant. Concentration less than 10X multiple of blank (EPA 10X Rule-100 μg/L).
	Carbon disulfide	10 of 235	3 μg/L	Carbon disulfide has not been reported in ground water since 1992 indicating that the compound is no longer present in ground water.
	Ethylbenzene	9 of 356	7.3 μg/L	Not detected in ground water since 1992. Each well with detections has had multiple non-detects since.
	Methylene Chloride	19 of 919	160 μg/L	Common laboratory contaminant. Numerous non-detects have followed every reported detection.
	Phenolics	32 of 263	90 μg/L	Two of wells in which phenolics detected were upgradient of source. Phenolics reported in some blanks, but have not been detected anywhere since change in analytical method.
	Radium-226	63 of 271	1.3 pCi/L	Decay product of naturally occurring Uranium-238 (U-238). Not a constituent of concern in the Compliance Monitoring Program. Detected in upgradient well K6-04 at concentrations up to 0.8 pCi/L. Believed to be of natural origin.
	Radium-228	4 of 35	1.12 pCi/L	Decay product of naturally occurring Thorium-232 (Th-232). Not a constituent of concern in the Compliance Monitoring Program. Believed to be of natural origin.

Table 2.5-2. Screening out of contaminants of potential concern (COPCs) in ground and surface water. (Cont. page 2 of 9)

OU	Contaminant of potential concern	No. of detections/ No. of samples	Maximum concentration	Rationale for screening out contaminant
OU3: Pit 6 Landfill (cont.)	Silver	11 of 365	3.5 mg /L	Silver has been detected in five wells. Most recent detections (5/96) in two wells at concentration slightly above background; one upgradient of source. No detections in wells since 5/96.
	Tetrahydrofuran	1 of 1	2 μg/L	Insufficient data. Tetrahydrofuran is present in PVC pipe adhesive and/or tape. Contaminant in sample may have been the result of contamination contributed by well pipe.
	Total xylenes	28 of 306	15 μg/L	Not detected in ground water since 1991. All wells have reported multiple non-detects since.
	Chloroform, in surface water (BC6-13)	1 of 23	5.1 μg/L	Not detected in surface water since 1987. BC6-13 has reported multiple non-detects since.
	1,2-DCA, in surface water (BC6-13)	2 of 23	3.5 μg/L	Not detected in surface water since 1988. BC6-13 has reported multiple non-detects since.
	Methylene chloride, in BC6-13	1 of 23	8.9 μg/L	Not detected in surface water since 1987. BC6-13 has reported multiple non-detects since.
	Toluene, in surface water (BC6-13)	1 of 13	0.9 μg/L	Not detected in surface water since 1991. BC6-13 has reported multiple non-detects since.
	Total xylenes, in surface water (BC6-13)	1 of 13	1.6 μg/L	Not detected in surface water since 1991. BC6-13 has reported multiple non-detects since.
	Toluene	29 of 381	17 μg/L	Toluene not detected since 1993, and well shows non-detect in 1999.
OU4: HE Process Area				
Bldg. 815 area	Phenolics	10 of 39	330 μg/L	Not reported in ground water since analyses changed from EPA 420.1 to 625, in 1995/6. Detections in blanks of 420.1 method.
	Tetrahydrofuran	1 of 1	8 mg/L	Insufficient data. Tetrahydrofuran is present in PVC pipe adhesive and/or tape. Contaminant in sample may have been the result of contamination contributed by well pipe.

Table 2.5-2. Screening out of contaminants of potential concern (COPCs) in ground and surface water. (Cont. page 3 of 9)

OU	Contaminant of potential concern	No. of detections/ No. of samples	Maximum concentration	Rationale for screening out contaminant
Bldg. 815 area (cont.)	Tritium	58 of 267	940 pCi/L	Only reported activity above background was in 1987, followed by numerous below background results.
	1,1,2-TCA, in surface water (W-817-03A)	2 of 56	3.3 μg/L	Not detected in surface water since 1992. W-817-03A has reported multiple non-detects since.
	Toluene	25 of 730	230[a] μg/L	Toluene not detected since 1993, and wells show non-detect in 1999.
	Total Xylenes	8 of 292	17 μg/L	Xylenes not detected since 1991, and wells show non-detect in 1999.
	Carbon disulfide	12 of165	46 μg/L	Carbon disulfide has not been detected in ground water since 1993, indicating that the compound is no longer present in ground water.
HE Lagoons	Beryllium	23 of 788	0.018 mg /L	Detected only once, in one well, at concentration above background in 1993.
	1,3-dinitrobenzene	3 of 67	0.37 μg/L	All reported detections came on same day, whereas previous and more recent analyses report non-detect.
	2,6-dinitrotoluene	6 of 147	1.2 μg/L	Duplicate analyses contradict detections. Numerous non-detects in all wells.
	2-amino-4,6-dinitrotoluene	4 of 67	0.71 μg/L	Duplicate analyses contradict detections. Numerous non-detects in all wells.
	Radium-228	7 of 25	5.12 pCi/L	Radium-228 was detected in wells which monitor the HE Burn Pits. Radium-228 will be monitored as part of the Post-Closure Plan for the HE Burn Pits. Background levels will be developed for Radium-228 by the time the Post-Closure Plan monitoring is in place. Believed to be of natural origin, it will not be considered as a COC at this time.
	Silver	24 of 735	0.020 mg /L	Detected in 6 wells including 1 upgradient well. Maximum concentration detected in 1989. Not detected in wells since 1995. Detected in HE surface impoundment detection wells; continued monitoring as part of WDR 96-248.

Table 2.5-2. Screening out of contaminants of potential concern (COPCs) in ground and surface water. (Cont. page 4 of 9)

OU	Contaminant of potential concern	No. of detections/ No. of samples	Maximum concentration	Rationale for screening out contaminant
OU5: Bldg. 850 (includes Pit 7 Complex)[b]	Benzoic Acid	3 of 74	120 μg/L	Detected on one well upgradient of Pit 1. Will be investigated as part of Building 865 area characterization. Outside area of contamination from or pumping for, the B850 OU. Benzoic acid would not be affected by any OU5 remediation.
	Bismuth	57 of 62	0.6 μg/L	Detected in ground water sample from upgradient well NC7-44 at 0.004 mg/L and in a water sample from deep/confined well NC7-69 is free of tritium thus demonstrating this well is isolated from anthropogenic contaminants.
	Carbon disulfide	5 of 220	9 μg/L	No carbon disulfide has been detected in ground water samples since 1992 indicating that this compound, if it once occurred as a ground water contaminant, is no longer present.
	Freon 113	141 of 1,698	380 μg/L	Freon 113 has been detected in K1 wells in the Pit 1 area. The highest concentrations have been detected in wells upgradient from Pit 1. The freon 113 in ground water is believed to emanate from releases in the Building 865 (Advanced Test Accelerator) area and not from releases at Pit 1. Because the B865 area will be the subject of full characterization, and freon would not be affected by any OU 5 remediation, freon 113 is not included as a COC for the Bldg. 850 area.
	Phenolics	55 of 497	460 μg/L	Potential lab contaminant. Not a constituent of concern in the Compliance Monitoring Program. No phenolics detected since change in analytical method.
	Radium-226	529 of 1,165	624[a]pCi/L	Radium-226 (Ra-226) is a daughter product of U-238. This extreme outlier had a duplicate analysis of 0.42 pCi/L, which is typical for that well. Monitoring conducted since indicates activities are within normal background established for Radium-226.

Table 2.5-2. Screening out of contaminants of potential concern (COPCs) in ground and surface water. (Cont. page 5 of 9)

OU	Contaminant of potential concern	No. of detections/ No. of samples	Maximum concentration	Rationale for screening out contaminant
OU5: Bldg. 850 (cont.)	Radium-228	17 of 78	14.2 pCi/L	Naturally occurring decay product of Th-232. A routine sample from upgradient well K7-06 contained 14.2 pCi/L. The duplicate sample collected on the same day (7/21/98) contained 1.0 pCi/L. Believed to be of natural origin.
	Silver	33 of 1,015	0.60 mg /L	Detected in 28 wells at concentration above background. Not detected above background concentration since 1985, when silver was also reported above background in upgradient well K7-06.
	Thorium-230	248 of 510	91.5 pCi/L	Part of the Uranium-234 decay series. Detected in upgradient well K7-06 at a maximum concentration of 17 pCi/L and at far downgradient well NC7-47 at a concentration of 39.5 pCi/L.
	PCE in Spring 6	1 of 13	0.57 μg/L	Not detected in surface water since 1995. Spring 6 has reported multiple non-detects since.
	TCE in Spring 6	1 of 13	0.76 μg/L	Not detected in surface water since 1995. Spring 6 has reported multiple non-detects since.
OU6: Bldg. 854	Beryllium	2 of 8	0.092 mg /L	Detected twice in one well at concentrations above background. We will continue monitoring.
	Bis (2-ethylhexyl) phthalate	1 of 14	8.6 μg/L	Detected once in one well. Potential lab contaminant.
	Dimethyl-phthalate	1 of 14	9 μg/L	Detected once in one well. Potential lab contaminant.
	Phenolics	1 of 1	9 μg/L	Potential lab contaminant. Not enough data to determine source. Reported before change of analytical method.

Table 2.5-2. Screening out of contaminants of potential concern (COPCs) in ground and surface water. (Cont. page 6 of 9)

OU	Contaminant of potential concern	No. of detections/ No. of samples	Maximum concentration	Rationale for screening out contaminant
OU6: Bldg. 854 (cont.)	Toluene	3 of 104	14 μg/L	Pattern of reported detections suggests analytical laboratory or field contamination. Reported detections followed by numerous non-detects.
	TCE in Springs 10 and 11	4 of 21	1.0 μg/L	Not detected in surface water since 1996. Springs have reported multiple non-detects since.
	Tritium	3 of 30	410 pCi/L	Detected only once at activity above background – and that well has subsequent reports below background.
	Uranium	N/A	3.18 pCi/L	One well had an initial U235/U238 ratio of 0.007, borderline of natural ratio. Subsequent analysis showed a ratio of 0.0074, suggesting that initial reading may have been within natural range (0.00715 +/-)
OU7: Bldg. 832 Canyon				
	Toluene	2 of 66	4.8 μg/L	The only detections of toluene occurred in splits of a single sample from one well (W-830-11) in June 1992. No toluene has been detected in that or any other well since indicating that it is not currently present.
	cis-1,2-DCE, in Spring 3	1 of 10	2.2 μg/L	Not detected in surface water since 1996. Spring 3 has reported multiple non-detects since.
	trans-1,2-DCE, in Spring 3	1 of 11	0.53 μg/L	Not detected in surface water since 1996. Spring 3 has reported multiple non-detects since.
	PCE, in Spring 3	1 of 21	3.7 μg/L	Not detected in surface water since 1985. Spring 3 has reported multiple non-detects since.
OU8: Site 300				
Bldg. 801	Acetone	5 of 68	14 μg/L	Not detected since 1990. All reported occurrences on the same day, in wells with long histories of no detections. Potential lab contamination.
	Ethylbenzene	3 of 77	2.1 μg/L	Not detected since 1990. All reported occurrences on the same day, in wells with long histories of no detections. Potential lab contamination.

Table 2.5-2. Screening out of contaminants of potential concern (COPCs) in ground and surface water. (Cont. page 7 of 9)

OU	Contaminant of potential concern	No. of detections/ No. of samples	Maximum concentration	Rationale for screening out contaminant
Bldg. 801 (cont.)	Radium-226	14 of 44	91.3 pCi/L	Naturally occurring decay product of U-238. Believed to be of natural origin.
	Radium-228	1 of 4	0.68 pCi/L	Naturally occurring decay product of Th-232. Believed to be of natural origin.
	Silver	1 of 46	0.5 μg/L	Reported once in one well at concentrations just above background. Believed to be of natural origin.
	Toluene	6 of 77	4 μg/L	No detections reported since 1990. Pattern of reported detections suggests analytical laboratory or field contamination.
	Total xylenes	7 of 69	7.4 μg/L	No detections reported since 1990. Pattern of reported detections suggests analytical laboratory or field contamination.
Building 833	Carbon disulfide	1 of 6	0.7 μg/L	Detected once in one well at just above detection limit. Not enough data to determine source.
	Benzene	1 of 12	1.1 μg/L	Detected once in one well at just above detection limit. Subsequent 1998-1999 sampling show non-detect.
	Toluene	3 of 12	17 μg/L	Not detected in area since 1993. Non-detects subsequently observed.
Building 845	Carbon disulfide	1 of 33	2 μg/L	Potential lab contaminant. Detected once in one well.
	Phenolics	5 of 9	16 μg/L	Not detected since analyses changed from EPA 420.1 to 625, in 1995. Detections in blanks of 420.1 method.
	Radium-226	9 of 41	0.39 pCi/L	Naturally-occurring decay product of U-238. Believed to be of natural origin.
	Silver	7 of 48	2.1 μg/L	Detected in all four B845 wells; however, highest concentration in two cross/upgradient wells from the source area, indicating that detection is not the result of a release.
	Toluene	1 of 39	1 μg/L	Toluene was detected in one sample from one well in the B845 area. Toluene was not detected any an subsequent samples collected in the following 6 years. The data support the conclusion that toluene is not currently present in ground water.

Table 2.5-2. Screening out of contaminants of potential concern (COPCs) in ground and surface water. (Cont. page 8 of 9)

OU	Contaminant of potential concern	No. of detections/ No. of samples	Maximum concentration	Rationale for screening out contaminant
Building 851	Freon 113	2 of 35	1.1 μg/L	Not detected since 1993. Non-detects observed after each of the two reported detections.
	PCE	1 of 36	1.7 μg/L	Not detected since 1992. Non-detects observed after the reported detection.
	1,1,1-TCA	1 of 36	0.8 μg/L	Not detected since 1991. Non-detects observed after the reported detection.
	TCE	1 of 36	2.7 μg/L	Not detected since 1992. Non-detects observed after the reported detection.
	Acetone	2 of 26	11 μg/L	Not detected since 1991, and then during a period where acetone detections are suspect. Multiple non-detects observed after each of the two reported detections.
	Benzene	1 of 28	2 μg/L	Benzene was detected once, in one well in the B851 area in July 1991. The sample duplicated was reported as non-detect. No benzene was detected in any other well or in any samples from that well above the detection limit in subsequent years.
	Radium-226	2 of 5	1.3 pCi/L	Naturally-occurring decay product of U-238. Maximum concentration was detected in water sample from an upgradient well. Believed to be of natural origin.
	Radium-228	3 of 5	3.5 pCi/L	Naturally-occurring decay product of Th-232. Maximum concentration was detected in water from well an upgradient well. Believed to be of natural origin.
	Tetrahydrofuran	1 of 1	30 μg/L	Insufficient data. Tetrahydrofuran is present in PVC pipe adhesive and/or tape. Contaminant present in sample may have been result of contamination contributed by well pipe.
	Toluene	3 of 28	3 μg/L	Toluene was detected one time in three wells. All detections occurred in 1991 with no toluene reported in any subsequent sampling. Data supports that toluene is not currently present in ground water.

Table 2.5-2. Screening out of contaminants of potential concern (COPCs) in ground and surface water. (Cont. page 9 of 9)

OU	Contaminant of potential concern	No. of detections/ No. of samples	Maximum concentration	Rationale for screening out contaminant
Building 851 (cont.)	Total xylenes	1 of 27	3 μg/L	Xylenes were detected only once in one well in April 1991. Five subsequent samples did not contain xylenes above the detection limit. Data supports that xylenes are not currently present in ground water.
Springs unrelated to release sites				
Spring 9	1,2-DCE (total), in surface water	1 of 4	6.1 μg/L	Not detected in surface water since 1993. Spring 9 has reported subsequent non-detects.
	TCE in surface water	1 of 5	7.0 μg/L	Not detected in surface water since 1993. Spring 9 has reported subsequent non-detects.
Spring 12	1,2- DCE (total), in surface water	1 of 5	3.2 μg/L	Not detected in surface water since 1993. Spring 12 has reported subsequent non-detects.
	TCE, in surface water	1 of 6	1.0 μg/L	Not detected in surface water since 1993. Spring 12 has reported subsequent non-detects.

[a] Extreme outlier; not consistent with other data.

[b] For consistency with the SWFS, detections and maximum concentrations in the OU5 section include the Pit 7 Complex, which was included in that document. No conclusions differ because of this inclusion.

Notes:

DCA = Dichloroethane
DCE = Dichloroethylene
EPA = U.S. Environmental Protection Agency.
HE = High Explosives.
OU = Operable Unit.
PCE = Tetrachloroethylene
PVC = Polyvinyl Chloride.
TCA = Trichloroethane
TCE = Trichloroethylene
Th-232 = Thorium-232.
U-238 = Uranium-238.
WDR = Waste Discharge Requirements.

Table 2.7-1. Contaminants of concern in surface soil at Site 300.

Operable unit (OU)	Contaminant of concern	Historical maximum concentration (in mg/kg unless otherwise indicated)
OU2: Building 834	None	N/A
OU3: Pit 6 Landfill	None	N/A
OU4: HE Process Area	HMX	4.0
	RDX	0.18
OU5: Building 850/Pits 3 & 5		
Building 850 Firing Table	HMX	2.4
	Metals:	
	Beryllium	15
	Cadmium	8.6
	Copper	1,000
	PCB 1254	180
	1,2,3,4,6,7,8 Heptachlorinated (HpC) dibenzo-p-dioxins (DD)	6E-04
	1,2,3,4,6,7,8-HpC dibenzofurans (DF)	6.4E-04
	1,2,3,4,7,8,9-HpCDF	2E-04
	1,2,3,4,7,8-Hexachlorinated (HxC) DD	8.6E-07
	1,2,3,4,7,8-HxCDF	2.3E-03
	1,2,3,6,7,8-HxCDD	3.7E-06
	1,2,3,6,7,8-HxCDF	2.1E-03
	1,2,3,7,8,9-HxCDD	2.4E-06
	1,2,3,7,8,9-HxCDF	2.5E-04
	1,2,3,7,8 Pentachlorinated (PeC) DF	2.6E-03
	2,3,4,6,7,8-HxCDF	7.5E-04
	2,3,4,7,8-PeCDF	9.1E-03
	2,3,7,8-Tetrachlorinated (TC) DD	1.4E-06
	2,3,7,8-TCDD	4.3E-06
	Other HpCDFs	1.3E-03
	Other HpCDDs	1E-04
	Other HxCDFs	1.1E-02
	Other HxCDDs	2E-05
	Octachlorinated (OcC) DFs	1.1E-04
	OcCDDs	5.5E-04
	Other PeCDFs	5.7E-02
	TCDFs	4.8E-02
	Other TCDDs	4.3E-06
	Uranium-238	24.8 pCi/g

Table 2.7-1. Contaminants of concern in surface soil at Site 300. (Cont. page 2 of 2)

Operable unit (OU)	Contaminant of concern	Historical maximum concentration (in mg/kg unless otherwise indicated)
OU6: Building 854	HMX	150
	Metals:	
	Lead	98
	Zinc	1,400
	PCB 1242 (1 of 13)	34
	PCB 1248 (1 of 13)	52
	Tritium	317 pCi/L_{sm}
OU7: Building 832 Canyon	HMX	0.2
OU8: Site 300		
Building 801 Dry Well	None	N/A
Building 833 Area	None	N/A
Building 845 Firing Table	None	N/A
Building 851 Firing Table	RDX	0.131
	Metals:	
	Cadmium	9
	Copper	79
	Zinc	360
	Uranium-238	14.1 pCi/g

Notes:

DD = Dibenzodioxin.
DF = Dibenzofuran.
HMX = High melting explosive.
HpC = Heptachlorinated.
HxC= Hexachlorinated.
N/A = Not applicable.
OcC= Octachlorinated.
OU = Operable Unit.
PCB = Polychlorinated biphenyl.
PeC = Pentachlorinated.
RDX = Research department explosive.
TC = Tetrachlorinated.

Table 2.7-2. Contaminants of concern in subsurface soil and rock at Site 300.

Operable unit (OU)	Contaminants of concern	Historical maximum concentration (in mg/kg except where noted)
OU2: Building 834	**VOCs**	
	PCE	0.09
	Toluene	0.052
	TCE	970
OU3: Pit 6 Landfill	None	N/A
OU4: HE Process Area	**VOCs**[a]	
	Benzene	0.9
	Chloroform	0.4
	cis-1,2-DCE	0.026
	Ethylbenzene	0.0006
	Freon 113	0.0031
	Freon 12	0.0024
	Methylene chloride	0.013
	PCE	0.0034
	Toluene	0.003
	TCE	33
	Total xylenes	0.021
	HMX	21
	RDX	3.25
OU5: Building 850/Pits 3 & 5		
Building 850 Firing Table:	Tritium	11,000,000 [c]pCi/L_{sm}
	Uranium-238	28.2 pCi/g
OU6: Building 854	*TCE*	30.7[b]

Table 2-7.2. Contaminants of concern in subsurface soil and rock at Site 300. (Cont. page 2 of 2)

Operable unit (OU)	Contaminants of concern	Historical maximum concentration (in mg/kg except where noted)
OU7: Building 832 Canyon	VOCs	
	Freon 113	0.0016
	Methylene chloride	0.0099
	TCE	6.3
	HMX	0.2
	Nitrate	13.5
OU8: Site 300		
Building 801 Dry Well	TCE	0.057
Building 802 Firing Table	None	N/A
Building 833 Area	TCE	1.5
Building 845 Firing Table and Landfill Pit 9	HMX	0.054
	Uranium-238	1.2 pCi/g
Building 851 Firing Table	VOCs	
	cis-1,2-DCE	0.012
	TCE	0.0003
	Uranium-238	11 pCi/g

Notes:

DCE = Dichloroethylene.
HMX = High melting explosive.
N/A = Not applicable.
OU = Operable unit.
PCE = Tetrachloroethylene.
RDX = Research department explosive.
TCE = Trichloroethylene.
VOCs = Volatile organic compounds.

[a] For individual compounds, risk and the hazard index were below 10^{-6} and 1.0 respectively. However, the total additive risk for all VOCs was 1.42×10^{-6}, therefore all compounds were listed as contaminants of concern.

[b] Soil with a reported maximum of 1,000 mg/kg was excavated.

[c] Soil with 11,000,000 pCi/L_{sm} removed with firing table gravel.

Table 2.7-3. Contaminants of concern in ground water at Site 300.

Operable Unit (OU)	Contaminant of concern	Historical maximum concentration (μg/L unless otherwise indicated)	Maximum conc. in 1999 (μg/L unless otherwise indicated)	Hydrogeologic units affected
OU2: Building 834				
	VOCs			Qt-Tpsg and Tps-Tnsc$_2$
	Chloroform	950 (1989)	270	
	cis-1,2-DCE	540,000 (1990)	110,000	
	PCE	10,000 (1993)	840	
	1,1,1-TCA	33,000[a] (1991)	12,000[a]	
	TCE	800,000 (1993)	94,000	
	Other			
	TBOS/TKEBS	7,300,000 (1995)	770,000	
	Nitrate (as NO_3)	480 mg/L (1997)	321 mg/L	
OU3: Pit 6 Landfill				
	VOCs			Qt-Tmss
	Chloroform	14 (1994)	ND	
	1,2-DCA	1.7 (1991)	ND	
	cis-1,2-DCE	12 (1990)	2.4	
	trans-1,2-DCE	33 (1990)	0.92	
	PCE	3.2 (1988)	0.93	
	1,1,1-TCA	13 (1990)	ND	
	TCE	250 (1988)	6.3	
	Radionuclides			
	Tritium	2,520 pCi/L (1999)	2,520 pCi/L	
	Other			
	Nitrate (as NO_3)	228 mg/L (1998)	228 mg/L	
	Perchlorate	65.2 (1998)	57	
OU4: HE Process Area				
Building 815	VOCs			Tps, Tnbs$_2$, and Tnsc$_1$
	Chloroform	5.8 (1992)	1.9	
	1,1-DCE	4.7 (1998)	4.4	
	cis-1,2-DCE	3.3 (1993)	2.2	
	TCE	450 (1992)	160	
HE Lagoons	HE Compounds			Tps and Tnbs$_2$
	RDX	350 (1988)	100	
	HMX	67[b] (1998)	19	
	4-Amino-2,6-dinitrotoluene	24 (1997)	9.5	
	Other			
	Nitrate (as NO_3)	583 mg/L (1998)	490	
	Perchlorate	50 (1998)	42	
Burn Pit	VOCs			Tnsc$_1$
	TCE	1,000 (1993)	310	
	cis-1,2-DCE	12 (1993)	2.9	
	Other			
	Nitrate (as NO_3)	230 mg/L (1994)	230	
	Perchlorate	24 (1998)	24	

Table 2.7-3. Contaminants of concern in ground water at Site 300. (Cont. page 2 of 3)

Operable Unit (OU)	Contaminant of concern	Historical maximum concentration (µg/L unless otherwise indicated)	Maximum conc. in 1999 (µg/L unless otherwise indicated)	Hydrogeologic units affected
OU5: Building 850/Pits 3 & 5				
Building 850 Firing Table & Sandpile	<u>Radionuclides</u>			Qal-Tmss
	Tritium	566,000 pCi/L (1985)	99,400 pCi/L	
	Uranium-238	18.4 pCi/L (1996)	5.1 pCi/L	
	<u>Other</u>			
	Nitrate (as NO_3)	140 mg/L (1995)	88 mg/L	
Pit 2 Landfill	<u>Other</u>			Qal-Tmss
	Nitrate (as NO_3)	186mg/L (1993)	61 mg/L	
Pit 1 Landfill	<u>Other</u>			Qal-Tmss
	Perchlorate	6.4 (1998)	6.4	
	Nitrate (as NO_3)	146mg/L (1993)	52 mg/L	
OU6: Building 854	<u>VOCs</u>			Qal-Tmss
	TCE	2,900 (1997)	270	
	<u>Other</u>			
	Nitrate (as NO_3)	200 mg/L (1999)	200 mg/L	
	Perchlorate	16 (1999)	16	
OU7: Building 832 Canyon				
Building 830	<u>VOCs</u>			Qal, $Tnsc_1$, $Tnbs_2$, $Tnbs_1$
	Acetone[c]	41 (1996)	no analyses	
	Chloroform	30 (1986)	0.74	
	cis-1,2-DCE	1.4 (1998)	1.4	
	PCE	10 (1998)	ND	
	TCE	30,000 (1997)	8,400	
	<u>Other</u>			
	Nitrate (as NO_3)	501 mg/L (1998)	215 mg/L	
	Perchlorate	51 (1998)	11(2000)	
Building 832	<u>VOCs</u>			Qal, $Tnsc_1$, $Tnbs_2$, $Tnbs_1$
	cis-1,2-DCE	8.6 (1998)	10	
	TCE	1,800 (1998)	1,200	
	<u>Other</u>			
	Nitrate (as NO_3)	177 mg/L (1999)	177 mg/L	
	Perchlorate	17 (1999)	17	

Table 2.7-3. Contaminants of concern in ground water at Site 300. (Cont. page 3 of 3)

Operable Unit (OU)	Contaminant of concern	Historical maximum concentration (μg/L unless otherwise indicated)	Maximum conc. in 1999 (μg/L unless otherwise indicated)	Hydrogeologic units affected
OU8: Site 300				
Building 801 Dry Well & Pit 8				
	VOCs			Qal-Tmss
	Chloroform	2.4 (1992)	ND	
	1,2-DCA	5 (1990)	2.4	
	TCE	6 (1988)	4.6	
	Other			
	Nitrate (as NO_3)	47 mg/L (1998)	ND	
	Perchlorate	4.1 (1999)	4.1	
Building 802 Firing Table				
	None	NA	NA	NA
Building 833 Area				
	VOCs			Qt-$Tnsc_2$
	cis-1,2-DCE	58 (1993)	ND	
	TCE	2,100 (1992)	30	
Building 845 Firing Table & Pit 9				
	None	NA	NA	NA
Building 851 Firing Table				
	Radionuclides			Qal-Tmss
	Uranium-238	1.3 pCi/L (1990)	0.17 pCi/L	

Notes:

DCA = Dichloroethane.
DCE = Dichloroethylene.
HE = High explosives.
HMX = High melting explosive.
NA = Not applicable.
ND = Not detected above the method detection limit..
PCE = Tetrachloroethylene.
RDX = Research department explosive.
TBOS/TKEBS = Tetra-butyl-orthosilicate/tetra-kis-2-ethylbutylorthosilicate.
TCA = Trichloroethane.
TCE = Trichloroethylene.
VOCs = Volatile organic compounds.

[a] Extreme outlier; not consistent with other data.

[b] Duplicate sample was <5 μg/L. Next highest historical concentration was 58 μg/L in 1993.

[c] Contaminant not reported in last 2 years, but sampling history not yet adequate to exclude as a COC.

Table 2.7-4. Contaminants of concern in surface water at Site 300.

Operable Unit (OU)	Surface water body affected	Contaminant of concern	Historic maximum concentration (in μg/L unless otherwise indicated)	Maximum concentration for 1999 (in μg/L unless otherwise indicated)
OU2: Building 834				
	None	NA	NA	NA
OU3: Pit 6 Landfill				
	Spring 7[a] (sampled at BC6-13[a])	cis-1,2 DCE	12 (1990)	ND
		trans-1,2-DCE	33 (1990)	ND
		PCE	1.4 (1988)	0.52
		TCE	110 (1988)	0.83
	Spring 15[a]	None		
OU4: HE Process Area				
	Spring 5[a] (sampled at W-817-03A[a])	cis-1,2-DCE	3.3 (1993)	2.2
		TCE	150 (1987)	93
	Spring 4	None		
	Spring 14	None		
OU5: Building 850/ Pits 3 & 5				
	Spring 6	None		
	Well 8 Spring	Tritium	770,000 pCi/L (1972)	38,500 pCi/L
OU6: Building 854				
	Spring 10	None	NA	NA
	Spring 11	None	NA	NA
OU7: Building 832 Canyon				
Building 830	Spring 3	TCE	200 (1985)	21
Building 832	None	NA	NA	NA
OU8: Site 300				
Building 801 Dry Well	None	NA	NA	NA
Building 802 Firing Table	None	NA	NA	NA

Table 2.7-4. Contaminants of concern in surface water at Site 300. (Cont. page 2 of 2)

Operable Unit (OU)	Surface water body affected	Contaminant of concern	Historic maximum concentration (in μg/L unless otherwise indicated)	Maximum concentration for 1999 (in μg/L unless otherwise indicated)
OU8: Site 300 (cont.)				
Building 833	None	NA	NA	NA
Building 845 Firing Table	None	NA	NA	NA
Building 851 Firing Table	None	NA	NA	NA

Notes:

DCE = Dichloroethylene.
NA = Not applicable.
ND = Not detected above method detection limit.
PCE = Tetrachloroethylene.
TCE = Trichloroethylene.

[a] No surface flow.

Table 2.7-5. Summary of human health risks and hazards.

Operable Unit	Baseline Risk	Baseline Hazard	Comments
Building 834			
Subsurface soil, inhalation			
Inside 834D: TCE	**9×10^{-4}**	**35**	**Building used only for storage. Soil vapor extraction began in 1998.**
PCE	**1×10^{-4}**	**0.7**	
Outside 834D: TCE	**6×10^{-4}**	**21**	**Onsite workers only. Soil vapor extraction began in 1998.**
PCE	**8×10^{-5}**	**0.4**	
Pit 6 Landfill			
Subsurface soil, inhalation			
From landfill: VOCs	**5×10^{-6}**	**<1**	**Landfill capped in 1998, mitigating volatilization to air.**
Surface water, inhalation			
From Spring 7: TCE	**3×10^{-5}**	**1.1**	**Current concentrations below baseline. No surface water, no onsite workers.**
PCE	**1×10^{-6}**	**<1**	**Only one detection in last 10 years**
1,2-DCA	**3×10^{-6}**	**NA**	**ND for over 10 years**
chloroform	**3×10^{-6}**	**<1**	**ND for over 10 years**
From SVRA pond: TCE	**2×10^{-6}**	**<1**	**No TCE detected in SVRA pond.**
HE Process Area			
Subsurface soil, inhalation			
Outside B815: TCE	**4×10^{-6}**	**<1**	
PCE	**1×10^{-6}**	**<1**	
Surface water, inhalation			
Spring 5: 1,1-DCE	**8×10^{-6}**	**<1**	**Spring 5 is dry, but is represented by W-817-03A. 1,1-DCE ND since 1987.**
TCE	**5×10^{-6}**	**<1**	**Current subsurface TCE below baseline.**
Ground water, ingestion			
At site boundary: 1,1-DCE	**5×10^{-6}**	**<1**	**Based on modeling of pre –1993 concentrations, all of which have decreased.**
TCE	**3×10^{-6}**	**<1**	
RDX	**2×10^{-6}**	**<1**	

Table 2.7-5. Summary of human health risks and hazards. (Cont. page 2 of 3)

Operable Unit	Baseline Risk	Baseline Hazard	Comments
Building 850			
Surface soil, ingestion, contact			
B850 firing table: PCBs	5×10^{-4}	NC	
CDDs+CDFs	1×10^{-4}	NA	
Building 854			
Surface soil, ingestion, contact			
PCBs 1242, 1248			
	7×10^{-5}	NA	PCBs detected in one sample. No onsite workers.
Subsurface soil, inhalation			
Inside B854F: chloroform	5×10^{-6}	<1	Based on 1996 ambient air sample.
TCE	3×10^{-7}	NC	Based on 1996 ambient air sample.
Other VOCs	4×10^{-6}	<1	Based on detection limits for VOCs not detected
Outside B854F: chloroform	9×10^{-6}	<1	Based on 1996 ambient air sample.
1,2-DCA	1×10^{-6}	<1	Not reported in soil near B854 – not a COC.
Inside B854A: 6 VOCs	1×10^{-6}	<1	Based on detection limits for VOCs not detected.
Building 832 Canyon			
Subsurface soil, inhalation			
Inside Building 830:			
vinyl chloride	2×10^{-6}	NC	Based on 1996 ambient air sample. Concurrent air flux measurements were all non-detect for vinyl chloride.
TCE	3×10^{-7}	NC	
Outdoors, near B830:			
chloroform	4×10^{-6}	NC	Based on 1996 ambient air samples. Vinyl chloride and 1,2-DCA have not been detected in the B830 area in the vadose zone. Concurrent air flux measurements were non-detect for all these VOCs.
1,2-DCA	4×10^{-6}	NC	
vinyl chloride	2×10^{-6}	NC	
Inside Building 832:			
dichloropropane	3×10^{-6}	NC	Based on 1996 ambient air samples. Concurrent air flux measurements were all non-detect.

Table 2.7-5. Summary of human health risks and hazards. (Cont. page 3 of 3)

Operable Unit	Baseline Risk	Baseline Hazard	Comments
Surface water, Spring 3: TCE	6×10^{-5}	2.3	Current concentrations below baseline. No one works in the vicinity.
PCE	5×10^{-6}	<1	No PCE detected in last 5 years.
Building 801 Dry Well	$<10^{-6}$	<1	
Building 833			
Subsurface soils, inhalation			
inside Building 833: TCE	6×10^{-7}	<1	
chloroform	6×10^{-7}	<1	
Building 845 Firing Table	$<10^{-6}$	<1	
Building 851 Firing Table	$<10^{-6}$	<1	

Notes:

NA = No hazard PRG available.
NC = Not calculated
ND = Not detected.

Table 2.7-6. Summary of ecological hazards.

Operable Unit	Baseline Hazard Quotient	Comments
Building 834 Area		
Inhalation		
TCE		
Individual ground squirrel (J & A)	**>1**	**Surveys found no impact to the population.**
Individual kit fox (J & A)	**>1**	**Surveys found no evidence of kit fox in area.**
PCE		
Individual ground squirrel (J & A)	**>1**	**Surveys found no impact to the population.**
Individual kit fox (J & A)	**>1**	**Surveys found no evidence of kit fox in area.**
Oral		
Cadmium		
Individual adult ground squirrels	**>1**	**Surveys found no impact to the population.**
Individual deer (J & A)	**>1**	**Surveys found no impact to the population.**
Individual adult kit fox	**>1**	**Surveys found no evidence of kit fox in area.**
Pit 6 Landfill		
Inhalation		
TCE		
Individual juvenile ground squirrel	**>1**	**Surveys found no impact to the population.**
Individual kit fox (J & A)	**>1**	**Surveys found no evidence of kit fox in area.**
PCE		
Individual juvenile ground squirrel	**>1**	**Surveys found no impact to the population.**
Individual juvenile kit fox	**>1**	**Surveys found no evidence of kit fox in area.**
Total VOCs (in addition to species above)		
Individual adult ground squirrels	**>1**	**Surveys found no impact to the population.**
Individual adult kit fox	**>1**	**Surveys found no evidence of kit fox in area.**

Table 2.7-6. Summary of ecological hazards. (Cont. page 2 of 3)

Operable Unit	Baseline Hazard Quotient	Comments
HE Process Area		
Oral and inhalation		
Cadmium		
Individual adult ground squirrels	>1	Surveys found no impact to the population.
Individual juvenile deer	>1	Surveys found no impact to the population.
Individual adult deer	>1	Surveys found no impact to the population.
Spring 5		
Copper		
Aquatic toxicity		No surface water currently present.
Building 850 Area		
Oral and inhalation		
Cadmium		
Individual adult ground squirrels	>1	Surveys found no impact to the population.
Individual deer (J & A)	>1	Surveys found no impact to the population.
PCBs/CDDs/CDFs Individual ground squirrels Individual deer	NC	Hazard indices were not calculated, but a literature review indicated individual animals were potentially at risk due to the ability of these compounds to bioaccumulate. Surveys found no impact to deer or ground squirrel populations, and no evidence of kit fox in the area.
Spring 6		
Copper and Zinc		
Aquatic toxicity	>1	Bioassays indicate no hazard.
Combined copper and cadmium		
Oral intake by adult ground squirrels	>1	Surveys found no impact to the population.
Building 854 Area	NC	Majority of area paved, no ecological habitat.
Building 832 Canyon	<1	
Building 801 Dry Well		
Oral and inhalation		
Cadmium		
Individual adult ground squirrels	>1	Surveys found no impact to the population.
Individual deer (J & A)	>1	Surveys found no impact to the population.
Building 802 Firing Table	<1	

Table 2.7-6. Summary of ecological hazards. (Cont. page 3 of 3)

Operable Unit	Baseline Hazard Quotient	Comments
Building 833 Area	<1	
Building 845 Firing Table	NC	Data from this area added to other individual populations throughout the EFA/WFA.
Building 851 Firing Table		
Oral and inhalation		
Cadmium		
Individual adult ground squirrels	>1	Surveys found no impact to the population.
Individual deer (J & A)	>1	Surveys found no impact to the population.

Notes:

J & A Juvenile and adult

NC = Hazard quotients not calculated.

VOCs Volatile Organic Compounds

Data from SWRI Tables 6-74, 6-118 and 6-119.

Table 2.9-1. Summary of remedial alternatives for LLNL Site 300.

	Building 834			Pit 6 Landfill			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 and sand pile adjacent to firing tables										√	√	√																			
Landfill waste characterization with contingent monitoring, capping, and/or excavation															√							√						√			
Estimated 30-year cost	$0	$12.1M	$14.5	$0	$2.4M	$6.0M	$0	$27.6M	$0	$4.0M	$8.3M	$16.1M	$0	$0.5M	$22.2M	$0	$9.2M	$0	$26.8M	$0	$0.5M	$21.6M	$0	$0.8M	$4.3M	$0	$0.5M	$7.1M	$0	$0.5M	$4.2M

Note: **Shaded columns are the selected remedies.**

Table 2.9-2. Summary of institutional controls for LLNL Site 300 remedial alternatives.

	Building 834			Landfill Pit 6			HE Process Area		Building 850 Firing Table				Landfill Pit 2			Building 854		Building 832 Canyon		Building 801, Landfill Pit 8			Building 833			B845 Firing Table, Landfill Pit 9			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
Risk and hazard monitoring and assessment		√	√		√	√		√		√	√	√					√		√					√	√						
Outdoor air sampling		√	√		√	√		√											√												
Indoor air sampling		√	√														√		√					√	√						
Surface soil sampling										√	√	√					√														
Building occupancy restrictions		√	√														√		√					√	√						
Land use restrictions		√	√		√	√		√		√	√	√					√		√					√	√						
Building ventilation[a]		√	√														√		√					√	√						
Warning signs		√	√		√	√		√		√	√	√					√		√					√	√						
Wildlife surveys		√	√		√	√				√	√	√					√														

Shaded columns indicate the selected remedies.

[a] **To be implemented if building is regularly occupied.**

Table 2.11-1. Description of the selected remedy for Building 834 (Alternative 2).

Element	Scope
Monitoring	**· Sample and analyze ground water and measure water levels at approximately 47 wells.**
Risk and hazard management	**· Maintain building occupancy and land use restrictions in the vicinity of Building 834D and install warning signs. If sampling of indoor air within Building 834D indicates that risks currently exceed 10^{-6} or the HI exceeds 1, institute restrictions in building use or, if building use is again anticipated, install a building ventilation system and operate it whenever the building is occupied.** **· Develop and implement a risk and hazard monitoring and assessment program:** **1. Sample outdoor ambient air annually for VOCs near Building 834D; until risk <10^{-6} and HI <1 for at least 2 years;** **2. Sample indoor ambient air annually for VOCs in Building 834D; until risk <10^{-6} and HI <1 for at least 2 years;** **3. Conduct annual wildlife surveys by biologists to evaluate the presence of the San Joaquin kit fox and other burrowing species of special concern;** **4. Integrate these data into risk assessment calculations to determine any changes in risks and hazards; and** **5. Review these data to evaluate compliance with RAOs.** **· Develop and implement Operational Safety Procedures for all remedial actions where risks can be foreseen.**
Ground water and soil vapor extraction and treatment	**· Simultaneously extract ground water and soil vapor from approximately 25 extraction wells.** **· Use seventeen existing extraction wells.** **· Convert up to seven existing ground water monitoring wells to extraction wells.** **· Install one additional extraction well.** **· Install a total of approximately 1,400 feet of additional piping from the extraction wells to the treatment system.** **· The screened intervals in these extraction wells range from 20 to 80 feet bgs. All extraction wells would be completed in a shallow perched water-bearing zone (Tps gravel).** **· Perform hydraulic tests and soil vapor extraction tests to evaluate sustainable ground water flow rates, hydraulic capture zones, and soil vapor extraction rates.** **· The estimated flow rate for ground water is 0.1 to 2 gpm per well, with a total flow rate to the treatment system of about 1 gpm.** **· Estimated maximum contaminant concentrations in extracted ground water are 72,000 μg/L TCE and 200 mg/L nitrate (as NO_3). Based on a weighted average from all extraction wells, the estimated concentrations in treatment system influent are 8,000 μg/L TCE, and 45 mg/L nitrate.**

Table 2.11-1. Description of the selected remedy for Building 834 (Alternative 2). (Cont. page 2 of 2)

Element	Scope
Ground water and soil vapor extraction and treatment (cont.)	· **The estimated soil vapor flow rate is about 1.0 scfm per well, with a total flow rate of about 25 to 30 scfm. The design applied vacuum is 5 to 10 inches of Hg with an estimated radius of influence of 20 to 30 feet.** · **The estimated maximum TCE concentration in extracted soil vapor is 20 to 30 $ppm_{v/v}$. Based on a weighted average from all extraction wells, the estimated initial TCE vapor concentration in treatment system influent is 10 to 20 $ppm_{v/v}$.** · **Treat all extracted ground water and soil vapor using the existing system. Ground water will be treated using an air sparging unit with aqueous-phase GAC polish. Treat offgas using vapor-phase GAC. An oil-water gravity separator is used to separate TBOS/TKEBS from ground water prior to entering the air sparging system.** · **Treat all extracted soil vapor using vapor-phase GAC.** · **Discharge all treated water using the existing misting system.** · **Dispose spent GAC offsite.**

Note:

Remediation-specific details, such as the number and location of extraction wells used for a pump-and-treat alternative, are approximations based on best professional judgement and are presented in this Interim ROD for purposes of costing and strategy preparation only. The actual site- and technology-specific details will be based on additional data and design criteria presented in Remedial Design documents.

Table 2.11-2. Description of the selected remedy for the Pit 6 Landfill (Alternative 2).

Element	Scope
Monitoring	· Sample and analyze ground water for potential COCs, and measure water levels at approximately 30 wells. · Sample and analyze surface water from two springs and from the pond at the ranger station.
Risk and hazard management	· Maintain land use restrictions in the vicinity of the Pit 6 Landfill and install warning signs. · Develop and implement a risk and hazard monitoring and assessment program: 1. Inspect Spring 7 in conjunction with quarterly ground water monitoring of the Pit 6 Landfill to determine if the spring is flowing. Ambient air sampling would only be conducted if water is flowing; 2. Sample outdoor ambient air annually for VOCs near the Pit 6 Landfill; until risk $<10^{-6}$ for at least 2 years; 3. Conduct annual wildlife surveys by biologists to evaluate the presence of the San Joaquin kit fox and other burrowing species of special concern. Should burrowing species of special concern be found, action described in Section 2.9.1.2 will be taken. 4. Integrate new data into risk assessment calculations to determine any changes in risks and hazards; and 5. Review these data to evaluate compliance with RAOs. · Develop and implement Operational Safety Procedures for all remedial actions where risks can be foreseen.
Monitored natural attenuation of TCE and tritium	· Install two new monitor wells east of Pit 6 Landfill. Both will be approximately 150 feet deep. · Perform fate and transport modeling to predict the spatial distribution of contaminants of concern over time and demonstrate the efficacy of monitored natural attenuation in meeting RAOs and ARARs. · Develop contingency criteria for determining whether a more active remediation is necessary to address any COCs.

Note:

Remediation-specific details, such as the number and location of extraction wells used for a pump-and-treat alternative, are approximations based on best professional judgement and are presented in this Interim ROD for purposes of costing and strategy preparation only. The actual site- and technology-specific details will be based on additional data and design criteria presented in Remedial Design documents.

Table 2.11-3. Description of the selected remedy for the HE Process Area (Alternative 2).

Element	Scope
No further action for: (1) VOCs in soil and bedrock at the HE rinsewater lagoons, and (2) VOCs and HMX/RDX in soil and bedrock at the HE Burn Pit	· No further investigation, sampling, or analyses would be performed for: 1. HE compounds in surface soil and subsurface bedrock, and VOCs in bedrock beneath the HE rinsewater lagoons. The HE lagoons were excavated and closed in 1985-1989. HE compounds in ground water remain COCs. 2. HE compounds beneath the HE Burn Pits and the VOCs beneath the former Drying Shed area. VOCs and perchlorate in ground water beneath the former Drying Shed area remain COCs.
Monitoring	· Sample and analyze ground water and measure water levels at approximately 70 wells. · Sample and analyze surface water from springs.
Risk and hazard management	· Implement building occupancy and land use restrictions in the vicinity of Building 815 and Spring 5 and install warning signs, as necessary to prevent exposure. · Develop and implement a risk and hazard monitoring and assessment program: 1. Sample outdoor ambient air annually for VOCs near Building 815, until risk is $<10^{-6}$ for at least two years; 2. Sample outdoor ambient air annually for VOCs near Spring 5, if water is flowing; 3. Integrate these data into risk assessment calculations to determine any changes in risks and hazards; and 4. Review these data to evaluate compliance with RAOs. 5. Ecological surveys will be performed, as described in Section 2.9.1.2. · Develop and implement Operational Safety Procedures for all remedial actions where risks can be foreseen.
Ground water extraction and treatment of VOCs and nitrate at the leading edge of the Building 815 TCE plume	· Two extraction wells will be located near the southern Site 300 boundary near the downgradient extent of the TCE plume. Both extraction wells will be converted monitor wells. A third extraction well will be added, if necessary, to prevent offsite migration. · The screened intervals in the extraction wells will be between 150 and 200 feet bgs. The extraction wells are completed in bedrock. · About 50 feet of piping from the extraction wells to the treatment systems will be required. In addition, approximately 450 feet of piping would also be required to convey treated water to the discharge location. · Ground water extracted from well W-35C-04 will be treated using a treatment unit fitted with aqueous-phase GAC. · At the first treatment unit, the estimated TCE concentration is 2 to 5 μg/L and the estimated flow rate is 3 gpm. · Pumping from the leading edge of the TCE plume may eventually capture or influence upgradient contaminants such as RDX and perchlorate, although extraction rates can be adjusted to minimize these effects. If the contaminants entering the treatment facility change, treatment technologies will be adjusted to treat any additional

Table 2.11-3. Description of the selected remedy for the HE Process Area (Alternative 2). (Cont. page 2 of 2)

Element	Scope
	contaminants as appropriate.
Ground water extraction and treatment of VOCs, HE compounds, nitrate, and perchlorate released from Building 815 and the high explosives rinsewater lagoons	· **At least eight extraction wells will be located near Building 815 and in the area downgradient (south-southeast) of Building 815.** · **Convert about seven existing monitor wells to extraction wells.** · **Install at least one additional extraction well.** · **The screened intervals for the extraction wells will be approximately 80 to 100 feet bgs. At least six of the extraction wells will be completed in bedrock (Tnbs2), and at least two of the extraction wells will be completed in a shallow perched water-bearing zone (Tps).** · **Perform hydraulic tests.** · **Install approximately 850 feet of piping from the extraction wells to the treatment systems. In addition, 450 feet of piping will also be required to convey treated water to the discharge locations.** · **The estimated flow rate for ground water is 1 to 2 gpm per bedrock well and 0.1 to 0.5 gpm per Tps well, for a total flow rate from all wells of 8 to 12 gpm.** · **Treat extracted ground water using about four treatment units, all using aqueous-phase GAC and fixed-film bioreactors, or other equivalent technology demonstrated to be effective in removing VOCs, HE compounds, nitrate, and perchlorate from ground water.** · **The estimated weighted average concentrations for these units vary from 1 to 300 μg/L TCE, from 2 to 120 μg/L RDX, from 5 to 50 μg/L perchlorate, and from 5 to 300 mg/L nitrate (as NO_3). The total flow rate for these units is estimated to be between 10 and 15 gpm.**
Ground water extraction and treatment of VOCs, perchlorate, and nitrate in the HE Burn Pit Area	· **Extract ground water from two existing monitor wells converted to extraction wells. Install one new extraction well, if necessary.** · **The screened intervals in the extraction wells will be between 75 and 100 feet bgs. The wells will be completed in alluvium or bedrock.** · **Perform hydraulic tests to determine sustainable flow rates.** · **Install approximately 100 feet of piping from the extraction wells to the treatment system.** · **The estimated flow rate for ground water is 0.1 to 0.5 gpm per well, with a total flow rate of 0.3 to 1.5 gpm.** · **The maximum estimated TCE concentration in the extraction wells is 310 μg/L. Based on a weighted average from all extraction wells, the estimated contaminant concentration in treatment system influent is 200 to 300 μg/L TCE, 15 μg/L perchlorate, and 100 mg/L nitrate (as NO_3).** · **Treat ground water using aqueous-phase GAC and a fixed-film bioreactor, or other equivalent technologies, contained in one treatment facility.**

Note:

Remediation-specific details, such as the number and location of extraction wells used for a pump-and-treat alternative, are approximations based on best professional judgement and are presented in this Interim ROD for purposes of costing and strategy preparation only. The actual site- and technology-specific details will be based on additional data and design criteria presented in Remedial Design documents.

Table 2.11-4. Description of the selected remedy for Building 850 (Alternative 2).

Element	Scope
Monitoring	· Sample and analyze ground water and measure water levels at about 47 wells. · Sample and analyze surface water at well 8 spring and Spring 6.
Risk and hazard management	· Maintain land use restrictions in the vicinity of the Building 850 firing table and install warning signs. · Develop and implement a risk and hazard monitoring and assessment program: 1. Sample surface soil annually for PCBs near the Building 850 firing table, until removal; 2. Sample surface soil annually for dioxins and furans near the Building 850 firing table, until removal; 3. Conduct annual wildlife surveys by biologists to evaluate the presence of any species of special concern while PCBs, dioxins, and furans remain at hazardous concentrations; 4. Integrate these data into risk assessment calculations to determine any changes in risks and hazards; and 5. Review these data to evaluate compliance with RAOs. · Develop and implement Operational Safety Procedures for all remedial actions where risks can be foreseen.
Monitored natural attenuation of tritium	· Perform fate and transport modeling to predict the spatial distribution of contaminants of concern over time and demonstrate the efficacy of monitored natural attenuation in meeting RAOs and ARARs. · Develop contingency criteria for determining for whether a more active remediation is necessary to address any COCs.
Removal of contaminated sand pile	· Remove the contaminated sand pile adjacent to the Building 850 Firing Table. · The estimated areal extent of removal is 1,250 ft^2. · The sand pile is approximately 10 feet high. · The total estimated volume of material to be removed is 460 yd^3. · The maximum concentrations of contaminants detected in the sand pile were 204,000 pCi/L (soil moisture) tritium, and 4.5 mg/L copper using the STLC method.
Removal of contaminated soil adjacent to the firing table	· Remove the surface soil contaminated with ejecta from explosive tests at the Building 850 firing table. · The estimated areal extent of removal is 43,700 ft^2. · The estimated depth of removal is approximately 0.5 feet, however excavation will continue until PCBs, dioxins, and furans are below PRGs.. · The total estimated volume of material to be removed is 800 yd^3. · The maximum concentrations of contaminants associated with the surface soil are 25 pCi/g uranium-238, 51,200 pCi/L (soil moisture) tritium, 180 mg/kg PCBs, 4.3 pg/g dioxins, 15,000 pg/g furans, 1,000 mg/kg copper (TTLC method), 15 mg/kg beryllium (TTLC method), 43 mg/kg lead (TTLC method), and 2.4 mg/kg HMX.

Note:

Remediation-specific details, such as the number and location of extraction wells used for a pump-and-treat alternative, are approximations based on best professional judgement and are presented in this Interim ROD for purposes of costing and strategy preparation only. The actual site- and technology-specific details will be based on additional data and design criteria presented in Remedial Design documents.

Table 2.11-5. Description of the selected remedy for the Pit 2 Landfill (Alternative 2).

Element	Scope
Monitoring	· **Sample and analyze ground water and measure water levels at least at 3 wells.** · **Reengineer surface water drainage.** · **Inspect landfill surface for damage that could compromise the integrity of the landfill, and repair any damage found.** · **Evaluate sample data to determine if there have been any changes that could impact human health or the environment.**

Note:

Remediation-specific details, such as the number and location of extraction wells used for a pump-and-treat alternative, are approximations based on best professional judgement and are presented in this Interim ROD for purposes of costing and strategy preparation only. The actual site- and technology-specific details will be based on additional data and design criteria presented in Remedial Design documents.

Table 2.11-6. Description of the selected remedy for Building 854 (Alternative 2).

Element	Scope
No further action for metals, HMX, PCBs, and tritium in surface soil.	· **No further investigation, sampling, or analyses will be performed for metals, HMX, and tritium in surface soil in extremely low concentrations.**
Monitoring	· **Sample and analyze ground water and measure water levels at approximately 14 wells.** · **Sample and analyze surface water from two springs.**
Risk and hazard management	· **Maintain building occupancy and land use restrictions in the vicinity of Building 854F and install warning signs as necessary to prevent exposure. If sampling of indoor air within Building 854A or 854F indicates that risks currently exceed 10^{-6} or the HI exceeds 1, institute building restrictions or, if building use is again anticipated, install a building ventilation system and operate it whenever the building is occupied.** · **Develop and implement a risk and hazard monitoring and assessment program:** 1. **Sample indoor ambient air annually for VOCs in Building 854F and Building 854A until, until risk is $<10^{-6}$ and HI is <1 for at least two years;** 2. **Sample surface soil annually for PCBs in the Building 854 complex and evaluate whether soil removal is warranted;** 3. **Conduct semi-annual wildlife surveys to evaluate the presence of any species of concern.** 4. **Integrate these data into risk assessment calculations to determine any changes in risks and hazards; and** 5. **Review these data to evaluate compliance with RAOs.** · **Develop and implement Operational Safety Procedures for all remedial actions where risks can be foreseen.**
Ground water and soil vapor extraction and treatment	**<u>Source area wellfield</u>** · **Extract ground water and soil vapor simultaneously from approximately six wells located in the vicinity of the Building 854 Complex.** · **Convert one well from a monitor well.** · **Install about five new extraction wells. The screened intervals for the extraction wells will be between approximately 140 and 160 feet bgs.** · **Extract soil vapor (only) from about six new wells located in the core complex area. The screened interval for the new wells would be between 10 and 30 feet bgs.** · **Perform hydraulic tests and soil vapor extraction tests.** · **Install about 500 feet of piping from the extraction wells to the source area treatment system.** · **The estimated flow rate for ground water is 1.0 to 2.0 gpm per well, with a total flow rate of 6 to 12 gpm.**

Table 2.11-6. Description of the selected remedy for Building 854 (Alternative 2). (Cont. page 2 of 2)

Element	Scope
	· Estimated maximum contaminant concentrations in extracted ground water are 260 μg/L TCE and 80 mg/L nitrate. Based on a weighted average from all extraction wells, the estimated contaminant concentrations in treatment system influent are 150 μg/L TCE and 60 mg/L nitrate. · The estimated flow rate for soil vapor is 0.8 to 1.0 scfm per well, with a total flow rate of 10 to 12 scfm. · The design applied vacuum is 5 to 10 inches of Hg with an estimated radius of influence of 20 to 30 feet per well. · The estimated maximum TCE concentration in extracted soil vapor is 20 $ppm_{v/v}$. Based on a weighted average from all extraction wells, the estimated initial TCE vapor concentration in treatment system influent is 10 to 20 $ppm_{v/v}$. · Treat all extracted ground water by a GWTU using aqueous-phase GAC and a fixed-film bioreactor, or other equivalent technologies. Treat all extracted soil vapor using vapor-phase GAC. Downgradient wellfield · Extract ground water (only) from at least three wells located downgradient of the complex. · Convert one existing ground water monitoring well to an extraction well. · Install new extraction wells, as necessary. · The screened interval for the wells is expected to be between 140 and 160 feet bgs. · Complete all extraction wells in bedrock ($Tnbs_1$). · Perform hydraulic tests on the extraction wells. · Install about 400 feet of piping from the extraction wells to the downgradient treatment systems. · The estimated flow rate for ground water is 0.5 to 1 gpm per well, with a total flow rate of 1 to 2 gpm. · Based on a weighted average from all extraction wells, the estimated contaminant concentrations in treatment system influent are 100 μg/L TCE and 40 mg/L nitrate. · Treat all extracted ground water by a treatment unit using aqueous-phase GAC.

Note:

Remediation-specific details, such as the number and location of extraction wells used for a pump-and-treat alternative, are approximations based on best professional judgement and are presented in this Interim ROD for purposes of costing and strategy preparation only. The actual site- and technology-specific details will be based on additional data and design criteria presented in Remedial Design documents.

Table 2.11-7. Description of the selected remedy for the Building 832 Canyon (Alternative 2).

Element	Scope
No further action for: (1) HMX in surface soil and nitrate in subsurface soil and bedrock at B830, and (2) HMX and nitrate in soil and bedrock at B832.	· No further investigation, sampling, or analyses will be performed for: 1. Nitrate in subsurface bedrock. Nitrate in ground water remains a COC. 2. HMX in surface soil (Building 830) and subsurface bedrock (Building 832).
Monitoring	· Sample and analyze ground water for potential COCs, and measure water levels at about 33 wells at Building 830 and about 18 wells at Building 832. · Sample and analyze surface water from Spring 3.
Risk and hazard management	· Maintain land use restrictions in the vicinity of Building 830 and 832. If sampling of indoor air within Building 833 indicates that risks currently exceed 1×10^{-6} or the HI exceeds 1, institute building restrictions or, if building use is again anticipated, install a building ventilation system and operate it whenever the building is occupied. · Develop and implement a risk and hazard monitoring and assessment program: 1. Sample outdoor ambient air annually for VOCs near Building 830, until risk is $<10^{-6}$ for at least two years; 2. Sample indoor ambient air annually for VOCs in Building 830, until risk is $<10^{-6}$ for at least two years; 3. Sample outdoor ambient air annually for VOCs near Spring 3, until risk is $<10^{-6}$ and HI <1 for at least two years; 4. Integrate these data into risk assessment calculations to determine any changes in risks and hazards; and 5. Review these data to evaluate compliance with RAOs. · Develop and implement Operational Safety Procedures for all remedial actions where risks can be foreseen.
Ground water and soil vapor extraction and treatment of VOCs, perchlorate, and nitrate at Building 832	<u>Source area wellfield</u> · Simultaneously extract ground water and soil vapor from about 10 wells located in the immediate vicinity of the Building 832 Complex. · Convert about ten monitor wells to complete the extraction wellfield. · The screened intervals of the extraction wells are approximately 7 to 35 feet bgs. Extraction wells will be completed in alluvium, fill, and bedrock. · Perform hydraulic tests and soil vapor extraction tests. · Install about 400 feet of piping from the extraction wells to the source area treatment system. · The estimated flow rate for ground water is 0.1 to 1 gpm per well, with a total flow rate of 1 to 3 gpm. · Estimated maximum contaminant concentrations in extracted ground water are 1,200 μg/L TCE, 140 mg/L nitrate, and 14 μg/L perchlorate.

Table 2.11-7. Description of the selected remedy for the Building 832 Canyon (Alternative 2). (Cont. page 2 of 4)

Element	Scope
	Based on a weighted average from all extraction wells, the estimated contaminant concentrations in treatment system influent are 300 μg/L TCE, 90 mg/L nitrate, and 10 μg/L perchlorate.
	· The estimated flow rate for soil vapor is 0.8 to 1.0 scfm per well, with a total flow rate of 8 to 10 scfm. The design applied vacuum is 5 to 10 inches of Hg with an estimated radius of influence of 20 to 30 feet based on a permeability of 10^{-9} cm^2.
	· The estimated maximum TCE concentration in extracted soil vapor is 30 $ppm_{v/v}$. Based on a weighted average from all extraction wells, the estimated initial TCE vapor concentration in treatment system influent is 10 to 20 $ppm_{v/v}$.
	· All extracted ground water from the extraction wells near the Building 832 Complex would be treated by a treatment unit using aqueous-phase GAC and a fixed-film bioreactor, or other equivalent technologies.
	· Treat all extracted soil vapor using vapor-phase GAC.
	Downgradient wellfield
	· About four ground water extraction wells would be located several hundred feet downgradient of the Building 832 Complex.
	· Convert about three monitor wells to extraction wells.
	· Install at least one additional extraction well.
	· The screened intervals of the extraction wells will be approximately 25 to 40 feet bgs. All extraction wells will be completed in bedrock.
	· Perform hydraulic tests.
	· About 375 feet of piping from the extraction wells to the downgradient treatment systems will be required.
	· Water extracted from the four downgradient ground water (only) extraction wells would be treated using two treatment units using aqueous-phase GAC and fixed-film bioreactors, or other equivalent technologies.
	· The two treatment units in the Building 832 area are estimated to have concentrations of between 80 μg/L to 150 μg/L TCE, and between 60 to 80 mg/L nitrate (as NO_3). Each unit is expected to have a total flow rate of about 0.2 to 0.6 gpm.
· Ground water and soil vapor extraction and treatment of VOCs, perchlorate, and nitrate at Building 830	· Simultaneously extract ground water and soil vapor from about 10 wells located in the immediate vicinity of Building 830.
	· Convert about six monitor wells to extraction wells.
	· Install about four additional extraction wells.
	· The screened intervals of the extraction wells will be approximately 10 to 20 feet, and the screened depths will range from 14 to 50 feet bgs.
	· All extraction wells would be completed in alluvium, fill, and/or bedrock.

Table 2.11-7. Description of the selected remedy for the Building 832 Canyon (Alternative 2). (Cont. page 3 of 4)

Element	Scope
	· Perform hydraulic tests and four soil vapor extraction tests. · Install approximately 400 feet of piping from the extraction wells to the source area treatment system. · The estimated flow rate for ground water is 0.1 to 1 gpm per well, with a total flow rate of 1 to 3 gpm. · Estimated maximum contaminant concentrations in extracted ground water are 80,000 μg/L TCE, 500 mg/L nitrate, and 22 μg/L perchlorate. · Based on a weighted average from all extraction wells, the estimated contaminant concentrations in treatment system influent are 2,000 μg/L TCE, 200 mg/L nitrate, and 10 μg/L perchlorate. · The estimated flow rate for soil vapor is 0.8 to 1.0 scfm per well, with a total flow rate of 8 to 10 scfm. The design applied vacuum is 5 to 10 inches of Hg with an estimated radius of influence of 20 to 30 feet based on a permeability of 10^{-9} cm^2. · The estimated maximum TCE concentration in extracted soil vapor is 1,000 $ppm_{v/v}$. Based on a weighted average from all extraction wells, the estimated TCE concentration in treatment system influent is 50 to 100 $ppm_{v/v}$. · Treat all extracted ground water from the extraction wells near Building 830 by a treatment unit using aqueous-phase GAC and a fixed-film bioreactor, or other equivalent technologies. · Treat all extracted soil vapor using vapor-phase GAC. <u>Downgradient wellfield</u> · About five ground water extraction wells will be located downgradient of Building 830. · Convert about three existing ground water monitoring wells to extraction wells. · Install about two additional extraction wells. · The screened intervals of the extraction wells will be approximately 10 to 20 feet, and the screened depths would range from approximately 25 to 100 feet bgs, in bedrock. · Perform hydraulic tests on the extraction wells. · Install approximately 610 feet of piping from the extraction wells to the downgradient treatment systems. · Treat water extracted from the five downgradient ground water extraction wells using two treatment units using aqueous-phase GAC and fixed-film bioreactors, or other equivalent technologies. · The two treatment units in the Building 830 area are estimated to have concentrations of between 100 μg/L to 400 μg/L TCE, and between 60 to 80 mg/L nitrate (as NO_3). Each unit is expected to have a total flow rate of about 0.1 to 0.5 gpm.

Table 2.11-7. Description of the selected remedy for the Building 832 Canyon (Alternative 2). (Cont. page 4 of 4)

Element	Scope
Downgradient ground water extraction using a siphon with *ex situ* treatment of VOCs by iron filings	· **Install about two additional monitor wells and four new extraction wells at the siphon location; all wells will be about 70 ft deep.** · **Perform hydraulic tests on extraction wells.** · **Develop a ground water flow and contaminant transport model.** · **Perform bench-scale laboratory tests on ground water from the extraction zone to help select the reactive material and to predict chemical reactions. Perform a field column test at the siphon location to verify results.** · **The estimated concentrations of contaminants on the upgradient side of the siphon are 70 μg/L TCE and 60 mg/L nitrate. The treatment system will be designed to reduce the TCE concentration to levels below detection limits.** · **The capability of iron filings to reduce nitrate concentration will continue to be investigated.** · **Convey treated water in a pipe to the culvert at the bottom of the Building 832 Canyon.**

Note:

Remediation-specific details, such as the number and location of extraction wells used for a pump-and-treat alternative, are approximations based on best professional judgement and are presented in this Interim ROD for purposes of costing and strategy preparation only. The actual site- and technology-specific details will be based on additional data and design criteria presented in Remedial Design documents.

Table 2.11-8. Description of the selected remedy for Building 801 and the Pit 8 Landfill (Alternative 2).

Element	Scope
No further action for VOCs in subsurface soil at the B801 dry well	· No further investigation, sampling, or analyses would be performed for VOCs in subsurface bedrock below the Building 801 Dry Well.
Monitoring	· Sample and analyze ground water and measure water levels at about six wells. Inspect landfill surface for damage that could compromise its integrity, and repair damage found. · Evaluate sample data to determine if there have been any changes that could impact human health or the environment.

Note:

Remediation-specific details, such as the number and location of extraction wells used for a pump-and-treat alternative, are approximations based on best professional judgement and are presented in this Interim ROD for purposes of costing and strategy preparation only. The actual site- and technology-specific details will be based on additional data and design criteria presented in Remedial Design documents.

Table 2.11-9. Description of the selected remedy for Building 833 (Alternative 2).

Element	Scope
Monitoring	· Sample and analyze ground water at about nine wells to track changes in plume concentrations and size and determine when cleanup goals are achieved.
Risk and hazard management	· Implement building occupancy restrictions in the vicinity of Building 833 and install warning signs, if necessary to prevent exposure. If sampling of indoor air within Building 833 indicates that risks currently exceed 1×10^{-6} or the HI exceeds 1, institute building restrictions or, if building use is again anticipated, install a building ventilation system and operate it whenever the building is occupied. 1. Develop and implement a risk and hazard monitoring and assessment program: 2. Sample indoor ambient air annually for VOCs in Building 833, until risk is $<10^{-6}$; 3. Integrate these data into risk assessment calculations to determine any changes in risks and hazards; and 4. Review these data to evaluate compliance with RAOs. · Develop and implement Operational Safety Procedures for all remedial actions where risks can be foreseen.

Note:

Remediation-specific details, such as the number and location of extraction wells used for a pump-and-treat alternative, are approximations based on best professional judgement and are presented in this Interim ROD for purposes of costing and strategy preparation only. The actual site- and technology-specific details will be based on additional data and design criteria presented in Remedial Design documents.

Table 2.11-10. Description of the selected remedy for Building 845 and the Pit 9 Landfill. (Alternative 2)

Element	Scope
No further action for HMX and uranium in soil and bedrock	· No further investigation, sampling, or analyses will be performed for: 1. Uranium in subsurface soil below the Building 845 firing table. 2. HMX in subsurface soil below the Building 845 firing table.
Monitoring	· Sample and analyze ground water and measure water levels at about four wells. · Inspect landfill surface for damage that could compromise its integrity the and repair damage found. · Evaluate sample data to determine if there have been any changes that could impact human health or the environment.

Note:

Remediation-specific details, such as the number and location of extraction wells used for a pump-and-treat alternative, are approximations based on best professional judgement and are presented in this Interim ROD for purposes of costing and strategy preparation only. The actual site- and technology-specific details will be based on additional data and design criteria presented in Remedial Design documents.

Table 2.11-11. Description of the selected remedy for Building 851 (Alternative 2).

Element	Scope
No further action for VOCs and uranium in soil and bedrock and for RDX and metals in surface soil	· **No further investigation, sampling, or analyses would be performed for.** **1. TCE in subsurface bedrock below the Building 851 firing table.** **2. Uranium in subsurface bedrock below the Building 851 firing table.** **3. Uranium in surface soil adjacent to the Building 851 firing table.** **4. Cadmium in surface soil adjacent to the Building 851 firing table.** **5. Copper in surface soil adjacent to the Building 851 firing table.** **6. Zinc in surface soil adjacent to the Building 851 firing table.** **7. RDX in surface soil adjacent to the Building 851 firing table.**
Monitoring	· **Sample and analyze ground water and measure water levels at about five wells.**

Note:

Remediation-specific details, such as the number and location of extraction wells used for a pump-and-treat alternative, are approximations based on best professional judgement and are presented in this Interim ROD for purposes of costing and strategy preparation only. The actual site- and technology-specific details will be based on additional data and design criteria presented in Remedial Design documents.

Table 2.11-12. Cost summary for Building 834 (OU2) Alternative 2.

Activity	Parameter	Quantity	Unit	Direct capital ($)	Indirect capital ($)	Annual O&M ($)
Monitoring of ground water						
Monitoring						
Water levels	Wells measured monthly	47	ea			3,807
Water quality sampling/analysis	Wells sampled quarterly	47	ea			118,346
Data analysis & representation	Labor	200	hr			18,400
Pump maintenance or replacement	Wells	47	ea			6,251
Subtotal costs				**0**	**0**	**146,804**
Risk and Hazard Management						
Institutional Controls						
Prepare Building Occupancy and Land Use Plan	Plan	1	ea		3,663	
Review Building Occupancy and Land Use Plan	Report	0.2	ea			733
Install warning signs	Signs	1	lot	535		
Subtotal costs				**535**	**3,663**	**733**
Risk and Hazard Monitoring						
Prepare Risk and Hazard Monitoring Plan	Plan	1	ea		10,990	
Soil vapor testing	Location	2	ea			2,898
Conduct wildlife survey	Survey	2	ea			3,297
Report	Report	1	ea			6,960
Subtotal costs				**0**	**10,990**	**13,154**
Operational Safety Plans						
Prepare Operational Safety Plans	Plan	1	ea		2,381	
Subtotal costs				**0**	**2,381**	**0**
Ground water and soil vapor extraction and treatment of VOCs, TBOS/TKEBS, and nitrate						
Install Ground Water and SVE Wellfield						
Drilling preparation	New wells	1	ea	2,614		
Drilling	New wells	1	ea	4,051		
Drilling footage	Avg. depth of wells	30	ft	5,280		
Well design and construction	New wells	1	ea	8,645		
Hydraulic testing	Pump tests	8	ea		101,040	
Soil vapor testing	SVE tests	4	ea		48,116	
Subtotal costs				**20,590**	**149,156**	**0**
Design and Construct Remediation System						
Remedial design report	Reports	1	ea		31,070	
Data analysis & representation	Labor	200	hr		18,400	
Modeling	Labor	200	hr		18,400	
Modify B834 SVE System	Treatment systems	1	ea	145,158		
Add-on bioreactor to existing facility	GWTU-BIO	1	ea	70,871		
Construct pipeline	Length of pipeline	1,400	ft	221,200		
Hook up wells	Wells	8	ea	160,816		
Subtotal costs				**598,045**	**67,870**	**0**
O&M - B834-TF1						
Control/inst. calibration and maintenance	Treatment systems	1	ea			79,888
Mechanical O&M (GWTU)	Treatment systems	1	ea			134,333
Facility documentation and data collection	Treatment systems	1	ea			181,500
Extraction well sampling & analysis	Treatment systems	1	ea			105,248
Remedial system permit report	Treatment systems	1	ea			46,800
Dispose of GW GAC canisters (1,000 lb)	Canisters	0.2	ea			778
Dispose of SVE GAC canisters (2,000 lb)	Canisters	2	ea			6,300
Manage wellfield flow	Treatment systems	1	ea			20,868
Subtotal costs				**0**	**0**	**575,715**
Total costs				**619,170**	**234,060**	**736,406**
Cost summary						
Capital costs	**$853,000**					
Present worth of O&M costs[a], 5% discount rate	**$11,272,000**					
Total present worth costs	**$12,125,000**					

[a] **O&M assumes 30 years of monitoring, risk and hazard management, and ground water extraction and treatment, and 10 years of soil vapor extraction and treatment.**

Note: project management and support, and contingency costs are not included. The information in this cost estimate summary table is based on the best available information regarding the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. This is on order-of-magnitude engineering cost estimate that is expected to be within + 50% to - 30% of the actual project cost.

Table 2.11-13. Cost summary for Pit 6 Landfill (OU3) Alternative 2.

Activity	Parameter	Quantity	Unit	Direct capital ($)	Indirect capital ($)	Annual O&M ($)
Monitoring of ground and surface water						
Monitoring						
Water levels	Wells measured quarterly	30	ea			2,430
Water quality sampling/analysis	Wells sampled quarterly	30	ea			75,540
Surface water quality sampling/analysis	Locations sampled quarterly	4	ea			9,716
Data analysis & representation	Labor	200	hr			18,400
Pump maintenance or replacement	Wells	30	ea			3,990
Subtotal costs				**0**	**0**	**110,076**
Risk and Hazard Management						
Institutional Controls						
Prepare Building Occupancy and Land Use Plan	Plan	1	ea		3,663	
Review Building Occupancy and Land Use Plan	Report	0.2	ea			733
Install warning signs	Signs	1	lot	535		
Subtotal costs				**535**	**3,663**	**733**
Risk and Hazard Monitoring						
Prepare Risk and Hazard Monitoring Plan	Plan	1	ea		10,990	
Inspect Spring 7 (in conjunction with quarterly ground water monitoring of Pit 6)	Event	4	ea			0
Sample ambient air (VOCs)	Location	1	ea			1,449
Conduct wildlife survey	Survey	2	ea			3,297
Report	Report	1	ea			6,960
Subtotal costs				**0**	**10,990**	**11,706**
Operational Safety Plans						
Prepare Operational Safety Plans	Plan	1	ea		2,381	
Subtotal costs				**0**	**2,381**	**0**
Monitored natural attenuation of VOCs and tritium in ground water						
Monitoring well installation						
Drilling preparation	New wells	2	ea	5,228		
Drilling	New wells	2	ea	8,102		
Drilling footage	Avg. depth of wells	150	ft	52,800		
Well design and construction	New wells	2	ea	17,290		
Hydraulic testing	Pump tests	2	ea		25,260	
Subtotal costs				**83,420**	**25,260**	**0**
Monitoring						
Water levels	Wells measured quarterly	2	ea			162
Water quality sampling/analysis	Wells sampled quarterly	2	ea			5,036
Pump maintenance or replacement	Wells	2	ea			266
Data analysis & representation	Labor	100	ea			9,200
Modeling	Labor	100	ea			9,200
Subtotal costs				**0**	**0**	**23,864**
Total costs				**83,955**	**42,294**	**146,378**
<u>**Cost summary**</u>						
Capital costs	**$126,000**					
Present worth of O&M costs[a], 5% discount rate	**$2,250,000**					
Total present worth costs	**$2,376,000**					

[a] O&M assumes 30 years of monitoring and risk and hazard management.

Note: project management and support, and contingency costs are not included. The information in this cost estimate summary table is based on the best available information regarding the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. This is on order-of-magnitude engineering cost estimate that is expected to be within + 50% to - 30% of the actual project cost.

Table 2.11-14. Cost summary for HE Process Area (OU4) Alternative 2.

Activity	Parameter	Quantity	Unit	Direct capital ($)	Indirect capital ($)	Annual O&M ($)
Monitoring of ground and surface water						
Monitoring						
Water levels	Wells measured quarterly	70	ea			5,670
Water quality sampling/analysis	Wells sampled quarterly	70	ea			176,260
Surface water quality sampling/analysis	Locations sampled quarterly	2	ea			4,858
Data analysis & representation	Labor	200	hr			18,400
Pump maintenance or replacement	Wells	70	ea			9,310
Subtotal costs				**0**	**0**	**214,498**
Risk and Hazard Management						
Institutional Controls						
Prepare Building Occupancy and Land Use Plan	Plan	1	ea		3,663	
Review Building Occupancy and Land Use Plan	Report	0.2	ea			733
Install warning signs	Signs	1	lot	535		
Subtotal costs				**535**	**3,663**	**733**
Risk and Hazard Monitoring						
Prepare Risk and Hazard Monitoring Plan	Plan	1	ea		10,990	
Sample ambient air (VOCs)	Location	2	ea			2,898
Prepare Risk and Hazard and RAO Compliance Report	Report	1	ea			6,960
Subtotal costs				**0**	**10,990**	**9,858**
Operational Safety Plans						
Prepare Operational Safety Plans	Plan	1	ea		2,381	
Subtotal costs				**0**	**2,381**	**0**
Ground water extraction and treatment of VOCs and nitrate at the leading edge of the Building 815 TCE plume						
Design and construct remediation system						
Remedial design report	Report	1	ea		31,071	
Data analysis & representation	Labor	200	hr		18,400	
Modeling	Labor	200	hr		18,400	
Permitting	Permits	1	ea		9,158	
Site Preparation	SWAT	1	ea	50,000		
Construct B815-TF1	SWAT-GAC	1	ea	116,562		
Site Preparation	GWTU	1	ea	150,000		
Construct B815-TF2	GWTU-GBI	1	ea	231,780		
Construct pipeline	Length of pipeline	50	ft	7,900		
Hookup wells	Wells	2	ea	40,204		
Construct discharge pipeline	Length of pipeline	450	ft	13,500		
Subtotal costs				**609,946**	**77,029**	**0**
O & M - B815-TF1						
Control/inst. calibration and maintenance	Treatment systems	1	ea			27,877
Mechanical O & M (SWAT)	Treatment systems	1	ea			52,221
Facility documentation and data collection	Treatment systems	1	ea			32,013
Extraction well sampling & analysis	Extraction wells	1	ea			1,768
Remedial system permit report	Treatment systems	1	ea			34,124
Dispose of GW GAC canisters	Canisters	0.02	ea			6
Manage wellfield flow	Treatment systems	1	ea			18,316
Subtotal costs				**0**	**0**	**166,325**
O & M - B815-TF2						
Control/inst. calibration and maintenance	Treatment systems	1	ea			52,353
Mechanical O & M (GWTU)	Treatment systems	1	ea			46,724
Facility documentation and data collection	Treatment systems	1	ea			32,013
Remedial system permit report	Treatment systems	1	ea			34,124
Extraction well sampling & analysis	Extraction wells	1	ea			1,768
Dispose of GW GAC canisters (200 lb)	Canisters	0.2	ea			61
Subtotal costs				**0**	**0**	**167,043**

Table 2.11-14. Cost summary for HE Process Area (OU4) Alternative 2. (Cont. page 2 of 3)

Activity	Parameter	Quantity	Unit	Direct capital ($)	Indirect capital ($)	Annual O&M ($)
Ground water extraction and treatment of VOCs, HE compounds, nitrate, and perchlorate released from Building 815 and the high explosives rinsewater lagoons						
Install ground water wellfield						
Drilling preparation	New wells	1	ea	2,614		
Drilling	New wells	1	ea	4,051		
Drilling footage	Avg. depth of wells	100	ft	17,600		
Well design and construction	New wells	1	ea	8,645		
Hydraulic testing	Pump tests	8	ea		101,040	
Subtotal costs				**32,910**	**101,040**	**0**
Design and construct remediation system						
Remedial design report	Report	1	ea		31,071	
Data analysis & representation	Labor	200	hr		18,400	
Modeling	Labor	200	hr		18,400	
Permitting	Permits	1	ea		9,158	
Site Preparation	SWAT	4	ea	200,000		
Construct B815-TF3 through B815-TF6	SWAT-GBI	4	ea	749,732		
Construct pipeline	Length of pipeline	850	ft	134,300		
Hookup wells	Wells	8	ea	160,816		
Construct discharge pipe	Length of pipeline	450	ft	13,500		
Subtotal costs				**1,258,348**	**77,029**	**0**
O & M - B815-TF3 through B815-TF6						
Control/inst. calibration and maintenance	Treatment systems	4	ea			334,528
Mechanical O & M (SWAT)	Treatment systems	4	ea			208,884
Facility documentation and data collection	Treatment systems	4	ea			128,040
Extraction well sampling & analysis	Extraction wells	8	ea			14,144
Remedial system permit report	Treatment systems	4	ea			136,496
Dispose of GW GAC canisters (200 lb)	Canisters	2	ea			606
Manage wellfield flow	Treatment systems	1	ea			18,316
Subtotal costs				**0**	**0**	**841,014**
Ground water extraction and treatment of VOCs, perchlorate and nitrate released from the HE Burn Pit						
Install ground water wellfield						
Drilling preparation	New wells	1	ea	2,614		
Drilling	New wells	1	ea	4,051		
Drilling footage	Avg. depth of wells	100	ft	17,600		
Well design and construction	New wells	1	ea	8,645		
Hydraulic testing	Pump tests	3	ea		37,890	
Subtotal costs				**32,910**	**37,890**	**0**
Design and construct remediation system						
Remedial design report	Report	1	ea		31,071	
Data analysis & representation	Labor	200	hr		18,400	
Modeling	Labor	200	hr		18,400	
Permitting	Permits	1	ea		9,158	
Site Preparation	SWAT	1	ea	50,000		
Construct B815-TF7	SWAT-GBI	1	ea	187,433		
Construct pipeline	Length of pipeline	100	ft	15,800		
Hookup wells	Wells	3	ea	60,306		
Subtotal costs				**313,539**	**77,029**	**0**
O & M - B815-TF7						
Control/inst. calibration and maintenance	Treatment systems	1	ea			83,632
Mechanical O & M (SWAT)	Treatment systems	1	ea			52,221
Facility documentation and data collection	Treatment systems	1	ea			32,010
Extraction well sampling & analysis	Extraction wells	3	ea			5,304
Remedial system permit report	Treatment systems	1	ea			34,124
Dispose of GW GAC canisters	Canisters	1	ea			303
Manage wellfield flow	Treatment systems	1	ea			18,316
Subtotal costs				**0**	**0**	**225,910**
Total costs				**2,248,188**	**387,051**	**1,625,380**
Cost summary						
Capital costs	**$2,635,000**					
Present worth of O&M costs[a], 5% discount rate	**$24,986,000**					
Total present worth costs	**$27,621,000**					

Table 2.11-14. Cost summary for HE Process Area (OU4) Alternative 2. (Cont. page 3 of 3)

[a] **O&M assumes 30 years of monitoring, risk and hazard management, and ground water extraction and treatment.**

Note: project management and support, and contingency costs are not included. The information in this cost estimate summary table is based on the best available information regarding the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. This is on order-of-magnitude engineering cost estimate that is expected to be within + 50% to - 30% of the actual project cost.

Table 2.11-15. Cost summary for Building 850 (OU5) Alternative 2.

Activity	Parameter	Quantity	Unit	Direct capital ($)	Indirect capital ($)	Annual O&M ($)
Monitoring of ground and surface water						
Monitoring						
Water levels	Wells measured quarterly	47	ea			3,807
Water quality sampling/analysis	Wells sampled quarterly	47	ea			118,346
Surface water quality sampling/analysis	Locations sampled quarterly	1	ea			2,429
Data analysis & representation	Labor	200	hr			18,400
Pump maintenance or replacement	Wells	47	ea			6,251
Subtotal costs				**0**	**0**	**149,233**
Risk and Hazard Management						
Institutional Controls						
Prepare Building Occupancy and Land Use Plan	Plan	1	ea		3,663	
Review Building Occupancy and Land Use Plan	Report	0.2	ea			733
Install warning signs	Signs	1	lot	535		
Subtotal costs				**535**	**3,663**	**733**
Risk and Hazard Monitoring						
Prepare Risk and Hazard Monitoring Plan	Plan	1	ea		10,990	
Sample surface soil (PCBs)	Location	1	ea			477
Sample surface soil (dioxins/furans)	Location	1	ea			1,943
Conduct wildlife survey	Survey	2	ea			3,297
Prepare Risk and Hazard and RAO Compliance Report	Report	1	ea			6,960
Subtotal costs				**0**	**10,990**	**12,677**
Operational Safety Plans						
Prepare Operational Safety Plans	Plan	1	ea		2,381	
Subtotal costs				**0**	**2,381**	**0**
Monitored natural attenuation of tritium in ground water and surface water						
Monitoring						
Data analysis & representation	Labor	100	ea			9200
Modeling	Labor	100	ea			9200
Subtotal costs				**0**	**0**	**18,400**
Removal of the contamintated sandpile at Building 850 and removal of contaminated soil adjacent to the Building 850 firing table						
Remove the contaminated sandpile at the Building 850 Firing Table with offsite disposal						
Remedial design report	Report	1	ea		31,070	
Excavate - Fixed Costs (See Note A)	Excavation	1	ea	129,487		
Excavate - Volume Dependent Costs	Volume	460	cy	131,100		
Low level waste disposal	Volume	460	cy	254,840		
Subtotal costs				**515,427**	**31,070**	**0**
Remove surface soil adjacent to the Buiding 850 Firing Table with offsite disposal						
Excavate - Fixed Costs (See Note A)	Excavation	1	ea	14,675		
Excavate - Volume Dependent Costs	Volume	800	cy	228,000		
Low level waste disposal	Volume	800	cy	443,200		
Subtotal costs				**685,875**	**0**	**0**
Total costs				**1,201,837**	**48,104**	**181,042**
<u>Cost summary</u>						
Capital costs		**$1,250,000**				
Present worth of O&M costs[a], 5% discount rate		**$2,783,000**				
Total present worth costs		**$4,033,000**				

[a] **O&M assumes 30 years of monitoring, risk and hazard management.**

Note A: Fixed costs include mob/demob costs for excavations at the Building 850 area.

Note B: project management and support, and contingency costs are not included. The information in this cost estimate summary table is based on the best available information regarding the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. This is on order-of-magnitude engineering cost estimate that is expected to be within + 50% to - 30% of the actual project cost.

Table 2.11-16. Cost Summary for Pit 2 Landfill (OU5) Alternative 2.

Activity	Parameter	Quantity	Unit	Direct capital ($)	Indirect capital ($)	Annual O&M ($)
Monitoring of ground and surface water						
Monitoring						
Water levels	Wells measured quarterly	8	ea			648
Water quality sampling/analysis	Wells sampled quarterly	8	ea			20,144
Surface water quality sampling/analysis	Locations sampled quarterly	1	ea			2,429
Data analysis & representation	Labor	100	hr			9,200
Pump maintenance or replacement	Wells	8	ea			1,064
Subtotal costs				**0**	**0**	**33,485**
Total costs				**0**	**0**	**33,485**
Cost summary						
Capital costs	**$0**					
Present worth of O&M costs[a], 5 % discount rate	**$515,000**					
Total present worth costs	**$515,000**					

[a] O&M assumes 30 years of monitoring.

Note: project management and support, and contingency costs are not included. The information in this cost estimate summary table is based on the best available information regarding the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. This is on order-of-magnitude engineering cost estimate that is expected to be within + 50% to - 30% of the actual project cost.

Table 2.11-17. Cost summary for Building 854 (OU6) Alternative 2.

Activity	Parameter	Quantity	Unit	Direct capital ($)	Indirect capital ($)	Annual O&M ($)
Monitoring of ground and surface water						
Monitoring						
Water levels	Wells measured quarterly	14	ea			1,134
Water quality sampling/analysis	Wells sampled quarterly	14	ea			35,252
Surface water quality sampling/analysis	Locations sampled quarterly	2	ea			4,858
Data analysis & representation	Labor	200	hr			18,400
Pump maintenance or replacement	Wells	14	ea			1,862
Subtotal costs				**0**	**0**	**61,506**
Risk and Hazard Management						
Institutional Controls						
Prepare Building Occupancy and Land Use Plan	Plan	1	ea		3,663	
Review Building Occupancy and Land Use Plan	Report	0.2	ea			733
Install warning signs	Signs	1	lot	535		
Subtotal costs				**535**	**3,663**	**733**
Risk and Hazard Monitoring						
Prepare Risk and Hazard Monitoring Plan	Plan	1	ea		10,990	
Sample ambient air (VOCs)	Location	2	ea			2,898
Sample surface soil (PCBs)	Location	1	ea			477
Conduct wildlife survey	Survey	2	ea			3,297
Prepare Risk and Hazard and RAO Compliance Report	Report	1	ea			6,960
Subtotal costs				**0**	**10,990**	**13,631**
Operational Safety Plans						
Prepare Operational Safety Plans	Plan	1	ea		2,381	
Subtotal costs				**0**	**2,381**	**0**
Ground water and soil vapor extraction and treatment of VOCs and nitrate						
Install Ground Water and SVE Wellfield						
Drilling preparation	New wells	13	ea	33,982		
Drilling (water wells)	New wells	7	ea	28,357		
Drilling footage (water wells)	Avg. depth of wells	160	ft	197,120		
Drilling (vapor wells)	New wells	6	ea	24,306		
Drilling footage (vapor wells)	Avg. depth of wells	30	ft	31,680		
Well design and construction	New wells	13	ea	112,385		
Hydraulic testing	Pump tests	9	ea		113,670	
Soil vapor testing	SVE tests	4	ea		48,116	
Subtotal costs				**427,830**	**161,786**	**0**
Design and Construct Remediation System						
Remedial design report	Report	1	ea		31,071	
Data analysis & representation	Labor	200	hr		18,400	
Modeling	Labor	200	hr		18,400	
Permitting	Permits	1	ea		9,158	
Site Preparation	GWTU	1	ea	150,000		
Construct treatment system (B854-TF1)	GWTU-GBI-SVE	1	ea	364,517		
Site Preparation	SWAT	1	ea	50,000		
Construct treatment system (B854-TF2)	SWAT-GBI	1	ea	187,433		
Construct pipeline	Length of pipeline	900	ft	142,200		
Hook up wells	Wells	15	ea	301,530		
Subtotal costs				**1,195,680**	**77,029**	**0**

Table 2.11-17. Cost summary for Building 854 (OU6) Alternative 2. (Cont. page 2 of 2)

O&M - B854-TF1						
Control/inst. calibration and maintenance	Treatment systems	1	ea			69,804
Mechanical O&M (GWTU)	Treatment systems	1	ea			46,724
Facility documentation and data collection	Treatment systems	1	ea			32,013
Extraction well sampling & analysis	Extraction wells	12	ea			21,216
Remedial system permit report	Treatment systems	1	ea			34,124
Dispose of GW GAC canisters (200 lb)	Canisters	2	ea			606
Dispose of SVE GAC canisters (140 lb)	Canisters	3	ea			2,133
Manage wellfield flow	Treatment systems	1	ea			18,316
Subtotal costs				**0**	**0**	**224,936**
O&M - B854-TF2						
Control/inst. calibration and maintenance	Treatment systems	1	ea			83,632
Mechanical O&M (SWAT)	Treatment systems	1	ea			52,221
Facility documentation and data collection	Treatment systems	1	ea			32,013
Extraction well sampling & analysis	Extraction wells	3	ea			5,304
Dispose of GW GAC canisters (200 lb)	Canisters	0.2	ea			61
Subtotal costs				**0**	**0**	**173,231**
Total costs				**1,624,045**	**255,849**	**474,036**

<u>Cost summary</u>

Capital costs	**$1,880,000**
Present worth of O&M costs[a], 5 % discount rate	**$7,287,000**
Total present worth costs	**$9,167,000**

[a] **O&M assumes 30 years of monitoring, risk and hazard management, and ground water extraction and treatment, and 10 years of soil vapor** extraction and treatment.

Note: project management and support, and contingency costs are not included. The information in this cost estimate summary table is based on the best available information regarding the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. This is on order-of-magnitude engineering cost estimate that is expected to be within + 50% to - 30% of the actual project cost.

Table 2.11-18. Cost summary for Building 832 Canyon (OU7) Alternative 2.

Activity	Parameter	Quantity	Unit	Direct capital ($)	Indirect capital ($)	Annual O&M ($)
Monitoring of ground and surface water						
Monitoring						
Water levels	Wells measured quarterly	51	ea			4,131
Water quality sampling/analysis	Wells sampled quarterly	51	ea			128,418
Surface water quality sampling/analysis	Locations sampled quarterly	1	ea			2,429
Data analysis & representation	Labor	200	hr			18,400
Pump maintenance or replacement	Wells	51	ea			6,783
Subtotal costs				**0**	**0**	**160,161**
Risk and Hazard Management						
Institutional Controls						
Prepare Building Occupancy and Land Use Plan	Plan	1	ea		3,663	
Review Building Occupancy and Land Use Plan	Report	0.2	ea			733
Install warning signs	Signs	1	lot	535		
Subtotal costs				**535**	**3,663**	**733**
Risk and Hazard Monitoring						
Prepare Risk and Hazard Monitoring Plan	Plan	1	ea		10,990	
Sample ambient air (VOCs)	Location	3	ea			4,346
Prepare Risk and Hazard and RAO Compliance Report	Report	1	ea			6,960
Subtotal costs				**0**	**10,990**	**11,306**
Operational Safety Plans						
Prepare Operational Safety Plans	Plan	1	ea		2,381	
Subtotal costs				**0**	**2,381**	**0**
Ground water and soil vapor extraction and treatment of VOCs, perchlorate, and nitrate at Building 832						
Install Ground Water and SVE Wellfield						
Drilling preparation	New wells	1	ea	2,614		
Drilling (water wells)	New wells	1	ea	4,051		
Drilling footage (water wells)	Avg. depth of wells	40	ft	7,040		
Well design and construction	New wells	1	ea	8,645		
Hydraulic testing	Pump tests	8	ea		101,040	
Soil vapor testing	SVE tests	4	ea		48,116	
Subtotal costs				**22,350**	**149,156**	**0**
Design and Construct Remediation System						
Remedial design report	Report	1	ea		31,071	
Data analysis & representation	Labor	200	hr		18,400	
Modeling	Labor	200	hr		18,400	
Permitting	Permits	1	ea		9,158	
Site Preparation	GWTU	1	ea	150,000		
Construct treatment system (B832-TF1)	GWTU-GBI-SVE	1	ea	364,517		
Site Preparation	SWAT	2	ea	100,000		
Construct treatment system (B832-TF2)	SWAT-GBI	1	ea	187,433		
Construct treatment system (B832-TF3)	SWAT-GBI	1	ea	187,433		
Construct pipeline	Length of pipeline	775	ft	122,450		
Hook up wells	Wells	14	ea	281,428		
Subtotal costs				**1,393,261**	**77,029**	**0**

Table 2.11-18. Cost summary for Building 832 Canyon (OU7) Alternative 2. (Cont. page 2 of 3)

Activity	Parameter	Quantity	Unit	Direct capital ($)	Indirect capital ($)	Annual O&M ($)
O&M - B832-TF1						
Control/inst. calibration and maintenance	Treatment systems	1	ea			69,804
Mechanical O&M (GWTU)	Treatment systems	1	ea			46,724
Facility documentation and data collection	Treatment systems	1	ea			32,013
Extraction well sampling & analysis	Extraction wells	10	ea			17,680
Remedial system permit report	Treatment systems	1	ea			34,124
Dispose of GW GAC canisters (200 lb)	Canisters	1	ea			303
Dispose of SVE GAC canisters (140 lb)	Canisters	2	ea			1,422
Manage wellfield flow	Treatment systems	1	ea			18,316
				0	**0**	**220,386**
O&M - B832-TF2 and B832-TF3						
Control/inst. calibration and maintenance	Treatment systems	2	ea			167,264
Mechanical O&M (SWAT)	Treatment systems	2	ea			104,442
Facility documentation and data collection	Treatment systems	2	ea			64,026
Extraction well sampling & analysis	Extraction wells	4	ea			7,072
Dispose of GW GAC canisters (200 lb)	Canisters	1	ea			303
Subtotal costs				**0**	**0**	**343,107**
Ground water and soil vapor extraction and treatment of VOCs, perchlorate, and nitrate at Building 830						
Install Ground Water and SVE Wellfield						
Drilling preparation	New wells	6	ea	15,684		
Drilling (shallow wells)	New wells	4	ea	16,204		
Drilling footage (shallow wells)	Avg. depth of wells	50	ft	35,200		
Drilling (deep wells)	New wells	2	ea	8,102		
Drilling footage (deep wells)	Avg. depth of wells	100	ft	35,200		
Well design and construction	New wells	6	ea	51,870		
Hydraulic testing	Pump tests	11	ea		138,930	
Soil vapor testing	SVE tests	4	ea		48,116	
Subtotal costs				**162,260**	**187,046**	**0**
Design and Construct Remediation System						
Remedial design report	Report	1	ea		31,071	
Data analysis & representation	Labor	200	hr		18,400	
Modeling	Labor	200	hr		18,400	
Permitting	Permits	1	ea		9,158	
Site Preparation	GWTU	1	ea	150,000		
Construct treatment system (B830-TF1)	GWTU-GBI-SVE	1	ea	364,517		
Site Preparation	SWAT	2	ea	100,000		
Construct treatment system (B830-TF2)	SWAT-GBI	1	ea	187,433		
Construct treatment system (B830-TF3)	SWAT-GBI	1	ea	187,433		
Construct pipeline	Length of pipeline	1,010	ft	159,580		
Hook up wells	Wells	15	ea	301,530		
Subtotal costs				**1,450,493**	**77,029**	**0**
O&M - B830-TF1						
Control/inst. calibration and maintenance	Treatment systems	1	ea			69,804
Mechanical O&M (GWTU)	Treatment systems	1	ea			46,724
Facility documentation and data collection	Treatment systems	1	ea			32,013
Extraction well sampling & analysis	Extraction wells	10	ea			17,680
Remedial system permit report	Treatment systems	1	ea			34,124
Dispose of GW GAC canisters (200 lb)	Canisters	7	ea			2,121
Dispose of SVE GAC canisters (140 lb)	Canisters	12	ea			8,532
Manage wellfield flow	Treatment systems	1	ea			18,316
Subtotal costs				**0**	**0**	**229,314**
O&M - B830-TF2 and B830-TF3						
Control/inst. calibration and maintenance	Treatment systems	2	ea			167,264
Mechanical O&M (SWAT)	Treatment systems	2	ea			104,442
Facility documentation and data collection	Treatment systems	2	ea			64,026

Table 2.11-18. Cost summary for Building 832 Canyon (OU7) Alternative 2. (Cont. page 3 of 3)

Activity	Parameter	Quantity	Unit	Direct capital ($)	Indirect capital ($)	Annual O&M ($)
Extraction well sampling & analysis	Extraction wells	5	ea			8,840
Dispose of GW GAC canisters (200 lb)	Canisters	1	ea			303
Subtotal costs				**0**	**0**	**344,875**
Downgradient ground water extraction using a siphon with *ex situ* treatment of VOCs by iron filings						
Install Ground Water and SVE Wellfield						
Drilling preparation	New wells	6	ea	15,684		
Drilling	New wells	6	ea	24,306		
Drilling footage	Avg. depth of wells	70	ft	73,920		
Well design and construction	New wells	6	ea	51,870		
Hydraulic testing	Pump tests	5	ea		63,150	
Subtotal costs				**165,780**	**63,150**	**0**
Design and Construct Remediation System						
Remedial design report	Report	1	ea		31,070	
Data analysis & representation	Labor	200	hr		18,400	
Modeling	Labor	200	hr		18,400	
Bench and field column tests	Labor	200	hr		18,400	
Permitting	Permits	1	ea		9,158	
Construct treatment system	Treatment system	1	ea	95,000		
Start-up testing	Labor	200	hr		18,400	
Construct pipeline	Length of pipeline	2,000	ft	204,000		
Hook up wells	Wells	4	ea	80,408		
Subtotal costs		1		**379,408**	**113,828**	**0**
O&M - B832-Treatment Facility						
Control/inst. calibration and maintenance	Treatment systems	1	ea			17,451
Mechanical O&M (GWTU)	Treatment systems	1	ea			46,724
Facility documentation and data collection	Treatment systems	1	ea			32,013
Extraction well sampling & analysis	Treatment systems	6	ea			10,608
Remedial system permit report	Treatment systems	1	ea			34,124
Manage wellfield flow	Treatment systems	1	ea			18,316
Subtotal costs				**0**	**0**	**159,236**
Total costs				**3,574,087**	**684,272**	**1,469,118**
Cost summary						
Capital costs		**$4,258,000**				
Present worth of O&M costs[a], 5 % discount rate		**$22,584,000**				
Total present worth costs		**$26,842,000**				

[a] **O&M assumes 30 years of monitoring, risk and hazard management, and ground water extraction and treatment, and 10 years of soil vapor extraction and treatment.**

Note: project management and support, and contingency costs are not included. The information in this cost estimate summary table is based on the best available information regarding the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. This is on order-of-magnitude engineering cost estimate that is expected to be within + 50% to - 30% of the actual project cost.

Table 2.11-19. Cost summary for Building 801/Pit 8 Landfill (OU8) Alternative 2.

Activity	Parameter	Quantity	Unit	Direct capital ($)	Indirect capital ($)	Annual O&M ($)
Monitoring of ground water						
Monitoring						
Water levels	Wells measured quarterly	6	ea			486
Water quality sampling/analysis	Wells sampled quarterly	6	ea			15,108
Data analysis & representation	Labor	200	hr			18,400
Pump maintenance or replacement	Wells	6	ea			798
Subtotal costs				**0**	**0**	**34,792**
Total costs				**0**	**0**	**34,792**
Cost summary						
Capital costs	**$0**					
Present worth of O&M costs[a], 5 % discount rate	**$535,000**					
Total present worth costs	**$535,000**					

[a] O&M assumes 30 years of monitoring.

Note: project management and support, and contingency costs are not included. The information in this cost estimate summary table is based on the best available information regarding the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. This is on order-of-magnitude engineering cost estimate that is expected to be within + 50% to - 30% of the actual project cost.

Table 2.11-20. Cost summary for Building 833 (OU8) Alternative 2.

Activity	Parameter	Quantity	Unit	Direct capital ($)	Indirect capital ($)	Annual O&M ($)
Monitoring of ground water						
Monitoring						
Water levels	Wells measured quarterly	9	ea			729
Water quality sampling/analysis	Wells sampled quarterly	9	ea			22,662
Data analysis & representation	Labor	200	hr			18,400
Pump maintenance or replacement	Wells	9	ea			1,197
Subtotal costs				**0**	**0**	**42,988**
Risk and Hazard Management						
Institutional Controls						
Prepare Building Occupancy and Land Use Plan	Plan	1	ea		3,663	
Review Building Occupancy and Land Use Plan	Report	0.2	ea			733
Install warning signs	Signs	1	lot	535		
Subtotal costs				**535**	**3,663**	**733**
Risk and Hazard Monitoring						
Prepare Risk and Hazard Monitoring Plan	Plan	1	ea		10,990	
Sample ambient air (VOCs)	Location	1	ea			1,449
Prepare Risk and Hazard and RAO Compliance Report	Report	1	ea			6,960
Subtotal costs				**0**	**10,990**	**8,409**
Operational Safety Plans						
Prepare Operational Safety Plans	Plan	1	ea		2,381	
Subtotal costs				**0**	**2,381**	**0**
Total costs				**535**	**17,034**	**52,129**
<u>**Cost summary**</u>						
Capital costs	**$18,000**					
Present worth of O&M costs[a], 5 % discount rate	**$801,000**					
Total present worth costs	**$819,000**					

[a] O&M assumes 30 years of monitoring and risk and hazard management.

Note: project management and support, and contingency costs are not included. The information in this cost estimate summary table is based on the best available information regarding the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. This is on order-of-magnitude engineering cost estimate that is expected to be within + 50% to - 30% of the actual project cost.

Table 2.11-21. Cost summary for Building 845 Firing Table/Pit 9 Landfill (OU8) Alternative 2.

Activity	Parameter	Quantity	Unit	Direct capital ($)	Indirect capital ($)	Annual O&M ($)
Monitoring of ground and surface water						
Monitoring						
Water levels	Wells measured quarterly	4	ea			324
Water quality sampling/analysis	Wells sampled quarterly	4	ea			10,072
Surface water quality sampling/analysis	Locations sampled quarterly	1	ea			2,429
Data analysis & representation	Labor	200	hr			18,400
Pump maintenance or replacement	Wells	4	ea			532
Subtotal costs				**0**	**0**	**31,757**
Total costs				**0**	**0**	**31,757**
Cost summary						
Capital costs	**$0**					
Present worth of O&M costs[a], 5 % discount rate	**$488,000**					
Total present worth costs	**$488,000**					

[a] O&M assumes 30 years of monitoring.

Note: project management and support, and contingency costs are not included. The information in this cost estimate summary table is based on the best available information regarding the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. This is on order-of-magnitude engineering cost estimate that is expected to be within + 50% to - 30% of the actual project cost.

Table 2.11-22. Cost summary for Building 851 Firing Table (OU8) Alternative 2.

Activity	Parameter	Quantity	Unit	Direct capital ($)	Indirect capital ($)	Annual O&M ($)
Monitoring of ground and surface water						
Monitoring						
Water levels	Wells measured quarterly	5	ea			405
Water quality sampling/analysis	Wells sampled quarterly	5	ea			12,590
Surface water quality sampling/analysis	Locations sampled quarterly	1	ea			2,429
Data analysis & representation	Labor	200	hr			18,400
Pump maintenance or replacement	Wells	5	ea			665
Subtotal costs				**0**	**0**	**34,489**
Total costs				**0**	**0**	**34,489**
Cost summary						
Capital costs	**$0**					
Present worth of O&M costs[a], 5 % discount rate	**$530,000**					
Total present worth costs	**$530,000**					

[a] O&M assumes 30 years of monitoring.

Note: project management and support, and contingency costs are not included. The information in this cost estimate summary table is based on the best available information regarding the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. This is on order-of-magnitude engineering cost estimate that is expected to be within + 50% to - 30% of the actual project cost.

Table 2.11-23. Summary of areas where long-term waste management would be required at LLNL Site 300.

Type of Area	Building 834			Landfill Pit 6			HE Process Area		Building 850 Firing Table				Landfill Pit 2			Building 854		Building 832 Canyon		Building 801, Landfill Pit 8			Building 833			B845 Firing Table, Landfill Pit 9			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
Landfills or disposal pits left in place or consolidated in an onsite disposal facility													√	√	√					√	√	√				√	√	√			
Closed landfills requiring long-term management				√	√	√																									
Surface soil contamination left in place under a no further action remedy									√							√													√		√
Vadose zone contamination left in place under a no further action remedy	√						√		√							√															

Shaded columns indicate the selected remedies.

Table 2.12-1. Principal and low level threat wastes at LLNL Site 300.

Source	Parameter	Medium	Source classification	Maximum human health risk[1]	Comments	How does the selected remedy address principal threat waste?
Building 834	VOCs	Subsurface soil	Principal	1×10^{-3}	Ongoing impact to ground water, human health risk	Ground water and soil vapor extraction
	TBOS/TKEBs	Subsurface soil	Low level		Low toxicity, low mobility	LNAPL extraction
Pit 6 Landfill	Landfill contents	Landfill waste	Principal		Landfill capped in 1997	Long-term monitoring and landfill cap maintenance
	TCE	Subsurface soil	Low level	5×10^{-6}	Declining concentration in ground water	Natural degradation
HE Process Area	TCE	Subsurface soil	Low level	5×10^{-6}	Low concentrations, limited distribution	—
	HMX, RDX	Subsurface soil	Low level		Sources (lagoons) closed in 1982-1985	—
Building 850	Depleted uranium	Subsurface soil	Low level		Depleted source	—
	Tritium	Subsurface soil	Low level		Depleted source	Natural decay
	PCBs	Surface soil	Principal	5×10^{-4}	High toxicity	Surface soil removal
	Dioxins, furans	Surface soil	Principal	1×10^{-4}	High toxicity	Surface soil removal
	Metals	Surface soil	Low level		Low concentration, low mobility	—
	HMX	Surface soil	Low level		Low concentration, low mobility	—
	Depleted uranium	Surface soil	Low level		Low concentration, low mobility	—

Table 2.12-1. Principal and low level threat wastes at LLNL Site 300. (Cont. page 2 of 3)

Source	Parameter	Media	Source classification	Maximum human health risk[1]	Comments	How does the selected remedy address principal threat waste?
Pit 2 Landfill	Landfill contents	Landfill contents	Undetermined		Uncharacterized, no evidence of releases	—
Building 854	VOCs	Subsurface soil	Principal	1×10^{-5}	Ongoing impact to ground water	Ground water and soil vapor extraction
	PCBs	Surface soil	Principal	7×10^{-5}	High toxicity	Exposure control during further characterization
	HMX	Surface soil	Low level		Low concentration, low mobility	—
	Tritium	Surface soil	Low level		Low concentration, limited extent	—
Building 830	VOCs	Subsurface soil	Principal	1×10^{-5}	Ongoing impact to ground water	Ground water and soil vapor extraction
	HMX	Surface soil	Low level		Low concentration, low mobility	—
	Nitrate	Subsurface soil	Low level		Low concentration	—
Building 832	VOCs	Subsurface soil	Principal		Ongoing impact to ground water	Ground water and soil vapor extraction
	Nitrate	Subsurface soil	Low level		Low concentration	—
	HMX	Subsurface soil	Low level		Low concentration, low mobility	—
Building 801	VOCs	Subsurface soil	Low level		Low concentration, limited extent	—
Pit 8 Landfill	Landfill contents	Landfill contents	Undetermined		Uncharacterized, no evidence of releases	—
Building 833	VOCs	Subsurface soil	Low level	1×10^{-6}	Low concentration,	Natural degradation

Table 2.12-1. Principal and low level threat wastes at LLNL Site 300. (Cont. page 3 of 3)

Source	Parameter	Media	Source classification	Maximum human health risk[1]	Comments	How does the selected remedy address principal threat waste?
					limited extent	
Building 845 Firing Table	Depleted uranium	Subsurface soil	Low level		Low concentration, low mobility	—
	HMX	Subsurface soil	Low level		Low concentration, low mobility	—
Pit 9 Landfill	Landfill contents	Landfill contents	Undetermined		Uncharacterized, no evidence of releases	—
Building 851 Firing Table	Depleted uranium	Surface soil	Low level		Low concentration, low mobility	—
	RDX	Surface soil	Low level		Low concentration, low mobility	—
	VOCs	Subsurface soil	Low level		Low concentration, limited extent	—
	Metals	Surface soil	Low level		Low concentration, low mobility	—

1 Risk estimate shown is the maximum at any receptor location through any exposure pathway (exclusive of ground water) which includes that parameter and media, if greater than 1×10^{-6}.

Table 2.13-1. ARARs for Site 300 selected remedies.

Medium/Action	*Source*/Requirement/(status)	Description of requirement	Action to be taken to attain requirement by the selected remedies
Ground water extraction, monitored natural attenuation, hydraulic control			
	State:		
	State Water Resources Control Board (SWRCB) Resolution 92-49, Paragraph IIIG[a] **(Applicable, action-specific)**	**Establishes requirements for investigation and cleanup and abatement of discharges.**	**All cleanup activities associated with implementation of the selected remedies will be conducted under the supervision of the CVRWQCB.** **DOE/LLNL will evaluate compliance with Resolution 92-49 in the Evaluation Summary report for the Final ROD.**
Ground water extraction, monitored natural attenuation, hydraulic control (cont.)	**Chapter 15, Code of California Regulations (CCR), Title 23, Sections 2550.7, 2550.10** **(Relevant and appropriate, action-specific)**	**Requires monitoring of the effectiveness of the remedial actions.**	**During and after completion of the selected remedies, concentrations of VOCs in *in situ* ground water will be measured.**
Soil vapor extraction	***State:***		
	Chapter 15, CCR, Title 23, Sections 2550.7, 2550.10 **(Relevant and appropriate, chemical-specific)**	**Requires monitoring of the effectiveness of the remedial actions.**	**During and after completion of the selected remedy, concentrations of *in situ* contaminants in soil vapor will be measured.**
	22 CCR 66264.601, Article 16, Miscellaneous Units	**Provides performance standards for operation of SVE units.**	**Operation of all SVE units will comply with the substantive requirements of this provision.**

Table 2.13-1. ARARs for Site 300 selected remedies. (Cont. page 2 of 6)

Medium/Action	*Source*/Requirement/(status)	Description of requirement	Action to be taken to attain requirement by the selected remedies
Surface discharge of treated ground water			
	State:		
	SWRCB Resolution 68-16 **(Antidegradation policy)** **(Applicable, chemical-specific)**	**Requires that high quality surface and ground water be maintained to the maximum extent possible.**	**Under the selected remedies, ground water treatment system effluent will be monitored to ensure that surface and ground water quality will be maintained to the maximum extent possible. (See Appendix B).**
	Water Quality Control Plan (Basin Plan) for CVRWCB **(Applicable, chemical-specific)**	**Establishes beneficial uses and water quality objectives for ground water and surface waters in the Central Valley Region as well as implementation plans to meet water quality objectives and protect beneficial uses.**	**Under the selected remedies, any activity, including but not limited to, the discharge of contaminated waters will be precluded from resulting in actual water quality exceeding water quality objectives.** **Any new discharge to surface water shall be subject to either an NPDES permit adopted by the Regional Board or substantive requirements concurred in by the RWQCB. Any NPDES permit or substantive requirement must include applicable state requirements under the Water Code, including the antidegradation policy.**

Table 2.13-1. ARARs for Site 300 selected remedies. (Cont. page 3 of 6)

Medium/Action	*Source*/Requirement/(status)	Description of requirement	Action to be taken to attain requirement by the selected remedies
Treated ground water reinjection	*Federal:*		
	Safe Drinking Water Act Underground Injection Control Program (40 CFR 144.26-144.27) (Applicable, action-specific)	Requires monitoring for reinjection of treated water.	If reinjection is conducted as part of the selected remedies, treated ground water will be analyzed to verify complete removal of contaminants to regulatory treatment standards, prior to reinjection.
	State:		
	SWRCB Resolution 68-16 (Anti-degradation policy) (Applicable, chemical-specific)	Requires that high quality ground water be maintained to the maximum extent possible.	During the selected remedies, treated ground water will be analyzed to verify removal of contaminants to regulatory treatment standards, prior to reinjection.
	Water Quality Control Plan (Basin Plan) for CVRWCB (Applicable, chemical-specific)	Establishes beneficial uses and water quality objectives for ground water and surface waters in the Central Valley Region as well as implementation plans to meet water quality objectives and protect beneficial uses.	During the selected remedies, monitoring will be conducted to preclude any activity, including, but not limited to, the discharge of contaminated waters from resulting in actual water quality exceeding water quality objectives.
Treated soil vapor discharge	*Local:*		
	San Joaquin Valley Unified Air Pollution Control District (SJVUAPCD) Rules and Regulations, Rules 4651 and 2201 (Applicable, chemical-specific)	Regulates stationary sources of air contaminants and limits VOC emissions from the excavation and treatment of contaminated soil.	During the selected remedies, soil vapor will be treated with granular activated carbon (GAC) or equivalent technologies, and discharged to the atmosphere. The compliance standards for treated soil vapor are contained in the Authority to Construct and subsequent Permit to Operate issued by the SJVUAPCD.

Table 2.13-1. ARARs for Site 300 selected remedies. (Cont. page 4 of 6)

Medium/Action	*Source*/Requirement/(status)	Description of requirement	Action to be taken to attain requirement by the selected remedies
Disposition of waste	*State:*		
	California Health and Safety Code, Division 20, Chapter 6.5, CCR, Title 22, Division 4.5, Chapters 11 and 12: Minimum Standards for Management of Hazardous and Extremely Hazardous Wastes (Applicable, action-specific)	Controls hazardous wastes from point of generation through accumulation, transportation, treatment, storage, and ultimate disposal.	For the selected remedies, this will be applied primarily to the spent GAC and resin vessels, and to excavated contaminated soil.
	CCR, Title 23, Division 3, Chapter 15 (Applicable, action-specific)	Regulates hazardous wastes which are discharged to land.	Waste classification system will be used as basis for determining which wastes may be discharged at each class of waste management unit. Standards for the handling of hazardous waste will be met.
	CCR, Title 27, Division 2, Subdivision 1 (Applicable, action-specific)	Regulates the disposal of designated waste, municipal solid waste and inert waste.	Waste and site classifications and waste management requirements will be applied for solid waste storage or disposal on land.
Closure	*Federal:*		
	Resource Conservation and Recovery Act (RCRA) 40 CFR 264.11-120	Requires a facility be closed in a manner that minimizes the need for further maintenance and is protective of human health and the environment and provides for post-closure care.	Any facility closures meet the requirements of RCRA.
	State:		
	22 CCR 66264.11-120	Requires a facility be closed in a manner that minimizes the need for further maintenance and is protective of human health and the environment and provides for post-closure care.	

Table 2.13-1. ARARs for Site 300 selected remedies. (Cont. page 5 of 6)

Medium/Action	*Source*/Requirement/(status)	Description of requirement	Action to be taken to attain requirement by the selected remedies
Storm water controls	*Federal:*		
	40 CFR Parts 122, 123, 124, National Pollution Discharge Elimination System, implemented by California Storm Water Permit for Industrial Activities, State Water Resources Control Board Order #97-03-DWQ. (Applicable, action-specific)	Regulates pollutants in discharges of storm water associated with hazardous waste treatment, storage, and disposal facilities, wastewater treatment plants, landfills, land application sites, and open dumps. Contains requirements to ensure storm water discharges do not contribute to a violation of surface water quality standards.	The selected remedies include measures to minimize and/or eliminate pollutants in storm water discharges and monitoring to demonstrate compliance. LLNL Site 300 has and will maintain a Storm Water Pollution Prevention Plan.
Protection of Endangered Species	*Federal:*		
	Endangered Species Act of 1973, 16 USC Section 1531 et seq. 50 CFR Part 200, 50 CFR Part 402 [40 CFR 257.3-2] (Applicable, location-specific)	Requires that facilities or practices not cause or contribute to the taking of any endangered or threatened species of plants, fish, or wildlife. NEPA implementation requirements may apply.	Prior to any well installation, facility construction, or similar potentially disruptive activities, wildlife surveys will be conducted and mitigation measures implemented if required.
Protection of Endangered Species (cont.)	*State:*		
	California Endangered Species Act, California Department of Fish and Game Sections 2050-2068 (Applicable, location-specific)	Requires that facilities or practices not cause or contribute to the taking of any endangered or threatened species of plants, fish, or wildlife.	Prior to any well installation, facility construction, or similar potentially disruptive activities, wildlife surveys will be conducted and mitigation measures implemented if required.
Floodplain protection	*Federal:*		
	Clean Water Act, Section 401 (Relevant and appropriate, action-specific)	Requires certification that actions will not adversely affect State water quality.	Prior to activities, either apply for certification or meet the substantive requirements of such a certification.

Table 2.13-1. ARARs for Site 300 selected remedies. (Cont. page 6 of 6)

Medium/Action	*Source*/Requirement/(status)	Description of requirement	Action to be taken to attain requirement by the selected remedies
	State:		
	22 CCR 66264.18 (b)(1) (Relevant and appropriate, location-specific)	Requires that Treatment, Storage and Disposal (TSD) facilities within a 100-year floodplain must be designed, constructed, operated, and maintained to prevent washout of hazardous waste by a 100-year flood.	If it becomes necessary to install a treatment system within the 100-year floodplain, the system would be constructed in accordance with this requirement.

[a] ARARs pertaining to cleanup standards will be selected at the time of the Final ROD.

Table 2.13-2. Cost and effectiveness evaluation for the Building 834 area, OU2.

RELEVANT CONSIDERATIONS FOR COST-EFFECTIVENESS DETERMINATION:

- Contaminant plume consists of approximately 1,770,000 cubic feet of ground water.
- No water supply-wells are located in or near the Building 834 Complex.
- Contaminant plume is contained in a localized, perched water-bearing unit.
- TCE is present in ground water in concentrations up to 94,000 ppb.
- Baseline individual cancer risk for onsite workers for inhalation of VOCs volatilizing from subsurface soil inside Building 834D was $1x10^{-3}$ with an HI of 36.
- Baseline individual cancer risk for onsite workers for inhalation of VOCs volatilizing from subsurface soil outside Building 834D was $7 x10^{-4}$ with an HI of 21.

Alternative	Present-Worth Cost	Incremental Cost	Long-Term Effectiveness and Permanence	Reduction of TMV through Treatment	Short-term Effectiveness
1. No action	$0	---	* No reduction in long-term risk to human health and the environment. * Baseline individual cancer inhalation risk was 1×10^{-3} (inside B834D) and 7×10^{-4} (outside B834D)	* No reduction in toxicity * No reduction in mobility * No reduction in volume	* No short-term risk to workers * No short-term risk to community * No short-term impact to environment * May not achieve remedial goals in a reasonable timeframe
2. Dual-phase extraction and treatment with institutional controls and monitoring	$12,125,000	+$12,125,000	+ Residual risk<10^{-6} + Would effectively and permanently reduce contaminant concentrations through the extraction and treatment of ground water and soil vapor. + High potential for remedy success due to use of proven technology	+ Reduction in toxicity + Reduction in mobility + Reduction in volume	- Minimal short-term impact to workers ** No short-term risk to community - Minimal short-term impact to environment + Potential to achieve MCLs/WQOs in approximately 30 years

Table 2.13-2. Cost and effectiveness evaluation for the Building 834 area, OU2. (Cont. page 2 of 2)

Alternative	Present-Worth Cost	Incremental Cost	Long-Term Effectiveness and Permanence	Reduction of TMV through Treatment	Short-term Effectiveness
3. All components of Alt. 2 plus innovative ground water treatment (enhanced *in situ* bioremediation)	$14,504,000	+$2,379,000	** Residual risk <10^{-6} ** Although Alternative 3 may achieve cleanup goals somewhat faster than Alternative 2, it would provide no significant quantifiable health risk benefit compared to Alternative 2.	? The ability to further reduce contaminant toxicity, mobility and volume above that attained by Alternative 2 is not yet known.	** No additional short-term risk to workers ** No additional short-term risk to community ** No additional short-term impact to environment ** Potential to achieve MCLs/WQOs in less than 30 years not clear due to uncertainties associated with innovative technology
COST-EFFECTIVENESS SUMMARY: Alternative 1 is not considered cost-effective. Alternative 2 is considered cost-effective. Due to the uncertainties associated with the application of the innovative technology under Alternative 3, it is considered to be less cost-effective than Alternative 2.					
Key: *Baseline characteristic + Potentially more "effective" compared to previous alternative. - Potentially less "effective" compared to previous alternative.			** No change compared to previous alternative. ? Change compared to previous alternative is unknown. TMV = Toxicity, mobility and volume		

Table 2.13-3. Cost and effectiveness evaluation for the Pit 6 Landfill, OU3.

RELEVANT CONSIDERATIONS FOR COST-EFFECTIVENESS DETERMINATION:

- **Contaminant plume consists of approximately 1,250,000 cubic feet of ground water.**
- **No water-supply wells are contaminated with VOCs or other contaminants from the Pit 6 Landfill.**
- **VOC concentrations in ground water have decreased to near drinking water MCLs or below and continue to decline.**
- **Tritium activities in ground water are below the drinking water MCLs.**
- **A landfill cap has been installed to mitigate inhalation risk and prevent further releases of contaminants from the landfill.**

Alternative	Present-Worth Cost	Incremental Cost	Long-Term Effectiveness and Permanence	Reduction of TMV through Treatment	Short-term Effectiveness
1. No action	$0	---	* May not protect human health and the environment: without monitoring, there would be no means of determining changes in plume size or concentration that could impact downgradient receptors.	* Reduction in toxicity * Reduction in mobility * Reduction in volume	* No short-term risk to workers * No short-term risk to community * No short-term impact to environment. * Potential to achieve MCLs/WQOs in approximately 2 to 4 years
2. Monitored natural attenuation of VOCs and tritium in ground water with institutional controls	$2,376,000	+$2,376,000	+ Would effectively and permanently reduce contaminant concentrations through natural attenuation and verify achievement of cleanup goals through monitoring.	** No additional reduction in toxicity ** No additional reduction in mobility ** No additional reduction in volume	** No additional short-term risk to workers ** No additional short-term risk to community ** No additional short-term impact to environment ** Potential to achieve MCLs/WQOs in approximately 2 to 4 years

Table 2.13-3. Cost and effectiveness evaluation for the Pit 6 Landfill OU. (Cont. page 2 of 2)

Alternative	Present-Worth Cost	Incremental Cost	Long-Term Effectiveness and Permanence	Reduction of TMV through Treatment	Short-term Effectiveness
3. Monitored natural attenuation of tritium in ground water with institutional controls and extraction and treatment of VOCs, perchlorate and nitrate in ground water.	$5,939,000	+$3,563,000	** Although Alternative 3 may achieve cleanup goals somewhat faster than Alternative 2, it would provide no significant quantifiable health risk benefit compared to Alternative 2.	** No additional reduction in toxicity ** No additional reduction in mobility ** No additional reduction in volume	- May pose additional short-term risk to workers if tritiated water is brought to the surface ** No additional short-term risk to community ** No additional short-term impact to environment ** Potential to achieve remedial goals in approximately 2 to 4 years

COST-EFFECTIVENESS SUMMARY:

Alternative 1 is not considered cost-effective.

Both Alternatives 2 and 3 are considered cost-effective; however Alternative 3 may not provide significantly faster cleanup and may increase short-term risk to worker for an additional $3.5M cost.

Key:

*Baseline characteristic	** No change compared to previous alternative.
+ Potentially more "effective" compared to previous alternative.	? Change compared to previous alternative is unknown.
- Potentially less "effective" compared to previous alternative.	TMV = Toxicity, mobility and volume

Table 2.13-4. Cost and effectiveness evaluation for the High Explosives Process Area, OU4.

RELEVANT CONSIDERATIONS FOR COST-EFFECTIVENESS DETERMINATION:

- Contaminant plume consists of approximately 994,000,000 cubic feet of ground water.
- No water-supply wells are contaminated with VOCs or other contaminants from the HE Process Area.
- TCE is present in ground water at concentrations of up to 160 µg/L in the Building 815 area and 310 µg/L at the Burn Pit.

Alternative	Present-worth cost	Incremental cost	Long-term effectiveness and permanence	Reduction of TMV through treatment	Short-term effectiveness
1. No action	$0	---	* May not protect human health and the environment because no active measures are taken to reduce contaminant concentrations in ground water. * Baseline individual cancer risk was 5×10^{-6} in the vicinity of Building 815.	* No reduction in toxicity * No reduction in mobility * No reduction in volume.	* No short-term risk to workers * No short-term risk to community * No short-term impact to environment * May not achieve remedial goals in a reasonable timeframe
2. Ground water extraction and treatment with institutional controls and monitoring	$27,621,000	+$27,621,000	+ Would effectively and permanently reduce contaminant concentrations through the extraction and treatment of ground water. + Residual risk$<10^{-6}$ + High potential for success due to use of proven technology.	+ Reduction in toxicity + Reduction in mobility + Reduction in volume	** No additional short-term risk to workers ** No additional short-term risk to community ** No additional short-term impact to environment + Potential to achieve MCLs/WQOs in approximately 25 to 30 years

COST-EFFECTIVENESS SUMMARY:

Alternative 1 is not considered cost-effective.

Alternative 2 is considered cost-effective.

Key:

*Baseline characteristic

+ Potentially more "effective" compared to previous alternative.

- Potentially less "effective" compared to previous alternative

** No change compared to previous alternative.

? Change compared to previous alternative is unknown.

TMV = Toxicity, mobility and volume.

Table 2.13-5. Cost and effectiveness evaluation for the Building 850 area, OU5.

RELEVANT CONSIDERATIONS FOR COST-EFFECTIVENESS DETERMINATION:

- Contaminant plume consists of approximately 113,000,000 cubic feet of ground water.
- No water-supply wells contain contaminants from the Building 850 area.
- Uranium is present in ground water at activities below the drinking water MCL.
- Tritium is present in ground water at activities of up to 96,500 pCi/L. Tritium activities in ground water have significantly decreased over time.
- Data indicate that the tritium source is diminishing.

Alternative	Present-Worth Cost	Incremental Cost	Long-Term Effectiveness and Permanence	Reduction of TMV through Treatment	Short-term Effectiveness
1. No action	$0	---	* May not protect human health and the environment: without monitoring, there would be no means of determining changes in plume size or activity that could impact downgradient receptors. * Baseline individual cancer combined inhalation, ingestion, and dermal contact risk associated with PCBs in surface soil was $5x10^{-4}$	* Reduction in toxicity * Reduction in mobility * Reduction in volume	* No short-term risk to workers * No short-term risk to community * No short-term impact to environment * Potential to achieve tritium MCL in approximately 40 years
2. Monitored natural attenuation of tritium in ground water with removal of contaminated sand pile and surface soil and institutional controls	$4,033,000	+$4,033,000	+ Would effectively and permanently reduce tritium activity through natural attenuation and verify achievement of cleanup goals through monitoring. + Soil removal would reduce PCB risk to $<10^{-6}$	** No additional reduction in toxicity + Reduction in mobility ** No additional reduction in volume	** No additional short-term risk to workers ** No additional short-term risk to community ** No additional short-term impact to environment ** Potential to achieve tritium MCL in approximately 40 years
3. Monitored natural attenuation of tritium in ground water with excavation of contaminated bedrock, removal of contaminated sand pile and surface soil and institutional controls	$8,246,000	+$4,213,000	** Alternative 3 would provide no significant quantifiable health risk benefit compared to Alternative 2.	** No additional reduction in toxicity + Reduction in mobility ** No additional reduction in volume	- May pose additional short-term risk to workers if tritium-contaminated bedrock is brought to the surface ** No additional short-term risk to community - May pose additional short-term impact to environment during excavation activities

Table 2.13-5. Cost and effectiveness evaluation for the Building 850 area, OU5. (Cont. page 2 of 2)

Alternative	Present-Worth Cost	Incremental Cost	Long-Term Effectiveness and Permanence	Reduction of TMV through Treatment	Short-term Effectiveness
4. Monitored natural attenuation of tritium in ground water; active remediation of uranium and nitrate in ground water with excavation of contaminated bedrock, removal of contaminated sand pile and surface soil, and institutional controls	$16,097,000	+$12,064,00	** Alternative 4 would provide no significant quantifiable health risk benefit compared to Alternative 2.	** No additional reduction in toxicity + Reduction in mobility ** No additional reduction in volume	- May pose additional short-term risk to workers if tritiated and uranium-contaminated water and/or tritium contaminated bedrock is brought to the surface ** No additional short-term risk to community - May pose additional short-term impact to environment during excavation activities ** Potential to achieve tritium, MCL in approximately 40 years

COST-EFFECTIVENESS SUMMARY:

Alternative 1 is not considered cost-effective.

Alternative 2 is considered cost-effective.

Alternatives 3 and 4 are not considered cost-effective as they may not provide significantly faster cleanup and may increase short-term risk to workers and cost from $4M to $12M more than Alternative 2.

Key:

***Baseline characteristic**

+ Potentially more "effective" compared to previous alternative.

- Potentially less "effective" compared to previous alternative.

**** No change compared to previous alternative.**

? Change compared to previous alternative is unknown.

TMV = Toxicity, mobility and volume

Table 2.13-6. Cost and effectiveness evaluation for the Pit 2 Landfill, OU 5.

RELEVANT CONSIDERATIONS FOR COST-EFFECTIVENESS DETERMINATION:

- No contaminants of concern have been identified in surface soil, subsurface soil/bedrock, ground water or surface water associated with the Pit 2 Landfill.
- No water-supply wells are present near the Pit 2 Landfill area.
- No risk or hazard to human health or ecological receptors was identified in the baseline risk assessment.

Alternative	Present-Worth Cost	Incremental Cost	Long-Term Effectiveness and Permanence	Reduction of TMV through Treatment	Short-term Effectiveness
1. No action	$0	---	* May not protect human health and the environment: without monitoring, there would be no means of detecting potential future releases from the landfill.	* Not applicable; no contaminants detected in any environmental media * No reduction in TMV of potentially contaminated waste	* No short-term risk to workers * No short-term risk to community * No short-term impact to environment
2. Ground water monitoring	$515,000	+$515,000	+ Monitoring would 1) demonstrate continued compliance with ARARs and 2) detect future contaminant releases from the landfill, if any.	** Not applicable; no contaminants detected in any environmental media ** No reduction in TMV of potentially contaminated waste	** No additional short-term risk to workers ** No additional short-term risk to community ** No additional short-term impact to environment
3. Ground water monitoring and waste characterization with contingent monitoring, capping, and/or excavation of the Pit 2 Landfill	Between $767,000 and $22,250,000, depending on the amount of waste excavated	+$252,000 to $21,735,000, depending on the amount of waste excavated	** Alternative 3 would provide no significant quantifiable health risk benefit compared to Alternative 2.	** Not applicable; no contaminants detected in any environmental media + Reduction in mobility of potential contaminants in waste ** No additional reduction in volume or toxicity of potential contaminants in waste.	- May pose additional short-term risk to workers if contaminated waste is excavated ** No additional short-term risk to community - May pose additional short-term impact to environment during excavation or capping activities

COST-EFFECTIVENESS SUMMARY:
Alternative 1 is not considered cost-effective.
Alternative 2 is considered cost-effective.
Alternative 3 is not considered cost-effective as 1) there is currently no contamination in environmental media in the Pit 2 Landfill area, 2) excavation and capping may increase short-term risk to workers and impact to the environment, and 3) additional costs range from $252,000 to $21,735,000 over the cost of Alternative 2.

Key:
*Baseline characteristic
+ Potentially more "effective" compared to previous alternative.
- Potentially less "effective" compared to previous alternative
** No change compared to previous alternative.
? Change compared to previous alternative is unknown.
TMV = Toxicity, mobility and volume.

Table 2.13-7. Cost and effectiveness evaluation for the Building 854 area, OU6.

RELEVANT CONSIDERATIONS FOR COST-EFFECTIVENESS DETERMINATION:

- Contaminant plume consists of approximately 6,000,000 cubic feet of ground water.
- No water supply wells are located in or near the OU.
- Contaminant plume is contained in a perched water-bearing unit.
- TCE is present in ground water at concentrations of up to 270 ppb and is decreasing over time.
- Baseline individual cancer risk for onsite workers for inhalation of VOCs from subsurface soil inside Building 854F was 9 x 10^{-6}, and inside Building 854A was 4 x 10^{-6}
- Baseline individual cancer risk for onsite workers for inhalation of VOCs from subsurface soil outside Building 854F was 1x10^{-5}

Alternative	Present-Worth Cost	Incremental Cost	Long-Term Effectiveness and Permanence	Reduction of TMV through Treatment	Short-term Effectiveness
1. No action	$0	---	* No reduction in long-term risk to human health and the environment. * Baseline individual cancer inhalation risk was 10^{-6} (inside B854F)	* No reduction in toxicity * No reduction in mobility * No reduction in volume	* No short-term risk to workers * No short-term risk to community * No short-term impact to environment. * May not achieve remedial goals in a reasonable timeframe.
2. Dual-phase extraction and treatment with institutional controls and monitoring	$9,167,000	+$9,167,000	+ Residual risk<10^{-6} + Would effectively and permanently reduce contaminant concentrations through the extraction and treatment of ground water and soil vapor. + High potential for success due to use of proven technology.	+ Reduction in toxicity + Reduction in mobility + Reduction in volume	- Minimal short-term impact to workers ** No short-term risk to community - Minimal short-term impact to environment. + Potential to achieve MCLs/WQOs in approximately 30 years

COST-EFFECTIVENESS SUMMARY:
Alternative 1 is not considered cost-effective.
Alternative 2 is considered cost-effective.

Key:
*Baseline
+ Potentially more "effective" compared to previous alternative.
- Potentially less "effective" compared to previous alternative.
** No change compared to previous alternative.
? Change compared to previous alternative is unknown.
TMV = Toxicity, mobility and volume

Table 2.13-8. Cost and effectiveness evaluation for the Building 832 Canyon, OU7.

RELEVANT CONSIDERATIONS FOR COST-EFFECTIVENESS DETERMINATION:

- Contaminant plume consists of approximately 4,670,000 cubic feet of ground water.
- No water supply wells are located in or near the Building 832 Canyon area.
- TCE is present in ground water at concentrations of up to 8,400 ppb and are decreasing over time.
- Baseline individual cancer risk for onsite workers for inhalation of VOCs inside Building 830 was 2×10^{-6}.
- Baseline individual cancer risk for onsite workers for inhalation of VOCs inside Building 832 was 3×10^{-6}.
- Baseline individual cancer risk for onsite workers for inhalation of VOCs volatilizing from subsurface soil outside Building 830 was 1×10^{-5}

Alternative	Present-Worth Cost	Incremental Cost	Long-Term Effectiveness and Permanence	Reduction of TMV through Treatment	Short-term Effectiveness
1. No action	$0	---	* No reduction in long-term risk to human health and the environment. * Baseline individual cancer inhalation risk was 1×10^{-5} (outside Building 830)	* No reduction in toxicity * No reduction in mobility * No reduction in volume	* No short-term risk to workers * No short-term risk to community * No short-term impact to environment * May not achieve remedial goals in a reasonable timeframe
2. Dual-phase extraction and treatment with institutional controls and monitoring	$26,842,000	+$26,842,000	+ Residual risk<10^{-6} + Would effectively and permanently reduce contaminant concentrations through extraction and treatment of ground water and soil vapor. + High potential for success due to use of proven technology.	+ Reduction in toxicity + Reduction in mobility + Reduction in volume	- Minimal short-term impact to workers ** No short-term risk to community - Minimal short-term impact to environment + Potential to achieve MCLs/WQOs in approximately 30 years

COST-EFFECTIVENESS SUMMARY:
Alternative 1 is not considered cost-effective.
Alternative 2 is considered cost-effective.

Key:
*Baseline characteristic
+ Potentially more "effective" compared to previous alternative.
- Potentially less "effective" compared to previous alternative
** No change compared to previous alternative.
? Change compared to previous alternative is unknown.
TMV = Toxicity, mobility and volume.

Table 2.13-9. Cost and effectiveness evaluation for the Building 801/Pit 8 Landfill area, OU8.

RELEVANT CONSIDERATIONS FOR COST-EFFECTIVENESS DETERMINATION:

- **TCE is present in ground water below the Building 801 dry well at concentrations below the drinking water MCL. Concentrations are decreasing over time.**
- **No contaminants of concern have been identified in surface soil, subsurface soil/bedrock, ground water or surface water associated with the Pit 8 Landfill.**
- **No water-supply wells are present in the vicinity of the Building 801/Pit 8 Landfill area.**
- **No risk or hazard to human health or ecological receptors associated with the Building 801/Pit 8 Landfill was identified in the baseline risk assessment.**

Alternative	Present-Worth Cost	Incremental Cost	Long-Term Effectiveness and Permanence	Reduction of TMV through Treatment	Short-term Effectiveness
1. No action	$0	---	* May not protect human health and the environment: without monitoring, there would be no means of detecting potential future releases from the landfill, if any, or determining changes in VOC plume size or concentration that could impact downgradient receptors.	* Reduction in TMV of VOCs in ground water * No reduction in TMV of potentially contaminated waste	* No short-term risk to workers * No short-term risk to community * No short-term impact to environment
2. Ground water monitoring	$535,000	+$535,000	+ Monitoring would 1) demonstrate continued decrease in VOC concentrations in ground water and 2) detect future contaminant releases from the landfill, if any.	** No additional reduction in TMV of VOCs in ground water. ** No reduction in TMV of potentially contaminated waste	** No additional short-term risk to workers ** No additional short-term risk to community ** No additional short-term impact to environment

Table 2.13-9. Cost and effectiveness evaluation for the Building 801/Pit 8 Landfill area, OU8. (Cont. page 2 of 2)

Alternative	Present-Worth Cost	Incremental Cost	Long-Term Effectiveness and Permanence	Reduction of TMV through Treatment	Short-term Effectiveness
3. Ground water monitoring and waste characterization with contingent monitoring, capping, and/or excavation of the Pit 8 Landfill	Between $742,000 and $21,612,000, depending on the amount of waste excavated	+$207,000 to $21,077,000, depending on the amount of waste excavated	** Alternative 3 would provide no significant quantifiable health risk benefit compared to Alternative 2.	** No additional reduction in TMV of VOCs in ground water + Reduction in mobility of potential contaminants in waste ** No additional reduction in volume or toxicity of potential contaminants in waste	- May pose additional short-term risk to workers if contaminated waste is excavated ** No additional short-term risk to community - May pose additional short-term impact to environment during excavation or capping activities

COST-EFFECTIVENESS SUMMARY:

Alternative 1 is not considered cost-effective.

Alternative 2 is considered cost-effective.

Alternative 3 is not considered cost-effective as 1) VOC concentrations in ground water in the vicinity of the Building 801 dry well are below drinking water standards, 2) there is currently no contamination in environmental media associated with the Pit 8 Landfill area, 3) excavation and capping of the pit may increase short-term risk to workers and impact to the environment, and 4) additional costs range from $207,000 to $21,077,000 over the cost of Alternative 2.

Key:

Baseline characteristic** — * No change compared to previous alternative.**

+ Potentially more "effective" compared to previous alternative. — **? Change compared to previous alternative is unknown.**

- Potentially less "effective" compared to previous alternative. — **TMV = Toxicity, mobility and volume**

Table 2.13-10. Cost and effectiveness evaluation for the Building 833 area, OU8.

RELEVANT CONSIDERATIONS FOR COST-EFFECTIVENESS DETERMINATION:

- **Contaminant plume consists of approximately 36,000 cubic feet of ground water.**
- **No water supply wells are located in or near the area.**
- **Contaminant plume is contained in a localized, perched water-bearing unit.**
- **TCE is present in ground water at concentrations up to 30 ppb. VOC concentrations have been decreasing over time.**
- **Baseline individual cancer risk for onsite workers for inhalation of VOCs volatilizing from subsurface soil inside Building 833 was 1×10^{-6}**

Alternative	Present-Worth Cost	Incremental Cost	Long-Term Effectiveness and Permanence	Reduction of TMV through Treatment	Short-term Effectiveness
1. No action	$0	---	* May not protect human health and the environment: without monitoring, there would be no means of determining changes in plume size or concentration that could impact downgradient receptors * Baseline individual cancer inhalation risk was 1×10^{-6} inside B833	* Does not actively reduce TMV, however TMV reduction may be achieved through natural attenuation	* No short-term risk to workers * No short-term risk to community * No short-term impact to environment * Potential to achieve MCLs/WQOs in approximately 5 to 10 years
2. Monitoring with institutional controls	$819,000	+$819,000	+ Would effectively and permanently reduce contaminant concentrations through natural attenuation, and would verify achievement of cleanup goals through monitoring	** Does not actively reduce TMV, however TMV reduction may be achieved through natural attenuation	** No short-term impact to workers ** No short-term risk to community ** No short-term impact to environment ** Potential to achieve MCLs/WQOs in approximately 5 to 10 years

Table 2.13-10. Cost and effectiveness evaluation for the Building 833 area, OU8. (Cont. page 2 of 2)

Alternative	Present-Worth Cost	Incremental Cost	Long-Term Effectiveness and Permanence	Reduction of TMV through Treatment	Short-term Effectiveness
3. All components of Alt. 2 plus extraction and treatment of ground water and soil vapor	$4,256,000	+$3,437,000	** Although Alternative 3 may achieve cleanup goals somewhat faster than Alternative 2, it would provide no significant quantifiable health risk benefit compared to Alternative 2.	+ Reduction in toxicity + Reduction in mobility + Reduction in volume	** No additional short-term risk to workers ** No additional short-term risk to community ** No additional short-term impact to environment ** Potential to achieve remedial goals in approximately 5 to 10 years

COST-EFFECTIVENESS SUMMARY:

Alternative 1 is not considered cost-effective.

Both Alternatives 2 and 3 are considered cost-effective; however Alternative 3 may not provide significantly faster cleanup and costs $3.4M more than Alternative 2.

Key:

*Baseline characteristic

+ Potentially more "effective" compared to previous alternative.

- Potentially less "effective" compared to previous alternative.

** No change compared to previous alternative.

? Change compared to previous alternative is unknown.

TMV = Toxicity, mobility and volume

Table 2.13-11. Cost and effectiveness evaluation for the Building 845/Pit 9 Landfill area, OU8.

RELEVANT CONSIDERATIONS FOR COST-EFFECTIVENESS DETERMINATION:

- Very low concentrations of uranium and HMX have been detected in subsurface soil/rock in the vicinity of the Building 845 firing table. No contaminants of concern have been detected in ground water, surface soil or surface water in the Building 845 firing table area.
- No contaminants of concern have been identified in surface soil, subsurface soil/bedrock, ground water or surface water associated with the Pit 9 Landfill.
- No water-supply wells are present in the vicinity of the Building 845/Pit 9 Landfill area.
- No risk or hazard to human health or ecological receptors associated with the Building 845/Pit 9 Landfill was identified in the baseline risk assessment.

Alternative	Present-Worth Cost	Incremental Cost	Long-Term Effectiveness and Permanence	Reduction of TMV through Treatment	Short-term Effectiveness
1. No action	$0	---	* May not protect human health and the environment: without monitoring, there would be no means of detecting potential future releases from the landfill.	* No reduction in TMV of potentially contaminated waste in the landfill	* No short-term risk to workers * No short-term risk to community * No short-term impact to environment
2. Ground water monitoring	$488,000	+$488,000	+ Monitoring would detect future contaminant releases from the landfill, if any.	** No reduction in TMV of potentially contaminated waste in the landfill	** No additional short-term risk to workers ** No additional short-term risk to community ** No additional short-term impact to environment
3. Ground water monitoring and waste characterization with contingent monitoring, capping, and/or excavation of the Pit 9 Landfill	Between $693,000 and $7,065,000, depending on the amount of waste excavated	+$205,000 to $6,577,000, depending on the amount of waste excavated	** Alternative 3 would provide no significant quantifiable health risk benefit compared to Alternative 2.	+ Reduction in mobility of potential contaminants in waste	- May pose additional short-term risk to workers if contaminated waste is excavated ** No additional short-term risk to community - May pose additional short-term impact to environment during excavation or capping activities.

Table 2.13-11. Cost and effectiveness evaluation for the Building 845/Pit 9 Landfill area, OU8. (Cont. Page 2 of 2)

COST-EFFECTIVENESS SUMMARY: **Alternative 1 is not considered cost-effective.** **Alternative 2 is considered cost-effective.** **Alternative 3 is not considered cost-effective as 1) low concentrations of uranium and HMX is subsurface soil/rock in the vicinity of the Building 845 firing table do not pose a risk and have not impacted ground water, 2) there is currently no contamination in environmental media associated with the Pit 9 Landfill area, 3) excavation and capping of the pit may increase short-term risk to workers and impact to the environment, and 4) additional costs range from $205,000 to $6,577,000 over the cost of Alternative 2.**	
Key: ***Baseline characteristic** **+ Potentially more "effective" compared to previous alternative.** **- Potentially less "effective" compared to previous alternative.**	 **** No change compared to previous alternative.** **? Change compared to previous alternative is unknown.** **TMV = Toxicity, mobility and volume**

Table 2.13-12. Cost and effectiveness evaluation for the Building 851 Firing Table area, OU8.

RELEVANT CONSIDERATIONS FOR COST-EFFECTIVENESS DETERMINATION:

- Low concentrations of VOCs and depleted uranium have been detected in subsurface soil/rock in the vicinity of the Building 851 firing table. Metals, uranium, and RDX have been detected in surface soil. VOCs and depleted uranium have been detected in ground water in the past but are no longer present above background concentrations.
- No water-supply wells are present in the vicinity of the Building 851 firing table area.
- No risk or hazard to human health or ecological receptors associated with the Building 851 firing table was identified in the baseline risk assessment.

Alternative	Present-Worth Cost	Incremental Cost	Long-Term Effectiveness and Permanence	Reduction of TMV through Treatment	Short-term Effectiveness
1. No action	$0	---	* May not protect human health and the environment: without monitoring, there would be no means of detecting potential future releases from the landfill.	* Not applicable: no contaminants currently detected in any environmental media	* No short-term risk to workers * No short-term risk to community * No short-term impact to environment.
2. Ground water monitoring	$530,000	+$530,000	+ Monitoring would detect future contaminant releases from the firing table, if any.	** Not applicable: no contaminants currently detected in any environmental media	** No additional short-term risk to workers ** No additional short-term risk to community ** No additional short-term impact to environment
3. Extraction and treatment of ground water	$4,198,000	+$3,668,000	** Alternative 3 would provide no significant quantifiable health risk benefit compared to Alternative 2.	** Not applicable, no contaminants currently detected in any environmental media	** No additional short-term risk to workers ** No additional short-term risk to community ** No additional short-term impact to environment

COST-EFFECTIVENESS SUMMARY:
Alternative 1 is not considered cost-effective.
Alternative 2 is considered cost-effective.
Alternative 3 is not considered cost-effective because 1) low concentrations of VOCs and HMX is subsurface soil/rock and metals uranium, and RDX in surface soil in the vicinity of Building 851 firing table do not pose a risk and no longer impact ground water; 2) VOC concentrations in ground water have decreased below the detection limit; 3) uranium activities in ground water are below the MCL; and 4) it costs $3.7M more than Alternative 2.

Key:
*Baseline characteristic
+ Potentially more "effective" compared to previous alternative.
- Potentially less "effective" compared to previous alternative.
** No change compared to previous alternative.
? Change compared to previous alternative is unknown.
TMV= Toxicity, mobility, and volume.

Appendix A

Naming Convention for Treatment Facilities

Table A-1. New treatment facility location naming convention at LLNL Site 300.

Old name in documents	OU	Location	Proximity relative to contamination/plume	New treatment facility location document name	New name abbreviation
EGSA-TF1	**1**	**EGSA**	**Source**	**EGSA-Source**	**EGSA-SRC**
CGSA-TF1	**1**	**CGSA**	**Source**	**CGSA-Source**	**CGSA-SRC**
B834-TF1	**2**	**B834**	**Source**	**B834-Source**	**B834-SRC**
B815-TF5	**4**	**B815**	**Source**	**B815-Source**	**B815-SRC**
B815-TF3	4	B815	Proximal	B815-Proximal	B815-PRX
B815-TF2	4	B815	Distal	B815-Distal	B815-DIS
B815-TF1	**4**	**B815**	**Distal-Site Boundary**	**B815-Distal Site Boundary**	**B815-DSB**
B815-TF6	4	B817	Source	B817-Source	B817-SRC
B815-TF4	4	B817	Proximal	B817-Proximal	B817-PRX
HEBP-TF1	4	B829	Source	B829-Source	B829-SRC
B854-TF1	**6**	**B854**	**Source**	**B854-Source**	**B854-SRC**
B854-TF2	**6**	**B854**	**Proximal**	**B854-Proximal**	**B854-PRX**
New B854 TF	6	B854	Distal	B854-Distal	B854-DIS
B832-TF1	**7**	**B832**	**Source**	**B832-Source**	**B832-SRC**
B832-TF2	7	B832	Proximal	B832-Proximal	B832-PRX
B832-TF3	7	B832	Distal	B832-Distal	B832-DIS
B830-TF1	7	B830	Source	B830-Source	B830-SRC
New B830 TF	**7**	**B830**	**Proximal-North**	**B830-Proximal-North**	**B830-PRXN**
B830-TF2	7	B830	Proximal	B830-Proximal	B830-PRX
B830-TF3	7	B830	Distal	B830-Distal	B830-DIS
B830-IFTF	**7**	**B830**	**Distal-South**	**B830-Distal-South**	**B830-DISS**

Notes:

Bold text indicates existing treatment facilities.

Normal text indicates proposed Treatment Facilities per the selected remedies in the Interim Site-Wide Record of Decision for Site 300.

B834 = Building 834.

B815 = Building 815 in the HE Process Area OU.

B817 = Building 817 in the HE Process Area OU.

B829 = Building 829 in the HE Process Area OU.

B832 = Building 832 in the Building 832 Canyon OU.

B830 = Building 830 in the Building 832 Canyon OU.

HEBP = High Explosives Burn Pit.

IFTF = Iron Filings Treatment Facility.

OU = Operable Unit.

TF = Treatment Facility.

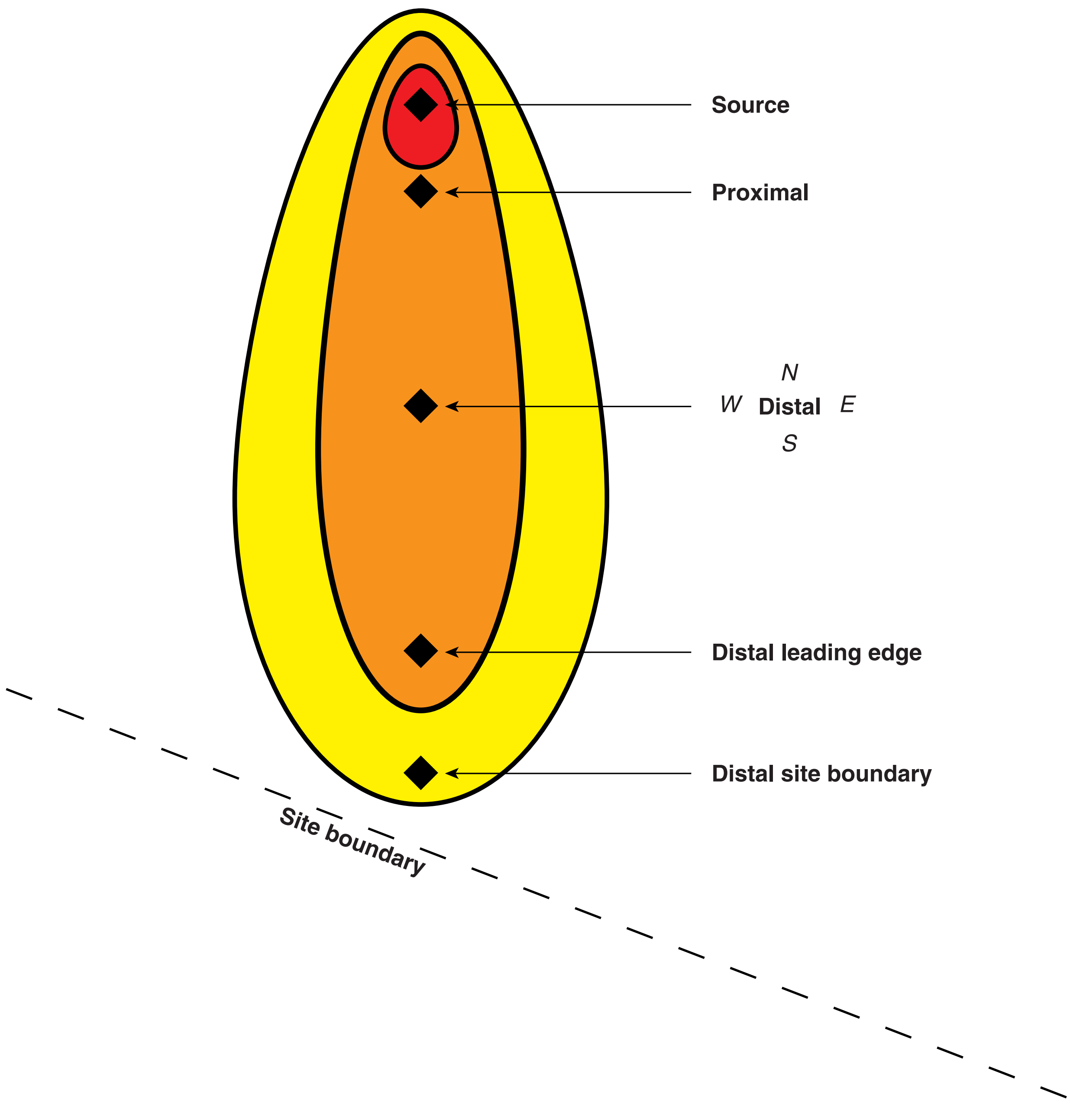


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Figure A-1. Example of naming convention relative to contaminant plume.

Appendix B

Effluent Discharge Limitations, Prohibitions, Specifications, and Provisions

Appendix B

Effluent Discharge Limitations, Prohibitions, Specifications, and Provisions

A. Discharge Prohibitions

1. Bypass or overflow of untreated or partially treated waste is prohibited.
2. Discharge of waste classified as 'hazardous' or 'designated', as defined in the California Code of Regulations (CCR), Title 23, Chapter 15, Sections 2521(a) and 2522(a) is prohibited.
3. Discharge in violation of State Water Resources Control Board Resolution 68-16 is prohibited.
4. No runoff from the discharge locations will occur.
5. Discharge of treated ground water at a location or in a manner different from that specified in the Substantive Requirements is prohibited.
6. Discharge of wastes to surface waters or surface water drainage courses is prohibited.
7. Discharge of untreated or partially treated waste to ground is prohibited.

B. Effluent Limitations

1. The discharge of ground water effluent, in excess of the following limits is prohibited:

Table B-1. Building 834 ground water treatment system.

Compound	Monthly median concentration (μg/L)	Maximum daily concentration (μg/L)[1]
Tetrachloroethylene	0.5	5.0
Trichloroethylene	0.5	5.0
1,1-Dichloroethylene	0.5	5.0
1,2-Dichloroethylene	0.5	5.0
1,1,1-Trichloroethane	0.5	5.0
1,2-Dichloroethane	0.5	5.0
Chloroform	0.5	5.0
Carbon Tetrachloride	0.5	5.0
Benzene	0.5	5.0
Ethylbenzene	0.5	5.0
Toluene	0.5	5.0
Total Xylene Isomers	0.5	5.0
Freon 11	0.5	5.0
Freon 113	0.5	5.0
Total Petroleum Hydrocarbons	50	100
Total Volatile Organic Compounds [2]	0.5	5.0

[1] Using EPA Method 601/602 (and Freon 113) with a detection limit of 0.5 μg/L or less, and Modified EPA 8015.

[2] Total VOCs will be the sum of all VOCs detected above the 0.5 μg/L concentration.

Table B-2. Building 815 ground water treatment systems.

Compound	Monthly median concentration (µg/L)	Maximum daily concentration (µg/L)[1]
Tetrachloroethylene	0.5	5.0
Trichloroethylene	0.5	5.0
1,1-Dichloroethylene	0.5	5.0
1,2-Dichloroethylene	0.5	5.0
1,1,1-Trichloroethane	0.5	5.0
1,2-Dichloroethane	0.5	5.0
Chloroform	0.5	5.0
Total Volatile Organic Compounds [2]	0.5	5.0
Nitrate (as NO_3)	45,000	45,000

[1] Using EPA Method 601 with a detection limit of 0.5 µg/L or less for halogenated VOCs and EPA Method 353.2 with a detection limit of 500 µg/L for nitrate.

[2] Total VOCs will be the sum of all VOCs detected above the 0.5 µg/L concentration.

Table B-3. Buildings 830 and 832/Building 854 ground water treatment systems.

Compound	Monthly median concentration (µg/L)	Maximum daily concentration (µg/L)[1]
Tetrachloroethylene	0.5	5.0
Trichloroethylene	0.5	5.0
1,1-Dichloroethylene	0.5	5.0
1,2-Dichloroethylene	0.5	5.0
1,1,1-Trichloroethane	0.5	5.0
1,2-Dichloroethane	0.5	5.0
Chloroform	0.5	5.0
Freon 11	0.5	5.0
Total Volatile Organic Compounds [2]	0.5	5.0
Nitrate (as NO_3)	45,000	45,000
Perchlorate[3]	<4	18.0

[1] Using EPA Method 601 with a detection limit of 0.5 µg/L or less for halogenated VOCs and EPA Method 353.2 with a detection limit of 500 µg/L for nitrate.

[2] Total VOCs will be the sum of all VOCs detected above the 0.5 µg/L concentration.

[3] Using EPA Method 300.0 with a detection limit of 4 µg/L.

2. The discharge of individual VOCs other than those listed in B.1 above in excess of the 5.0 µg/L maximum daily concentration and the 0.5 µg/L monthly median concentration using EPA Method 601 is prohibited.
3. All chromatograph peaks for EPA Method 601 shall be identified.

4. The treated ground water will not have a pH less than 6.5 or greater than 8.5.
5. The Discharger shall use the best practicable cost-effective control technique currently available to limit mineralization to no more than a reasonable increment.

C. Discharge Specifications

1. System Check

Prior to operating the ground water treatment system with contaminated ground water, a system check shall be conducted to confirm the proper construction and operation of the treatment system. The following minimum requirements apply to this system check phase:

a) A conformance inspection shall be conducted to confirm that all equipment, piping, instrumentation, and control systems of the ground water treatment system have been installed according to the approved design. Any deficiencies in the ground water treatment system shall be corrected.

b) All instrumentation, control systems, and equipment shall be inspected for malfunctions. All automatic controls, such as shutdown or alarm switches necessary for the operation of each treatment system phase, shall be certified operational prior to startup of that phase. Mechanical equipment, such as pumps, air blowers, and valves, required for the operation of the treatment phases, will be cycled or operated. Any functional deficiencies shall be corrected.

2. Full Scale Operation

a) All extracted ground water will be treated by the treatment systems and discharged directly to the ground or indirectly to the ground surface via misting.

b) The Discharger shall operate the treatment systems to maximize the removal of VOCs from the extracted ground water.

c) The system operations shall be monitored in accordance with the full scale operational phase monitoring plan in the Monitoring and Reporting Program.

d) All treatment, transport, and disposal components (including pumping valves, liquid level controllers, pipelines, blowers, flow meters, pressure gauges, etc.) will be inspected for leaks and/or malfunctions each business day that the system is operational during manual operations and weekly during automated operation.

3. During All Phases of Operations

a) Neither the treatment nor the discharge shall cause a nuisance or condition of pollution as defined by the California Water Code, Section 13050.

b) The discharge shall not cause degradation of any water supply.

c) Any collected screenings, sludge, and other solids removed from liquid wastes shall be disposed of in a manner consistent with CCR Title 23,Chapter 15, Division 3.

d) The discharge shall not cause the ground water outside the boundaries of the plume to contain taste and odor producing substances in concentrations that cause nuisance or adversely affect beneficial uses.

D. Ground Water Limitations

The discharge shall not cause underlying ground water to contain waste constituents in concentrations statistically greater than background water quality.

Appendix C

SWRCB Resolution 92-49 Compliance Evaluation

Appendix C

SWRCB Resolution 92-49 Compliance Evaluation

DOE/LLNL proposes to conduct the Resolution 92-49/Basin Plan Compliance Evaluation on an OU by OU basis. The results of these evaluations will be presented in the Remediation Evaluation Summary report currently scheduled for 2005. These evaluations will include, but not be limited to, modeling using ground water extraction under five scenarios. These five scenarios have been selected to evaluate the economic and technical feasibility of achieving potential ground water cleanup levels at the time of the Final Site-Wide Record of Decision. The numeric ground water cleanup levels selected for evaluation in the five scenarios are intended for modeling purposes only and do not presuppose any specific final cleanup standard. The five scenarios are described as follows:

1) Ground water extraction at source areas and at downgradient locations within the plume to maximize the rate of mass removal and reduce contaminant concentrations to Maximum Contaminant Levels (MCLs), followed by natural attenuation to further reduce concentrations to background levels. As plume capture to the MCL concentration contour may not be complete under this scenario, natural attenuation may also be relied upon to reduce volatile organic compound (VOC) concentrations in ground water to MCLs at the plume fringes.

2) Ground water extraction with complete hydraulic capture of contaminant concentrations above MCLs, followed by natural attenuation to further reduce concentrations to background levels.

3) Ground water extraction at source areas and at downgradient locations within the plume to maximize the rate of mass removal and reduce contaminant concentrations to background levels. As plume capture may not be complete under this scenario, natural attenuation may be relied upon to reduce contaminant concentrations to background near the plume boundaries, except where there is a threat of offsite plume migration.

4) Ground water extraction with complete hydraulic capture of contaminant concentrations above the 2.3 ppb Office of Environmental Health Hazard Assessment (OEHHA) one-in one-million cancer potency factor for trichloroethylene (TCE), followed by natural attenuation to further reduce concentrations to background levels.

5) Ground water extraction with complete hydraulic capture of contaminant concentrations above background to reduce contaminant concentrations to background levels. [Note: The modeling of this “capture-to-background level for TCE” scenario is considered to be equivalent to the modeling of “capture to the Water Quality Objectives (WQO)” scenario as the detection limit for TCE (0.5 ppb) is so close to the WQO for TCE (0.8 ppb)].

As part of the evaluation, the modeling for the five scenarios will be conducted using the contaminant of concern (COC) with the plume of the greatest areal extent as an indicator of the length of time to cleanup. In most cases, this will be trichloroethylene which generally has both the highest concentrations and the greatest areal extent in ground water. The rationale for using an indicator COC in the modeling is that the COC plumes of lesser extent will be remediated before the largest COC plume is remediated. However, DOE/LLNL will also evaluate the characteristics of the other COCs (i.e., retardation factors) to support this assumption. If the assumption that TCE is the most difficult COC to remediate does not prove valid, an evaluation of other COCs will be conducted.

The evaluation results will include: (1) the estimated length of time to reach MCLs, WQOs, and background concentrations in ground water, (2) design parameters and extraction well configurations necessary to achieve the results of these scenarios, and (3) the estimated cost for implementing each remediation scenario. The evaluation will also address known or potential technical challenges in implementing the remedy under the different scenarios.

The results of the evaluation will be used to determine the final cleanup standards in the Final Site-Wide Record of Decision.