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Lawrence Livermore National Laboratory

Lawrence Livermore National Security, LLC Livermore, California 94551

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LLNL
Ground Water Project

2009 Annual Report

Technical Editors

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M. Dresen*
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Contributing Authors

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Environmental Restoration Department

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Acknowledgements

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Summary

In 2009, environmental restoration activities for the Lawrence Livermore National Laboratory (LLNL) Livermore Site Ground Water Project included:

- Removing approximately 46.3 kilograms (kg) of volatile organic compounds (VOCs) from ground water, and 39.4 kg of VOCs from soil vapor (Table Summ-1).
- Maintaining 29 ground water treatment facilities and 9 soil vapor treatment facilities.
- Maintaining a network of 95 ground water extraction wells, 1 ground water injection well, 27 dual extraction[1] wells, 31 soil vapor extraction wells, and 1 soil vapor injection well.
- Continuing hydraulic control and treatment of VOCs in ground water along the western ands southern margins of the site where concentrations remained relatively stable during the year.
- Confirming that tritium activities in ground water samples from all wells remained below the 20,000 picocuries per liter (pCi/L) Maximum Contaminant Level (MCL) and continued to decline by radioactive decay.
- Submitting the 2008 Annual Report and 2009 quarterly reports in compliance with regulatory agreements.

During 2009, restoration activities at the Livermore Site were primarily focused on restoring operations at treatment facilities that were shut down or required repair due to the fiscal year 2008 budget shortfall. The ERD process, known as the Remediation Evaluation (REVAL) process, was used to carefully and systematically restart and improve the reliability and operation of extraction wells and treatment facilities. The benefits of the REVAL process are described in detail in Section 4.1 and Appendix F.

Ground water concentration and hydraulic data indicate very little change in the VOC concentrations and areal extent of the contaminant plumes in 2009. There is little to no evidence of measureable contaminant plume migration whilst many treatment facilities were not operating during late 2008 and early 2009.

Hydraulic containment along most portions of the western and southern boundaries of the site was fully re-established and limited progress was made toward interior plume and source area clean up.

Since remediation began in 1989, more than 3.8 billion gallons of ground water and about 372 million cubic feet of soil vapor have been treated, removing an estimated 2,792 kg of VOCs (Table Summ-2) from the subsurface.

Table Summ-1. Summary of 2009 Livermore Site VOC remediation.

Treatment area[a]	Volume of ground water treated (Mgal)[b]	Estimated VOC mass removed from ground water (kg)[c]	Volume of soil vapor treated (kft^3)[b]	Estimated VOC mass removed from soil vapor (kg)[c]	Estimated VOC mass removed (kg)[c, d]
TFA	75	3.7	na	na	3.7
TFB	28	2.8	na	na	2.8
TFC	39	5.8	na	na	5.8
TFD	38	24.9	8,309	2.3	27.2
TFE	23	5.9	8,335	2.1	8.0
TFG	6	0.5	na	na	0.5
TFH	11	2.7	18,638	35.0	37.7
Totals[d]	220	46.3	35,282	39.4	85.7

Notes:

Mgal = Millions of gallons.

kg = Kilograms.

kft^3 = Thousands of cubic feet.

na = Not applicable.

[a] **Treatment facilities in each treatment area (refer to Table 1 for abbreviations):**

TFA area: TFA, TFA-E, TFA-W

TFB area: TFB

TFC area: TFC, TFC-E, TFC-SE

TFD area: TFD, TFD-E, TFD-HPD, TFD-S, TFD-SE, TFD-SS, TFD-W, VTFD-ETCS, VTFD-HPD, VTFD-HS

TFE area: TFE-E, TFE-HS, TFE-NW, TFE-SE, TFE-SW, TFE-W, VTFE-ELM, VTFE-HS

TFG area: TFG-1, TFG-N

TFH area: TF406, TF406-NW, VTF406-HS, VTF511, TF518-N, TF518-PZ, VTF518-PZ, TF5475-1, TF5475-2, TF5475-3, VTF5475

TFF started operation in February 1993 for fuel hydrocarbon remediation. In August 1995, the regulatory agencies agreed that the vadose zone remediation was complete, and in October 1996 No Further Action status was granted for fuel hydrocarbons in ground water.

[b] **Volumes and VOC mass are from the sum of individual extraction wells shown in Table 5.**

[c] **VOC mass values are best estimates accounting for measurement uncertainties in both volume and chemical analyses.**

[d] **Rounded numbers.**

Table Summ-2. Summary of cumulative Livermore Site VOC remediation.

Treatment area	Volume of ground water treated (Mgal)[a]	Estimated VOC mass removed from ground water (kg)[b]	Volume of soil vapor treated (kft^3)[a]	Estimated VOC mass removed from soil vapor (kg)[b]	Estimated VOC mass removed (kg)[b, c]
TFA	1,641	198	na	na	198
TFB	386	75	na	na	75
TFC	400	94	na	na	94
TFD	864	789	58,017	87	876
TFE	318	201	132,557	143	344
TFG	63	10	na	na	10
TFH	140	32	181,847	1,163	1,195
Totals[b]	3,812	1,399	372,421	1,393	2,792

Notes:

Mgal = Millions of gallons.

kg = Kilograms.

kft^3 = Thousands of cubic feet.

na = Not applicable.

[a] **Refer to Table Summ-1 footnote "a" for facilities in each treatment area.**

[b] **The VOC mass values are best estimates accounting for measurement uncertainties in both volume and chemical analyses.**

[c] **Rounded numbers.**

1. Introduction

This report summarizes the Lawrence Livermore National Laboratory (LLNL) Livermore Site Ground Water Project (GWP) field and regulatory compliance activities, and the remedial action program for calendar year 2009. The field activities section describes ground water monitoring and the Enhanced Source Area Remediation (ESAR) activities. The remedial action program section describes treatment facility operations, ground water discharges, remediation performance evaluation, and decision support analysis. The treatment areas, treatment facilities, and wells at the Livermore Site are shown on Figures 1 and 2 (a, b, c, d). Table 1 defines the treatment facility abbreviations used in this report, Table 2 summarizes the milestones completed in 2009, Table 3 presents the type and number of wells at the site, Table 4 summarizes treatment facility discharge sampling locations, and Table 5 summarizes extraction well performance during 2009. Acronyms and abbreviations used in this report are defined in Section 6 of this report.

In March 2009, the Remedial Project Managers (RPMs) signed a Consensus Statement for Environmental Restoration of Lawrence Livermore National Laboratory Site. Table 5 of the Remedial Action Implementation Plan was amended to include 32 new Federal Facility Agreement (FFA) milestones. Throughout the remainder of 2009 and following the restoration of staff, all 2009 FFA milestones were met early or on schedule, including reactivation of 21 treatment facilities (Table 2).

Details of 2009 treatment facility operations are described further in Section 4.1 of this report.

2. Regulatory Compliance

In 2009, the U.S. Department of Energy (DOE)/LLNL submitted all regulatory documents on schedule; these documents included:

- GWP 2008 Annual Report (Valett et al., 2009);
- GWP quarterly self-monitoring reports (Yow and Wong, 2009, a, b, and 2010);
- Building 212 Soil Removal Project Status Report (LLNL, 2009);
- Resolution of Mixed Waste Management Issues Associated with Operation of Soil Vapor and Ground Water Treatment Facilities at LLNL, Livermore Site (LLNL, 2009a);
- Treatability Study Summary and Proposed Cleanup Alternatives for the TFA West Area (Noyes et al., 2009); and
- LLNL Livermore Site Consensus Statement Schedules (McKereghan and Wong, 2009).

Livermore Site environmental community relations activities in 2009 included:

- Maintaining the Environmental Community Relations website https://www-envirinfo.llnl.gov/ consisting of project documents and reports, public notices, and other environment-related information;

- Supporting Environmental Information Repositories and the Administrative Record;
- Disseminating environment-related news releases and internal/external newsletter articles and responding to journalists' inquiries regarding environmental cleanup; and
- Conducting tours of site environmental activities upon request.

General community questions and requests for information were addressed via electronic mail, posted mail or telephone with the assistance of the Laboratory's Public Affairs Office. In addition, DOE/LLNL met with members of Tri-Valley Communities Against a Radioactive Environment (Tri-Valley CAREs) and their scientific advisor in October as part of the activities funded by a U.S. Environmental Protection Agency (EPA) Technical Assistance Grant. In addition, a Community Working Group meeting was held in November 2009 involving regulatory agencies, members of Tri-Valley CAREs, community stakeholder groups, and the general public.

During fiscal year 2008, a significant funding shortfall resulted in shutdown or run-to-failure of several treatment facilities and loss of approximately 60% of the technical staff before DOE identified and Congress approved reprogramming of funds to restore the budget. DOE directed LLNL to cautiously begin re-staffing and restarting treatment facilities based on funding projections under a Continuing Resolution that were scheduled to last from October 1, 2008, through March 6, 2009.

In a December 19, 2008 letter to DOE, EPA expressed its concern regarding the lengthy process to restart components of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) remedy. EPA subsequently issued a letter dated January 6, 2009; to DOE, assessing penalties for violations of the CERCLA Section 120 FFA at LLNL Livermore Site. This was followed by a series of meetings and negotiations with the RPMs to discuss the issues and constraints associated with restart of treatment facilities and to identify actions needed to meet CERCLA requirements.

A Consensus Statement for Environmental Restoration of the Lawrence Livermore National Laboratory Site was signed by the RPMs in March 2009 and Table 5 of the Remedial Action Implementation Plan was amended to include 32 new FFA milestones. All of these milestones were met early or on schedule, including restart of 23 treatment facilities (21 restarted in 2009; Table 2). As of September 30, 2009, 33 ground water and vapor treatment facilities were operating at the Livermore Site. This included 10 facilities that remained operational during 2009.

Five facilities remained off-line, including TFA West, which was shutdown per EPA direction in January 2008 following the conclusion of a one year treatability study (Noyes et al., 2009). Operation of the remaining four facilities will be determined by the results of a Focused Feasibility Study (FFS) requested by EPA. On December 18, 2009, a Preliminary List of Alternatives for Treatment Facilities TF5475-1, TF5475-3, VTF5475, and TF518 North was submitted to the regulatory agencies (McKereghan and Wong, 2009a). Additional evaluation of the FFS alternatives is planned for fiscal year 2010.

3. Field Activities

3.1. Ground Water Monitoring

With the restoration of funding, the modified sampling program used in 2008 during the budget shortfall (Valett et al., 2009) was no longer needed in 2009, and ground water monitoring schedules were once again fully compliant with the LLNL Livermore Site and Site 300 Standard Operating Procedures (Goodrich and Lorega, 2009). During 2009, ground water levels were measured quarterly as described below.

3.1.1. Ground Water Level Measurements

In 2009, ground water levels were measured on a quarterly basis. These measurements were taken within a three-week period each quarter. These data are complemented by continuous ground water level measurements collected from extraction wells at the treatment facilities. In 2009, a total 2,217 ground water levels were manually measured in 569 wells. These data were mainly used in generating the hydraulic capture maps for each extraction well.

As part of the REVAL process, ground water level measurements were coordinated with facility startups to collect data representative of subsurface conditions, and to define the hydraulic influence of each extraction well.

3.1.2. Ground Water Sampling

LLNL ERD and Permits and Regulatory Affairs Division (PRAD) personnel evaluated data quality objectives, analytical results, historical trends, the Cost Effective Sampling (CES) algorithm, and hydraulic data to determine the sampling frequency, chemical analyses, and methods for collecting ground water samples. The ground water samples were analyzed for VOCs, fuel hydrocarbons, polychlorinated biphenyls (PCBs), metals, radionuclides, or combinations thereof depending upon the location.

During 2009, the GWP conducted 739 well sampling events. The samplers were unable to complete 58 sampling events due to various circumstances, e.g., dry wells, inoperable pumps, etc. The methods and numbers of samples collected were:

- Specific-Depth Grab Sampling (SDGS) using the Voss EasyPump: 586 events (79%).
- Three-volume purge using a dedicated electric submersible pump: 72 events (10%).
- Low-volume purge: 14 events (2%).
- Other methods (bailer, portable electronic submersible pump, etc.): 67 events (9%).

Ongoing and significant cost reduction was achieved again in 2009 through the use of SDGS and low-volume purge methods. SDGS is the preferred method for collecting ground water samples, especially at well locations where the purge water might contain mixed waste consisting of both VOCs and tritium. The benefits of these methods include:

- Eliminating the need to replace dedicated pumps and related sampling equipment;
- Increasing technician efficiency and reducing sampling time;
- Increasing personnel safety through the use of low voltage equipment; and

- Eliminating collection, treatment, and disposal of more than 50,000 gallons of purge water, including water that would be considered mixed waste due to the presence of both VOCs and tritium.

3.2. Enhanced Source Area Remediation Activities

In 2009, DOE/LLNL reprioritized its activities to focus on operation and maintenance of existing ground water and soil vapor treatment facilities. Accordingly, ESAR related work was mostly limited to minor modifications to the facilities that will be part of the ESAR activities to accommodate the field treatability tests. These modifications included instrumentation of treatability test wells with level transducers to observe the influence of nearby pumping at the TFD Helipad and limited testing of a pump that can withstand high temperatures at the VTFE Eastern Landing Mat ESAR site.

3.2.1. Source Area Cleanup Technology Evaluation

In 2007, a data evaluation and numerical modeling analysis methodology called the Source Area Cleanup Technology Evaluation (SACTE) analysis was developed by ERD to evaluate potential technologies to accelerate source area cleanup (McNab et al., 2007). There were no significant advancements in this activity in 2009 due to the focus in restarting existing treatment facilities. ERD plans to resume this evaluation in 2010 to assist the three ESAR field activities discussed below.

3.2.2. Trailer 5475 Source Area

In 2008, ESAR activities in the Trailer 5475 Source Area involved dynamic wellfield operations (DWFOs) whereby several modes of vapor extraction and injection were used to impact stagnation zones in the subsurface to maximize mass removal. No ESAR activities occurred in the trailer 5475 source area during 2009. The field activities in this source area will resume pending the results of the FFS for TF5475-1, TF5475-2, VTF5475, and TF518 North.

3.2.3. TFE Eastern Landing Mat Source Area

In 2009, VTFE Eastern Landing Mat vapor and TFE East ground water treatment facilities were restarted. These two facilities will be used to conduct the ESAR field treatability testing in this source area. The treatability test will involve thermally enhanced remediation both in the saturated and unsaturated zones by injecting heated air and by heating ground water in some wells while extracting both vapor and ground water in others. This ESAR activity will also include DWFOs. During the REVAL activities for these two facilities, we began preparing for the upcoming ESAR work. In addition, ERD staff reviewed the control system for the ESAR activities and identified necessary modifications and upgrades for these facilities.

3.2.4. TFD Helipad Source Area

In 2009, the VTFD Helipad vapor and TFD Helipad ground water treatment facilities were restarted. TFD Helipad will be used to conduct the ESAR field treatability testing in this source area. The treatability test will involve *in situ* bioremediation in the saturated zone. During the REVAL activities for these two facilities, we began preparing for the upcoming ESAR work. In addition, ERD staff reviewed the control system for the ESAR activities and identified necessary modifications and upgrades for these facilities.

3.3. Drilling Activities

During 2009, two new extraction wells, W-2501 and W-2502, were drilled and constructed in the TFB area (Figure 1 and Appendix A). Both wells were completed within hydrostratigraphic unit-2 (HSU 2) and located near the western border of the Livermore Site where concentrations remain above the MCL for trichloroethene (TCE), which has historically been measured in nearby monitor wells W-422 and W-1420. Extraction wells W-2501 and W-2502 were designed to facilitate full hydraulic capture and treatment of the two areas while also helping to stabilize subsurface pressures and operations of the TFB remedial wellfield (Figure 1).

3.4. Building 212

Building 212 was located in the south-central part of the Livermore Site (Figure 1). The building was originally constructed as a drill hall for Naval Air Station Livermore in 1943 and later modified for physics experiments using laser accelerators. During decontamination and demolition of the superstructure in April 2008, free-phase mercury and low-level radiological contamination were discovered. The initial cleanup action, which consisted of removing soil along the northeast side of the building slab (LLNL, 2009), determined that contamination remained within the excavated trench below the “stopping points” set forth in the work plan (LLNL, 2008). Accordingly, additional work to define the lateral and vertical extent of the mercury contamination is being planned. A work plan to characterize the extent of mercury will be submitted to the RPMs in the first quarter of 2010.

4. Summary of Remedial Action Program

This section summarizes the CERCLA remedial action program at the Livermore Site. In 2009, DOE/LLNL maintained 29 ground water treatment facilities in the TFA, TFB, TFC, TFD, TFE, TFG, and TFH areas (Figure 1 and Table 1). The ground water extraction and dual extraction wells produced approximately 220 million gallons of ground water and the treatment facilities removed an estimated 46.3 kg of VOCs (Table Summ-1, Figure 3, and Table 5). In 2008, the ground water treatment facilities removed approximately 38.5 kg of VOCs. The higher mass removed in 2009 reflects the larger number of facilities and extraction wells that operated for longer periods of time as operations were restored across the site. Since remediation began in 1989, more than 3.8 billion gallons of ground water have been treated, resulting in removal of an estimated 1,399 kg of VOCs (Table Summ-2 and Figure 3).

In 2009, DOE/LLNL also operated 9 soil vapor treatment facilities in the TFD, TFE, and TFH areas (Figure 1 and Table 1). The soil vapor extraction and dual extraction wells produced more than 35 million cubic feet of soil vapor, and the treatment facilities removed approximately 39.4 kg of VOCs (Table Summ-1, Figure 3, and Table 5). In 2008, the soil vapor treatment facilities removed approximately 52.9 kg of VOCs. All soil vapor treatment facilities removed more mass during 2009 except for VTF511. VTF511 remained in operation until August 2008 and was restarted under the REVAL process, in June 2009. Due to shorter operational time and declining concentrations, the total mass removed by VTF511 soil vapor extraction was lower in 2009 than in 2008. Since initial operation, more than 372 million cubic feet of soil vapor has been extracted and treated, removing an estimated 1,393 kg of VOCs (Table Summ-2 and Figure 3).

Treatment facility performance is evaluated using multiple data sets. Figures 4, 6, 8, 10, 12, and 14 show the estimated hydraulic capture areas in HSUs 1B, 2, 3A, 3B, 4, and 5, respectively, based on ground water elevation data collected during the third quarter of 2009. Figures 5, 7, 9, 11, 13, and 15 are isoconcentration maps showing total VOCs above MCLs in the same six HSUs during the third quarter of 2009. The estimated hydraulic capture areas for third quarter 2009 have been superimposed on the isoconcentration contour maps to highlight where hydraulic containment of contaminant plumes was achieved during this time period. Contaminant concentration trends (Section 4.3) were also used to evaluate hydraulic capture and treatment facility performance.

4.1. Summary of Treatment Facility Operations

During calendar year 2009, 21 Livermore Site treatment facilities (13 ground water and 8 vapor, Table 2) were restarted under ERD's Remediation Evaluation (REVAL) process (Appendix F). These facilities were previously shut down due to the fiscal year 2008 budget reduction or had pre-existing maintenance tasks that were postponed because of manpower issues. Five treatment facilities (TFA West, TF5475-1, TF5475-3, VTF5475, and TF518 North) remain shut down due to regulatory concerns or mixed waste issues. The remaining five facilities and their planned restart are described later in this section.

As first described in the 2008 Annual Report, REVAL was developed to restart facilities in a phased and deliberate fashion based on risk to human health and the environment, and importance to the overall cleanup effort. Western and southern site boundary control and offsite contaminant plume clean up were given the highest priority. Extraction wells that hydraulically control higher-concentration ground water plumes that had the potential to move beyond the reach of existing cleanup infrastructure were also considered high priority. REVAL ensures that each system operates in a safe and optimal manner to remove and treat contaminated soil vapor and ground water, and ultimately expedite cleanup of the subsurface. As part of the calendar year 2009 treatment facility operations summarized below, the REVAL benefits are described for each facility that underwent this process.

During the REVAL process, an initial round of analytical sampling was conducted at many extraction wells and monitor wells located within or adjacent to Livermore Site source areas. The sampling was conducted prior to the start of any reactivation activities that could potentially have impacted subsurface conditions. The primary objective of the sampling was to measure any concentration rebound that occurred during the hiatus in pumping activities. The amount of rebound measured can be indicative of the relative strength of source area, and therefore has implications as to how long it might take to achieve the cleanup at that location. Analysis of the initial sampling results is underway and will be discussed in the upcoming 2010 Annual Report.

4.1.1. Treatment Facility A Area

Two treatment facilities, TFA and TFA East (Figure 1), operated in compliance with all permit requirements during 2009.

A third facility, TFA West, remained shut down during 2009 due to regulatory concerns pertaining to the use of the Livermore Water Reclamation Plan (LWRP) for treatment of low concentrations of VOCs. A year-long treatability test was conducted from 2007 to 2008 to evaluate the effectiveness of ground water extraction and an alternative remedy for cleanup of the detached portion of the HSU 2 plume in the vicinity of offsite well W-404 in the TFA West area (Figure 7). The treatability test was concluded on January 14, 2008. Analytical results from a subsequent rebound test show that PCE concentrations in the TFA West area plume decreased by about 40% as a result of ground water extraction during the treatability test. A hydrogeologic analysis of treatability and rebound test results indicated the well W-404 area plume would take considerably longer than the two years described in the Explanation of Significant Differences (ESD) (Berg et al., 2007) to achieve ground water cleanup. These findings were used as a basis for developing long-term cleanup alternatives for the TFA West area as described in *Treatability Summary and Proposed Cleanup Alternatives for the TFA West Area Report*, submitted to regulators on September 28, 2009 (Noyes et al., 2009). In this report, four treatment alternatives were evaluated for cleanup of VOCs in ground water in the well W-404 area, including:

- A pipeline extension to connect well W-404 to the Arroyo Seco Pipeline (Alternative 1);
- Installation of a GAC system near well W-404 (Alternative 2);
- Installation of a sulfur modified iron (SMI) treatment system near well W-404 (Alternative 3); and
- *In situ* destruction of VOCs by injection of a zero valent iron (ZVI) slurry in the well W-404 area (Alternative 4).

All alternatives will require extensive consultation with, and approval by, the City of Livermore prior to implementation. Alternative 1 is the approved remedy (DOE, 1992) and offers the best balance of evaluation criteria. Alternatives 2 and 3 require acquisition of land in Big Trees Park for locating new treatment facilities, and therefore may not be acceptable to the City of Livermore and the community. Alternatives 3 and 4 are newer innovative technologies and, as such, include some uncertainty regarding their effectiveness. Bench- and field-scale testing would be required to reduce this uncertainty. In addition, existing structures may limit effective application of ZVI under Alternative 4. At the end of 2009, these alternatives were being discussed with regulators and the community.

At the start of 2009, TFA remained shut down due to multiple electronic control issues. The facility was reactivated under REVAL. In late January, intermittent operations began at the facility under the REVAL testing and verification phase (Appendix F). Initially, extraction wells along the western and northern pipelines were operated and additional wells were added as they became available. In late February, continuous operation of the facility and its extraction wellfield began and ERD achieved the first quarter 2009 FFA restart milestone. Initially, eleven extraction wells were operated (W-109, W-408, W-415, W-457, W-605, W-712, W-714, W-904, W-1001, W-1004, and W-1009), but W-614 and W-903 required additional repair work.

At the TFA treatment facility, mechanical and electronic upgrades were performed as part of REVAL to increase data accuracy and reliability and to improve operations. During REVAL, two wells were identified that may require pump upgrades to meet their target flow rates (W-109 and W-712). Additionally, it was found that well W-712's performance was declining and may need redevelopment. Wells along the west pipeline were brought back on-line in a two-step procedure, which proved beneficial in maintaining stable operational flow rates. Robust data acquisition system with accurate water levels allows for more effective optimization of hydraulic capture (particularly of the detached offsite plume) and cleanup (Figure 1).

TFA East was reactivated under REVAL in late 2008 and similar procedures were used to evaluate the pump in well W-254. As a result, the stacked Shurflow pumps in well W-254 were lowered to increase the available drawdown in the well and thus increase the operating flow rate and mass removal. TFA East operated during most of 2009 and was shut down only intermittently for routine maintenance issues.

4.1.2. Treatment Facility B Area

TFB (Figure 1) operated in compliance with all permit requirements during 2009. This facility was taken offline for two days in late October due to failed electronic control hardware. Additionally in late October, this facility was shut off for one day to perform maintenance on the airflow metering equipment. TFB extraction wells W-2501 and W-2502 were drilled in late 2009 as described in Section 3.3.

4.1.3. Treatment Facility C Area

Three treatment facilities, TFC, TFC East, and TFC Southeast (Figure 1), operated in compliance with all permit requirements during 2009.

TFC operated during most of 2009 and was shut down intermittently for routine maintenance issues. TFC was shut down November 30 to upgrade electronic and mechanical equipment under the REVAL process.

At the start of 2009, TFC East remained shut down due to the 2008 budget reduction, with plans to restart this facility under REVAL. Notable activities that occurred at TFC East included:

- During the first quarter of 2009, an engineering assessment and associated facility repairs were completed and initial wellfield sampling was conducted.
- In early March, intermittent operations at the facility began under the REVAL testing and verification phase.
- In early to mid-April, continuous operation of the facility and its associated extraction wellfield began and ERD achieved the second quarter 2009 FFA restart milestone.
- From late April to early May, extraction well step drawdown tests were performed on wells W-413 and W-368 and a step-phased, full extraction wellfield startup test was performed during mid-May.

At the start of 2009, TFC Southeast remained shut down due to the 2008 budget reduction, with plans to restart this facility under REVAL. Notable activities that occurred at TFC Southeast included:

- In mid-January, the facility was operated during work hours only to conduct REVAL testing and verification; facility assessments and initial wellfield sampling were completed.
- In mid-February, continuous operation of the facility and its extraction wellfield began and ERD achieved the first quarter 2009 FFA restart milestone.
- From mid-February to mid-March, extraction well step drawdown tests were performed on wells W-1213 and W-2201, and a step-phased, full extraction wellfield test was performed during late March.

During REVAL, step flow rate testing was performed on each of the wells in the TFC East and TFC Southeast wellfields (W-368, W-413, W-1213, and W-2201). Analysis of these data provides a basis for evaluating long-term well performance, improves analysis of extraction wellfield performance, and indicates that available drawdown exists in both of the TFC East extraction wells. Increased flow rates at HSU 1B and 2 extraction wells have led to improve hydraulic capture at the leading edge of contaminant plumes as well as improved mass removal rates (Figures 5 and 7). Additionally, at TFC East and TFC Southeast, mechanical and electronic upgrades were performed to increase data accuracy and reliability, and to improve operations.

4.1.4. Treatment Facility D Area

Nine of ten treatment facilities, TFD, TFD East, TFD South, TFD Southeast, TFD Southshore, TFD West, VTFD East Traffic Circle (ETC) South, VTFD Helipad, and VTFD Hotspot (Figure 1), operated in compliance with all permit requirements during all or part of 2009.

TFD Helipad began continuous operation in mid-September (thereby meeting the fourth quarter 2009 FFA restart milestone), and operated in compliance for the remainder of 2009, except for part of September and October. On September 21, TFD Helipad was shut down following the accidental release of untreated ground water from a burst pipe associated with extraction well W-1254. Approximately 3,360 gallons of water containing an estimated 1.3 grams (0.003 lbs) of VOCs were discharged to the ground surface between September 20 and 21. The appropriate repairs were made and the facility was restarted on September 24. As the untreated ground water potentially flowed offsite, this information was reported to the Bay Area Regional Water Quality Control Board as a Low Impact/Nuisance discharge in accordance with LLNL's Storm Water Pollution Prevention Plan (SWPPP) spill reporting matrix and Industrial Storm Water Permit (95-174). The volume of ground water and mass of VOCs released were below permit limits.

At the start of 2009, TFD remained shut down due to continued air stripper and blower maintenance during REVAL. Notable activities that occurred at TFD included:

- In April, initial facility operations began under the REVAL testing and verification phase; facility assessments and initial wellfield sampling was completed.
- In mid-June, continuous operation of the facility and its extraction wellfield began and ERD achieved the second quarter 2009 FFA restart milestone.
- From mid-June to mid-August, extraction well step drawdown tests were performed on wells W-351, W-906, W-1206, and W-1208.
- In early September, a step-phased, full extraction wellfield test was implemented with wells W-351, W-906, W-1206, and W-1208 activated at half the target flow rate; in early December, extraction well flow rates were increased to full flow.

TFD East operated during most of 2009 and was shut down only intermittently for routine maintenance.

At the start of 2009, TFD South remained shut down due to the 2008 budget reduction, with plans to bring the facility back on line under REVAL. Notable activities at TFD South included:

- In January, initial wellfield sampling was conducted.
- In mid-March, initial facility operations began under the REVAL testing and verification phase.
- In late April, continuous operation of the facility and its extraction wellfield began and ERD achieved the second quarter 2009 FFA restart milestone.

- During most of May, extraction well step drawdown tests were performed on wells W-1510 and W-1503, and in early June, a step-phased, full extraction wellfield startup test was performed.

TFD Southeast, TFD Southshore, and TFD West operated during most of 2009 and were shut down only intermittently for routine maintenance.

At the start of 2009, VTFD ETC South remained shut down due to the 2008 budget reduction, with plans to restart this facility under the REVAL process. Notable activities that occurred at VTFD ETC South included:

- In early June, initial wellfield sampling was conducted.
- In early July, REVAL testing and verification began.
- In early August, continuous operation of the facility and its vapor extraction wellfield began and ERD achieved the third quarter 2009 FFA restart milestone.

At the start of 2009, VTFD Helipad remained shut down due to the 2008 budget reduction, with plans to restart this facility under REVAL. Notable activities that occurred at VTFD Helipad included:

- From mid-July to mid-August, facility assessments and initial wellfield sampling were completed.
- In mid-September, REVAL testing and verification began.
- In late September, continuous operation of the facility and its vapor extraction well began and ERD achieved the December 31, 2009 FFA restart milestone ahead of schedule.

At the start of 2009, VTFD Hotspot remained shut down due to the 2008 budget reduction, with plans to restart this facility under REVAL. Notable activities that occurred at VTFD Hotspot included:

- In early July, facility assessments were completed.
- In early August, initial wellfield sampling was conducted.
- In early September, REVAL testing and verification began.
- In mid-September, continuous operation of the facility and its vapor extraction wellfield began and ERD achieved the December 31, 2009 FFA restart milestone ahead of schedule.

During REVAL of TFD and TFD-South, step flow rate testing was performed on wells W-906, W-1206, W-1208, W-351, W-1504, W-1506, and W-1510. Analysis of the data provides a basis for evaluating long-term well performance and will improve analysis of extraction wellfield performance. Furthermore, to improve performance analysis and future operations, treatment facility mechanical and electronic upgrades were performed under REVAL to increase data accuracy and reliability and to improve operations. Additionally, during REVAL of TFD it was determined that the existing blind-packer in well W-907-2 was compromised. A new W-907 packer design that separates the upper HSU 4 screened interval from the lower HSU 5 screened interval will be implemented in the next year.

During REVAL of the VTFD ETC South, VTFD Helipad, and VTFD Hotspot treatment facilities, several key improvements were made both to the facilities themselves and to ERD's procedures. The facility improvements included a new wellhead design for dual-extraction wells at VTFD Hotspot, and a modification to the installation of measurement devices (i.e. flow meters) that not only improved data accuracy but also reduced maintenance frequency. At VTFD ETC South, optimal vapor extraction flow rates were determined for both maximizing mass removal and maximizing the life of equipment. Procedures to identify issues at these facilities were improved and standard solutions were developed and applied to other vapor facilities.

During 2009, ERD began a TFD-area-wide hydraulic test of HSU 4 in conjunction with the REVAL restart of many TFD treatment facilities. The test involved careful monitoring of flow rates and water levels as HSU 4 extraction wells were sequentially restarted during the latter part of 2009 and the beginning of 2010. The primary objectives of the test were to better understand the hydraulic communication and interference between these wells, to determine their optimal sustainable flow rates, and to establish stable flow conditions across the entire HSU 4 TFD area remedial wellfield. Analysis of test results is ongoing and will be further discussed in the 2010 Annual Report.

4.1.5. Treatment Facility E Area

Eight treatment facilities, TFE East, TFE Hotspot, TFE Northwest, TFE Southeast, TFE Southwest, TFE West, VTFE Eastern Landing Mat, and VTFE Hotspot (Figure 1), operated in compliance with all permit requirements during all or parts of 2009.

At the start of 2009, TFE East remained shut down due to control system failure in June 2008 with plans to restart this facility under REVAL. Notable activities that occurred at TFE East included:

- In mid-May, facility operations began only intermittently under the REVAL testing and verification phase.
- In June, initial wellfield sampling was conducted.
- In early August, wellfield startup commenced with flow rate tests for wells W-566 and W-1109 performed between mid-August and early September.
- In mid-September, normal facility operations began and ERD achieved the third quarter 2009 FFA restart milestone.

At the start of 2009, TFE Hotspot remained shut down due to cyclic pumping problems that arose in June 2008, with plans to restart this facility under REVAL. Notable activities that occurred at TFE Hotspot include:

- In late January, initial wellfield sampling was conducted and intermittent operations of the facility began primarily during work hours, under the REVAL testing and verification phase.
- In early March, a step drawdown test of extraction well W-2012 was conducted.
- In late March, the extraction wellfield start-up test was completed, normal facility operations began, and ERD achieved the first quarter 2009 FFA restart milestone.

TFE Northwest operated during most of 2009, and was shut down only intermittently for routine maintenance issues.

At the start of 2009, TFE Southeast remained shut down due to pump and control system failures in April 2008, with plans to restart this facility under REVAL. In March, initial wellfield sampling was conducted. In early May, the facility began operating intermittently primarily during work hours only under the REVAL testing and verification phase. In early June, ERD began normal, continuous facility operations and achieved the second quarter 2009 FFA restart milestone.

TFE Southwest and TFE West operated during most of 2009, and were shut down only intermittently for routine maintenance.

At the start of 2009, VTFE Eastern Landing Mat and VTFE Hotspot facilities remained shut down due to the 2008 budget reduction, with plans to restart this facility under REVAL. In July, initial wellfield sampling was conducted for both facilities. In late August, these facilities underwent REVAL testing and verification. In early September, normal facility operations began and ERD achieved the third quarter 2009 FFA restart milestone.

During 2009, REVAL was performed for TFE Hotspot, TFE Southeast and TFE East to assess their performance and improve operations. Step drawdown tests were conducted on wells W-2105, W-2012, W-359, W-566, and W-1109. Test data will provide a basis for evaluating long-term well performance and improve extraction wellfield performance. Furthermore, to improve performance analysis and future operations, treatment facility mechanical and electronic upgrades were performed under REVAL to increase data accuracy and reliability, and to improve operations. Specifically at TFE Hotspot, this included replacement of the bubbler system with a water level transducer to record more accurate water levels. Flow rates for the primary well at this location, W-2012, were tripled and the anomalous cycling of the well was resolved resulting in improved mass removal rates. At TFE Southeast, the step drawdown test on well W-359 has improved the understanding of HSU 5 hydraulics at the edge of saturation that will optimize ground water extraction at this location.

During REVAL of the VTFE Eastern Landing Mat and VTFE Hotspot treatment facilities, the capacity and optimal operation of different blower units were evaluated. At VTFE Eastern Landing Mat, the REVAL activities also included preparing for an ESAR feasibility study that is based on thermally enhanced remediation.

4.1.6. Treatment Facility G Area

Two treatment facilities, TFG-1 and TFG North (Figure 1), operated in compliance with all permit requirements during all or part of 2009.

TFG-1 operated during most of 2009 and was shut down only intermittently for routine maintenance.

At the start of 2009, TFG North remained shut down due to discharge pump control failures in June 2008, with plans to restart this facility under REVAL. Notable activities that occurred at TFG North include:

- In early April, facility operations began only intermittently under the REVAL testing and verification phase.
- In mid-July, initial wellfield sampling was conducted.
- In mid-August, normal facility operations began and ERD achieved the third quarter 2009 FFA restart milestone.
- In late August, step drawdown tests were performed on wells W-1806 and W-1807, and a step-phased wellfield startup was performed in early September.

During REVAL of TFG North, step drawdown tests were performed on wells W-1806 and W-1807. These data provide a basis for evaluating long-term well performance and improving analysis of extraction wellfield performance. Furthermore, to improve performance analysis and future operations, treatment facility mechanical and electronic upgrades were performed under REVAL to increase data accuracy and reliability, and improve operations.

4.1.7. Treatment Facility H Area

Treatment facilities in the TFH area in the southeast corner of the Livermore Site include those near Buildings 406 and 518, and near Trailer 5475 (Figure 1). Facility operations in the TFH area are discussed below.

4.1.7.1. Treatment Facilities Near Building 406

Three treatment facilities, TF406, TF406 Northwest, and VTF406 Hotspot (Figure 1), operated in compliance with all permit requirements during all or part of 2009.

TF406 operated during most of 2009 and was shut down only intermittently for routine maintenance. In late March, the pump was removed from extraction well GSW-445 to examine downhole conditions. Bio-growth was observed on the removed downhole equipment and a subsequent downhole camera survey was conducted to examine a previously installed pump lodged at the bottom of the well. Well GSW-445 has remained off-line for the remainder of 2009, and plans are being developed to remove the lodged pump.

At the start of 2009, TF406 Northwest remained shut down due to low influent flow rates possibly related to bio-fouling issues identified in February 2008, with plans to restart this facility under REVAL. Notable activities that occurred at TF406 Northwest include:

- In mid-March, a downhole camera survey was conducted in well W-1801 and bio-growth was observed on the well screen. A corroded tagline weight was also observed and subsequently removed. In early May, mechanical rehabilitation of well W-1801 was completed and a new submersible pump and transducer were installed.
- In mid-May, facility operations began only intermittently under the REVAL testing and verification phase.
- In late May, normal facility operations began and ERD achieved the second quarter 2009 FFA restart milestone.

At the start of 2009, VTF406 Hotspot remained shut down due to instrumentation issues in June 2008, with plans to restart this facility under REVAL. In early March, the facility began operating intermittently primarily during work hours only under the REVAL testing and verification phase. In mid-March, normal facility operations began and ERD achieved the first quarter 2009 FFA restart milestone.

TF406 was operating at the start of 2009, but did undergo a restart under REVAL in late 2008. A step flow rate test was conducted on HSU 5 extraction well W-1310. These data provide a basis for evaluating long-term well performance and improving extraction wellfield performance. During REVAL, it was identified that the pump in well W-1310 could be lowered, increasing available drawdown and allowing for a higher flow rate. Additionally, water level data suggested a hydraulic connection across the HSU 4 and HSU 5 semi-confining layer that warrants further investigation. A broken discharge line in the pump for well W-1309 was also identified and replaced.

As part of the REVAL-based restart of TF406 Northwest in 2009, a step drawdown test was performed on extraction well W-1801. Iron bacteria bio-fouling of well W-1801 was identified through sampling and analysis. Mechanical redevelopment of the well improved its yield and should improve mechanical longevity of the submersible pump.

VTF406 Hotspot was the first vapor treatment facility for which REVAL was implemented. As a result, modifications were made to vapor-only wellhead designs, and also measurement devices were improved to obtain accurate and continuous data. Minor modifications were also made to this facility to incorporate features that will extend the life of system components as well as to improve the ease of facility operation and maintenance. Nearby piezometers were sampled to evaluate the effectiveness of the extraction wells. Starting with this facility, all of the nearby monitoring wellheads were sealed to minimize short-circuiting to the surface and to maximize mass removal.

4.1.7.2. Treatment Facilities Near Building 518

Three of four treatment facilities near Building 518, TF518 Perched Zone (PZ), VTF518-PZ, and VTF511 (Figure 1); operated in compliance with all permit requirements during all or part of 2009. The fourth facility, TF518 North, remained offline during 2009 due to mixed waste management issues.

TF518 North was designed to treat VOC-contaminated ground water from HSU 4 using granular activated carbon (GAC). Tritium was not known to be present in this area when the facility was designed and became operational in January 2000. However, in January 2007, unexpected tritium activities were detected in a treatment system effluent sample and as a result, the spent GAC required management as a mixed waste.

TF518 North has been shut down since February 20, 2008. In April 2009, a report titled *Resolution of Mixed Waste Management Issues Associated with Operation of Soil Vapor and Ground Water Treatment Facilities at LLNL, Livermore Site* was issued which included discussion of the history and possible resolution of mixed waste issues at TF518 North and three other facilities (LLNL, 2009a). In September 2009, a letter titled *LLNL Livermore Consensus Statement Schedule* was issued, which proposed September 13, 2010 as the draft submittal date for a FFS. A *Preliminary List of Alternatives for Treatment Facilities* was submitted to the regulatory agencies, in December 2009.

At the start of 2009, TF518-PZ and VTF518-PZ remained shut down due to the 2008 budget reduction, with plans to restart this facility under REVAL. In late August, operations at both facilities began only intermittently under the REVAL testing and verification phase. In late September, normal facility operations began at both facilities and ERD achieved the third quarter 2009 FFA restart milestone.

At the start of 2009, VTF511 remained shut down due to electronic issues in July 2008, with plans to restart this facility under REVAL. In early June, normal facility operations began and ERD achieved the second quarter 2009 FFA restart milestone.

During the REVAL of VTF511, the vapor pipelines from the facility to the extraction wells were modified to reduce potential short-circuit to atmospheric air, thereby improving the effectiveness of the treatment facility. Different types of blowers and blower configurations were also evaluated. During the REVAL of VTF518-PZ and TF518-PZ, a new wellhead design was developed that allowed effective dual-extraction using pneumatic ground water pumps. This new design is now the standard well design for low-yielding dual extraction wells.

4.1.7.3. Treatment Facilities Near Trailer 5475

Treatment facilities TF5475-1, TF5475-3, and VTF5475 remained off during 2009 due to mixed waste management issues. These facilities have been impacted by tritiated ground water and thus have GAC containing tritium and VOCs. In April 2009, a report titled *Resolution of Mixed Waste Management Issues Associated with Operation of Soil Vapor and Ground Water Treatment Facilities at LLNL, Livermore Site* was issued which included discussion of the history and possible resolution of mixed waste issues at these three facilities (LLNL, 2009a). In September 2009, a letter titled *LLNL Livermore Consensus Statement Schedule* was issued, which proposed September 13, 2010 as the draft submittal date for a FFS. A *Preliminary List of Alternatives for Treatment Facilities* was submitted to the regulatory agencies, in December 2009.

At the start of 2009, TF5475-2 remained shut down due to the 2008 budget reduction, with plans to restart this facility under REVAL. In late May, operations at the facility began only intermittently under the REVAL testing and verification phase. In late June, normal facility operations began and ERD achieved the second quarter 2009 FFA restart milestone.

During REVAL of TF5475-2, a step drawdown test was performed on extraction well W-1108. These data provided a basis for evaluating long-term well performance and improved extraction wellfield performance. Water level transducer installation in extraction well W-1415, conducted under REVAL, will supply performance data, to improve the pump control configuration, and to optimize contaminant mass removal. Furthermore, to improve performance analysis and future operations, mechanical and electronic upgrades were performed to increase data accuracy and reliability, and to improve operations.

4.2. Ground Water Discharges

In 2009, LLNL discharged approximately 220 million gallons (Mgal) of treated ground water to the ground surface. Specifically, approximately 112.5 Mgal were discharged to Arroyo Las Positas, 65.2 Mgal to the West Perimeter Drainage Channel, and 42.3 Mgal to Arroyo Seco. In addition, approximately 0.0037 Mgal of filtered ground water from extraction well W-404 were discharged to the Livermore Water Reclamation Plant during sampling events.

4.3. Remediation Performance Evaluation

In 2009, VOC concentrations decreased slightly or remained unchanged in most Livermore Site ground water plumes. This lack of significant change is primarily attributable to active remediation that was only restarted at many facilities part way through the calendar year. The relatively minor changes described below, however, are still consistent with the longer-term trends described in the 2007 Third Five-Year Review for the LLNL Livermore Site (Berg et al., 2007) that show steady mass removal and cleanup in both offsite and onsite areas.

With the hiatus in pumping that occurred in 2008 and 2009 at many idled facilities, monitoring for possible contaminant plume migration downgradient of these facilities became a primary focus of this year's remediation performance evaluation. Importantly, no significant westward migration of contaminants was observed during 2009. This is consistent with the risk-based strategy employed for determining which treatment facilities remained in operation during the budget shortfall. Treatment facilities considered critical for maintaining hydraulic control at the site boundaries or for containing fast-moving mobile contaminant plumes remained active, while less critical facilities were shut down or "run to failure" then not restarted.

Ground water elevation contour maps for each HSU showing estimated capture areas for the third quarter of 2009 are presented on Figures 4, 6, 8, 10, 12, and 14. Notable VOC concentrations trends and results from the third quarter 2007 through the third quarter 2008 are discussed below and are presented on isoconcentration contour maps showing VOCs above MCLs by HSU (Figures 5, 7, 9, 11, 13, and 15). Treatment facilities are shown on Figures 2a through 2d. Where available and relevant, concentration data more recent than third quarter 2009 are discussed in the text below.

4.3.1. Hydrostratigraphic Unit 1B

VOC concentrations in HSU 1B remained largely unchanged in all offsite areas of the Livermore Site during 2009. At TFA monitor well W-1425, the only remaining offsite well west of LLNL with VOC concentrations above MCLs, PCE concentrations were constant at 9 ppb (October 2008 to November 2009) despite the hiatus in pumping at TFA caused by the previous year's budget shortfall. Immediately east of Vasco Road in the TFA area, where a rise in concentrations had been observed close to the site boundary in 2008, concentrations fell with the resumption of pumping at TFA Main and TFA East (Figure 1). PCE concentrations at monitor well W-604 declined from 12 ppb (September 2008) to 1 ppb (November 2009), and from 73 ppb (November 2008) to 46 ppb (October 2009) at extraction well W-254. Concentrations in the TFA source area remained unchanged throughout the year.

At TFB, which operated throughout the year, TCE concentrations continued to slowly decline in response to pumping. TCE declined:

- In monitor well W-218, from 89 ppb (October 2008) to 22 ppb (October 2009).
- In monitor well W-615, from 14 ppb (January 2008) to 9 ppb (December 2009).
- In source area piezometer SIP-141-202, from 68 ppb (September 2007) to 54 ppb (March 2009).

To the north of TFC, which operated through November of 2009, TCE in extraction well W-1104 declined from 25 ppb (October 2008) to 13 ppb (October 2009) in response to pumping at this location. TCE in adjacent monitor well W-1427 also declined, falling from 27 ppb (August 2008) to 8 ppb (August 2009). At TFC East and TFC Southeast, both of which did not operate for large portions of the previous year due to the budget shortfall, TCE was essentially unchanged, and no evidence of westward migration of the contaminant plumes was observed.

As shown on Figures 4 and 5, the HSU 1B contaminant plumes along the western LLNL margin were hydraulically contained in the TFA, TFB, TFC, and TFC Southeast areas during the third quarter of 2009. To the east, contaminant plumes were partially captured at TFC East and TFG North, but fully contained downgradient at facilities located to the west. Since TFG North was restarted in late July 2009, the second quarter ground water elevation contour maps should show a significant increase in the capture areas associated with this facility.

4.3.2. Hydrostratigraphic Unit 2

VOC concentrations in HSU 2 were relatively unchanged in most areas along the western LLNL margin during 2009 (Figure 7). At TFA, while a slight increase in VOC concentrations was noted in several monitor wells, no westward migration of the PCE plume could be observed, despite the five-month hiatus in pumping during the end of 2008 and in early 2009. In the area offsite from TFA, PCE concentrations increased in non-operating TFA West extraction well W-404 during the rebound test (Noyes et al., 2009) from around 7 ppb (January 2008), to a high of 12 ppb (June 2009), then fell slightly to its most recent concentration of 10 ppb (November 2009). At nearby monitor well W-120, PCE remained constant at 3 ppb throughout the 2009. East of Vasco Road, PCE in monitor well W-264 increased from 34 ppb (November 2008) to 40 ppb (October 2009), while at nearby extraction well W-415, PCE remained steady at 14 ppb (April 2008 and November 2009). Throughout the TFA area, VOC concentrations are expected to continue their long-term decline in 2010, now that TFA has resumed continuous operations.

In the TFB area, TCE remained relatively unchanged throughout the year. TCE concentrations in wells W-422 and W-1420 along Vasco Road were monitored closely throughout 2009; monthly samples indicated TCE remained stable at both locations during the 2009 (12 ppb in well W-422 and approximately 6 ppb in well W-1420). However, due to their close proximity to the LLNL property boundary, and to ensure comprehensive cleanup there, two new HSU 2 extraction wells, W-2501 and W-2502, were drilled and constructed in 2009. The design of these wells was based on sieve analyses conducted on core samples collected from the two borings. In addition, well W-2502 was completed with multiple screens within HSU 2 to help stabilize subsurface pressure changes and TFB operations during pumping of the HSU 2 remedial wellfield.

In the eastern portion of the site, despite the downtime at several idled facilities, no definitive evidence for the westward migration of contaminant plumes could be observed during 2009. In fact, very few changes in concentrations were observed during the year, with the following exceptions. East of TFC East, TCE continued to decline at monitor well W-317 (from 19 ppb October 2008 to 9 ppb August 2009), probably in response to continued ground water extraction operations upgradient at TFD West. In the TFG North area, well W-1901-2 became available for conventional sampling for the first time because a throughput packer was installed, allowing for the sampling of the lower screened interval of the well. Concentrations of TCE there were observed to be 7 ppb in December 2009. TCE in the area, which is at the leading edge of a plume emanating from the TFE East source, is expected to decline in 2010 now that TFG North has resumed operations.

In the TFE Hotspot area (Figure 1), TCE in piezometer SIP-ETS-601 fell from 630 ppb (February, 2008) to 210 ppb (September 2009). This decline appears to be in response to intermittent pumping at nearby low-yield HSU 2 extraction well W-2105. Efforts to improve the pumping time of this well are underway. As part of this effort, the area has been proposed as the site for a 2010 pilot test of mechanical fracturing to improve access to contaminants trapped in fine-grained source area sediments, and to increase the sustainable yield of extraction wells screened in low-permeability sediments.

Figure 6 shows the estimated hydraulic capture areas in HSU 2 during the third quarter of 2009. As shown, the contaminant plumes in the TFA and TFB areas were entirely within the estimated capture areas except at wells W-404 and W-422 (Figure 7). Both chemical and hydraulic data suggest that the well W-404 PCE plume is currently within the stagnation zone of TFA west pipeline extraction well W-109 (Noyes et al., 2009). The well W-422 area should be completely hydraulically contained once pumping begins at new TFB extraction wells W-2501 and W-2502.

4.3.3. Hydrostratigraphic Unit 3A

During 2009, very little change was observed in the size and location of the contaminant plumes in HSU 3A (Figure 9). At well W-276 in the western TFE area, TCE continued to decline slowly from 67 ppb (October 2008) to 60 ppb (October 2009). This decline is likely a response to a resumption of pumping at TF406 Northwest extraction well W-1801, in May, 2009 after being shut down in mid-2008. A HSU 3A monitor well is planned for 2010 to evaluate the distribution of VOCs west of well W-276. At TFE Hotspot, TCE in upgradient monitor well W-1201 increased from 120 ppb (August 2008) to 210 ppb (November 2009). The increase may be due to the fact that operations at TFE Hotspot were suspended in June of 2008 due to the budget reduction, and were not restored until January 2009. However, TCE in downgradient monitor well W-1204 was essentially unchanged during the same period, suggesting that although contaminants did not migrate out of the area, a rebound in concentration did occur in the HSU 3A source area. Elsewhere in the eastern part of the site, no significant HSU 3A concentration trends were observed during 2009.

To the west in the TFA area, carbon tetracholoride along the western site boundary remained unchanged (4 ppb in well W-712 throughout the year), and PCE remained slightly above its 5 ppb MCL in well W-310 in TFB (7 ppb, December 2009). A pumping test will be conducted in 2010 to determine whether the PCE in well W-310 is attributable to a compromised completion in either well W-310 or adjacent wells W-218, W-418, W-419, or W-611.

Figure 8 shows the estimated hydraulic capture areas in HSU 3A during the third quarter of 2009. Hydraulic containment should be restored in the TFD and TFD Southshore areas by early 2010 once the capture areas associated with these two facilities are fully re-established.

4.3.4. Hydrostratigraphic Unit 3B

VOC concentrations in HSU 3B (Figure 11) remained relatively stable during 2009 with very few locations exhibiting either an increase or decline in concentrations. In the TFD South area, TCE concentrations increased in monitor well W-1511 from 140 ppb (November 2008), to the 225-275 ppb range (for most of 2009), then declined to 180 ppb (November 2009). At TFD Southeast a similar trend was observed in idled HSU 3B extraction well W-1403, from 430 ppb (July 2008) to 500 ppb (August 2009) to 400 ppb (October 2009). These trends are interpreted to reflect concentration rebound in the HSU 3B TFD Southeast source area coupled with migration of the associated TCE plume southeastward towards TFD South. As indicated by these latest data, TCE has declined in both areas since the two facilities were reactivated.

To the south at TFE Southwest, TCE declined in extraction well W-1522, from 220 ppb (October 2008) to 150 ppb (October 2009). The decline is interpreted to be the result of continued ground water extraction in this area. Pumping at well W-1522 was discontinued in October 2009 due to the presence of tritium in the well influent (2,580 pCi/L measured in October 2009). The well will be restarted once a resolution to the mixed-waste issue has been identified.

As shown on Figures 10 and 11, large portions of the TFD, TFE, and TFH areas were back under hydraulic control by the third quarter of 2009. The fourth quarter 2009 and first quarter 2010 ground water elevation contour maps are expected to show an increase in hydraulic containment in the TFD and TFD East areas, as the capture areas associated with these two facilities are fully re-established.

4.3.5 Hydrostratigraphic Unit 4

Although the HSU 4 extents were essentially unchanged from 2008, several notable concentration trends were observed in HSU 4 during 2009 (Figure 13). In extraction well W-1503 located at TFD South, a significant increase followed by a decline in TCE was observed from 190 ppb (July 2008) to 630 ppb (May 2009) to 120 ppb (October 2009); well W-1503 was not running between June 2008 and February 2009. The increase in TCE concentration likely reflects a rebound in the HSU 4 source area followed by a decline once pumping resumed in August 2009. During this time interval, TCE remained constant or fell slightly in downgradient and cross-downgradient wells W-1211 (12 ppb in October 2008 and 11 ppb in October 2009) and W-1418 (84 ppb in August 2008 and 43 ppb in November 2009) suggesting that no significant westward migration of the contaminant plume occurred during the pumping hiatus.

At TF406, TCE fell below its 5 ppb MCL at non-operating extraction well W-1309 (8 in ppb October 2008 and 2 ppb in October 2009). Accordingly, ground water extraction at well W-1309 will not be resumed (pumping ceased there in 2000 once TCE remained below 5 ppb for several consecutive quarters) but will continue to be monitored on a quarterly basis. At TFE Southwest, TCE in extraction well W-1520 fell from 100 ppb (October 2008) to 60 ppb (July 2009). The well was turned off in February due to the presence of tritium in the influent ground water (2,930 pCi/L in July, 2009). Along with well W-1522, well W-1520 will remain off until the mixed-waste issue has been resolved. An investigation to determine the source of the tritium in TF518 North and TFE Southwest influent has been initiated.

Figures 12 and 13 show the estimated hydraulic capture areas in HSU 4 during the third quarter of 2009. The area under hydraulic containment in HSU 4 is expected to expand in the eastern part of the site once pumping resumes at well W-314 in 2010.

4.3.6 Hydrostratigraphic Unit 5

Although the general configuration and locations of contaminant plumes in HSU 5 during 2009 remained essentially unchanged from 2008, some differences were observed (Figure 15). At TFD Main, where extraction well W-907-2 has been off since August 2008, TCE concentrations increased from 29 ppb (July 2008) to 92 ppb (April 2009). TCE at downgradient monitor well W-1803-2 increased 10 ppb during the same period, suggesting some westward migration of the plume may have occurred (25 ppb in October 2008 to 35 ppb in July 2009). Restart of well W-907-2 was delayed to completely re-design the packer system separating the non-pumping HSU 4 interval from the pumping HSU 5 interval. Well W-907-2 will be restarted in the first quarter of 2010, and concentrations are expected to rapidly decline in this well as well as at well W-1803-2.

At TFE East, TCE concentrations first increased, then fell following a year long hiatus in pumping (June 2008 to June 2009) at extraction well W-566 (58 ppb in April 2008, 100 ppb in June 2009 then 38 ppb in October 2009). A similar trend in TCE concentrations was observed in downgradient monitor well W-210 (25 ppb in October 2008, 69 ppb in January 2009, then

39 ppb in October 2009). The decline in concentration is interpreted to be due to the re-establishment of pumping and hydraulic containment as extraction well W-566 began pumping again. Along the southeastern margin of the site at TF406, TCE continued to decline following restart of pumping at extraction well W-1310 in October 2008. TCE along East Avenue at monitor well W-1112 declined from 10 ppb (September 2008) to 1 ppb in October 2009, while farther south at monitor well W-509, TCE remained essentially unchanged (6 ppb in October 2008 and 4 ppb in September 2009).

Figures 14 and 15 show the extent of the estimated hydraulic capture areas in HSU 5 during the third quarter of 2009. Only incipient hydraulic containment is shown at well W-566 in the TFE East area since the well just began pumping again in July 2009, the month for which the third quarter ground water elevation contour maps were developed. The first quarter 2010 maps should show well developed capture areas at TFE East and at TFD Main, once well W-907-2 resumes pumping.

4.4. Tritium

During 2009, tritium activities in ground water from all wells at the Livermore Site, including those in the Trailer 5475, Building 292, and Building 419 areas (Figure 1), remained below the 20,000 pCi/L MCL and continued to decline by radioactive decay. In the former Building 412 area, tritium was measured at 11,400 pCi/L in HSU 3A well W-2205, in June 2009. The source of tritium at this location is currently under investigation.

4.5. Decision Support Analysis

A variety of decision support tools are used and various analyses are conducted to evaluate the performance of the remedial systems, and to improve the quality, efficiency, and consistency of routine tasks. These decision support activities are grouped into four categories:

- Environmental Information Management System
- Automated Data Review and Mapping Tools
- Predictive Analysis Tools
- Project Management Tools

In 2009, use of the environmental database, and associated data entry and data review tools, continued. These tools were used on a daily basis for work tasks ranging from data entry to report preparation. For example, the treatment facility self-monitoring reporting tool allows facility operators to enter data using a web-based interface, and to automatically generate the resulting reports. These decision support tools were used extensively during REVAL for each treatment facility.

The next level of decision-support tools consist of sophisticated graphical, statistical, and numerical data analysis tools used for remedial performance evaluations. This suite of tools includes the CES algorithm that enables ERD personnel to quickly review concentration trends in wells and make sampling recommendations on a quarterly basis. Another frequently used tool is the Optimized Environmental Restoration Analysis (OPERA) tool. This web-tool enables ERD personnel to quickly view plume maps for each contaminant and compare current conditions with historical distributions. Approximately 8,000 plume maps and 1,800 ground water elevation maps that span the entire 25-year project history are updated each quarter within in a matter of hours. The map library was updated once per quarter in 2009 with the most recent sampling information available, and the resulting electronic map library is accessed using the OPERA web tool.

The ERD environmental database and the data analysis tools significantly reduce the effort required to develop analytical or numerical models for predictive analyses. In 2009, ERD developed a project management process to systematically start up facilities that were shutdown in 2008. The Remediation Evaluation (REVAL) Process is an example project management tool and is detailed in Appendix F. Regional-scale flow and transport models were used to evaluate the effectiveness and start order of extraction wellfields to be restarted as part of REVAL. The results of these analyses allowed ERD personnel to prioritize the maintenance and operation of critical facilities to ensure hydraulic containment.

5. References

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6. Acronyms and Abbreviations

1,1-DCA	1,1-dichloroethane
1,2-DCA	1,2-dichloroethane
1,1-DCE	1,1-dichloroethylene
1,2-DCE	1,2-dichloroethylene
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CES	Cost Effective Sampling
CFR	Code of Federal Regulations
DOE	U.S. Department of Energy
DWFO	Dynamic Wellfield Operation
ELM	Eastern Landing Mat
EM	Environmental Management
EPA	U.S. Environmental Protection Agency
ERD	Environmental Restoration Department (Lawrence Livermore National Laboratory)
ESAR	Enhanced Source Area Remediation
ESD	Explanation of Significant Differences
ETC	East Traffic Circle
ETCN	East Traffic Circle North
ETCS	East Traffic Circle South
ETS	East Taxi Strip
FFA	Federal Facility Agreement
FFS	Focused Feasibility Study
FY	fiscal year
GAC	Granular Activated Carbon

GTU	GAC Treatment Unit
GWP	Ground Water Project
HSU	Hydrostratigraphic Unit
kft^3	thousands of cubic feet
kg	kilogram
kgal	thousands of gallons
LLNL	Lawrence Livermore National Laboratory
LWRP	Livermore Water Reclamation Plan
MCL	Maximum Contaminant Level
Mgal	millions of gallons
MTU	Miniature Treatment Unit
NIF	National Ignition Facility
NNSA	National Nuclear Security Administration
O&M	Operations and Maintenance
OPERA	Optimized Environmental Restoration Analysis
PCB	polychlorinated biphenyl
PCE	perchloroethylene
pCi/L	picocuries per liter
ppb	parts per billion
PRAD	Permits and Regulatory Affairs Division (LLNL)
PSR	Phased Source Remediation
PTU	Portable Treatment Unit
REVAL	Remediation Evaluation (ERD)
ROD	Record of Decision
RPM	Remedial Project Manager
RWQCB	California Regional Water Quality Control Board
SACTE	Source Area Cleanup Technology Evaluation
SARA	Superfund Amendments and Reauthorization Act
SDGS	Specific Depth Grab Sampling
SNL	Sandia National Laboratories
STU	Solar Treatment Unit
SWPP	Storm Water Prevention Plan
TCE	trichloroethylene
TF	Treatment Facility
TF406	Treatment Facility 406
TF5475	Treatment Facility 5475
TF518	Treatment Facility 518
TFA	Treatment Facility A

TFB	Treatment Facility B
TFC	Treatment Facility C
TFD	Treatment Facility D
TFE	Treatment Facility E
TFF	Treatment Facility F
TFG	Treatment Facility G
TFH	Treatment Facility H
VES	vapor extraction system
VOC	volatile organic compound
VTF	soil vapor treatment facility
VTF406	Vapor Treatment Facility 406
VTF511	Vapor Treatment Facility 511
VTF518	Vapor Treatment Facility 518
VTF5475	Vapor Treatment Facility 5475
VTFE	Vapor Treatment Facility E
ZVI	zero valent iron

Figures

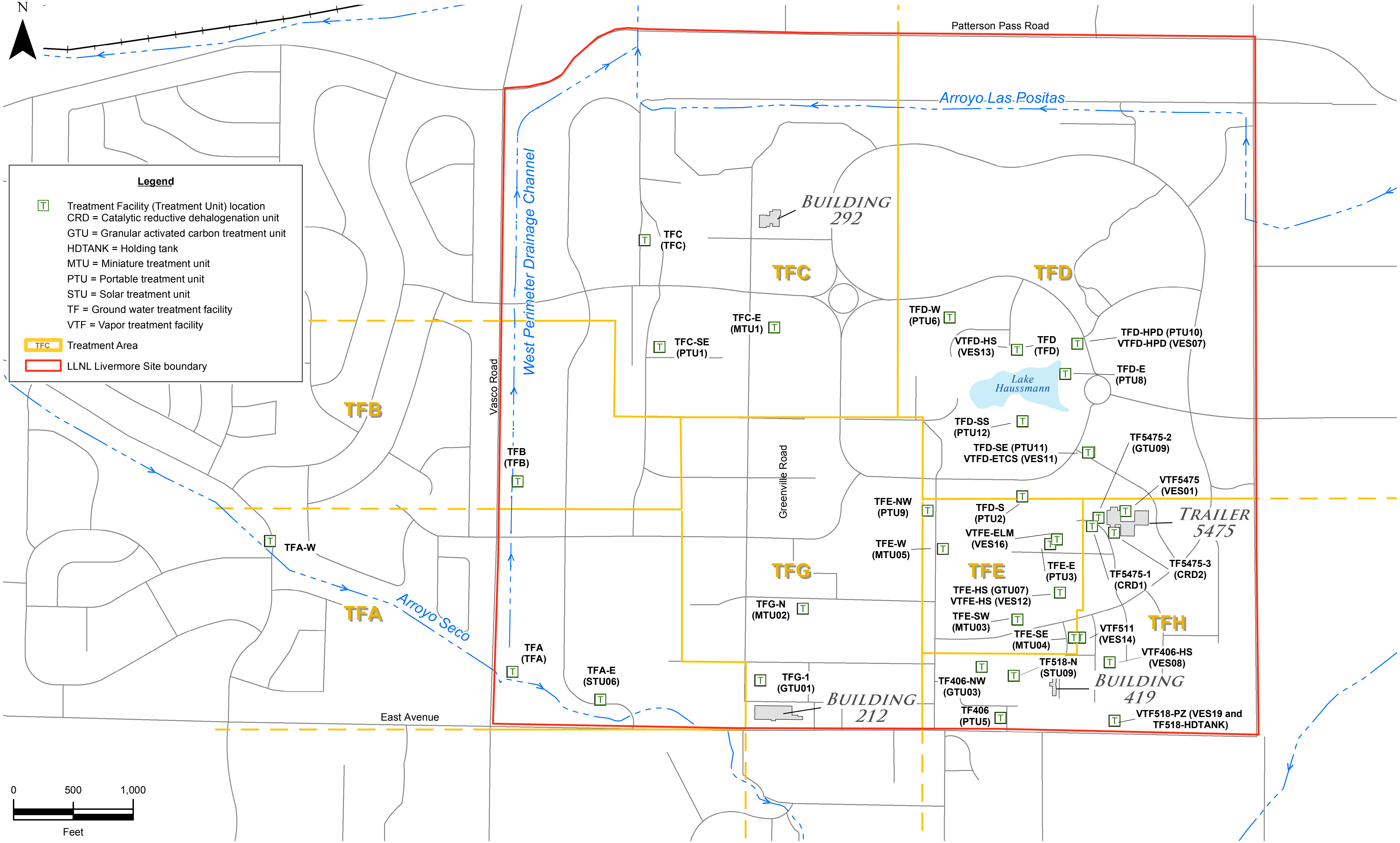

Figure 1. Livermore Site treatment areas and treatment facility locations.

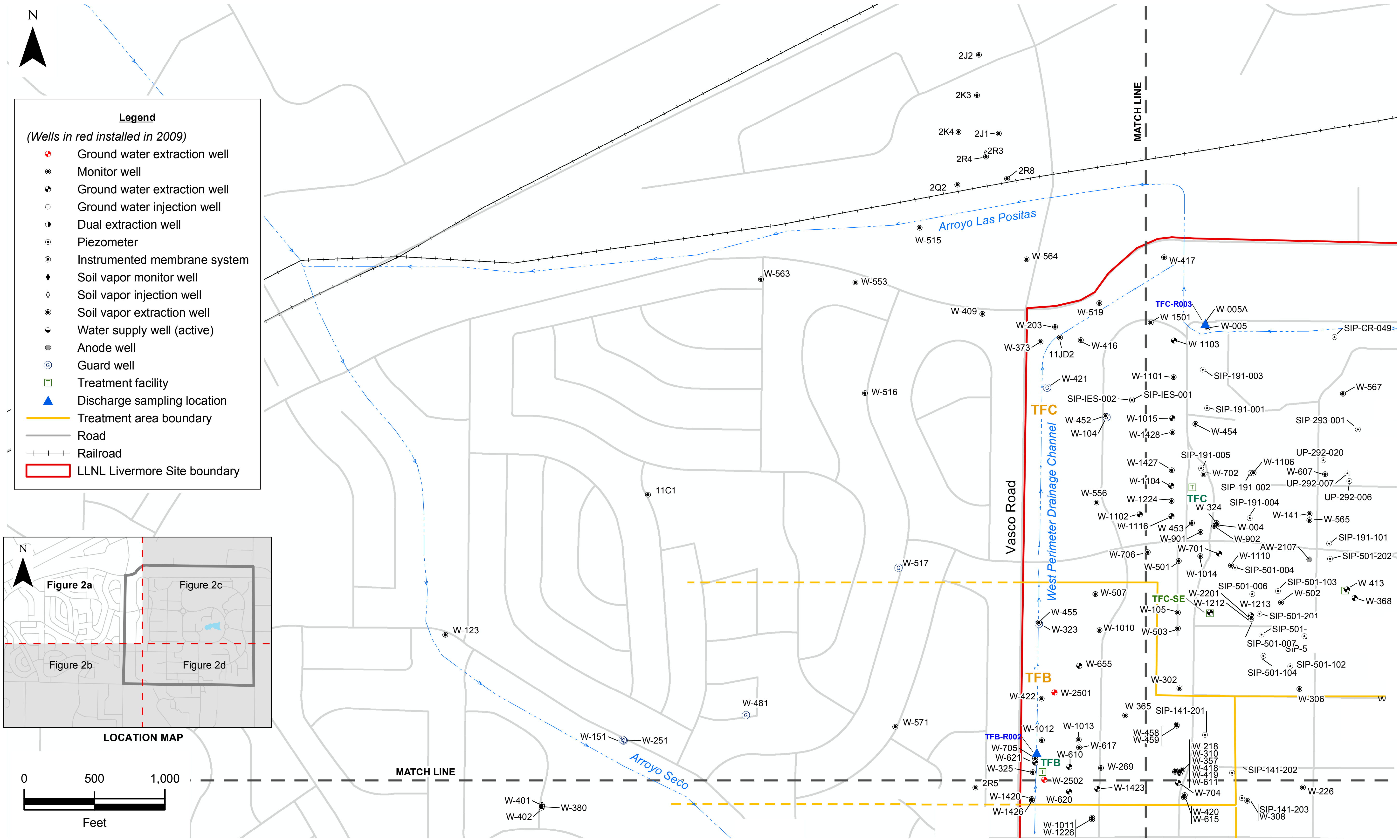

Figure 2a. Locations of Livermore Site wells and treatment facilities, December 2009.

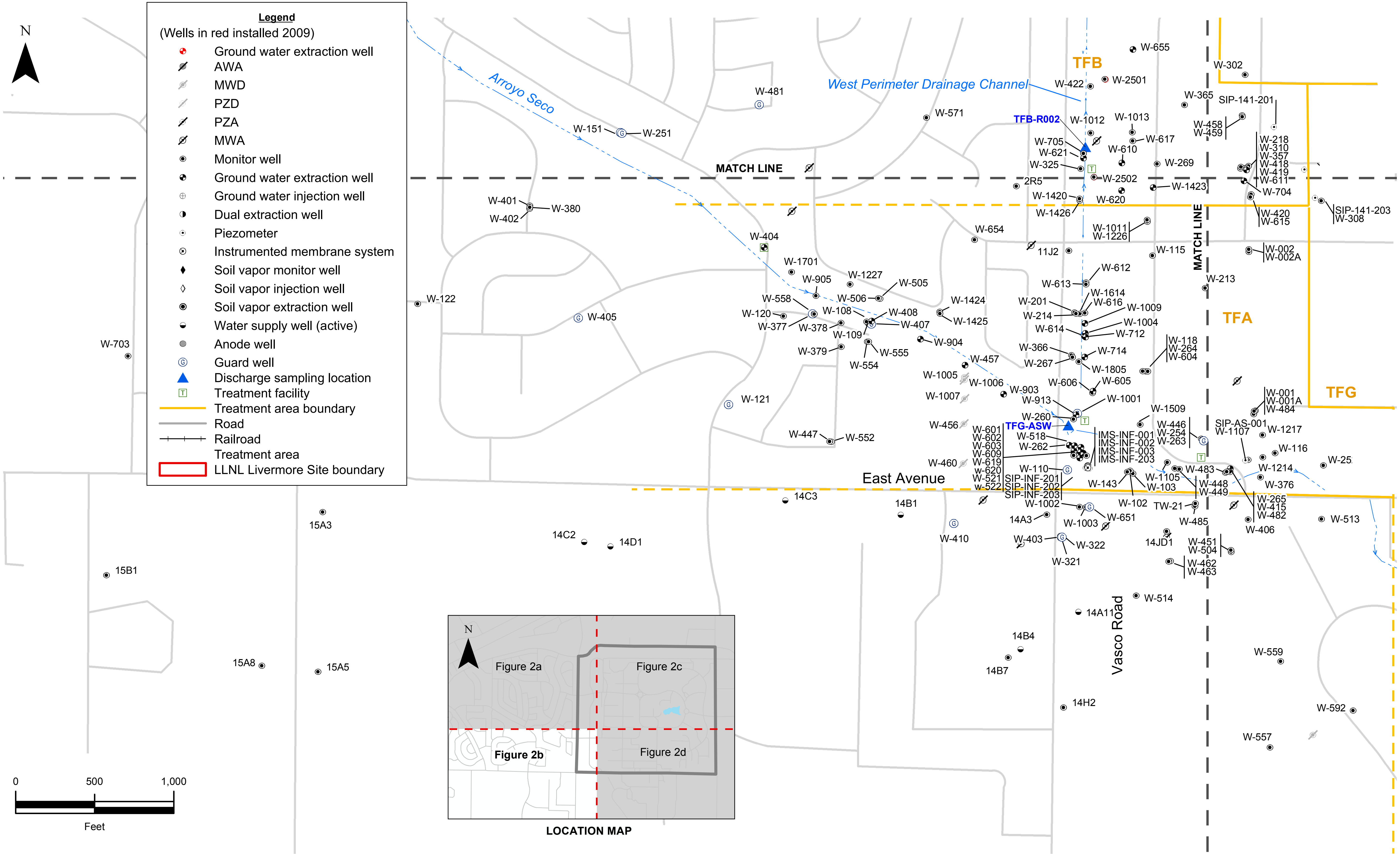

Figure 2b. Locations of Livermore Site wells and treatment facilities, December 2009.

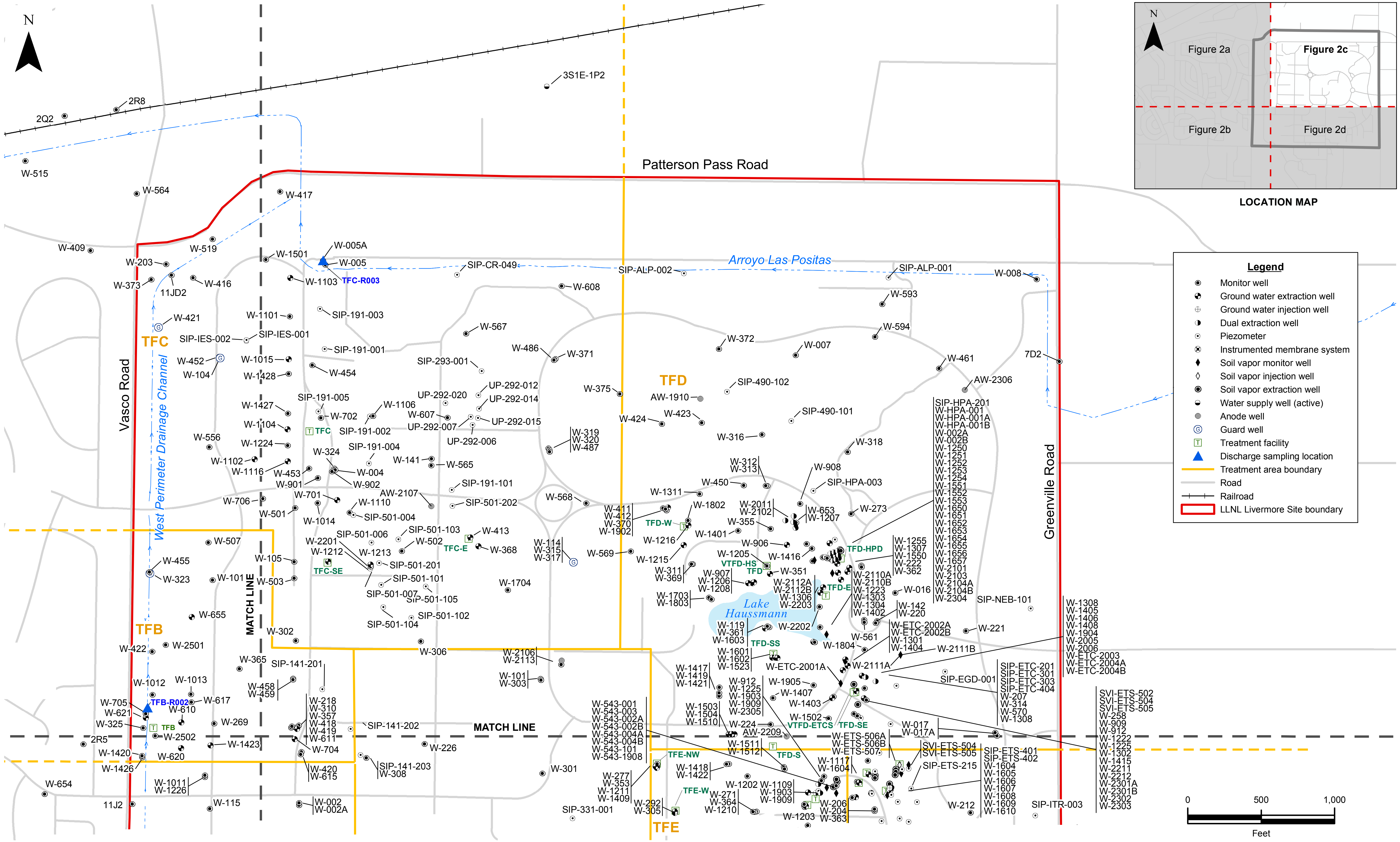

Figure 2c. Locations of Livermore Site wells and treatment facilities, December 2009.

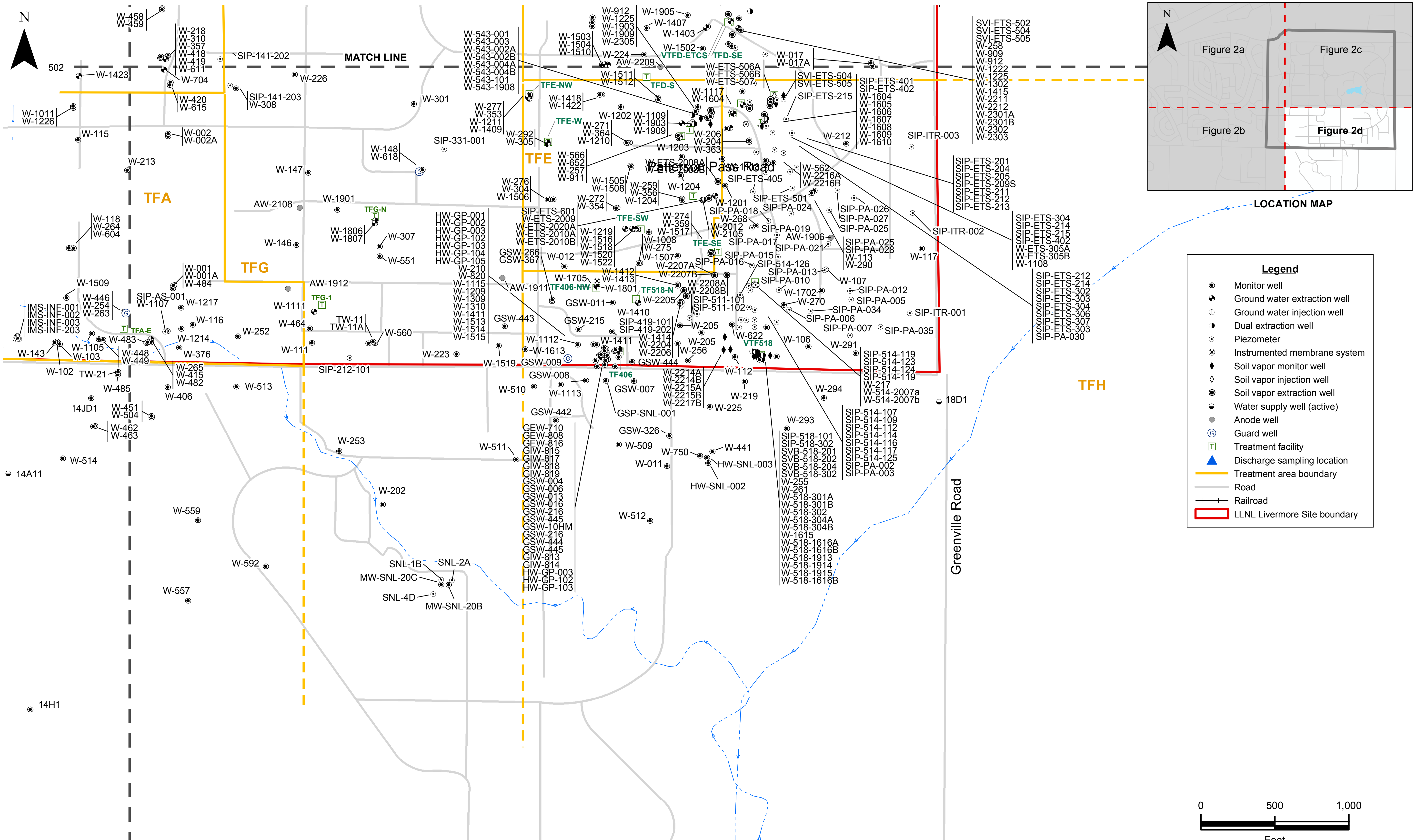

Figure 2d. Locations of Livermore Site wellsand treatment facilities, December 2009.

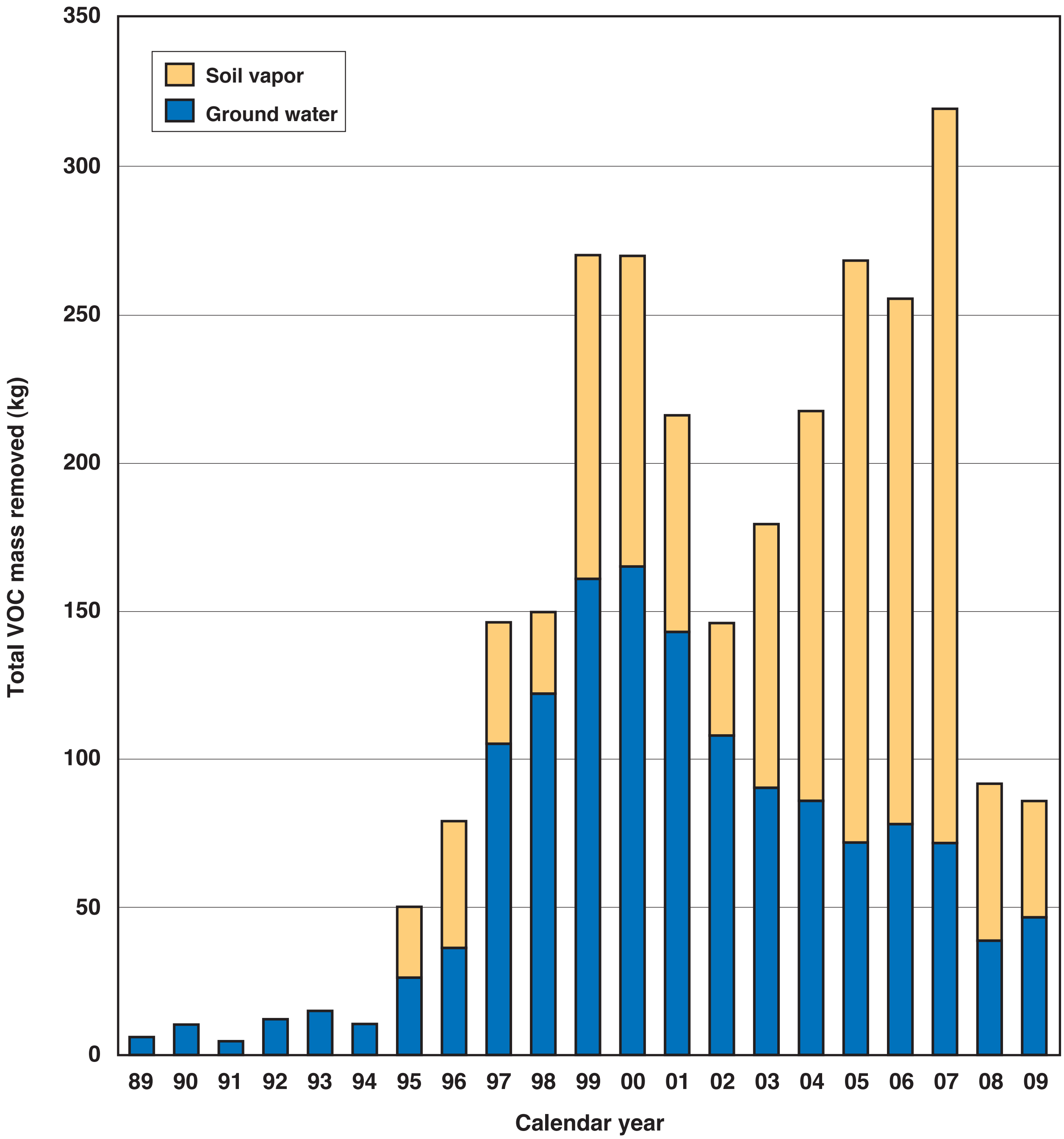

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Figure 3. Estimated total VOC mass removed from the Livermore Site subsurface since 1989.

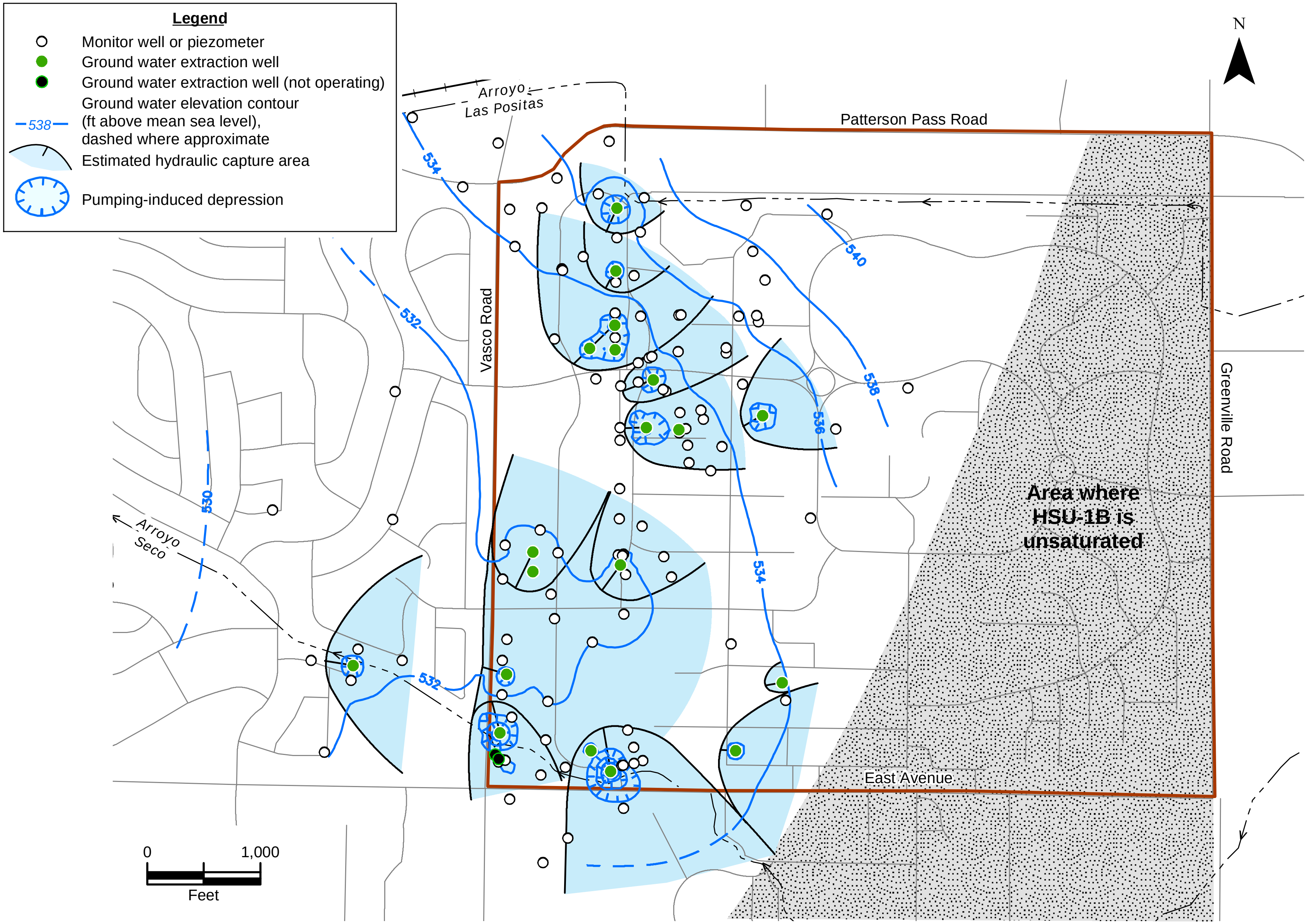

Figure 4. Ground water elevation contour map based on 127 wells completed within HSU-1B showing estimated hydraulic capture areas, LLNL and vicinity, July 2009.

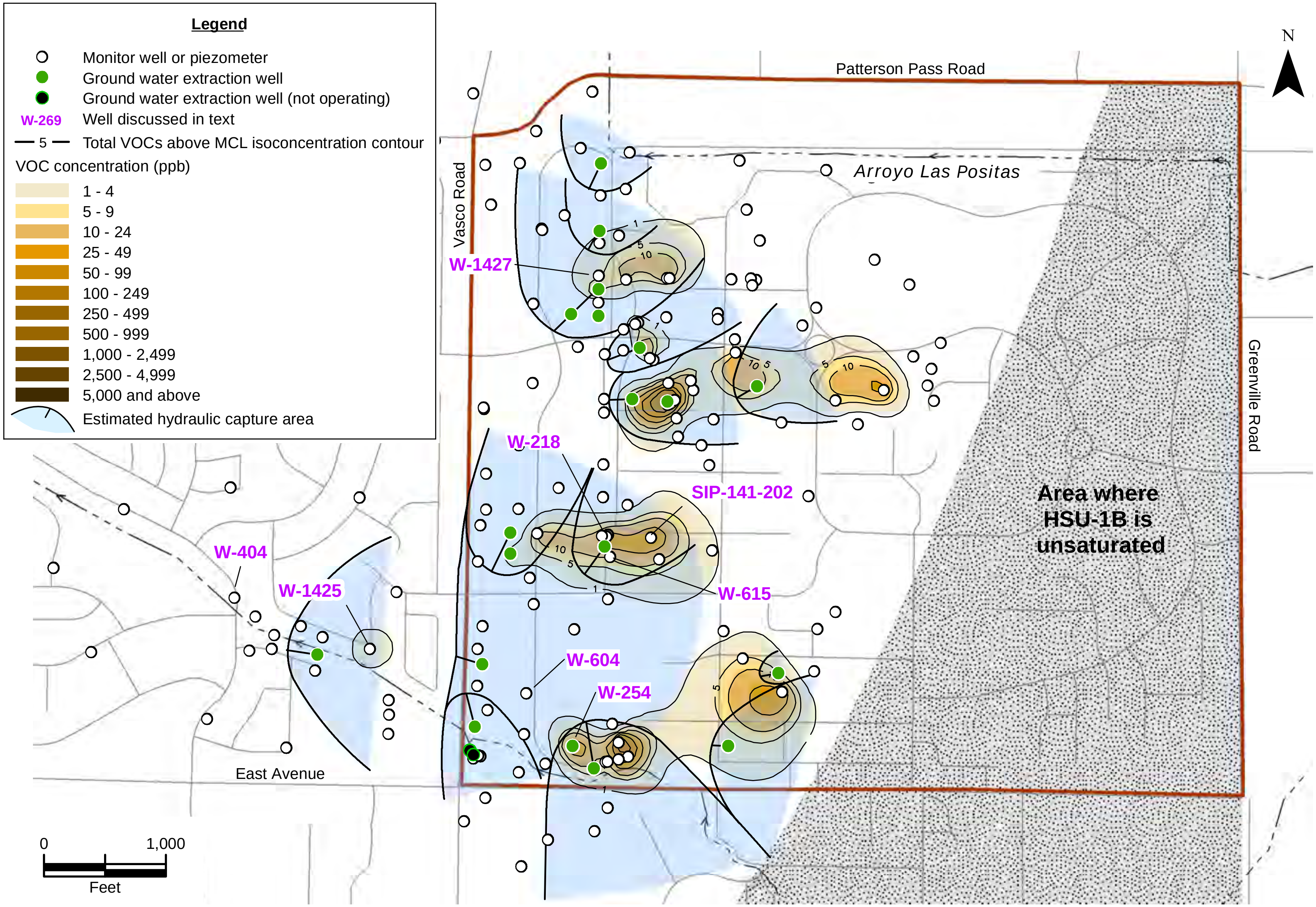

Figure 5. Isoconcentration contour map of total VOCs above MCLs from 128 wells completed within HSU-1B, third quarter 2009 (or the next most recent data), and supplemented with soil chemistry data from 41 borehole locations.

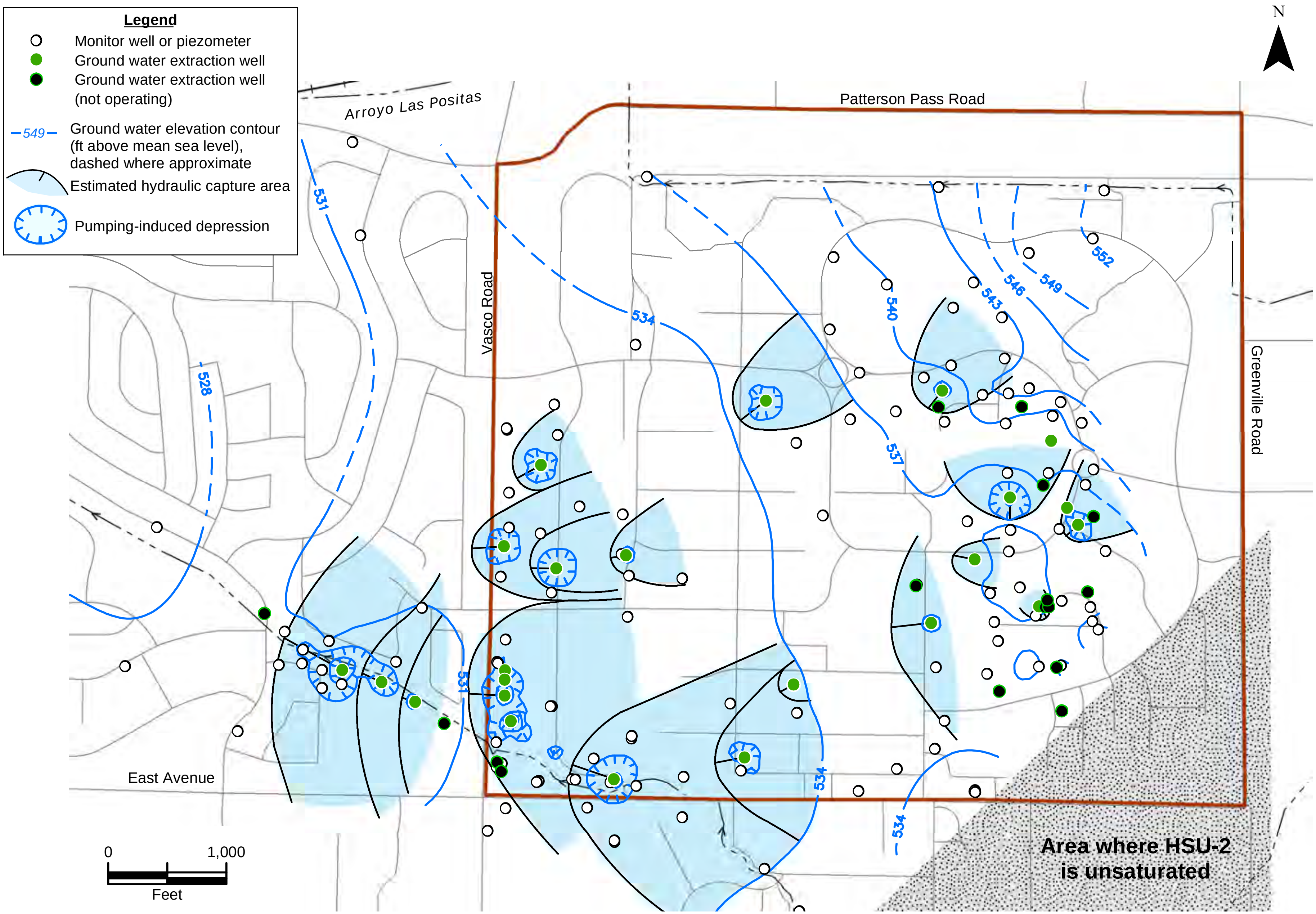

Figure 6. Ground water elevation contour map based on 163 wells completed within HSU-2 showing estimated hydraulic capture areas, LLNL and vicinity, July 2009.

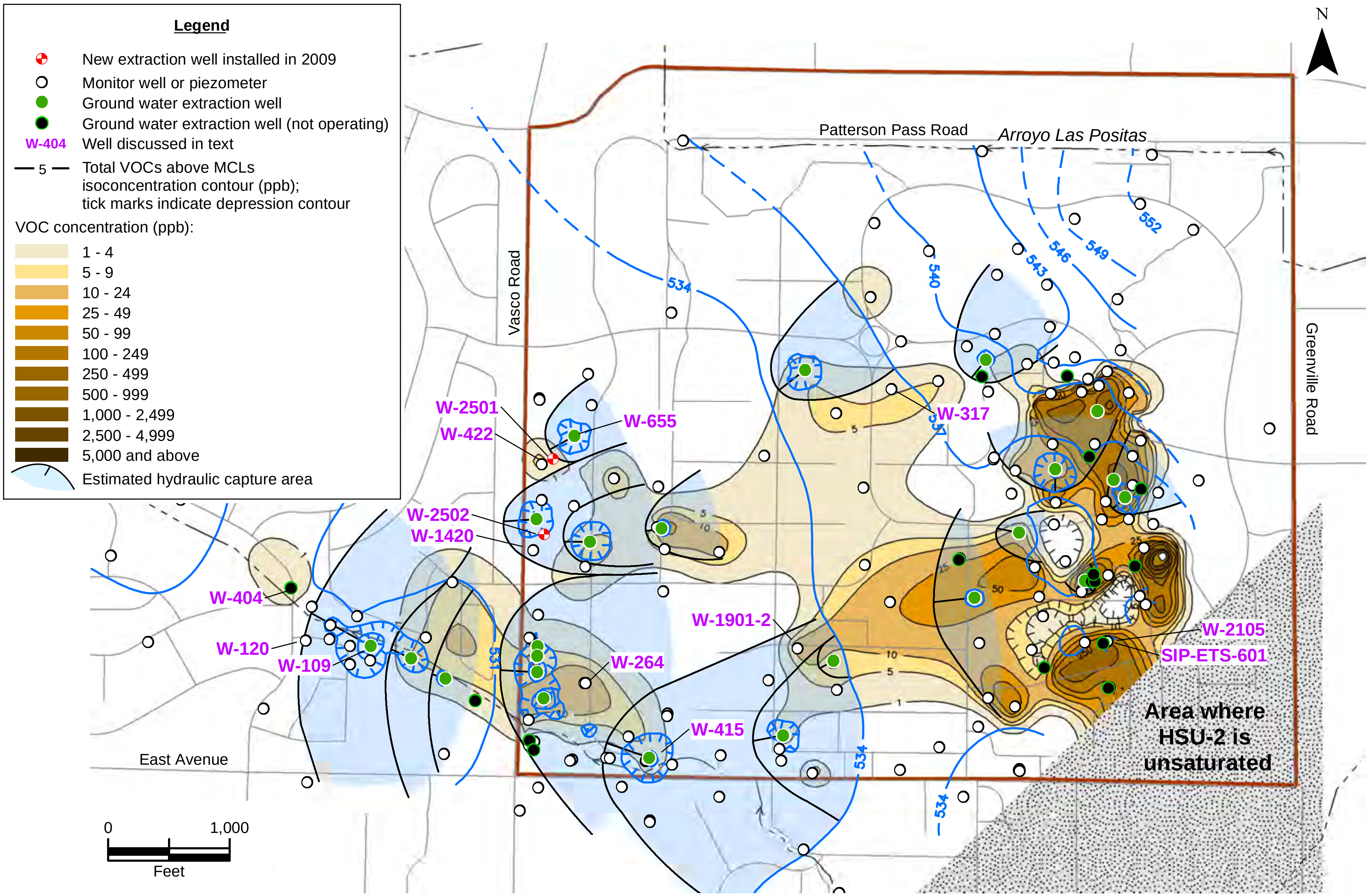

Figure 7. Isoconcentration contour map of total VOCs above MCLs from 193 wells completed within HSU-2, third quarter 2009 (or the next most recent data), and supplemented with soil chemistry data from 94 borehole locations.

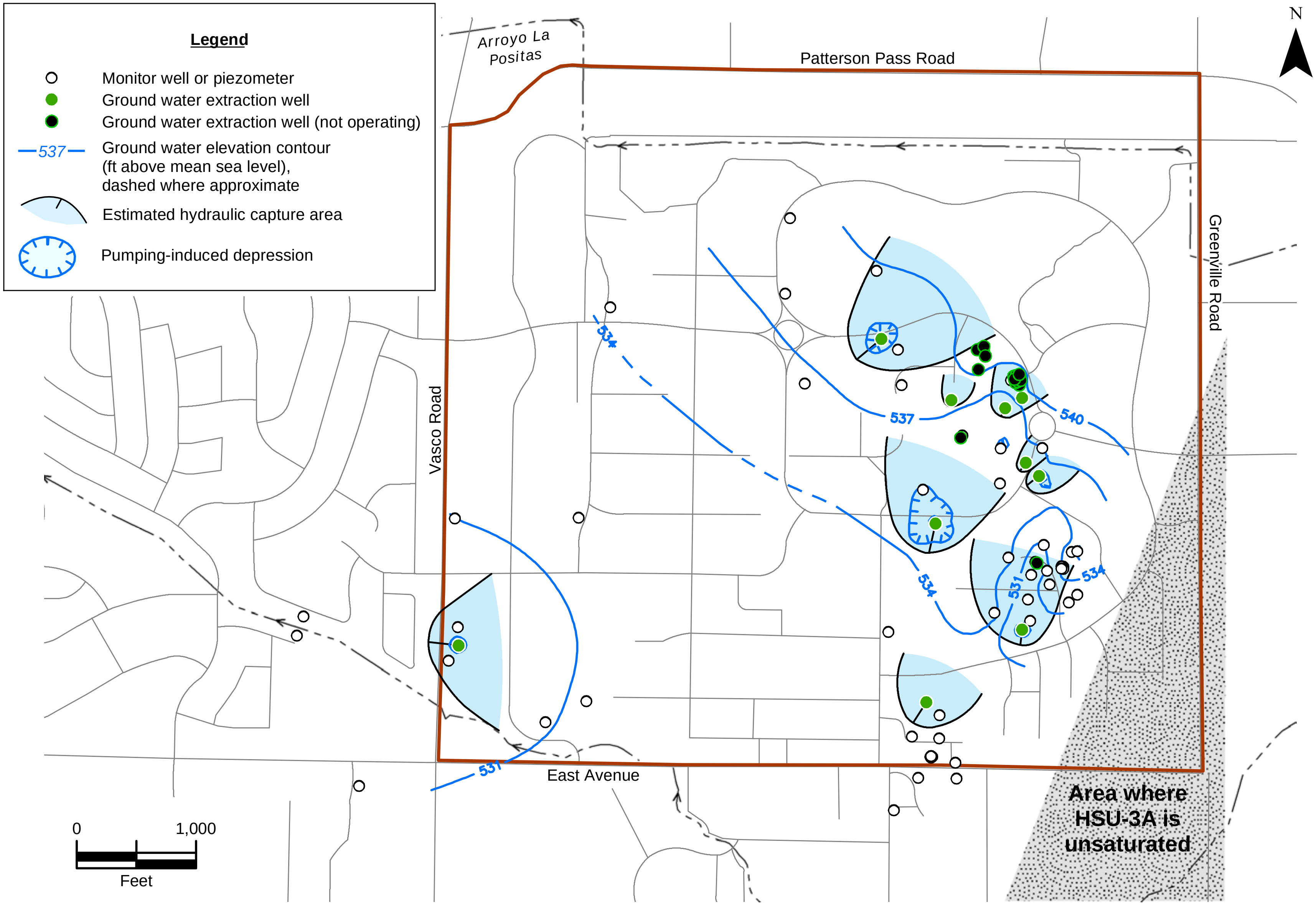

Figure 8. Ground water elevation contour map based on 78 wells completed within HSU-3A showing estimated hydraulic capture areas, LLNL and vicinity, July 2009.

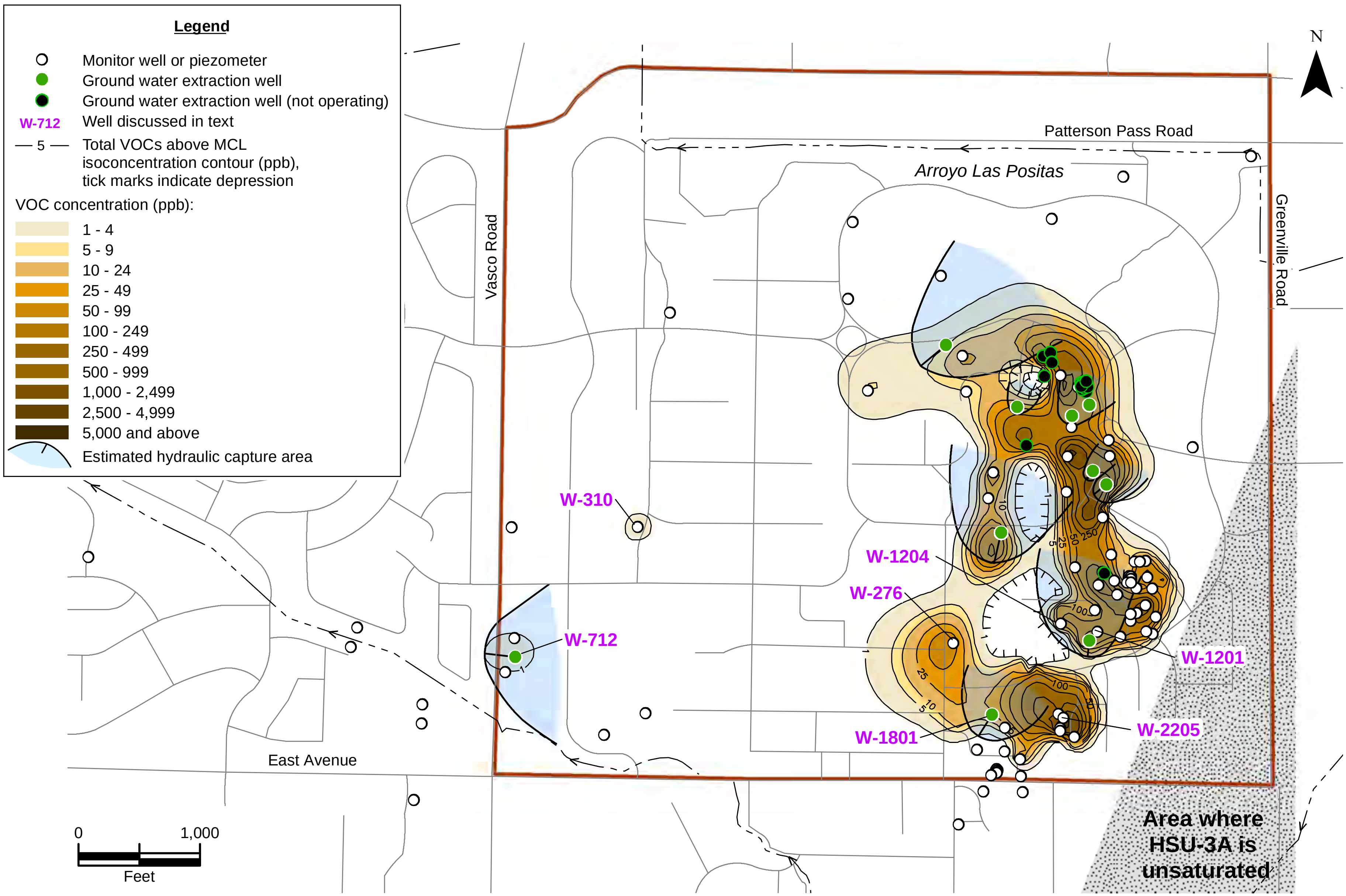

Figure 9. Isoconcentration contour map of total VOCs above MCLs from 107 wells completed within HSU-3A, third quarter 2009 (or the next most recent data), and supplemented with soil chemistry data from 144 borehole locations.

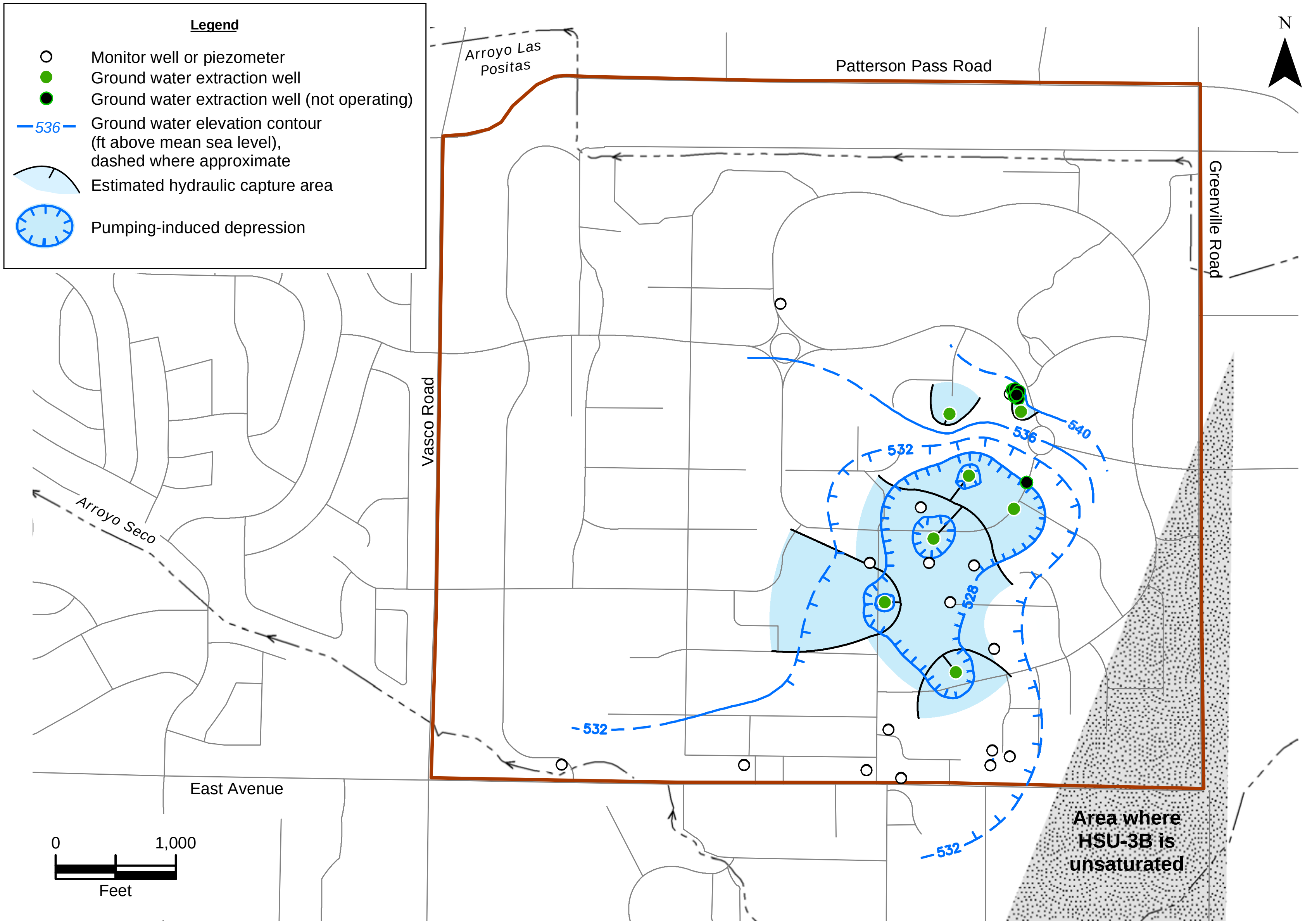

Figure 10. Ground water elevation contour map based on 31 wells completed within HSU-3B showing estimated hydraulic capture areas, LLNL and vicinity, July 2009.

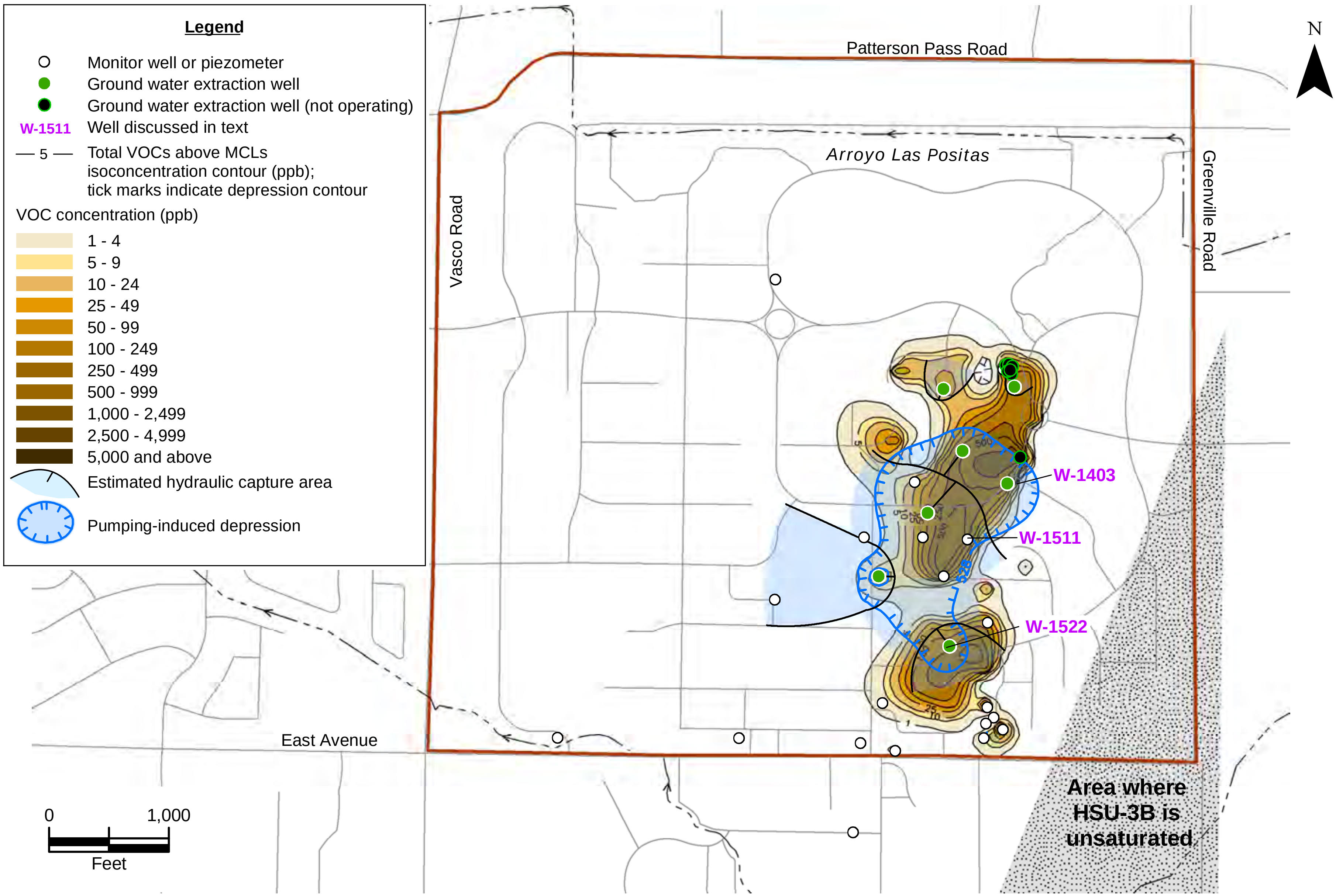

Figure 11. Isoconcentration contour map of total VOCs above MCLs from 35 wells completed within HSU-3B, third quarter 2008 (or the next most recent data), and supplemented with soil chemistry data from 109 borehole locations.

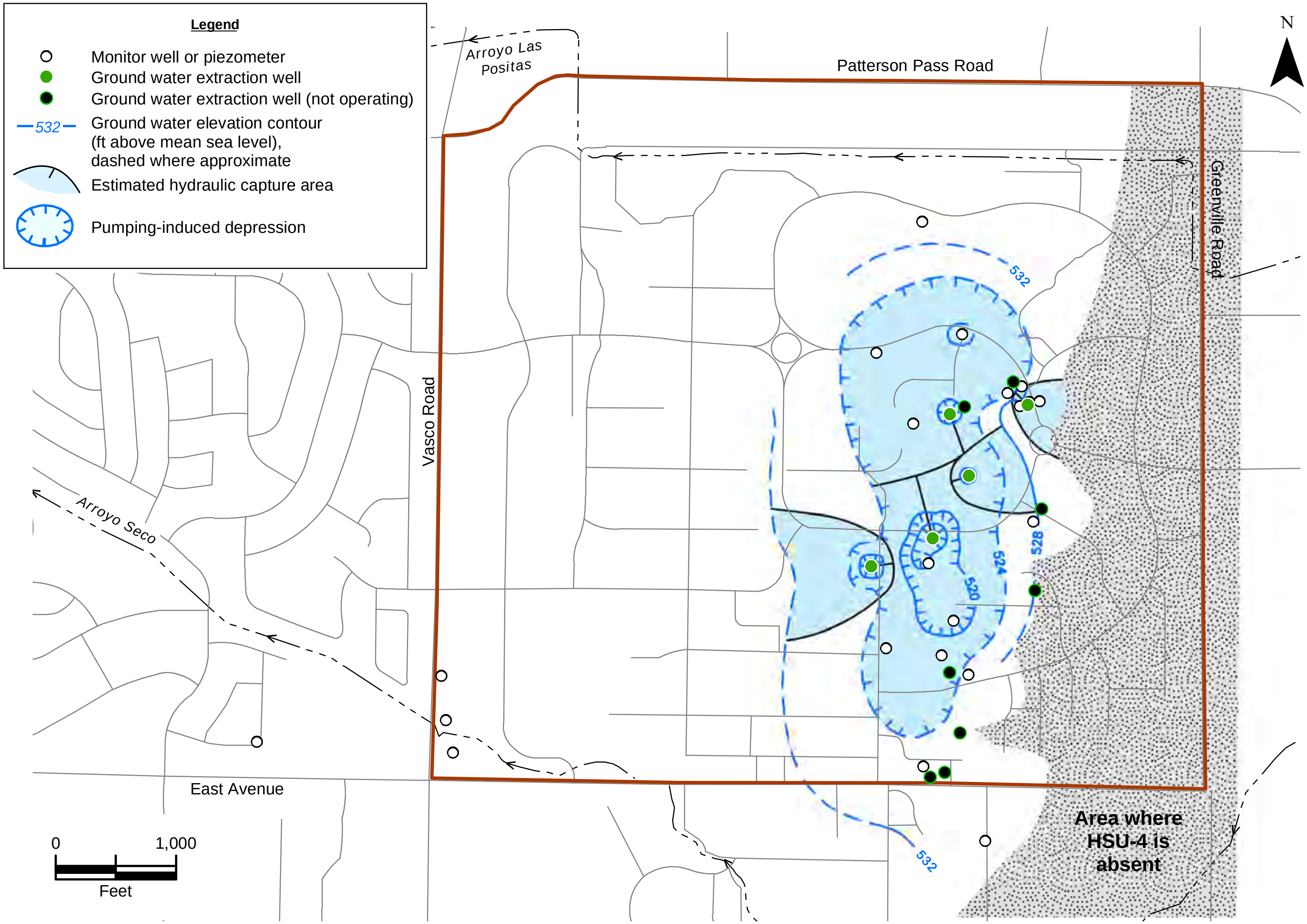

Figure 12. Ground water elevation contour map based on 34 wells completed within HSU-4 showing estimated hydraulic capture areas, LLNL and vicinity, July 2009.

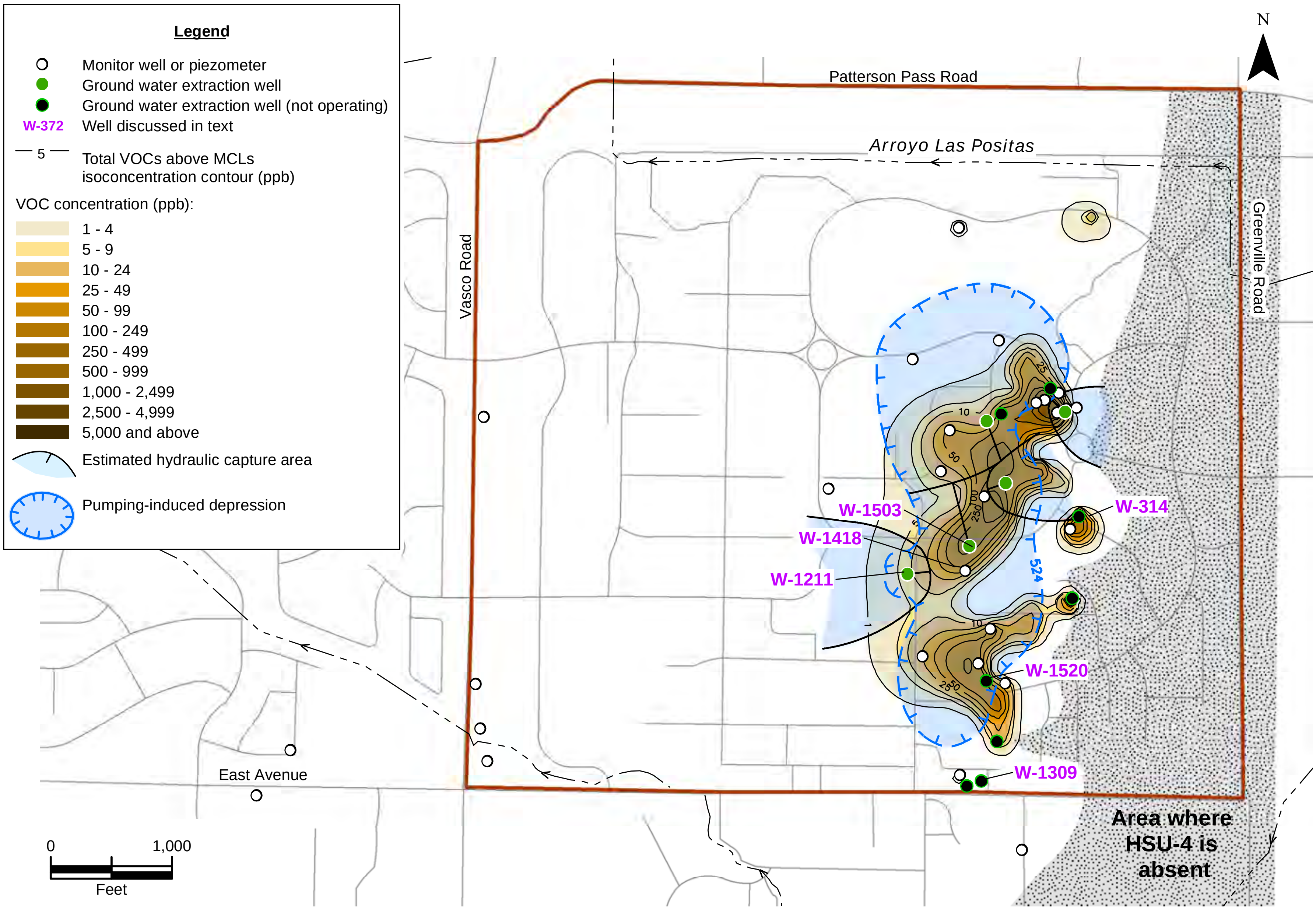

Figure 13. Isoconcentration contour map of total VOCs above MCLs from 41 wells completed within HSU-4, third quarter 2009 (or the next most recent data), and supplemented with soil chemistry data from 57 borehole locations.

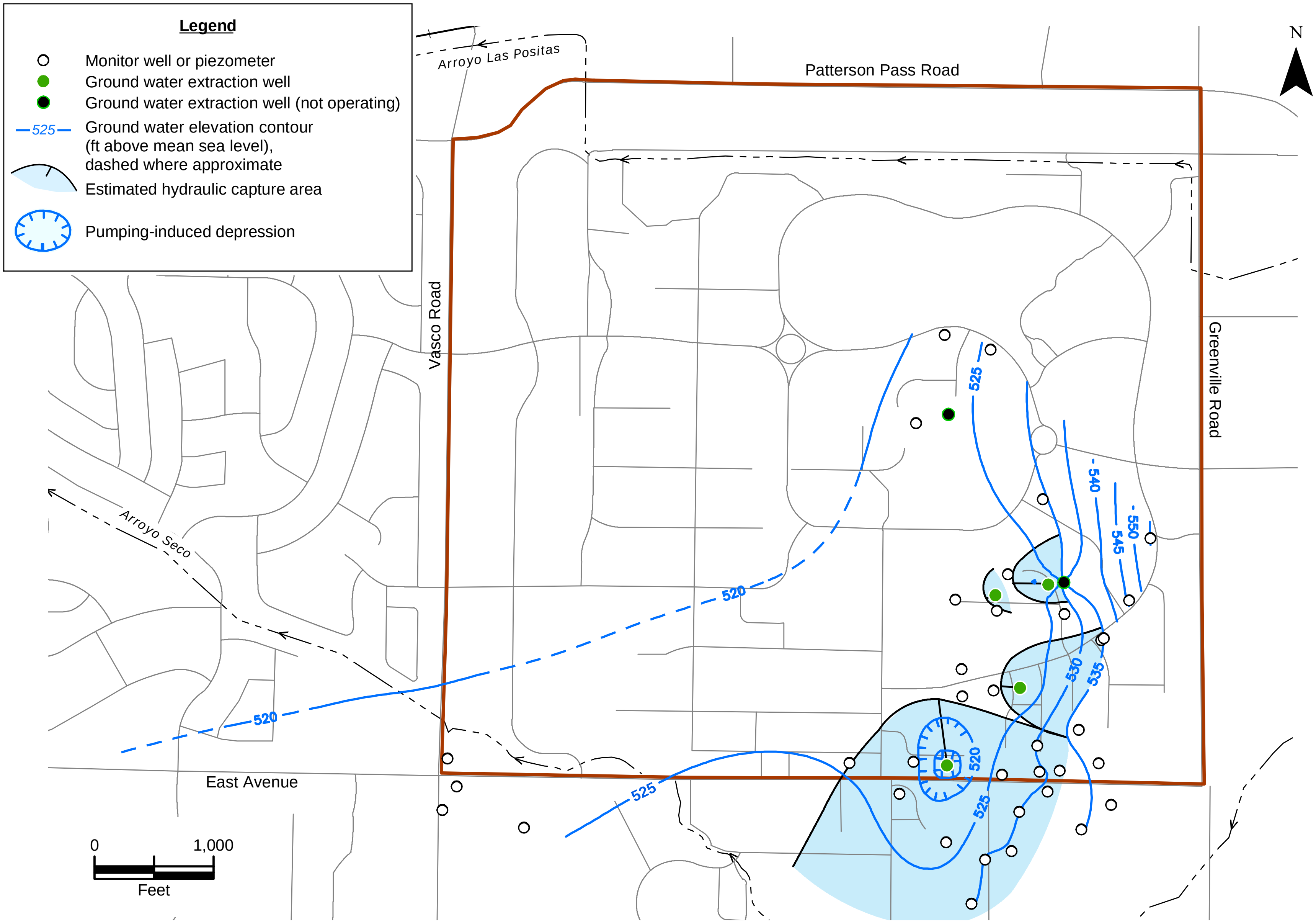

Figure 14. Ground water elevation contour map based on 43 wells completed within HSU-5 showing estimated hydraulic capture areas, LLNL and vicinity, July 2009.

Figure 15. Isoconcentration contour map of total VOCs above MCLs from 56 wells completed within HSU-5, third quarter 2009 (or the next most recent data), and supplemented with soil chemistry data from 95 borehole locations.

Tables

Table 1. Livermore Site treatment facility abbreviations.

Treatment facility	Abbreviation
TFA	TFA
TFA East	TFA-E
TFA West	TFA-W
TFB	TFB
TFC	TFC
TFC East	TFC-E
TFC Southeast	TFC-SE
TFD	TFD
TFD East	TFD-E
TFD Helipad	TFD-HPD
TFD South	TFD-S
TFD Southeast	TFD-SE
TFD Southshore	TFD-SS
TFD West	TFD-W
VTFD East Traffic Circle South	VTFD-ETCS
VTFD Helipad	VTFD-HPD
VTFD Hotspot	VTFD-HS
TFE East	TFE-E
TFE Hotspot	TFE-HS
TFE Northwest	TFE-NW
TFE Southeast	TFE-SE
TFE Southwest	TFE-SW
TFE West	TFE-W
VTFE Eastern Landing Mat	VTFE-ELM
VTFE Hotspot	VTFE-HS
TFG-1	TFG-1
TFG North	TFG-N
TF406	TF406
TF406 Northwest	TF406-NW
VTF406 Hotspot	VTF406-HS
VTF511	VTF511
TF518 North	TF518-N
TF518 Perched Zone	TF518-PZ
VTF518 Perched Zone	VTF518-PZ
TF5475-1	TF5475-1
TF5475-2	TF5475-2
TF5475-3	TF5475-3
VTF5475	VTF5475

Notes:

TF = Ground water treatment facility.

VTF = Soil vapor treatment facility.

Table 2. List of Federal Facility Agreement Treatment Facility Milestone Restart Dates [a].

Treatment Facility [b]	Milestone Restart Date	Actual Restart Date
TFC Southeast	March 31	February 9
TFA	March 31	February 27
TFE Hotspot	March 31	March 10
VTF406 Hotspot	March 31	March 26
TFC East	June 30	April 15
TFD South	June 30	April 28
TFE Southeast	June 30	June 5
VTF511	June 30	June 5
TFD	June 30	June 15
TF406 Northwest	June 30	June 18
TF5475-2	June 30	June 26
TFE East	September 30	August 8
TFG North	September 30	August 11
VTFD ETC South	September 30	August 11
VTFE Eastern Landing Mat	September 30	September 1
VTFE Hotspot	September 30	August 25
VTFD Hotspot	September 30	September 14
TFD Helipad	December 31	September 14
VTFD Helipad	December 31	September 21
TF518 Perched Zone	December 31	September 23
VTF518 Perched Zone	March 31, 2010	September 23

Notes:

[a] Refers only to treatment facilities that were stopped (prior to 2009) and restarted in 2009.

[b] Treatment facilities in each treatment area (refer to Table 1 for abbreviations):

TFA area: TFA, TFA-E, TFA-W
TFB area: TFB
TFC area: TFC, TFC-E, TFC-SE
TFD area: TFD, TFD-E, TFD-HPD, TFD-S, TFD-SE, TFD-SS, TFD-W, VTFD-ETCS, VTFD-HPD, VTFD-HS
TFE area: TFE-E, TFE-HS, TFE-NW, TFE-SE, TFE-SW, TFE-W, VTFE-ELM, VTFE-HS
TFG area: TFG-1, TFG-N
TFH area: TF406, TF406-NW, VTF406-HS, VTF511, TF518-N, TF518-PZ, VTF518-PZ, TF5475-1, TF5475-2, TF5475-3, VTF5475

TFF started operation in February 1993 for fuel hydrocarbon remediation. In August 1995, the regulatory agencies agreed that the vadose zone remediation was complete, and in October 1996 No Further Action status was granted for fuel hydrocarbons in ground water.

Table 3. Types and numbers of Livermore Site wells.

Well type	Number of wells
Anode wells (cathodic protection)[1]	9
Dual Extraction[2]	27
Ground Water Extraction	95
Ground Water Injection	1
Ground Water Monitor[a]	397
Ground Water Guard	20
Instrumented Membrane System	5
Piezometer	111
Soil Vapor Extraction	31
Soil Vapor Injection	1
Soil Vapor Monitor	41
Total	738

Notes:

The number of Livermore Site wells is current through the end of December 2009.

Table 5 lists extraction wells and Table A-1 of Appendix A summarizes construction information for all wells.

[a] **Does not include 35 offsite private or agency wells that are occasionally monitored by ERD.**

[1] **Protect metallic objects in contact with the ground with electrolytic corrosion.**

[2] **Extraction of ground water using a downhole pump with concurrent application of vacuum to the well. Ground water and soil vapor are removed in separate pipe manifolds and treated.**

Table 4. Summary of treatment facility discharge sampling locations.

Treatment facility		Discharge sampling location
TFA	TFA	Arroyo Seco (TFG-ASW) and West Perimeter Drainage Channel (TFB-R002)
	TFA East	Arroyo Seco (TFG-ASW)
	TFA West[a]	Livermore Water Reclamation Plant (TFA-W-E)
TFB	TFB	West Perimeter Drainage Channel (TFB-R002)
TFC	TFC	Arroyo Las Positas (TFC-R003)
	TFC East	Arroyo Las Positas (TFC-R003)
	TFC Southeast	Arroyo Las Positas (TFC-R003)
TFD	TFD	Arroyo Las Positas (TFC-R003)
	TFD East	Arroyo Las Positas (TFC-R003)
	TFD Helipad	Arroyo Las Positas (TFC-R003)
	TFD South	Arroyo Las Positas (TFC-R003)
	TFD Southeast	Arroyo Las Positas (TFC-R003)
	TFD Southshore	Arroyo Las Positas (TFC-R003)
	TFD West	Arroyo Las Positas (TFC-R003)
	VTFD East Traffic Circle South	Treated vapor to atmosphere
	VTFD Helipad	Treated vapor to atmosphere
	VTFD Hotspot	Treated vapor to atmosphere
TFE	TFE East	Arroyo Las Positas (TFC-R003)
	TFE Hotspot	Arroyo Las Positas (TFC-R003)
	TFE Northwest	Arroyo Las Positas (TFC-R003)
	TFE Southeast	Arroyo Las Positas (TFC-R003)
	TFE Southwest	Arroyo Las Positas (TFC-R003)
	TFE West	Arroyo Las Positas (TFC-R003)
	VTFE Eastern Landing Mat	Treated vapor to atmosphere
	VTFE Hotspot	Treated vapor to atmosphere
TFG	TFG-1	Arroyo Seco (TFG-ASW)
	TFG North	Arroyo Las Positas (TFC-R003)
TFH	TF406	Arroyo Las Positas (TFC-R003)
	TF406 Northwest	Arroyo Las Positas (TFC-R003)
	VTF406 Hotspot	Treated vapor to atmosphere
	VTF511	Treated vapor to atmosphere
	TF518 North	Arroyo Las Positas (TFC-R003)
	TF518 Perched Zone	Tankered to TF406 Northwest
	VTF518 Perched Zone	Treated vapor to atmosphere
	TF5475-1	CRD-1 injection (W-1302)
	TF5475-2	Arroyo Las Positas (TFC-R003)
	TF5475-3	CRD-2 injection (W-1610)
	VTF5475	Injection (SVI-ETS-505)

Notes appear on the following page.

Table 4. Summary of treatment facility discharge sampling locations. (Continued)

Notes:

[a] **Ground water from TFA West was shut down on January 14, 2008 per direction of the regulators over concern about using the Livermore Water Reclamation Plant (LWRP) for final treatment.**

Table 5. 2009 Livermore Site performance summary.

Treatment area	HSU	Ground water treatment facility	Extraction well	Volume of ground water treated (kgal)	Estimated VOC mass removed from ground water (kg)	Soil vapor treatment facility	Volume of soil vapor treated (kft^3)	Estimated VOC mass removed from soil vapor (kg)
TFA	1B	TFA	W-262	0	0.00	-	-	-
TFA	1B	TFA	W-408	10,497	0.03	-	-	-
TFA	1B	TFA	W-1001	976	<0.01	-	-	-
TFA	1B	TFA	W-1004	4,611	0.08	-	-	-
TFA	1B/2	TFA	W-415	15,986	1.43	-	-	-
TFA	2	TFA	W-109	12,951	0.12	-	-	-
TFA	2	TFA	W-457	3,561	0.08	-	-	-
TFA	2	TFA	W-518	0	0.00	-	-	-
TFA	2	TFA	W-522	0	0.00	-	-	-
TFA	2	TFA	W-605	3,832	0.38	-	-	-
TFA	2	TFA	W-614	4,312	0.14	-	-	-
TFA	2	TFA	W-714	3,437	0.15	-	-	-
TFA	2	TFA	W-903	0	0.00	-	-	-
TFA	2	TFA	W-904	5,363	0.27	-	-	-
TFA	2	TFA	W-1009	5,774	0.64	-	-	-
TFA	3A	TFA	W-712	3,281	0.21	-	-	-
TFA	1B	TFA East	W-254	604	0.13	-	-	-
TFA	2	TFA West	W-404	4	<0.01	-	-	-
TFB	1B	TFB	W-610	3,259	0.12	-	-	-
TFB	1B	TFB	W-620	1,844	0.10	-	-	-
TFB	1B	TFB	W-704	8,947	1.49	-	-	-
TFB	2	TFB	W-357	2,933	0.58	-	-	-
TFB	2	TFB	W-621	3,608	0.12	-	-	-
TFB	2	TFB	W-655	4,193	0.11	-	-	-
TFB	2	TFB	W-1423	3,153	0.31	-	-	-
TFC	1B	TFC	W-701	5,685	1.15	-	-	-
TFC	1B	TFC	W-1015	2,205	0.09	-	-	-
TFC	1B	TFC	W-1102	748	0.04	-	-	-
TFC	1B	TFC	W-1103	1,590	0.01	-	-	-
TFC	1B	TFC	W-1104	11,669	1.70	-	-	-
TFC	1B	TFC	W-1116	713	0.05	-	-	-
TFC	1B	TFC East	W-368	1,592	0.33	-	-	-
TFC	2	TFC East	W-413	5,286	0.86	-	-	-
TFC	1B	TFC Southeast	W-1213	4,037	0.61	-	-	-
TFC	1B	TFC Southeast	W-2201	5,212	1.02	-	-	-

Table 5. 2009 Livermore Site performance summary. (Continued)

Treatment area	HSU	Ground water treatment facility	Extraction well	Volume of ground water treated (kgal)	Estimated VOC mass removed from ground water (kg)	Soil vapor treatment facility	Volume of soil vapor treated (kft³)	Estimated VOC mass removed from soil vapor (kg)
TFD	2/3A	TFD	W-906	741	0.01	-	-	-
TFD	3A	TFD	W-653	31	0.13	VTFD Hotspot	32	<0.01
TFD	3A	TFD	W-2011	0	0.00	VTFD Hotspot	0	0.00
TFD	3A	TFD	W-2101	76	0.08	VTFD Hotspot	12	<0.00
TFD	3A	TFD	W-2102	0	0.00	VTFD Hotspot	0	0.00
TFD	3A/3B	TFD	W-1208	3,265	1.55	-	-	-
TFD	4	TFD	W-351	267	0.17	-	-	-
TFD	4	TFD	W-1206	1,409	0.14	-	-	-
TFD	5	TFD	W-907-2	2	<0.01	-	-	-
TFD	2	TFD East	W-1303	0	0.00	-	-	-
TFD	2	TFD East	W-1306	111	0.06	-	-	-
TFD	2	TFD East	W-1404	471	0.71	-	-	-
TFD	3A	TFD East	W-1301	508	1.09	-	-	-
TFD	3A	TFD East	W-1550	986	0.75	-	-	-
TFD	3A	TFD East	W-2203	262	0.17	-	-	-
TFD	3B	TFD East	W-2006	1	<0.01	-	-	-
TFD	4	TFD East	W-1253	0	0.00	-	-	-
TFD	4	TFD East	W-1255	0	0.00	-	-	-
TFD	4	TFD East	W-1307	2,832	0.29	-	-	-
TFD	2/3A	TFD Helipad	W-1655	0	0.00	VTFD Helipad	0	0.00
TFD	2/3A/3B	TFD Helipad	W-1651	0	0.00	VTFD Helipad	0	0.00
TFD	3A	TFD Helipad	W-1551	0	0.00	-	-	-
TFD	3A	TFD Helipad	W-1552	0	0.00	VTFD Helipad	0	0.00
TFD	3A	TFD Helipad	W-1650	0	0.00	VTFD Helipad	0	0.00
TFD	3A	TFD Helipad	W-1653	0	0.00	VTFD Helipad	0	0.00
TFD	3A	TFD Helipad	W-1654	0	0.00	VTFD Helipad	0	0.00
TFD	3A	TFD Helipad	W-1656	0	0.00	VTFD Helipad	0	0.00
TFD	3A/3B	TFD Helipad	W-1652	0	0.00	VTFD Helipad	0	0.00
TFD	3A/3B	TFD Helipad	W-1657	0	0.00	VTFD Helipad	0	0.00
TFD	4	TFD Helipad	W-1254	1,884	0.54	-	-	-
TFD	2	TFD South	W-1510	674	0.07	-	-	-
TFD	3A/3B	TFD South	W-1504	2,560	1.07	-	-	-
TFD	4	TFD South	W-1503	5,832	6.00	-	-	-
TFD	2	TFD Southeast	W-1308	1,410	2.01	-	-	-
TFD	2	TFD Southeast	W-1904	0	0.00	VTFD East Traffic Circle South	<1	<0.01
TFD	2	TFD Southeast	SIP-ETC-201	0	0.00	VTFD East Traffic Circle South	<1	<0.01
TFD	3A	TFD Southeast	W-2005	679	0.88	-	-	-
TFD	3B	TFD Southeast	W-1403	1,127	2.69	-	-	-
TFD	4	TFD Southeast	W-314	0	0.00	-	-	-

Table 5. 2009 Livermore Site performance summary. (Continued)

Treatment area	HSU	Ground water treatment facility	Extraction well	Volume of ground water treated (kgal)	Estimated VOC mass removed from ground water (kg)	Soil vapor treatment facility	Volume of soil vapor treated (kft³)	Estimated VOC mass removed from soil vapor (kg)
TFD	2	TFD Southshore	W-1602	2,504	0.32	-	-	-
TFD	3A	TFD Southshore	W-1603	<1	<0.01	-	-	-
TFD	3B	TFD Southshore	W-1601	626	1.03	-	-	-
TFD	4	TFD Southshore	W-1523	3,837	3.16	-	-	-
TFD	2	TFD West	W-1215	<1	<0.01	-	-	-
TFD	2	TFD West	W-1216	2,282	0.59	-	-	-
TFD	3A	TFD West	W-1902	3,219	1.36	-	-	-
TFD	1B	-	W-ETC-2003	-	-	VTFD East Traffic Circle South	3,340	0.67
TFD	1B/2	-	W-ETC-2004A	-	-	VTFD East Traffic Circle South	1,243	0.31
TFD	2	-	W-ETC-2004B	-	-	VTFD East Traffic Circle South	1,249	1.15
TFD	1B	-	W-HPA-002A	-	-	VTFD Helipad	2,432	0.17
TFD	2	-	W-HPA-002B	-	-	VTFD Helipad	0	0.00
TFD	3A	TFD Helipad	W-1552	0	0.00	VTFD Helipad	0	0.00
TFE	2	TFE East	W-1109	383	0.61	-	-	-
TFE	2	TFE East	W-1903	0	0.00	VTFE Eastern Landing Mat	0	0.00
TFE	2	TFE East	W-1909	0	0.00	VTFE Eastern Landing Mat	0	0.00
TFE	2	TFE East	W-2305	3	0.03	VTFE Eastern Landing Mat	0	0.00
TFE	2/3A	TFE East	W-2305	3	0.03	VTFE Eastern Landing Mat	0	0.00
TFE	5	TFE East	W-566	1,277	0.30	-	-	-
TFE	2	TFE Hotspot	W-2105	16	0.01	VTFE Hotspot	0	0.00
TFE	3A	TFE Hotspot	W-2012	979	0.99	-	-	-
TFE	2	TFE Northwest	W-1409	0	0.00	-	-	-
TFE	4	TFE Northwest	W-1211	8,931	0.59	-	-	-
TFE	5	TFE Southeast	W-359	2,601	1.13	-	-	-
TFE	2	TFE Southwest	W-1518	287	0.02	-	-	-
TFE	3B	TFE Southwest	W-1522	599	0.50	-	-	-
TFE	4	TFE Southwest	W-1520	<1	<0.01	-	-	-
TFE	2	TFE West	W-305	4,508	1.36	-	-	-
TFE	3B	TFE West	W-292	3,053	0.33	-	-	-
TFE	1B	-	W-543-1908	-	-	VTFE Eastern Landing Mat	0	0.00
TFE	2	-	W-543-001	-	-	VTFE Eastern Landing Mat	0	0.00
TFE	2	-	W-543-003	-	-	VTFE Eastern Landing Mat	2,765	0.74
TFE	1B	-	W-ETS-2008A	-	-	VTFE Hotspot	1,963	0.11
TFE	1B/2	-	W-ETS-2010A	-	-	VTFE Hotspot	1,907	0.12
TFE	2	-	W-ETS-2008B	-	-	VTFE Hotspot	1,644	1.08
TFE	2	-	W-ETS-2009	-	-	VTFE Hotspot	32	<0.01
TFE	2	-	W-ETS-2010B	-	-	VTFE Hotspot	25	<0.01
TFG	1B	TFG North	W-1806	448	0.04	-	-	-
TFG	2	TFG North	W-1807	826	0.09	-	-	-

Table 5. 2009 Livermore Site performance summary. (Continued)

Treatment area	HSU	Ground water treatment facility	Extraction well	Volume of ground water treated (kgal)	Estimated VOC mass removed from ground water (kg)	Soil vapor treatment facility	Volume of soil vapor treated (kft³)	Estimated VOC mass removed from soil vapor (kg)
TFH	1B/2	TFG-1	W-1111	4,425	0.33	-	-	-
TFH	4	TF406	W-1309	<1	<0.01	-	-	-
TFH	4	TF406	GSW-445	<1	<0.01	-	-	-
TFH	5	TF406	W-1310	8,056	0.29	-	-	-
TFH	3A	TF406 Northwest	W-1801	1,287	0.20	-	-	-
TFH	4	TF518 North	W-1410	0	0.00	-	-	-
TFH	1B	TF518 Perched Zone	W-518-1914	0	0.00	VTF518 Perched Zone	0	0.00
TFH	1B/2	TF518 Perched Zone	W-1615	<1	<0.01	VTF518 Perched Zone	526	4.19
TFH	2	TF518 Perched Zone	W-518-1913	0	0.00	VTF518 Perched Zone	0	0.00
TFH	2	TF518 Perched Zone	W-518-1915	<0	<0.01	VTF518 Perched Zone	64	1.58
TFH	2	TF518 Perched Zone	SVB-518-201	0	0.00	VTF518 Perched Zone	0	0.00
TFH	2	TF518 Perched Zone	SVB-518-204	0	0.00	VTF518 Perched Zone	0	0.00
TFH	3A	TF5475-1	W-1302-2	0	0.00	-	-	-
TFH	2	TF5475-2	W-1415	0	0.00	-	-	-
TFH	5	TF5475-2	W-1108	1,213	2.21	-	-	-
TFH	3A	TF5475-3	W-1605	0	0.00	-	-	-
TFH	3A	TF5475-3	W-1608	0	0.00	-	-	-
TFH	4	TF5475-3	W-1604	0	0.00	-	-	-
TFH	5	TF5475-3	W-1609	0	0.00	-	-	-
TFH	1B/2	-	W-514-2007A	-	-	VTF406 Hotspot	2,161	0.60
TFH	2/5	-	W-514-2007B	-	-	VTF406 Hotspot	4,320	2.71
TFH	5	-	W-217	-	-	VTF406 Hotspot	9,148	10.21
TFH	1B	-	W-2207A	-	-	VTF511	62	0.01
TFH	2	-	W-274	-	-	VTF511	0	0.00
TFH	2	-	W-1517	-	-	VTF511	0	0.00
TFH	2	-	W-2204	-	-	VTF511	0	0.00
TFH	2	-	W-2206	-	-	VTF511	0	0.00
TFH	2	-	W-2207B	-	-	VTF511	1,146	1.09
TFH	2	-	W-2208A	-	-	VTF511	63	0.10
TFH	2	-	W-2208B	-	-	VTF511	1,147	14.51
TFH	2	-	W-2205	-	-	VTF511	0	0.00
TFH	1B/2	-	W-ETS-507	-	-	VTF5475	0	0.00
TFH	2	-	W-2211	-	-	VTF5475	0	0.00
TFH	2	-	W-2302	-	-	VTF5475	0	0.00
TFH	2	-	W-2303	-	-	VTF5475	0	0.00
TFH	2	-	SVI-ETS-504	-	-	VTF5475	0	0.00
TFH	3A	-	W-1605	-	-	VTF5475	0	0.00
TFH	3A	-	W-1608	-	-	VTF5475	0	0.00
TFH	3A	-	W-2212	-	-	VTF5475	0	0.00

Notes appear on the following page.

Table 5. 2008 Livermore Site performance summary. (Continued)

Notes:

- = Not applicable.
HSU = Hydrostratigraphic Unit.
kg = Kilogram.
kgal = Thousands at gallons.
kft^3 = Thousands of cubic feet.
VOC = Volatile Organic Compound.

Appendix A

Well Construction and Closure Data

Table A-1. Well construction data, LLNL Livermore Site and vicinity, Livermore, California.

Well	Well type	Date Completed	Borehole depth (ft)	Casing depth (ft)	Screen position	Screen interval (ft)	HSU	Initial flow rate (gpm)
W-001	GW Monitor	21-Oct-80	122.5	116	1	95-100	1B	6
					2	104-114	2	6
W-001A	GW Monitor	12-Apr-84	180	156	1	145-156	2	5.3
W-002	GW Monitor	29-Aug-80	102.5	101	1	86-101	1B	2.8
W-002A	GW Monitor	2-Apr-84	185	164	1	150-164	2	9.3
W-004	GW Monitor	28-Jul-80	92	92	1	75-90	1B	7
W-005	GW Monitor	24-Oct-80	93.5	90	1	56-71	1B	7
					2	81-86	1B	7
W-005A	GW Monitor	9-Apr-84	115	105	1	95-105	2	11.5
W-007	GW Monitor	3-Oct-80	110.5	100	1	76-81	2	1.5
					2	88-98	3A	1.5
W-008	GW Monitor	14-May-81	110	105	1	72-77	3A	7
					2	92-102	3B	7
W-011	GW Monitor	3-Jun-81	252	191	1	136-141	5	8.5
					2	177-187	5	8.5
W-012	GW Monitor	14-Aug-80	115.8	115	1	99-114	2	5
W-016	GW Monitor	30-Oct-80	122.7	119	1	NA	NA	NA
W-017	GW Monitor	8-Oct-80	114	109	1	94-109	5	0.4
W-017A	GW Monitor	20-May-81	181.4	160	1	127-132	7	5.5
					2	147-157	7	5.5
W-101	GW Monitor	25-Jan-85	77	72	1	62-72	1B	2
W-102	GW Monitor	14-Feb-85	396.5	171.5	1	151.5-171.5	2	6.6
W-103	GW Monitor	14-Feb-85	96	89.5	1	79.5-89.5	1B	6.2
W-104	GW Monitor	21-Feb-85	61.5	56.5	1	38.75-56.5	1B	3.1
W-105	GW Monitor	26-Feb-85	69	62	1	42-62	1B	1
W-106	GW Monitor	6-Mar-85	144	134.5	1	127.5-134.5	5	0.3
W-107	GW Monitor	13-Mar-85	128	122	1	115-122	5	2.5
W-108	GW Monitor	21-Mar-85	113.5	69	1	57-69	1A	13
W-109	GW Extraction	2-Apr-85	289	147	1	137-147	2	13
W-110	GW Monitor	26-Apr-85	371	365	1	340-365	5	16
W-111	GW Monitor	2-May-85	122	117	1	97-117	2	3.4
W-112	GW Monitor	10-May-85	129	123.5	1	111-123.5	5	3.5
W-113	GW Monitor	16-May-85	124	115	1	100-115	5	0.4
W-114	GW Monitor	23-May-85	70.5	66	1	51-63	1B	0.5
W-115	GW Monitor	3-Jun-85	106	95	1	88-95	1B	5.4

Table A-1. Well construction data, LLNL Livermore Site and vicinity, Livermore, California.

Well	Well type	Date Completed	Borehole depth (ft)	Casing depth (ft)	Screen position	Screen interval (ft)	HSU	Initial flow rate (gpm)
W-116	GW Monitor	14-Jun-85	181	92.6	1	86-91	1B	0.3
W-117	GW Monitor	27-Jun-85	202	150.1	1	138-148	7	6
W-118	GW Monitor	19-Jul-85	206.5	110	1	99-110	2	10
W-119	GW Monitor	2-Aug-85	139	102.5	1	87.5-102.5	2	9
W-120	GW Monitor	19-Aug-85	195	153	1	147-153	2	3.5
W-121	GW Monitor	23-Aug-85	194	171	1	159-171	2	6
W-122	GW Monitor	17-Aug-85	189	132	1	125-132	2	13.4
W-123	GW Monitor	1-Oct-85	174	47.7	1	37.3-47.7	1A	6
W-141	GW Monitor	23-Mar-85	61.5	60	1	45-60	1B	0.5
W-142	GW Monitor	29-Mar-85	74.2	72	1	62-72	2	0.5
W-143	GW Monitor	12-Apr-85	130	126	1	121-126	2	6
W-146	GW Monitor	16-Jul-85	225	125	1	115-125	2	9.4
W-147	GW Monitor	26-Jul-85	137	87	1	77-87	1B	0.5
W-148	GW Monitor	8-Aug-85	152	98	1	83-98	1B	0.5
W-151	GW Monitor	30-Sep-85	247	158	1	148.5-157.5	2	8
W-201	GW Monitor	17-Oct-85	211	161	1	151-161	2	14
W-202	GW Monitor	7-Nov-85	191	109	1	99-109	2	0.4
W-203	GW Monitor	15-Nov-85	87	41	1	31-41	1A	5
W-204	GW Monitor	22-Nov-85	160	110	1	100-110	2	2.5
W-205	GW Monitor	9-Dec-85	180	117	1	107-117	3B	0.3
W-206	GW Monitor	19-Dec-85	188	118	1	106-118	3A	NA
W-207	GW Monitor	24-Jan-86	150	85	1	69-85	2	0.4
W-210	GW Monitor	11-Mar-86	176	113	1	108-113	3B	0.3
W-212	GW Monitor	28-Mar-86	183	136	1	124-136	5	1.3
W-213	GW Monitor	4-Apr-86	174	100	1	94-100	1B	4
W-214	GW Monitor	11-Apr-86	146	141.5	1	134-141.5	2	18
W-217	SV Extraction	20-May-86	200	112.5	1	98.5-112.5	5	0.3
W-218	GW Monitor	30-May-86	201	71	1	64.5-71	1B	10
W-219	GW Monitor	13-Jun-86	214	148	1	141-148	5	4.5
W-220	GW Monitor	25-Jun-86	196	92.5	1	82.5-92.5	2	0.4
W-221	GW Monitor	7-Jul-86	178	95	1	82-95	3A	2
W-222	GW Monitor	17-Jul-86	197	83	1	63-83	2	15
W-223	GW Monitor	15-Aug-86	202	153	1	146-153	2	4.2
W-224	GW Monitor	26-Aug-86	199	88	1	78-88	2	8.1
W-225	GW Monitor	9-Sep-86	238	166	1	152-166	5	4.2

Table A-1. Well construction data, LLNL Livermore Site and vicinity, Livermore, California.

Well	Well type	Date Completed	Borehole depth (ft)	Casing depth (ft)	Screen position	Screen interval (ft)	HSU	Initial flow rate (gpm)
W-226	GW Monitor	25-Sep-86	173	86	1	71-86	1B	0.5
W-251	GW Monitor	3-Oct-85	50	47.5	1	35.5-47.5	1A	7.9
W-252	GW Monitor	18-Oct-85	197	126	1	108-126	2	6
W-253	GW Monitor	30-Oct-85	180	128	1	112.5-128	2	2.3
W-254	GW Extraction	21-Nov-85	277	89	1	82-89	1B	2
W-255	GW Monitor	5-Dec-85	187	124	1	115-124	5	10
W-256	GW Monitor	19-Dec-85	187	137	1	132-137	5	6
W-257	GW Monitor	15-Jan-86	197	96.5	1	82.5-96.5	2	0.5
W-258	GW Monitor	31-Jan-86	157	121.5	1	116.5-121.5	3A	NA
W-259	GW Monitor	7-Feb-86	200	99	1	93.5-99	2	0.3
W-260	GW Monitor	27-Feb-86	215	151	1	141-151	2	5.1
W-261	GW Monitor	12-Mar-86	225	118.5	1	109-118.5	5	0.5
W-262	GW Extraction	20-Mar-86	256	100	1	91-100	1B	12
W-263	GW Monitor	7-Apr-86	146	130	1	123-130	2	3
W-264	GW Monitor	14-Apr-86	170	151	1	141-151	2	15
W-265	GW Monitor	25-Apr-86	216	211	1	205-211	3B	2.5
W-267	GW Monitor	27-May-86	196	179	1	172.5-179	3A	3.3
W-268	GW Monitor	4-Jun-86	213	150.5	1	138-150.5	5	6
W-269	GW Monitor	16-Jun-86	185	92	1	79-92	1B	6.8
W-270	GW Monitor	26-Jun-86	185	127	1	113-127	5	0.3
W-271	GW Monitor	7-Jul-86	201	112	1	105-112	2	7.2
W-272	GW Monitor	18-Jul-86	226	110	1	95-110	2	1.3
W-273	GW Monitor	11-Aug-86	203	84	1	64-84	2	3.4
W-274	Dual Extraction	21-Aug-86	217	95	1	90-95	2	NA
W-275	GW Monitor	5-Sep-86	262	184	1	179-184	5	5.9
W-276	GW Monitor	17-Sep-86	267	170	1	153.5-169.5	3A	12
W-277	GW Monitor	3-Oct-86	254	169	1	163-169	3B	6
W-290	GW Monitor	8-Jul-86	181	126	1	119.5-126	5	0.3
W-291	GW Monitor	24-Jul-86	194	137	1	127-137	5	0.3
W-292	GW Extraction	10-Aug-86	250	184.5	1	176-184.5	3B	NA
W-293	GW Monitor	27-Aug-86	229	155	1	145-155	5	5
W-294	GW Monitor	15-Sep-86	251	139	1	122-139	5	6
W-301	GW Monitor	7-Oct-86	203	141	1	136-141	2	10
W-302	GW Monitor	22-Oct-86	191	83.5	1	78-83.5	1B	2
W-303	GW Monitor	28-Oct-86	197	128	1	124-128	2	24

Table A-1. Well construction data, LLNL Livermore Site and vicinity, Livermore, California.

Well	Well type	Date Completed	Borehole depth (ft)	Casing depth (ft)	Screen position	Screen interval (ft)	HSU	Initial flow rate (gpm)
W-304	GW Monitor	12-Nov-86	207	200	1	195-200	4	0.7
W-305	GW Extraction	18-Nov-86	146	138	1	128-138	2	16.2
W-306	GW Monitor	4-Dec-86	207	110	1	98-110	2	8.3
W-307	GW Monitor	15-Dec-86	214	102	1	93-102	1B	1.4
W-308	GW Monitor	13-Jan-87	194	113	1	107-113	2	2.4
W-310	GW Monitor	4-Feb-87	202	184.5	1	176.5-184.5	3A	20
W-311	GW Monitor	20-Feb-87	226.5	147.5	1	134.5-147.5	3A	NA
W-312	GW Monitor	5-Mar-87	224.5	168	1	160-168	4	16.7
W-313	GW Monitor	12-Mar-87	99	85	1	80-85	2	7.8
W-314	GW Extraction	20-Mar-87	228	142	1	129-142	4	19
W-315	GW Monitor	3-Apr-87	215	156	1	141-156	3A	15
W-316	GW Monitor	15-Apr-87	196	72	1	68-71	2	7
W-317	GW Monitor	20-Apr-87	100	95	1	88-95	2	14
W-318	GW Monitor	28-Apr-87	200	81	1	74-81	2	6
W-319	GW Monitor	5-May-87	198	125	1	119-125	3A	15
W-320	GW Monitor	11-May-87	106	99	1	94-99	2	5
W-321	GW Monitor	29-May-87	356	321.5	1	305-321.5	5	17
W-322	GW Monitor	1-Jul-87	565.5	152	1	142-152	2	8
W-323	GW Monitor	4-Aug-87	200	127	1	122-127	2	5.6
W-324	GW Monitor	17-Aug-87	219	189	1	184-189	3A	15
W-325	GW Monitor	28-Aug-87	312	170	1	158-170	3A	10
W-351	GW Extraction	17-Oct-86	191	152	1	146-152	4	6.5
W-353	GW Monitor	12-Nov-86	205	101	1	95.5-101	2	2.4
W-354	GW Monitor	24-Nov-86	185	179	1	163-179	4/5	17.6
W-355	GW Monitor	5-Dec-86	202	107	1	102-107	2	1.7
W-356	GW Monitor	18-Dec-86	237	137	1	133-137	3B	5
W-357	GW Extraction	12-Jan-87	197	123	1	107-123	2	13.6
W-359	GW Extraction	10-Feb-87	195	150.5	1	138-150.5	5	5
W-361	GW Monitor	5-Mar-87	257	135	1	125-135	3A	6
W-362	GW Monitor	13-Mar-87	151	145	1	131-145	4	15
W-363	GW Monitor	24-Mar-87	195	129	1	117-129	3A	6
W-364	GW Monitor	31-Mar-87	195	165	1	155-165	3B	6.5
W-365	GW Monitor	9-Apr-87	187	125	1	120-125	2	10
W-366	GW Monitor	20-Apr-87	273	251	1	240-251	4	17.6

Table A-1. Well construction data, LLNL Livermore Site and vicinity, Livermore, California.

Well	Well type	Date Completed	Borehole depth (ft)	Casing depth (ft)	Screen position	Screen interval (ft)	HSU	Initial flow rate (gpm)
W-368	GW Extraction	6-May-87	206	78	1	70-78	1B	3.5
W-369	GW Monitor	14-May-87	204	113	1	107-113	2	7
W-370	GW Monitor	29-May-87	286	208	1	196.5-208	4	10
W-371	GW Monitor	12-Jun-87	233	162	1	155-162	3A	5
W-372	GW Monitor	25-Jun-87	218	152.5	1	147.5-152.5	4	7.5
W-373	GW Monitor	6-Jul-87	178	99	1	89-99	1B	9
W-375	GW Monitor	29-Jul-87	223	71	1	65-71	2	0.4
W-376	GW Monitor	27-Aug-87	249	172	1	162-172	2	4
W-377	GW Monitor	4-Sep-87	159	144	1	141.5-144	2	0.5
W-378	GW Monitor	9-Sep-87	155	150	1	146-150	2	0.5
W-379	GW Monitor	14-Sep-87	155	150	1	146-150	2	0.5
W-380	GW Monitor	1-Oct-87	195	182	1	170-182	3A	9.1
W-401	GW Monitor	5-Nov-87	159	153	1	109-153	2	18
W-402	GW Monitor	13-Oct-87	104	102	1	92-102	1B	20
W-403	GW Monitor	16-Nov-87	585	495	1	485-495	7	15
W-404	GW Extraction	4-Dec-87	245	158	1	150-158	2	20
W-405	GW Monitor	4-Jan-88	244	162	1	132-162	2	20
W-406	GW Monitor	20-Jan-88	213	94	1	79-84	1B	5
W-407	GW Monitor	4-Feb-88	215	205	1	192-205	3A	10
W-408	GW Extraction	16-Feb-88	131	122.5	1	101-122.5	1B	20
W-409	GW Monitor	7-Mar-88	272	78	1	71-78	1B	20
W-410	GW Monitor	30-Mar-88	369	205	1	193-205	3A	16
W-411	GW Monitor	12-Apr-88	192	138	1	131-138	2	20
W-412	GW Monitor	18-Apr-88	104	74	1	67-74	1B	4
W-413	GW Extraction	28-Apr-88	163	115	1	100-115	2	12
W-415	GW Extraction	12-Aug-88	205	183.7	1	79-179	1B/2	50
W-416	GW Monitor	10-Jun-88	152	80.5	1	72-80.5	1B	20
W-417	GW Monitor	20-Jun-88	152	60	1	51-60	1B	5
W-418	GW Monitor	24-Jun-88	124	124	1	108-118	2	0.5
W-419	GW Monitor	29-Jun-88	82	82	1	62.5-75.5	1B	0.5
W-420	GW Monitor	26-Jul-88	127	111	1	105-111	2	4
W-421	GW Monitor	23-Aug-88	181	90	1	75-90	1B	5
W-422	GW Monitor	2-Sep-88	203	139.5	1	133-139.5	2	9
W-423	GW Monitor	9-Sep-88	308	118	1	106-118	2	19
W-424	GW Monitor	4-Oct-88	208	144	1	137-144	3A	6

Table A-1. Well construction data, LLNL Livermore Site and vicinity, Livermore, California.

Well	Well type	Date Completed	Borehole depth (ft)	Casing depth (ft)	Screen position	Screen interval (ft)	HSU	Initial flow rate (gpm)
W-441	GW Monitor	14-Oct-87	250	144	1	135-144	5	3
W-446	GW Monitor	18-Dec-87	202	196	1	186-196	3A	0.5
W-447	GW Monitor	05-Feb-88	353	274	1	256-274	4	8
W-448	GW Monitor	17-Feb-88	235	127.5	1	120.5-127.5	2	20
W-449	GW Monitor	7-Mar-88	172	165	1	152-165	2	6
W-450	GW Monitor	21-Mar-88	300	200	1	193-200	5	6
W-451	GW Monitor	6-Apr-88	202	112	1	106-112	2	3
W-452	GW Monitor	15-Apr-88	210	79.5	1	64-79.5	1B	7
W-453	GW Monitor	27-Apr-88	185	130	1	121-130	2	8
W-454	GW Monitor	9-May-88	196	83	1	73-83	1B	3
W-455	GW Monitor	19-May-88	184	162.5	1	148-162.5	2	5
W-457	GW Extraction	22-Jun-88	289	149.5	1	130-149.5	2	20
W-458	GW Monitor	30-Jun-88	212.5	116	1	108-116	2	2
W-459	GW Monitor	20-Jul-88	76	73	1	59.5-73	1B	0.5
W-461	GW Monitor	16-Aug-88	133	50.5	1	41.5-50.5	2	0.5
W-462	GW Monitor	12-Sep-88	385	337	1	331-336.5	5	10
W-463	GW Monitor	16-Sep-88	93	92.8	1	87-92.5	1B	20
W-464	GW Monitor	30-Sep-88	253	104.5	1	96-104.5	2	7
W-481	GW Monitor	4-Nov-87	224.5	105	1	100-105	1B	2
W-482	GW Monitor	15-Jan-88	218	170	1	165-170	2	0.5
W-483	GW Monitor	26-Jan-88	140	130	1	115-130	2	0.5
W-484	GW Monitor	11-Feb-88	255	188	1	185-188	3A	0.5
W-485	GW Monitor	25-Feb-88	249	157	1	151-157	2	0.5
W-486	GW Monitor	11-Mar-88	167	110	1	100-108	2	6
W-487	GW Monitor	17-Mar-88	180	151	1	148-151	3B	5
W-501	GW Monitor	13-Oct-88	174	92	1	84-92	1B	6
W-502	GW Monitor	25-Oct-88	158	59	1	55-59	1B	0.5
W-503	GW Monitor	2-Nov-88	187	80	1	74-80	1B	2
W-504	GW Monitor	21-Nov-88	358	167	1	157-167	2	8
W-505	GW Monitor	15-Dec-88	278	180	1	167-180	2/3A	18
W-506	GW Monitor	22-Dec-88	120	115	1	101-115	1B	9
W-507	GW Monitor	18-Jan-89	158	139	1	129-139	2	15
W-508	GW Monitor	17-Feb-89	316	306	1	287-305	7	18
W-509	GW Monitor	3-Mar-89	305	184	1	179-184	5	2
W-510	GW Monitor	15-Mar-89	300	119.1	1	111-119	2	0.5

Table A-1. Well construction data, LLNL Livermore Site and vicinity, Livermore, California.

Well	Well type	Date Completed	Borehole depth (ft)	Casing depth (ft)	Screen position	Screen interval (ft)	HSU	Initial flow rate (gpm)
W-511	GW Monitor	31-Mar-89	316	176	1	167-176	3B	2
W-512	GW Monitor	13-Apr-89	261	176.5	1	166-176	5	2.5
W-513	GW Monitor	26-Apr-89	259	115	1	102-115	2	1
W-514	GW Monitor	17-May-89	386	115.5	1	92-115.5	1B	2
W-515	GW Monitor	30-May-89	211	78	1	68-78	1B	3
W-516	GW Monitor	9-Jun-89	203	119	1	114-119	2	10
W-517	GW Monitor	20-Jun-89	215	88.2	1	80-88	1B	8
W-518	GW Extraction	8-Aug-89	251	139.3	1	131-139	2	6.7
W-519	GW Monitor	14-Aug-89	186.5	80.6	1	60-80.5	1B	20
W-520	GW Extraction	30-Aug-89	160	101.5	1	94-101.5	1B	10
W-521	GW Monitor	13-Sep-89	166	95.4	1	86-95	1B	1.5
W-522	GW Extraction	5-Oct-89	145.5	141.5	1	134-141.5	2	16
W-551	GW Monitor	18-Oct-88	308	155.5	1	151-155.5	2	9
W-552	GW Monitor	25-Oct-88	70.5	64.5	1	48.5-64	1B	15
W-553	GW Monitor	3-Nov-88	186	106.5	1	99-106.5	2	2
W-554	GW Monitor	22-Nov-88	239	141.5	1	126.5-141.4	2	15
W-555	GW Monitor	5-Dec-88	122	116.5	1	102.5-116.5	1B	14.5
W-556	GW Monitor	15-Dec-88	192	81.5	1	76-81.5	1B	15
W-557	GW Monitor	22-Dec-88	122.5	118	1	102-118	2	10
W-558	GW Monitor	17-Jan-89	117	110.5	1	101-110.5	1B	20.5
W-559	GW Monitor	24-Jan-89	105	100	1	93-100	1B	1.2
W-560	GW Monitor	7-Feb-89	263	206.5	1	201-206.5	3B	5
W-561	GW Monitor	23-Feb-89	180	152	1	143-152	5	1
W-562	GW Monitor	8-Mar-89	263	158.5	1	145-158	5	1.5
W-563	GW Monitor	17-Mar-89	192	105.5	1	95-105	2	8
W-564	GW Monitor	30-Mar-89	184	85	1	79.5-85	1B	3.5
W-565	GW Monitor	6-Apr-89	177	82.5	1	75-82.5	1B	15
W-566	GW Extraction	19-Apr-89	317	207.5	1	197-207	5	15
W-567	GW Monitor	27-Apr-89	194	61.5	1	51-61	1B	10.5
W-568	GW Monitor	5-Jun-89	156	101	1	97-101	2	10
W-569	GW Monitor	16-May-89	215	109.5	1	101-109.5	2	3
W-570	GW Monitor	9-Jun-89	180	175	1	161-175	5	2
W-571	GW Monitor	15-Jun-89	223.5	107.5	1	102-107	1B	20
W-592	GW Monitor	12-Dec-88	136.5	113	1	101-112	2	1.2
W-593	GW Monitor	6-Feb-89	159	92.5	1	82-92.5	3A	2.1

Table A-1. Well construction data, LLNL Livermore Site and vicinity, Livermore, California.

Well	Well type	Date Completed	Borehole depth (ft)	Casing depth (ft)	Screen position	Screen interval (ft)	HSU	Initial flow rate (gpm)
W-594	GW Monitor	27-Feb-89	156	61	1	55-61	2	0.5
W-601	GW Extraction	13-Oct-89	146	96	1	88-96	1B	12
W-602	GW Extraction	6-Nov-89	268	100.2	1	90-100	1B	11
W-603	GW Extraction	15-Nov-89	150	147	1	141-147	2	6
W-604	GW Monitor	27-Nov-89	111	83	1	76-82	1B	0.4
W-605	GW Extraction	8-Dec-89	246	136	1	130-136	2	5
W-606	GW Monitor	21-Dec-89	145	89	1	73-89	1B	0.4
W-607	GW Monitor	24-Jan-90	186	55.1	1	49-55	1B	2
W-608	GW Monitor	7-Feb-90	162	66.3	1	55-66	1B	2
W-609	GW Extraction	21-Feb-90	120	112	1	104-112	2	3
W-610	GW Extraction	16-Mar-90	453	84.5	1	69-84.5	1B	5
W-611	GW Monitor	4-Apr-90	161	98	1	87.5-98	1B	3
W-612	GW Monitor	19-Apr-90	222	137	1	126-136	2	10
W-613	GW Monitor	2-May-90	93	88	1	81.5-88	1B	4.5
W-614	GW Extraction	18-May-90	262	123	1	100-123	2	6
W-615	GW Monitor	1-Jun-90	121	99.3	1	91-99	1B	5
W-616	GW Monitor	14-Jun-90	255	188	1	178-188	3A	4
W-617	GW Monitor	26-Jun-90	200	110	1	103-110	2	3
W-618	GW Monitor	17-Jul-90	357	205	1	201-205	3B	3
W-619	GW Monitor	7-Aug-90	330	252	1	232-252	3B/4	20
W-620	GW Extraction	30-Aug-90	206	88.5	1	75-88.5	1B	6
W-621	GW Extraction	9-Sep-90	149	120	1	113-120	2	3.5
W-622	GW Monitor	28-Sep-90	206	112.25	1	104-112	5	0.3
W-651	GW Monitor	22-Feb-90	155	89	1	82-89	1B	0.4
W-652	GW Monitor	15-Mar-90	318	256	1	245-256	7	2
W-653	Dual Extraction	29-Mar-90	225	128	1	122-128	3A	1
W-654	GW Monitor	11-Apr-90	240	158	1	140-158	2	20
W-655	GW Extraction	25-Apr-90	193	130	1	121-129.5	2	15
W-701	GW Extraction	10-Oct-90	159	86	1	74-86	1B	14
W-702	GW Monitor	24-Oct-90	180.5	95	1	77-95	1B	4
W-703	GW Monitor	3-Dec-90	586	325	1	298-325	5	NA
W-704	GW Extraction	2-Feb-91	135	107	1	67-76	1B	20
					2	88-97	1B	20
W-705	GW Monitor	26-Dec-90	126	90	1	77-90	1B	1
W-706	GW Monitor	25-Jan-91	178	85	1	71-85	1B	NA

Table A-1. Well construction data, LLNL Livermore Site and vicinity, Livermore, California.

Well	Well type	Date Completed	Borehole depth (ft)	Casing depth (ft)	Screen position	Screen interval (ft)	HSU	Initial flow rate (gpm)
W-712	GW Extraction	28-Aug-91	200	185.5	1	170-185.5	3A	8
W-714	GW Extraction	5-Dec-91	128.5	128	1	107-128	2	NA
W-750	GW Monitor	10-Apr-91	152	150	1	130-150	5	NA
W-901	GW Monitor	24-Feb-93	97.8	88	1	80-83	1B	1
W-902	GW Monitor	22-Jan-93	95.5	88	1	80-83	1B	1
W-903	GW Extraction	28-Apr-93	223	145	1	132-140	2	20
W-904	GW Extraction	6-May-93	212	154	1	121-133	2	30
					2	140-149	2	30
W-905	GW Monitor	7-Apr-93	221	144.5	1	134-144	2	3.5
W-906	GW Extraction	23-Jul-93	200	132	1	58-132	2/3A	8
W-907	GW Extraction	3-Aug-93	239	222	1	172.7-188.7	4	40
					2	204.5-215	5	40
W-908	GW Monitor	17-Aug-93	239	197	1	180-197	5/6	0.4
W-909	GW Monitor	11-Nov-93	252	113.5	1	80.5-113.5	2	2.5
W-911	GW Monitor	20-Sep-93	180	113.65	1	73.65-108.65	2	1.5
W-912	GW Monitor	7-Sep-93	239	174	1	168-174	5	3.5
W-913	GW Monitor	24-Nov-93	454	255	1	235-255	4	30
W-1001	GW Extraction	15-Dec-93	105	92	1	85-92	1B	1.5
W-1002	GW Monitor	12-Nov-93	293	260	1	246-260	5	20
W-1003	GW Monitor	2-Feb-94	184	147	1	140-147	2	1.5
W-1004	GW Extraction	23-Feb-94	100	97	1	71-91	1B	5
W-1008	GW Monitor	13-Apr-94	246	238	1	229.5-238	7	9.5
W-1009	GW Extraction	27-Apr-94	191	140	1	134-140	2	25
W-1010	GW Monitor	24-May-94	463	142	1	130-142	2	25
W-1011	GW Monitor	6-Jun-94	106	89	1	75-89	1B	2
W-1012	GW Monitor	20-Jun-94	161	117	1	96-112	2	2.5
W-1013	GW Monitor	29-Jun-94	147	73	1	65-73	1B	1.5
W-1014	GW Monitor	12-Jul-94	99	89	1	65-89	1B	30
W-1015	GW Extraction	10-Aug-94	437	94	1	84-94	1B	25
W-1101	GW Monitor	10-Nov-94	200	79	1	76-79	1B	1
W-1102	GW Extraction	29-Nov-94	163	95.6	1	76-94	1B	11
W-1103	GW Extraction	15-Dec-94	200	82	1	70-82	1B	4.5
W-1104	GW Extraction	18-Jan-95	165	99.3	1	77-87	1B	35
					2	92-98	1B	35
W-1105	GW Monitor	18-Jan-95	105	93	1	78-93	1B	3.75

Table A-1. Well construction data, LLNL Livermore Site and vicinity, Livermore, California.

Well	Well type	Date Completed	Borehole depth (ft)	Casing depth (ft)	Screen position	Screen interval (ft)	HSU	Initial flow rate (gpm)
W-1106	GW Monitor	17-Jan-95	245	86	1	76-85	1B	17.5
W-1107	GW Monitor	6-Mar-95	199.5	93	1	74-88	1B	1.5
W-1108	GW Extraction	17-Mar-95	250	156	1	142-156	5	22.5
W-1109	GW Extraction	11-Apr-95	121	113	1	94-113	2	6.5
W-1110	GW Monitor	4-Apr-95	252	92.9	1	68-92	1B	NA
W-1111	GW Extraction	1-June-95	152	129	1	88-108	1B/2	NA
					2	120-124	2	NA
W-1112	GW Monitor	28-Jun-95	263	210	1	201-210	5	NA
W-1113	GW Monitor	12-Jul-95	260	214	1	204-214	5	NA
W-1115	GW Monitor	12-Oct-95	126.5	118	1	108-118	3A	0.5
W-1116	GW Extraction	17-Aug-95	214.8	101	1	72-98	1B	NA
W-1117	GW Monitor	21-Aug-96	154	132.2	1	122-132	3A	1
W-1118	GW Monitor	27-Sep-95	225	125	1	115-125	3A	NA
W-1201	GW Monitor	18-Oct-95	225	133	1	125-133	3A	1
W-1202	GW Monitor	25-Oct-95	99.3	99	1	83-99	2	5
W-1203	GW Monitor	7-Nov- 95	224	206.2	1	196-206	5	18
W-1204	GW Monitor	20-Nov-95	225	126.2	1	118-126	3A	2.5
W-1205	GW Monitor	27-Nov-95	91	82	1	72-82	2	1
W-1206	GW Extraction	6-Dec-95	220	191	1	174-186	4	40
W-1207	GW Monitor	13-Dec-95	92	90	1	70-90	2	1
W-1208	GW Extraction	9-Jan-96	166	163	1	135-163	3A/3B	40
W-1209	GW Monitor	26-Jan-96	210	164	1	148-164	4	3
W-1210	GW Monitor	12-Feb-96	250	223	1	213-223	5	3
W-1211	GW Extraction	5-Mar-96	273	205	1	185-200	4	25
W-1212	GW Monitor	19-Mar-96	150	75	1	52-75	1B	3
W-1213	GW Extraction	2-Apr-96	129	76	1	64-76	1B	5
W-1214	GW Monitor	22-Apr-96	180	100	1	80-100	1B	2
W-1215	GW Extraction	17-Apr-96	175	120	1	108-118	2	8.5
W-1216	GW Extraction	7-May-96	200	124	1	94-124	2	14
W-1217	GW Monitor	15-May-96	182	98.5	1	78-98	1B	0.25
W-1219	GW Monitor	4-Jun-96	201	142	1	138-142	4	0.18
W-1222	GW Monitor	26-Jun-96	175	125.2	1	115-125	3A	6
W-1223	GW Monitor	23-Jul-96	175	102	1	87-97	2	4
W-1224	GW Monitor	5-Sep-96	125	104.5	1	99-104	1B	4.3
W-1225	GW Monitor	14-Aug-96	150	121.2	1	113-121	3A	2

Table A-1. Well construction data, LLNL Livermore Site and vicinity, Livermore, California.

Well	Well type	Date Completed	Borehole depth (ft)	Casing depth (ft)	Screen position	Screen interval (ft)	HSU	Initial flow rate (gpm)
W-1226	GW Monitor	6-Aug-96	155	126.5	1	116-126	2	1
W-1227	GW Monitor	9-Oct-96	200	134	1	126-134	2	11
W-1250	GW Monitor	7-Jun-96	210	200.3	1	130-135	4	0.25
W-1251	GW Monitor	3-Jul-96	210	200.3	1	134-139	4	1.3
W-1252	GW Monitor	25-Jul-96	208	202.3	1	135-140	4	0.15
W-1253	GW Extraction	15-Aug-96	206	200.3	1	127-132	4	0.15
W-1254	GW Extraction	28-Aug-96	210	200	1	131-141	4	26
W-1255	GW Extraction	27-Aug-96	208	200.7	1	124-129	4	0.2
W-1301	GW Extraction	4-Dec-96	180	120.3	1	112-120	3A	15
W-1302	GW Extraction	21-Jan-97	145	138.9	1	116.5-121.2	3A	7.5
					2	125.8-133.8	3A	7.5
W-1303	GW Extraction	6-Feb-97	199.5	107	1	78-102	2	10
W-1304	GW Monitor	20-Feb-97	149.5	125	1	120-125	3A	0.75
W-1306	GW Extraction	6-May-97	200	106	1	81-101	2	3.3
W-1307	GW Extraction	2-Jul-97	150	141	1	126-136	4	20
W-1308	GW Extraction	22-Jul-97	154	116	1	81-111	2	7
W-1309	GW Extraction	11-Aug-97	220	157	1	142-152	4	6
W-1310	GW Extraction	15-Sep-97	220	198	1	173-193	5	28
W-1311	GW Monitor	1-Oct-97	150	120.5	1	100-120	2	14
W-1401	GW Monitor	21-Oct-97	254	120	1	105-120	2	7.8
W-1402	GW Monitor	6-Nov-97	135	112	1	102-112	3A	4.1
W-1403	GW Extraction	13-Nov-97	175	142.5	1	132-142	3B	5
W-1404	GW Extraction	24-Nov-97	162	97.7	1	87-97	2	3.1
W-1405	GW Monitor	24-Nov-97	100	97.8	1	87-97	2	4.5
W-1406	GW Monitor	15-Dec-97	201	150	1	139.2-149.2	4	9.2
W-1407	GW Monitor	18-Dec-97	224	118	1	105-118	2	2
W-1408	GW Monitor	12-Jan-98	134	128	1	118-128	3A	3.8
W-1409	GW Extraction	23-Jan-98	143	140	1	80-135	2	13
W-1410	GW Extraction	19-Feb-98	208.5	131.1	1	126-131	4	9
W-1411	GW Monitor	4-Feb-98	133	128.1	1	114-128	3A	10.6
W-1412	GW Monitor	11-Mar-98	201	108	1	92-107	3A	1
W-1413	GW Monitor	26-Mar-98	163.5	163.5	1	147-157	5	1
W-1414	GW Monitor	31-Mar-98	128	107.5	1	97-107	3A	0.018
W-1415	GW Extraction	15-Apr-98	182	104.72	1	74.5-104.5	2	2
W-1416	GW Monitor	2-Jun-98	194.5	105	1	85-100	2	10.8

Table A-1. Well construction data, LLNL Livermore Site and vicinity, Livermore, California.

Well	Well type	Date Completed	Borehole depth (ft)	Casing depth (ft)	Screen position	Screen interval (ft)	HSU	Initial flow rate (gpm)
W-1417	GW Monitor	23-Apr-98	225	155	1	130-150	3A	8.9
W-1418	GW Monitor	5-May-98	252.5	190	1	176-190	4	9
W-1419	GW Monitor	13-May-98	175	115.5	1	90-110	2	4.45
W-1420	GW Monitor	17-Jun-98	175.5	112.5	1	102-112	2	20
W-1421	GW Monitor	28-May-98	230	172	1	157-167	3B	2.1
W-1422	GW Monitor	14-May-98	173.5	169.1	1	162-169	3B	11
W-1423	GW Extraction	2-Jul-98	175	134.5	1	99.5-109.5	2	22.4
					2	119.5-129.5	2	22.4
W-1424	GW Monitor	13-Aug-98	225.3	146	1	126-146	2	6.2
W-1425	GW Monitor	26-Aug-98	115	100.5	1	88.5-100.5	1B	1
W-1426	GW Monitor	3-Sep-98	89	85	1	70-85	1B	10
W-1427	GW Monitor	7-Sep-98	104	80.2	1	70-80	1B	17.7
W-1428	GW Monitor	29-Sep-98	104	78.2	1	63-78	1B	30
W-1501	GW Monitor	12-Oct-98	126.1	88	1	72-88	1B	7.5
W-1502	GW Monitor	27-Oct-98	204	98.7	1	88-98	2	1.7
W-1503	GW Extraction	16-Nov-98	234	181.5	1	171-181	4	24
W-1504	GW Extraction	14-Dec-98	165.2	162.5	1	140-160.4	3A/3B	21.7
W-1505	GW Monitor	20-Jan-99	276	184.5	1	174-184	4	10
W-1506	GW Monitor	3-Feb-99	160	120.5	1	110-120	2	3
W-1507	GW Monitor	19-Feb-99	201.5	169.5	1	159-169	5	0.5
W-1508	GW Monitor	3-Mar-99	135	128.5	1	118-128	2	0.75
W-1509	GW Monitor	24-Mar-99	175	88.5	1	73-88	1B	8
W-1510	GW Extraction	9-Apr-99	114.5	113.5	1	93-113	2	5
W-1511	GW Monitor	27-Apr-99	229	146	1	138-146	3B	15
W-1512	GW Monitor	3-May-99	100	100	1	88-98	2	0.5
W-1513	GW Monitor	11-May-99	122	120	1	108-120	2/3A	NA
W-1514	GW Monitor	24-May-99	127.5	126	1	103-121	2/3A	6.5
W-1515	GW Monitor	8-Jun-99	130	121.5	1	102-120	2/3A	3
W-1516	GW Monitor	17-Jun-99	204.5	200.25	1	188-200	5	17
W-1517	Dual Extraction	6-Jun-99	154	122.4	1	87-97	2	0.1
W-1518	GW Extraction	8-Jul-99	184	115	1	84-107	2	3
W-1519	GW Monitor	3-Aug-99	245	238	1	222-237	5	30
W-1520	GW Extraction	27-Jul-99	178.3	173	1	160-168	4	3.5
W-1522	GW Extraction	11-Aug-99	169	161	1	141-156	3B	9
W-1523	GW Extraction	7-Sep-99	216	172.3	1	164-172	4	15

Table A-1. Well construction data, LLNL Livermore Site and vicinity, Livermore, California.

Well	Well type	Date Completed	Borehole depth (ft)	Casing depth (ft)	Screen position	Screen interval (ft)	HSU	Initial flow rate (gpm)
W-1550	GW Extraction	24-Jun-99	200	130	1	98-125	3A	10
W-1551	GW Extraction	15-Jul-99	153	129	1	93-124	3A	10.5
W-1552	Dual Extraction	24-Jun-99	153.5	130	1	97.2-124.5	3A	2
W-1553	GW Monitor	17-Aug-99	153	130	1	98-125	3A/3B	1
W-1601	GW Extraction	13-Oct-99	169	160	1	150-155	3B	2.7
W-1602	GW Extraction	2-Nov-99	115.5	110.7	1	80-90	2	8
W-1603	GW Extraction	16-Nov-99	144	140	1	130-135	3A	71.2
W-1604	GW Extraction	2-Dec-99	194	148.7	1	138-148	4	8
W-1605	Dual Extraction	7-Mar-00	120.5	112	1	90-107	3A	NA
W-1606	SV Monitor	27-Jan-00	175	112	1	90-107	3A	NA
W-1607	SV Monitor	10-Feb-00	155.4	112	1	90-107	3A	0.1
W-1608	Dual Extraction	28-Feb-00	155	112	1	90-107	3A	NA
W-1609	GW Extraction	17-Apr-00	155	135	1	110-130	5	0.1
W-1610	GW Injection	4-May-00	155.3	135	1	110-130	5	0.5
W-1613	GW Monitor	27-Apr-00	219	173.4	1	168.4-173.4	3B	NA
W-1614	GW Monitor	18-May-00	100	89.8	1	79-89	1B	3
W-1615	Dual Extraction	15-Aug-00	55	48	1	15-48	1B/2	NA
W-1650	Dual Extraction	19-Jan-00	145	126	1	96-121	3A	2
W-1651	Dual Extraction	27-Jan-00	145	129	1	94-124	2/3A/3B	1
W-1652	Dual Extraction	9-Feb-00	145	127	1	92-122	3A/3B	0.5
W-1653	Dual Extraction	24-Feb-00	144	124	1	94-119	3A	1.2
W-1654	Dual Extraction	25-Feb-00	146.5	128	1	93-123	3A	1
W-1655	Dual Extraction	8-Mar-00	145	125	1	90-120	2/3A	0.5
W-1656	Dual Extraction	14-Mar-00	145	125.3	1	95.1-120.1	3A	5
W-1657	Dual Extraction	23-Mar-00	145	128	1	95-123	3A/3B	0.5
W-1701	GW Monitor	3-Jul-01	185	180.8	1	140-155	2	15
					2	165-175	2	15
W-1702	GW Monitor	15-Jun-01	15	14.25	1	4-13	2	NA
W-1703	GW Monitor	23-Aug-01	358	341.5	1	331-341	LL	22.6
W-1704	GW Monitor	19-Sep-01	240	118.8	1	98-118	2	2
W-1705	FLUTe	16-Oct-01	225	208.8	1	93-103	2	5
					2	123-128	3A	5
					3	138-143	3B	5
					4	203-208	5	5
W-1801	GW Extraction	18-Mar-02	143	134.4	1	124-134	3A	5

Table A-1. Well construction data, LLNL Livermore Site and vicinity, Livermore, California.

Well	Well type	Date Completed	Borehole depth (ft)	Casing depth (ft)	Screen position	Screen interval (ft)	HSU	Initial flow rate (gpm)
W-1802	GW Monitor	2-Apr-02	175	162.2	1	147-157	3A	NA
W-1803	GW Monitor	24-Apr-02	245	240.8	1	175-185	4	15
					2	225-235	5	15
W-1804	GW Monitor	22-May-02	155	110.8	1	80-95	3A	0.5
					2	100-105	3B	0.5
W-1805	GW Monitor	20-Aug-02	110	100.8	1	70-80	1B	6
					2	85-95	1B	6
W-1806	GW Extraction	12-Sep-02	260	106.2	1	80.7-101.2	1B	3
W-1807	GW Extraction	7-Oct-02	165	130	1	115-125	2	10
W-1901	GW Monitor	31-Oct-02	175	127	1	92-97	1B	7
					2	107-122	2	7
W-1902	GW Extraction	21-Nov-02	175	165	1	140-145	3A	20
					2	150-160	3A	20
W-1903	Dual Extraction	16-Dec-02	120	109	1	84-104	2	0.5
W-1904	Dual Extraction	23-Jan-03	120	101	1	75-100	2	0.5
W-1905	GW Monitor	20-May-03	210	123.5	1	103-113	3A	2.5
					2	118-123	3A	2.5
W-1909	Air Inlet	24-Jun-03	110	106.35	1	86-106	2	1.5
W-2005	GW Extraction	3-Feb-04	160	125	1	109-119	3A	2
W-2006	GW Extraction	24-Feb-04	160	132.5	1	122-132	3B	NA
W-2011	Dual Extraction	29-Feb-04	155	116.3	1	106-116	3A	0.3
W-2012	GW Extraction	21-Oct-04	155	136.6	1	111-116	3A	4
					2	126-131	3A	4
W-2101	Dual Extraction	18-Nov-04	160	135.3	1	110-130	3A	0.25
W-2102	Dual Extraction	14-Dec-04	160	138.35	1	118-133	3A	0.33
W-2103	GW Monitor	18-Jan-05	160	133.35	1	113-128	3A	0.5
W-2104A	SV Monitor	8-Feb-05	80	45.5	1	30-45	1B	NA
W-2104B	SV Monitor	8-Feb-05	80	72.55	1	52-72	2	NA
W-2105	Dual Extraction	9-Mar-05	126	115.33	1	90-110	2	0.25
W-2110A	SV Monitor	14-Jun-05	100	58.49	1	38-58	1B/2	NA
W-2110B	SV Monitor	14-Jun-05	100	85.49	1	65-85	2	NA
W-2111A	SV Monitor	22-Jun-05	90	40.3	1	25-40	1B	NA
W-2111B	SV Monitor	22-Jun-05	90	75.3	1	60-75	2	NA
W-2112A	SV Monitor	28-Jun-05	100	58.49	1	38-58	1B/2	NA
W-2112B	SV Monitor	28-Jun-05	100	78.49	1	68-78	2	NA

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Well	Well type	Date Completed	Borehole depth (ft)	Casing depth (ft)	Screen position	Screen interval (ft)	HSU	Initial flow rate (gpm)
W-2113	GW Monitor	21-Jul-05	220	201.5	1	190.5-200.5	4	9
W-2201	GW Extraction	26-Jan-06	130	98.8	1	43.4-53.4	1B	12
					2	73.4-93.4	1B	12
W-2202	GW Monitor	15-Dec-05	140	122.25	1	102-107	3A	0.4
					2	112-117	3A	0.4
W-2203	GW Extraction	10-Jan-06	136.5	131.4	1	121-126	3A	1
W-2204	SV Extraction	26-Jan-06	120	111.38	1	41-66	2	0.1
					2	71-76	2	0.1
					3	91-106	2/3A	0.1
W-2205	SV Extraction	3-Apr-06	127	125.4	1	40-65	2	NA
					2	70-80	2	NA
					3	90-120	2/3A	NA
W-2206	SV Extraction	16-Feb-06	91.5	78.05	1	40-75	2	NA
W-2207A	SV Extraction	9-Mar-06	103	60.41	1	25-35	1B	NA
					2	45-60	1B	NA
W-2207B	SV Extraction	9-Mar-06	103	100.4	1	65-95	2	NA
W-2208A	SV Extraction	30-Mar-06	104	71.38	1	36-66	2	0.1
W-2208B	SV Extraction	30-Mar-06	104	95.63	1	75.2-95.2	2	0.25
W-2211	SV Extraction	30-May-06	106.5	105.3	1	75-105	2	NA
W-2212	SV Extraction	6-Jun-06	115.4	115.4	1	90-115	3A	1
W-2214A	SV Monitor	24-Jul-06	135	39.3	1	6-39	1B/2	NA
W-2214B	SV Monitor	24-Jul-06	135	88.3	1	48-83	2	NA
W-2215A	SV Monitor	9-Aug-06	121.5	82.4	1	47-82	2	NA
W-2215B	SV Monitor	9-Aug-06	121.5	120.5	1	100-120	5	NA
W-2216A	SV Monitor	18-Sep-06	131.5	65.4	1	40-65	2	NA
W-2216B	GW Monitor	18-Sep-06	131.5	126.4	1	106-121	3A	0.2
W-2217A	SV Monitor	12-Oct-06	131.5	48.4	1	18-48	2	NA
W-2217B	SV Monitor	12-Oct-06	131.5	95.4	1	55-75	5	NA
					2	85-95	5	NA
W-2301A	SV Monitor	31-Oct-06	121	57.4	1	32-57	2	NA
W-2301B	SV Monitor	31-Oct-06	121	94.8	1	64.5-94.5	2/3A	NA
W-2302	SV Extraction	1-Feb-07	130	107.3	1	82-102	2	0.1
W-2303	SV Extraction	14-Feb-07	100	79.8	1	45-74.5	2	NA
W-2304	GW Monitor	19-Dec-06	130	124.3	1	114-119	3A	0.15
W-2305	Dual Extraction	23-Jan-07	115	108.3	1	83-103	2	0.5

Table A-1. Well construction data, LLNL Livermore Site and vicinity, Livermore, California.

Well	Well type	Date Completed	Borehole depth (ft)	Casing depth (ft)	Screen position	Screen interval (ft)	HSU	Initial flow rate (gpm)
W-2501	GW Extraction	9-Dec-09	175	144.2	1	128-133	2	15
W-2502	GW Extraction	28-Dec-09	177	164	1	101-106	2	15
					2	116-126	2	15
					3	143-153	2	15
SIP-141-201	Piezometer	2-Feb-96	77	74.2	1	57-74	1B	0.5
SIP-141-202	Piezometer	12-Feb-96	80	74	1	64-74	1B	0.5
SIP-141-203	Piezometer	20-Feb-96	87	83	1	72-83	1B	NA
SIP-191-001	Piezometer	1-Aug-94	50	NA	1	NA	1A	NA
SIP-191-002	Piezometer	21-Apr-94	66	61	1	45-61	1B	NA
SIP-191-003	Piezometer	26-Apr-94	50.5	45	1	35-45	1B	NA
SIP-191-004	Piezometer	15-Jul-94	57.5	NA	1	47.5-53.5	1B	NA
SIP-191-005	Piezometer	4-May-94	54	48	1	42-48	1A	NA
SIP-191-101	Piezometer	18-Nov-94	68.5	64	1	58-64	1B	NA
SIP-212-101	Piezometer	14-Mar-96	94	90.5	1	87-90.5	2	NA
SIP-293-001	Piezometer	5-Dec-90	56.5	50	1	45-50	1B	NA
SIP-331-001	Piezometer	21-Sep-95	122	116.5	1	106.5-116.5	2	NA
SIP-419-101	Piezometer	8-Sep-95	127	123	1	112-123	3B	NA
SIP-419-202	Piezometer	6-Mar-96	110	106.5	1	97-106.5	3A	NA
SIP-490-101	Piezometer	1-Nov-95	60	58	1	53-56	2	NA
SIP-490-102	Piezometer	8-Nov-95	75	73.5	1	53.5-73.5	2	0.5
SIP-501-004	Piezometer	20-Oct-92	60	56.9	1	48.5-56.9	1B	NA
SIP-501-006	Piezometer	11-Nov-92	59.5	56	1	50-56	1B	NA
SIP-501-007	Piezometer	16-Nov-92	64	59	1	53-59	1B	NA
SIP-501-101	Piezometer	10-May-94	77.5	73	1	69-73	1B	NA
SIP-501-102	Piezometer	16-May-94	77	73	1	67-73	1B	NA
SIP-501-103	Piezometer	20-May-94	63	57.5	1	51-57.5	1B	NA
SIP-501-104	Piezometer	15-Jul-94	67	62	1	50-62	1B	NA
SIP-501-105	Piezometer	1-Sep-94	73	68	1	63-68	1B	NA
SIP-501-201	Piezometer	29-Nov-94	65	58.5	1	54-58.5	1B	NA
SIP-501-202	Piezometer	1-Jul-95	70	64.5	1	58-64.5	1B	NA
SIP-511-101	Piezometer	25-Jan-96	110	106.7	1	100-106.7	3A	0.5
SIP-511-102	Piezometer	2-Apr-96	114	110	1	108-110	3B	0.5
SIP-514-107	Piezometer	3-Jan-90	21.5	17	1	9-17	1B	NA
SIP-514-109	Piezometer	5-Jan-90	21.5	21.5	1	7-21.5	1B	NA
SIP-514-112	Piezometer	8-Jan-90	21.5	18	1	7-18	1B	NA

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Well	Well type	Date Completed	Borehole depth (ft)	Casing depth (ft)	Screen position	Screen interval (ft)	HSU	Initial flow rate (gpm)
SIP-514-114	Piezometer	9-Jan-90	21.5	17	1	4-17	1B	NA
SIP-514-116	Piezometer	10-Jan-90	21.5	17	1	7-17	1B	NA
SIP-514-117	Piezometer	11-Jan-90	21.5	17.5	1	6-17.5	1B	NA
SIP-514-119	Piezometer	12-Jan-90	21.5	16	1	5-16	1B	NA
SIP-514-123	Piezometer	17-Jan-90	26.5	23	1	11.5-23	1B	NA
SIP-514-124	Piezometer	17-Jan-90	21.5	17	1	6-17	1B	NA
SIP-514-125	Piezometer	19-Jan-90	21.5	15	1	6-15	1B	NA
SIP-514-126	Piezometer	18-Jan-90	26.5	21.5	1	4-21.5	1B	NA
W-514-2007A	SV Extraction	18-Mar-04	110	45.5	1	15-45	1B/2	NA
W-514-2007B	SV Extraction	18-Mar-04	110	102.5	1	72-102	2/5	NA
SIP-518-101	Piezometer	20-Sep-90	125	61	1	55-61	2	NA
SVB-518-201	Dual Extraction	3-Mar-93	59.8	50	1	34-50	2	NA
SVB-518-202	SV Monitor	3-Nov-93	120.6	73.7	1	19-73.7	1B/2	NA
SIP-518-203	Piezometer	21-Oct-93	132.1	127	1	121-127	5	NA
SVB-518-204	Dual Extraction	5-Nov-93	121.5	50	1	24-46	2	NA
SVB-518-302	GW Monitor	22-Jun-95	104.5	39.5	1	11-39	NA	NA
W-518-1914	Dual Extraction	9-Oct-03	18	16	1	5.5-15.5	1B	NA
W-518-1915	Dual Extraction	15-Oct-93	104.5	41	1	30.5-40.5	2	NA
W-543-001	SV Extraction	25-Feb-03	71.5	67.5	1	52-67	2	NA
W-543-002A	SV Monitor	10-Mar-03	96	65.4	1	45-65	2	NA
W-543-002B	SV Monitor	10-Mar-03	96	82.5	1	72-82	2	NA
W-543-003	SV Extraction	20-Mar-03	95	80	1	69-79	2	NA
W-543-004A	SV Monitor	27-Mar-03	95	64.5	1	49-64	2	NA
W-543-004B	SV Monitor	27-Mar-03	95	80.5	1	70-80	2	NA
SIP-543-101	Piezometer	1-Jul-95	111	104	1	93-103	2	NA
W-543-1908	SV Extraction	12-Jun-03	40.8	40.4	1	20-40	1B	9
SIP-ALP-001	Piezometer	3-May-90	66.5	60	1	45-60	2	NA
SIP-ALP-002	Piezometer	7-May-90	62	57.5	1	47.5-57.5	2	NA
SIP-AS-001	Piezometer	30-Apr-90	100.5	90.5	1	81-90.5	1B	NA
SIP-CR-049	Piezometer	26-Feb-90	41.5	40	1	36-40	1B	NA
SIP-EGD-001	Piezometer	16-Oct-90	101.5	85	1	75-85	2	NA
SIP-ETC-201	Dual Extraction	26-Mar-96	106	100	1	80-100	2	0.5
SIP-ETC-301	Piezometer	9-Apr-99	102	NA	1	NA	NA	NA
SIP-ETC-303	Piezometer	24-May-99	111	88	1	82-88	2	NA
W-ETC-2001A	SV Monitor	10-Nov-03	95	23.5	1	18-23	1B	NA

Table A-1. Well construction data, LLNL Livermore Site and vicinity, Livermore, California.

Well	Well type	Date Completed	Borehole depth (ft)	Casing depth (ft)	Screen position	Screen interval (ft)	HSU	Initial flow rate (gpm)
W-ETC-2001B	SV Monitor	10-Nov-03	95	88.5	1	78-88	2	NA
W-ETC-2002A	SV Monitor	25-Nov-03	95	64.5	1	34-64	1B/2	NA
W-ETC-2002B	SV Monitor	25-Nov-03	95	85.5	1	75-85	2	NA
W-ETC-2003	SV Extraction	9-Dec-03	95	45.5	1	20-45	1B	NA
W-ETC-2004A	SV Extraction	17-Dec-03	95	53.5	1	28-53	1B/2	NA
W-ETC-2004B	SV Extraction	17-Dec-03	95	88.5	1	63-68	2	NA
SIP-ETS-201	Piezometer	5-Feb-91	95	90	1	85-90	3A	NA
SIP-ETS-204	Piezometer	7-May-91	102.5	97	1	87-97	3A	NA
SIP-ETS-205	Piezometer	20-Jun-91	103	95	1	89.5-95	3A	NA
SIP-ETS-209	Piezometer	25-Jul-91	96.6	90.5	1	79.5-89.8	2	NA
SIP-ETS-211	Piezometer	6-Aug-91	103	98.5	1	95-98.5	3A	NA
SIP-ETS-212	Piezometer	14-Aug-91	106.5	102.5	1	97.5-102.25	2	NA
SIP-ETS-213	Piezometer	15-Nov-91	118.5	116.5	1	108.5-116.5	3A	NA
SIP-ETS-214	Piezometer	22-Nov-91	101	101	1	86-101	3A	NA
SIP-ETS-215	Piezometer	3-Dec-91	94.5	94.5	1	84.5-94.5	3A	NA
SIP-ETS-302	Piezometer	30-Mar-92	117.4	113	1	97-113	3A	NA
SIP-ETS-303	Piezometer	2-Apr-92	110.7	102	1	95-102	3A	NA
SIP-ETS-304	Piezometer	27-Aug-92	100	97	1	90-97	3A	NA
SIP-ETS-306	Piezometer	11-Sep-92	101	93	1	80.5-93	3A	NA
SIP-ETS-307	Piezometer	8-Dec-92	105.5	NA	NA	NA	NA	NA
SIP-ETS-401	Piezometer	2-Aug-95	122	122	1	116-121	3A	NA
SIP-ETS-402	Piezometer	8-Aug-95	110	110	1	97-107	2	NA
SIP-ETS-404	Piezometer	22-Aug-95	99	99	1	83.5-95.5	2	NA
SIP-ETS-405	Piezometer	29-Aug-95	126	126	1	114.5-123	3A	NA
SIP-ETS-501	Piezometer	16-Nov-95	110	106.5	1	100-106.5	3A	NA
SIP-ETS-502	Piezometer	5-Dec-95	95	88	1	80-88	2	NA
SVI-ETS-504	SV Extraction	9-Jul-96	76.5	67	1	42-67	2	NA
SVI-ETS-505	SV Injection	18-Jul-96	80	77.5	1	45-75	2	NA
W-ETS-305A	SV Monitor	30-May-07	80.5	50	1	14.7-49.7	1B/2	NA
W-ETS-305B	SV Monitor	30-May-07	85	79.7	1	59.3-79.3	2	NA
W-ETS-506A	SV Monitor	29-May-07	75	37.5	1	17.1-37.1	1B/2	NA
W-ETS-506B	SV Monitor	29-May-07	75	63.3	1	43-63	2	NA
W-ETS-507	SV Extraction	27-Apr-96	75	65.5	1	25.1-65.1	1B/2	NA
SIP-ETS-601	Piezometer	7-Jun-99	115.5	104.8	1	98.3-104.8	2	NA
W-ETS-2008A	SV Extraction	7-Apr-04	110	40.5	1	20-40	1B	NA

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Well	Well type	Date Completed	Borehole depth (ft)	Casing depth (ft)	Screen position	Screen interval (ft)	HSU	Initial flow rate (gpm)
W-ETS-2008B	SV Extraction	7-Apr-04	110	85.5	1	50-85	2	NA
W-ETS-2009	SV Extraction	3-May-04	120	79.5	1	54-79	2	NA
W-ETS-2010A	SV Extraction	19-May-04	110.3	70.5	1	35-70	1B/2	NA
W-ETS-2010B	SV Extraction	19-May-04	110.3	100.5	1	80-100	2	NA
SIP-HPA-001	Piezometer	20-Apr-90	92.75	75	1	65-75	2	NA
W-HPA-001A	SV Monitor	15-Apr-03	80	45.5	1	30-45	1B	NA
W-HPA-001B	SV Monitor	15-Apr-03	80	73.5	1	63-73	2	NA
W-HPA-002A	SV Extraction	29-Apr-03	80	43	1	32.5-42.5	1B	NA
W-HPA-002B	SV Extraction	29-Apr-03	80	72.5	1	52-72	2	NA
SIP-HPA-003	Piezometer	19-Apr-90	91.5	66	1	61-66	2	NA
SIP-HPA-201	Piezometer	14-May-96	97.5	76	1	71-76	2	NA
SIP-IES-001	Piezometer	16-Sep-92	50	46.5	1	44-46.5	1B	NA
SIP-IES-002	Piezometer	5-Oct-92	41.5	39.2	1	33-39.2	1A	NA
IMS-INF-001	IMS	NA	67	NA	1	NA	NA	NA
IMS-INF-002	IMS	NA	67	NA	1	NA	NA	NA
IMS-INF-003	IMS	NA	67	NA	1	NA	NA	NA
SIP-INF-201	Piezometer	1-Jul-98	87.4	86.5	1	66-86.5	NA	35
SIP-INF-202	Piezometer	1-Jul-98	87	85.5	1	65.5-85.5	NA	0.5
IMS-INF-203	IMS	NA	63	63	1	NA	NA	NA
SIP-ITR-001	Piezometer	19-Apr-91	121.5	115	1	105-115	5	NA
SIP-ITR-002	Piezometer	2-Apr-91	100	84	1	79-84	5	NA
SIP-ITR-003	Piezometer	25-Apr-91	121.5	106	1	98.66-106	5	NA
SIP-NEB-101	Piezometer	23-Sep-92	68.7	66	1	57-66	2	NA
SIP-PA-002	Piezometer	29-Jan-90	16.5	16.5	1	4-16.5	1B	NA
SIP-PA-003	Piezometer	26-Jan-90	18	14	1	4-14	1B	NA
SIP-PA-005	Piezometer	4-Jan-90	11.5	8	1	3-8	1B	NA
SIP-PA-006	Piezometer	4-Jan-90	13.5	12	1	5-12	1B	NA
SIP-PA-007	Piezometer	4-Jan-90	11.5	5	1	1-5	1B	NA
SIP-PA-010	Piezometer	25-Jan-90	11.5	9	1	3-9	1B	NA
SIP-PA-012	Piezometer	29-Jan-90	11.5	9	1	2-9	1B	NA
SIP-PA-013	Piezometer	24-Jan-90	16.5	13	1	8-13	1B	NA
SIP-PA-015	Piezometer	25-Jan-90	21.5	17.5	1	2-17.5	1B	NA
SIP-PA-016	Piezometer	24-Jan-90	11.5	11.5	1	7-11.5	1B	NA
SIP-PA-017	Piezometer	24-Jan-90	16.5	14	1	7-14	1B	NA
SIP-PA-018	Piezometer	25-Jan-90	11.5	8	1	6-8	1B	NA

Table A-1. Well construction data, LLNL Livermore Site and vicinity, Livermore, California.

Well	Well type	Date Completed	Borehole depth (ft)	Casing depth (ft)	Screen position	Screen interval (ft)	HSU	Initial flow rate (gpm)
SIP-PA-019	Piezometer	26-Jan-90	16.5	12	1	2-12	1B	NA
SIP-PA-021	Piezometer	23-Jan-90	11.5	10	1	2-10	1B	NA
SIP-PA-024	Piezometer	23-Jan-90	16.5	15	1	5-15	1B	NA
SIP-PA-025	Piezometer	23-Jan-90	11.5	7	1	4-7	1B	NA
SIP-PA-026	Piezometer	29-Jan-90	11.5	10	1	2-10	1B	NA
SIP-PA-027	Piezometer	29-Jan-90	8.5	7	1	2-7	1B	NA
SIP-PA-028	Piezometer	23-Jan-90	11	8	1	5-8	1B	NA
SIP-PA-030	Piezometer	24-Jan-90	11.5	8	1	4-8	1B	NA
SIP-PA-034	Piezometer	4-Jan-90	6.5	5	1	3-5	1B	NA
SIP-PA-035	Piezometer	4-Jan-90	11.5	11.5	1	6.5-11.5	1B	NA
TW-11	GW Monitor	9-Jun-81	112.5	107	1	97-107	2	NA
TW-11A	GW Monitor	16-Mar-84	163	160	1	133-160	2	6
TW-21	GW Monitor	12-Jun-81	111.5	95	1	85-95	1B	3
UP-292-006	Piezometer	7-Jan-91	74	57.5	1	47.5-57.5	1B	NA
UP-292-007	Piezometer	7-Jan-91	71	56	1	46-56	1B	NA
UP-292-012	Piezometer	29-Jan-92	67.7	60	1	45-60	1B	NA
UP-292-014	Piezometer	29-Jan-92	66	66	1	50-60	1B	NA
UP-292-015	Piezometer	29-Jan-92	61.5	61.5	1	49.5-60.5	1B	NA
UP-292-020	Piezometer	3-Feb-93	68.5	68.5	1	56.5-64	1B	NA
GEW-710	GW Monitor	23-Sep-91	159	158	1	94-137	2/3A	NA
GEW-808	GW Monitor	5-Jun-92	150	150	1	50-140	2/3A	NA
GEW-816	GW Monitor	4-Aug-92	161.7	150	1	50-140	2/3A	NA
GIW-813	GW Monitor	5-Aug-92	140.7	127	1	67-87	2	NA
					2	89-99	2	NA
					3	107-127	2/3A	NA
GIW-814	GW Monitor	5-Aug-92	149.6	141	1	86.5-106.5	2	NA
					2	110-120	3A	NA
					3	121-141	3A/3B	NA
GIW-815	GW Monitor	5-Aug-92	143	137.5	1	77-97	2	NA
					2	102-112	2/3A	NA
					3	112.8-132.5	3A	NA
GIW-817	GW Monitor	NA	NA	NA	1	NA	NA	NA
GIW-818	GW Monitor	5-Aug-92	150	140	1	82-102	2	NA
					2	120-140	3A/3B	NA
GIW-819	GW Monitor	5-Aug-92	150	141	1	78.6-98.6	2	NA

Table A-1. Well construction data, LLNL Livermore Site and vicinity, Livermore, California.

Well	Well type	Date Completed	Borehole depth (ft)	Casing depth (ft)	Screen position	Screen interval (ft)	HSU	Initial flow rate (gpm)
					2	108-118	2/3A	NA
GIW-820	GW Monitor	5-Aug-92	143.3	132	1	85-105	2	NA
					2	112-132	3A	NA
GSW-004	GW Monitor	22-Feb-85	112	106	1	86-106	2	NA
GSW-006	GW Monitor	28-Feb-86	212	137	1	121-137	3A	11
GSW-007	GW Monitor	14-Mar-86	176.5	123.4	1	110.8-123.4	3A	5
GSW-008	GW Monitor	1-Apr-86	176	133	1	127.5-133	3A	2
GSW-009	GW Monitor	14-Apr-86	197.5	152.5	1	147-152.5	3B	5
GSW-011	GW Monitor	7-May-86	182.5	126	1	116-126	3A	5
GSW-013	GW Monitor	27-Jun-86	198	134.5	1	125-134.5	3A	NA
GSW-016	GW Monitor	19-Oct-87	146	145	1	23-28	1B	NA
					2	38-43	1B	NA
					3	50-55	2	NA
					4	61-66	2	NA
					5	78-83	2	NA
					6	95-105	2	NA
					7	120-130	3A	NA
GSW-215	GW Monitor	22-Apr-86	214	133.5	1	127-133.5	3A	6
GSW-216	GW Monitor	9-May-86	193	120.5	1	110.5-120.5	3A	7
GSW-266	GW Monitor	8-May-86	220	166	1	159-166	3B	3
GSW-326	GW Monitor	2-Oct-87	230	134	1	129-134	4	NA
GSW-367	GW Monitor	29-Apr-87	159	124	1	114-124	2	7
GSW-442	GW Monitor	27-Oct-87	270	145	1	138-145	3A	1
GSW-443	GW Monitor	9-Nov-87	291	141	1	123-141	2	5
GSW-444	GW Monitor	20-Nov-87	278	120	1	110-120	3B	NA
GSW-445	GW Extraction	9-Dec-87	319	161	1	155-161	4	3
HW-GP-001	GW Monitor	16-Apr-92	120	113	NA	NA	NA	NA
HW-GP-002	GW Monitor	12-Jan-95	120	117	NA	NA	NA	NA
HW-GP-003	GW Monitor	18-May-92	119	119	NA	NA	NA	NA
HW-GP-102	GW Monitor	24-Jan-95	140	142.5	1	70-132.5	NA	NA
HW-GP-103	GW Monitor	24-Jan-95	138	141.5	1	71.5-131.5	NA	NA
HW-GP-104	GW Monitor	24-Jan-95	138	142.2	1	72.2-132.5	NA	NA
HW-GP-105	GW Monitor	24-Jan-95	138	142.5	1	72.5-132.5	NA	NA
GSP-SNL-001	Piezometer	10-Jan-92	147	131	1	99-104	NA	NA
					2	118-131	NA	NA

Table A-1. Well construction data, LLNL Livermore Site and vicinity, Livermore, California.

Well	Well type	Date Completed	Borehole depth (ft)	Casing depth (ft)	Screen position	Screen interval (ft)	HSU	Initial flow rate (gpm)
MW-NLF-1	GW Monitor	13-Mar-91	26	NA	1	NA	NA	NA
MW-NLF-2	GW Monitor	13-Mar-91	NA	NA	1	NA	NA	NA
MW-NLF-3	GW Monitor	13-Mar-91	20	NA	1	NA	NA	NA
MW-NLF-4	GW Monitor	13-Mar-91	26	NA	1	NA	NA	NA
MW-NLF-20	GW Monitor	NA	NA	NA	1	NA	NA	NA
MW-NLF-21	GW Monitor	NA	NA	NA	1	NA	NA	NA
MW-NLF-22	GW Monitor	NA	NA	NA	1	NA	NA	NA
					2	118-131	NA	NA
SNL-1B	Piezometer	NA	NA	NA	1	NA	NA	NA
SNL-2A	Piezometer	NA	NA	NA	1	NA	NA	NA
SNL-4D	Piezometer	NA	NA	NA	1	NA	NA	NA
MW-SNL-20B	GW Monitor	28-Jun-84	140	140	1	90-105	NA	NA
MW-SNL-20C	GW Monitor	16-Jul-84	165	156	1	140-155	NA	NA
11C1	GW Monitor	8-Jun-76	68	66	1	56.2-61.2	1B	1
11J2	GW Monitor	26-Apr-79	112	112	1	90-92	1B	5
					2	102-108	2	5
14A3	GW Monitor	7-Dec-77	110	110	1	100-105	1B	NA
14B1	Water-supply (pumping)	13-Aug-59	300	300	1	146-149	2	NA
					2	192-195	3A	NA
					3	209-213	3A	NA
14B4	Water-supply (pumping)	1-Aug-60	260	260	1	143-148	2	NA
					2	155-159	2	NA
					3	186-189	3A	NA
					4	205-215	3A	NA
					5	245-250	4	NA
14B7	GW Monitor	25-Aug-87	NA	NA	NA	NA	NA	NA
14C2	Water-supply (pumping)	7-Jan-88	217	NA	1	135-150	2	NA
14C3	Water-supply (pumping)	19-Jan-88	405	NA	1	160-388	2/3A/3B/4/5	NA
14H1	GW Monitor	21-Dec-83	NA	288	1	0-288	NA	NA
14H2	GW Monitor	28-Aug-87	NA	NA	NA	NA	NA	NA
14JD1	GW Monitor	NA	NA	NA	NA	NA	NA	NA
14K1	GW Monitor	NA	372	361	1	153-157	NA	NA
					2	193-202	NA	NA

Table A-1. Well construction data, LLNL Livermore Site and vicinity, Livermore, California.

Well	Well type	Date Completed	Borehole depth (ft)	Casing depth (ft)	Screen position	Screen interval (ft)	HSU	Initial flow rate (gpm)
					3	217-251	NA	NA
					4	279-290	NA	NA
					5	300-336	NA	NA
					6	345-349	NA	NA
					7	354-361	NA	NA
15B1	GW Monitor	24-Jun-49	423	NA	NA	NA	NA	NA
18D1	Water-supply (pumping)	20-Apr-84	NA	NA	1	NA	7	12
2J2	GW Monitor	4-Jan-90	NA	NA	1	NA	NA	NA
2K3	GW Monitor	6-Mar-91	35	NA	1	NA	NA	NA
2K4	GW Monitor	6-Mar-91	35	NA	1	NA	1B	NA
2Q2	GW Monitor	6-Mar-91	40	NA	1	NA	1B	NA
2R3	GW Monitor	5-Mar-91	37	NA	1	NA	1B	NA
2R4	GW Monitor	5-Mar-91	37	NA	1	NA	NA	NA
2R8	GW Monitor	6-Mar-91	40	NA	1	NA	1B	NA
3S1E-1P2	Water-supply (pumping)	7-Oct-60	144	NA	NA	NA	NA	NA
3S2E-16B1	Water-supply (pumping)	1-Jul-44	410	410	1	140-235	NA	NA
					2	275-287	NA	NA
					3	304-320	NA	NA
					4	333-338	NA	NA
					5	347-352	NA	NA
					6	380-390	NA	NA
3S2E-16C1	Water-supply (pumping)	18-Feb-58	584	580	1	288-298	NA	950
					2	316-327	NA	950
					3	347-353	NA	950
					4	432-454	NA	950
					5	517-523	NA	950
3S2E-7C2	Water-supply (pumping)	NA	NA	49	1	39-44	NA	NA
3S2E-8P1	Water-supply (pumping)	NA	NA	273	1	122-263	NA	NA
3S2E-9Q1	Water-supply (pumping)	13-Jan-60	576	516	1	180-492	NA	510
7D2	GW Monitor	7-Jun-76	74	72	1	63-68	3A	NA
AW-1906	Anode Well	17-Jun-03	270	258	NA	NA	NA	NA
AW-1910	Anode Well	23-Jul-03	270	258	NA	NA	NA	NA

Table A-1. Well construction data, LLNL Livermore Site and vicinity, Livermore, California.

Well	Well type	Date Completed	Borehole depth (ft)	Casing depth (ft)	Screen position	Screen interval (ft)	HSU	Initial flow rate (gpm)
AW-1911	Anode Well	NA	290	NA	NA	NA	NA	NA
AW-1912	Anode Well	28-Aug-03	280	258	NA	NA	NA	NA
AW-2106	Anode Well	11-Apr-05	290	257.5	NA	NA	NA	NA
AW-2107	Anode Well	4-May-05	290	NA	NA	NA	NA	NA
AW-2108	Anode Well	2-Jun-05	290	258	NA	NA	NA	NA
AW-2306	Anode Well	31-Aug-07	280	261	NA	NA	NA	NA

Notes and footnotes appear on the following page.

Table A-1. Well construction data, LLNL Livermore Site and vicinity, Livermore, California.

Notes.

ft = Feet.
gpm = Gallons per minute.
GW = Ground Water.
HSU = Hydrostratigraphic Units.
IMS = Instrumented Membrane Systems.
NA = Not available.
SV = Soil Vapor.

In wells with more than one screen, the screen positions are numbered consecutively downward within a single well. Well numbers ending in A and B, indicate two wells installations in the same borehole. The "A" refers to the shallow well and "B" refers to the deeper well.

Hydrostratigraphic Units (HSUs) are numbered consecutively downward from ground surface. An HSU is defined as sediments that are grouped together based on their hydrogeologic and contaminant transport properties. The permeable layers within an HSU are considered to be in good hydraulic communication, whereas permeable layers in different HSUs are considered to be
in poor hydraulic communication. HSU contacts are interpreted and are periodically revised based on new data.

Well numbers were changed in December 1988 to be consistent with Alameda County Flood Control and Water Conservation District, Zone 7 well identification. Well number changes made on this table are:

4A6 ------> 14H2
18D81 ------> 18D1
14A84 ------> 14A11

Wells installed for the Dynamic Underground Stripping Demonstration Project include extraction wells (GEW series), injection wells (GIW series), gasoline spill piezometer (GSP series), and heating wells (HW series).

A FLUTe liner was installed to monitor ground water chemistry in multiple HSUs. Instrumented Membrane Systems were installed in the vadose zone to measure moisture content, pressure, temperature, and VOCs.

Piezometer SVI-518-303 was drilled out and replaced by SVW-518-1915.

Table A-2. Well closure data, LLNL Livermore Site and vicinity, Livermore, California.

Well number	Well type	Date installed	Borehole depth (ft)	Casing depth (ft)	Screen interval(s) (ft)	HSU monitored	Closure date
11A1	Other non-LLNL	8-Jun-76	66	64.7	54.7-59.7	NA	18-Aug-88
11BA[a]	Other non-LLNL	2-Mar-87	NA	NA	NA	NA	10-Jun-87
11H1	Other non-LLNL	4-Nov-41	NA	519	157-161	2/3A/4/5/6/7	31-Oct-88
					169-177		
					224-228		
					243-245		
					254-256		
					306-314		
					319-327		
					339-342		
					414-419		
					424-431		
					477-479		
11H4	Other non-LLNL	5-Apr-60	272	272	166-170	3/4/5	7-Oct-88
					174-176		
					183-185		
					200-202		
					211-214		
					224-230		
					250-252		
					260-265		
11J1	Other non-LLNL	1-Jan-41	160	160	NA	2	3-Aug-88
11J4	Other non-LLNL	1-Jan-65	NA	NA	NA	NA	11-Oct-88
11K1	Other non-LLNL	6-Jan-42	621	621	247-255	4/5/6	26-Sep-88
					272-276		
					297-304		
					322-339		
					554-557		
					580-602		
11K2	Other non-LLNL	NA	NA	232	NA	NA	3-Oct-88
11Q2	Other non-LLNL	20-Dec-83	NA	264	NA	NA	16-Aug-88
11Q3	Other non-LLNL	20-Dec-83	NA	120	NA	NA	10-Aug-88
11Q6	Other non-LLNL	20-Dec-83	NA	280	NA	NA	11-Jan-89
11R3	Other non-LLNL	8-May-61	140	117	NA	NA	3-Sep-85
11R4	Other non-LLNL	28-Oct-58	268	NA	165-177	NA	3-Sep-85
					252-258		

Table A-2. Well closure data, LLNL Livermore Site and vicinity, Livermore, California.

Well number	Well type	Date installed	Borehole depth (ft)	Casing depth (ft)	Screen interval(s) (ft)	HSU monitored	Closure date
11R5	Other non-LLNL	19-Dec-83	NA	NA	NA	NA	26-Jul-85
12M1	Other non-LLNL	12-Sep-42	702	702	375-378		15-Apr-84
					420-426		
					452-473		
					560-564		
					609-621		
					626-657		
12N1	Other non-LLNL	14-Apr-42	702	NA	392-399	7	24-Jan-89
					478-483		
					492-496		
					514-518		
					527-536		
					666-670		
					678-681		
13D1	Other non-LLNL	29-Oct-56	402	400	200-400	3B/4/5/6	23-Aug-88
14A1	Other non-LLNL	12-Jul-43	246	227	102-107		13-Sep-88
					113-119		
					144-148		
					176-179		
					188-190		
					192-194		
					219-222		
					223-227		
14A2	Other non-LLNL	15-Nov-56	229	229	122-130	2/3A	12-Sep-88
					140-150		
					160-180		
14A4	Other non-LLNL	15-Jun-59	252	248	167-170	3/4	29-Aug-88
					175-179		
					192-202		
					235-246		
14A8	Other non-LLNL	NA	NA	86	NA	NA	22-Jul-88
14B2	Other non-LLNL	22-Aug-56	312	312	185-312	3A/3B/4/5	11-Nov-88
14B8	Other non-LLNL	3-May-88	385	306	NA	NA	NA
14C1	Other non-LLNL	31-Jul-91	523	NA	NA	2/3A/4	NA
1N1	Other non-LLNL	15-Jan-88	600	600	427-442	7	21-Oct-88

Table A-2. Well closure data, LLNL Livermore Site and vicinity, Livermore, California.

Well number	Well type	Date installed	Borehole depth (ft)	Casing depth (ft)	Screen interval(s) (ft)	HSU monitored	Closure date
					450-453		
					465-469		
					500-515		
					575-588		
3S2E01P2	Other non-LLNL	7-Oct-60	144	144	124-144	NA	22-May-86
2R9 (11A5)	Other non-LLNL	NA	NA	NA	NA	NA	19-Jul-88
GEW-711	Extraction	24-May-91	167.5	157	94-137	3A/3B	16-Jun-92
GSW-001	Monitor	5-Feb-85	112	109	85-106	2	6-Jun-86
GSW-001A	Monitor	12-Jun-86	208	133	115-133	3A	NA
GSW-002	Monitor	14-Feb-85	113	107	87-107	2	NA
GSW-003	Monitor	7-Feb-85	115	105	85-105	2	NA
GSW-005	Monitor	19-Mar-85	110	104	94-104	2	NA
GSW-010	Monitor	29-Apr-86	205.5	127.5	114-127.5	3A	28-Jan-98
GSW-012	Monitor	27-May-86	205	191	186.5-191	5	NA
GSW-014	Monitor	17-Jul-86	141	NA	NA	NA	1-Nov-92
GSW-015	Monitor	14-Aug-87	148	145	20.5-28	1B/2/3A	NA
					38-44		
					50-56		
					60-64		
					68-73		
					77-83		
					95-105		
					120-130		
GSW-020	Monitor	18-May-84	134	101.3	95-101.3	2	3-Sep-87
GSW-208	Monitor	6-Feb-86	211	123	108-118	3A	NA
GSW-209	Monitor	27-Feb-86	204	135.2	112.8-132.8	3A	15-Aug-94
GSW-403-6	Monitor	11-May-84	138	100	90-110	2	NA
IMS-518-1616	IMS	16-Aug-00	55	NA	3-3.5	NA	31-May-07
					8-8.5		
					13-13.5		
					18-18.5		
					23-23.5		
					28-28.5		
					33.33.5		
					38-38.5		
					43-43.5		

Table A-2. Well closure data, LLNL Livermore Site and vicinity, Livermore, California.

Well number	Well type	Date installed	Borehole depth (ft)	Casing depth (ft)	Screen interval(s) (ft)	HSU monitored	Closure date
					48-48.5		
SEA-518-301	SEAMIST	22-Jun-95	102.6	39.3	1	NA	4-Jun-07
SEA-518-304	SEAMIST	11-Sep-95	104.5	NA	1	NA	31-May-07
SEA-ETS-305	SEAMIST	2-Sep-92	85	NA	1	NA	30-May-07
SEA-ETS-506	SEAMIST	24-Jul-96	75	75	NA	1B/2	29-May-07
SEA-ETS-507	SEAMIST	30-Jul-96	75	75	7-8	1B/2	27-Apr-06
					20-21	1B/2	
					25-26	1B/2	
					32-33	1B/2	
					38-39	1B/2	
					47-48	1B/2	
					52-53	1B/2	
					59-60	1B/2	
SIB-INF-001	NA	NA	67	66.8	NA	NA	7-Jan-10
SIB-INF-002	NA	NA	67	66.4	NA	NA	7-Jan-10
SIB-INF-003	NA	NA	67	66	NA	NA	7-Jan-10
SIB-INF-008	NA	NA	92	91.9	NA	NA	6-Jan-10
SIB-INF-009	NA	NA	92	92	NA	NA	6-Jan-10
SIB-INF-010	NA	NA	95	81.8	NA	NA	6-Jan-10
SIB-INF-012	NA	NA	16	11.2	NA	NA	7-Jan-10
SIB-INF-103	NA	NA	103.5	91.5	NA	NA	6-Jan-10
SIB-INF-104	NA	NA	92	91.7	NA	NA	6-Jan-10
SIB-INF-201	NA	NA	87.4	85.7	NA	NA	6-Jan-10
SIB-INF-203	NA	NA	63	62.7	NA	NA	7-Jan-10
SIB-INF-301	Piezometer	NA	NA	95	NA	NA	21-Dec-09
SIP-INF-011	Monitor	Apr-97	93.4	92	NA	NA	23-Dec-09
SIP-INF-101	Piezometer	NA	NA	95	NA	NA	23-Dec-09
SIP-INF-102	Piezometer	NA	NA	90	NA	NA	23-Dec-09
SIP-INF-202	Piezometer	NA	NA	85	NA	NA	23-Dec-09
SIP-INF-302	Monitor	Mar-95	NA	89	NA	NA	23-Dec-09
SIP-419-201	Piezometer	29-Feb-96	126	107	97-107	3A/3B	NA
SIP-490-101	Piezometer	1-Nov-95	59	56	53–56	2	21-Dec-95
SIP-514-101	Piezometer	28-Dec-89	26	22	7-22	1B	3-Sep-96
SVB-518-303	Monitor	29-Jun-95	104.5	40	6-40	1B/2	15-Oct-03
SIP-ETC-302	Piezometer	22-Apr-99	104	89.4	79–89	2	26-Apr-99
SIP-ETS-105	Piezometer	11-Dec-90	110	103	87-103	3A	6-Dec-93

Table A-2. Well closure data, LLNL Livermore Site and vicinity, Livermore, California.

Well number	Well type	Date installed	Borehole depth (ft)	Casing depth (ft)	Screen interval(s) (ft)	HSU monitored	Closure date
SIP-ETS-207	Piezometer	11-Jul-91	103	98.5	89.75-98.5	3A	5-Jan-00
SIP-HPA-102	Piezometer	8-Dec-94	76	72	67-72	2	9-Apr-02
SIP-HPA-103	Piezometer	1-Mar-95	77	73.5	67-72.5	2	9-Apr-02
SIP-INF-011	NA	NA	NA	92	NA	NA	23-Dec-09
SIP-INF-202	NA	NA	NA	85	NA	NA	23-Dec-09
SIP-INF-301	NA	NA	NA	95	NA	NA	23-Dec-09
SIP-INF-302	NA	NA	NA	89	NA	NA	23-Dec-09
SIP-PA-029	Piezometer	22-Jan-90	11.5	7	5-7	1B	18-Nov-93
TOM-001	Tomography	NA	NA	52	NA	NA	17-Dec-09
TOM-002	Tomography	NA	NA	55	NA	NA	17-Dec-09
TOM-003	Tomography	NA	NA	55	NA	NA	17-Dec-09
TOM-004	Tomography	NA	NA	54.6	NA	NA	17-Dec-09
TOM-005	Tomography	NA	NA	55	NA	NA	16-Dec-09
TOM-006	Tomography	NA	NA	55	NA	NA	16-Dec-09
TOM-007	Tomography	NA	NA	55	NA	NA	23-Dec-09
UP-292-001	Piezometer	7-Jan-91	54.5	49.5	44.5-49.5	1B	25-Sep-95
W-010A	Monitor	8-Sep-80	110.7	110	85-95	2	26-Feb-02
					100-105		
W-014A	Monitor	26-Aug-80	112.8	109	NA	2	11-Dec-87
					NA	2	
					NA	2	
W-015	Monitor	17-Nov-80	285	267	239-265	7	13-May-88
W-018	Monitor	22-Aug-80	161	152	80-90	2	11-Nov-85
					100-105	2	
					112-117	3A	
					128-133	5	
					143-152	5	
W-019	Monitor	19-Sep-80	164.8	161	147-157	7	22-Jun-06
W-149	Monitor	23-Aug-85	201	169	161-169	2	3-Sep-96
W-150	Monitor	13-Sep-85	212	162	157-162	2	11-Apr-90
W-211	Monitor	19-Mar-86	215.5	193	183-193	7	13-Jun-02
W-352	Monitor	29-Oct-86	235	201	181-201	4	5-Jan-98
W-358	Monitor	4-Feb-87	248	239	230-239	7	13-Apr-94
W-360	Monitor	24-Feb-87	260	204.5	181.5-204.5	4	26-Feb-02
W-414	Monitor	20-May-88	179	74	69.5-74	2	26-Feb-02
W-456	Monitor	9-Jun-88	343	180.5	172-180.5	3A	15-Nov-00

Table A-2. Well closure data, LLNL Livermore Site and vicinity, Livermore, California.

Well number	Well type	Date installed	Borehole depth (ft)	Casing depth (ft)	Screen interval(s) (ft)	HSU monitored	Closure date
W-460	Monitor	22-Jul-88	361	140.5	135-140.5	2	15-Nov-00
W-508	Monitor	17-Feb-89	316	306	287-305	7	NA
W-591	Monitor	29-Nov-88	112	107.5	97-107.5	2	18-Apr-06
W-1005	Monitor	14-Mar-94	192	110	98-110	1B	13-Nov-00
W-1006	Monitor	10-Mar-94	154	149	141-149	2	14-Nov-00
W-1007	Monitor	31-Mar-94	199.5	182	172-182	3A	14-Nov-00
W-1114	Monitor	7-Aug-95	223	205	177-200	5	23-Apr-97
W-1218	Monitor	29-May-96	240	145.5	127-145	3A	27-Feb-02
W-1220	Monitor	12-Jun-96	120	117	90-112	2	27-Feb-02
W-1221	Monitor	1-Jul-96	220	172	162-172	4	28-Feb-02
TEP-GP-001	Dynamic Stripping	15-Jan-92	165	160.5	NA	NA	9-Feb-93
				117	107-117	2/3A	
				160.5	NA	NA	
TEP-GP-002	Dynamic Stripping	24-Jun-92	161.4	NA	102-112.5	2/3A	13-Feb-93
				133	122-133	3A	
				161	NA	NA	
TEP-GP-003	Dynamic Stripping	28-Jan-92	161	129.5	124.5-129.5	3A	13-Feb-93
				161	NA	NA	
TEP-GP-004	Dynamic Stripping	5-Feb-92	161	106	96-106	2	13-Feb-93
				134	124-134	3A	
				161	NA	NA	
TEP-GP-005	Dynamic Stripping	18-Feb-92	161	124.5	114.5-124.5	3A	13-Feb-93
				161	NA	NA	
TEP-GP-006	Dynamic Stripping	26-Feb-92	161	127	107-127	2/3A	13-Feb-93
				161	NA	NA	
TEP-GP-007	Dynamic Stripping	13-Mar-92	161	125.5	115.5-125.5	3A	13-Feb-93
				161	NA	NA	
TEP-GP-008	Dynamic Stripping	3-Mar-92	161	110	100-110	2	13-Feb-93
				129	119-129	3A	
				161	NA	NA	
TEP-GP-009	Dynamic Stripping	6-May-92	161.7	107	98-107	2	13-Feb-93
				130.5	120.5-130.5	3A	
				161	NA	NA	
TEP-GP-010	Dynamic Stripping	24-Mar-92	161	124.5	114.5-124.5	3A	12-Feb-93
				161	NA	NA	
TEP-GP-011	Dynamic Stripping	7-Apr-92	161	108	98-108	2	13-Feb-93

Table A-2. Well closure data, LLNL Livermore Site and vicinity, Livermore, California.

Well number	Well type	Date installed	Borehole depth (ft)	Casing depth (ft)	Screen interval(s) (ft)	HSU monitored	Closure date
				161	NA	NA	
TEP-GP-106	Dynamic Stripping	21-Sep-93	137.5	135.5	NA	NA	NA
CPRS-02	Anode Well	NA	290	NA	NA	NA	
CPRS-03 (B482)	Anode Well	NA	180	NA	NA	NA	26-Sep-03
CPRS-06 (B543)	Anode Well	NA	NA	NA	NA	NA	29-Aug-06
CPS-1-325CT (B323)	Anode Well	24-Feb-77	290	NA	NA	NA	30-Oct-03
CPS-622	Anode Well	14-Feb-77	290	NA	NA	NA	15-Jan-04
CPS SC-5	Anode Well	NA	290	NA	NA	NA	21-Jul-05
W-1218	Monitor	29-May-96	240	145.5	127-145	3A	27-Feb-02
W-1220	Monitor	12-Jun-96	120	117	90-112	2	27-Feb-02
W-1221	Monitor	1-Jul-96	220	172	162-172	4	20-Feb-02

Notes:

ft = Feet.
HSU = Hydrostratigraphic unit.
NA = Not available.

Well numbers were changed in December 1988 to be consistent with Alameda County Flood Control and Water. Conservation District, Zone 7 well identification. Well number changes made on this table are:

11J81 ------> 11J4
11R81 ------> 11R5
11Q81 ------> 11Q6
13D81 ------> 13D1
14A81 ------> 14A1
14A82 ------> 14A2
14A83 ------> 14A4

Well 11A5 was renamed 2R9 by the Alameda County Flood Control and Water Conservation District, Zone 7 in November 1997. Well 11A5 now applies to monitor well W-409.

"Other non-LLNL" refers to agricultural, private or agency wells.

Piezometer SVI-518-303 was drilled out and replaced by well SVW-518-1915.

Temperature monitoring wells (TEP series) consist of a blank fiberglass 2-in. inside diameter (ID) casing instrumented with geophysical sensors. The blank fiberglass casing has no screened interval. Some boreholes also had one or two 1-inch piezometers installed adjacent to the blank casing. Therefore, the casing depths with accompanying screened intervals refer to the piezometers.

[a] **Well 11BA not recognized by Alameda County Flood Control and Water Conservation District, Zone 7.**

Appendix B

Hydraulic Test Results

Table B-1. Results of hydraulic tests[a].

Well	Date	Type of test[b]	Flow rate (Q) (gpm)	Transmissivity (T) (gpd/ft)	Hydraulic conductivity (K)[c] (gpd/sq ft)	Data quality[d]
W-001	1-Dec-83	Drawdown	5.7	2,000	110	Fair
W-001	23-Jan-85	Drawdown	7.1	3,100	170	Good
W-001A	22-Jan-85	Drawdown	1.4	190	19	Good
W-002	1-Dec-83	Slug	NA	110	34	Poor
W-002A	24-Jan-85	Drawdown	10.3	2,700	200	Good
W-004	1-Dec-83	Drawdown	3.3	63	13	Good
W-005	1-Dec-83	Drawdown	4.3	110	20	Good
W-005	24-Jan-85	Drawdown	7.9	1,100	210	Fair
W-005A	23-Jan-85	Drawdown	13.0	1,300	130	Poor
W-007	1-Dec-83	Slug	NA	43	14	Fair
W-008	1-Dec-83	Drawdown	2.9	29	4.9	Fair
W-011	1-Dec-83	Drawdown	4.1	130	15	Good
W-017	1-Dec-83	Slug	NA	38	2.5	Good
W-017	21-Feb-86	Slug	NA	85	5.7	Good
W-018	1-Dec-83	Drawdown	2.6	20	2.7	Poor
W-102	25-Mar-86	Drawdown	6.4	1,100	76	Good
W-102	5-Sep-86	Drawdown	24.0	770	53	Good
W-102	15-Sep-86	Longterm	27.5	4,200	290	Good
W-103	25-Apr-86	Drawdown	6.7	15,000	1,500	Good
W-104	3-Mar-88	Drawdown	5.4	1,200	170	Fair
W-104	25-Mar-88	Drawdown	3.3	450	45	Fair
W-105	6-Apr-87	Drawdown	0.8	73	7.3	Fair
W-106	19-Feb-86	Slug	NA	7.4	1.3	Excel
W-107	17-Jun-85	Drawdown	1.0	94	9.4	Poor
W-108	29-Oct-85	Drawdown	7.9	750	63	Poor
W-109	5-Mar-86	Drawdown	8.1	3,200	530	Good
W-109	4-Sep-87	Drawdown	20.0	1,600	270	Good
W-109	29-Sep-87	Longterm	11.6	130	22	Fair
W-109	16-Oct-87	Drawdown	8.0	2,300	380	Fair
W-110	18-Jun-85	Drawdown	5.0	1,300	130	Good
W-111	13-Jun-85	Drawdown	1.0	370	37	Good
W-111	21-Nov-85	Drawdown	1.0	370	37	Good
W-112	18-Nov-86	Drawdown	13.4	2,100	170	Fair
W-112	15-Dec-86	Longterm	13.2	3,100	260	Fair
W-112	5-Nov-96	Longterm	13.7	3,300	260	Fair

Table B-1. Results of hydraulic tests[a].

Well	Date	Type of test[b]	Flow rate (Q) (gpm)	Transmissivity (T) (gpd/ft)	Hydraulic conductivity (K)[c] (gpd/sq ft)	Data quality[d]
W-113	17-Apr-86	Slug	NA	7.4	1.2	Excel
W-115	5-Mar-86	Drawdown	1.1	180	30	Good
W-116	24-Dec-85	Slug	NA	37	7.5	Good
W-117	20-Feb-86	Slug	NA	2	0.4	Good
W-118	18-Sep-85	Drawdown	16	1,200	120	Poor
W-118	27-Sep-85	Drawdown	13	1,900	190	Poor
W-118	5-Mar-86	Drawdown	10.0	2,100	230	Good
W-119	8-Aug-85	Drawdown	2.0	1,600	110	Good
W-120	22-Apr-86	Drawdown	1.1	23	5.6	Poor
W-121	10-Sep-85	Drawdown	2.0	120	7.5	Good
W-121	23-Sep-85	Drawdown	4.0	23	1.5	Excel
W-121	14-Oct-85	Drawdown	3.0	34	2.2	Excel
W-121	15-Oct-85	Drawdown	4.5	45	3.0	Excel
W-122	28-Oct-85	Drawdown	10.8	490	49	Good
W-123	28-Oct-85	Drawdown	5.8	40	4.4	Poor
W-142	3-Mar-88	Slug	NA	2,600	330	Excel
W-143	3-Mar-88	Slug	NA	1,200	240	Excel
W-149	9-Sep-85	Drawdown	4.0	120	19	Good
W-149	11-Sep-85	Drawdown	8.0	95	16	Excel
W-149	11-Oct-85	Drawdown	4.8	58	9.7	Excel
W-149	11-Oct-85	Drawdown	7.0	70	12	Good
W-150	2-Oct-85	Drawdown	3.1	640	210	Fair
W-150	3-Oct-85	Drawdown	6.0	720	240	Fair
W-150	10-Oct-85	Drawdown	8.8	630	210	Fair
W-150	10-Oct-85	Drawdown	12.0	620	210	Fair
W-151	28-Oct-85	Drawdown	5.8	550	61	Poor
W-201	5-Mar-86	Drawdown	10.0	740	86	Excel
W-203	2-Mar-88	Drawdown	6.6	1,100	110	Good
W-204	23-Jan-86	Drawdown	1.9	100	15	Fair
W-205	14-Feb-86	Slug	NA	5.9	1.9	Good
W-205	18-Feb-86	Slug	NA	5.9	1.9	Good
W-206	14-Apr-86	Slug	NA	120	11	Good
W-206	27-Sep-93	Drawdown	0.19	3.0	0.20	Fair
W-206	18-Oct-93	Drawdown	0.3	4.0	0.30	Fair
W-207	2-Mar-88	Slug	NA	380	32	Excel

Table B-1. Results of hydraulic tests[a].

Well	Date	Type of test[b]	Flow rate (Q) (gpm)	Transmissivity (T) (gpd/ft)	Hydraulic conductivity (K)[c] (gpd/sq ft)	Data quality[d]
W-210	9-Jun-86	Slug	NA	0.6	0.1	Good
W-211	22-Oct-86	Drawdown	2.9	37	12	Fair
W-211	8-Dec-86	Longterm	1.0	44	15	Fair
W-211	16-Sep-97	Longterm	1.1	14	1.4	Good
W-212	12-May-86	Drawdown	0.8	18	3.1	Poor
W-213	22-Apr-86	Drawdown	3.8	190	38	Good
W-214	7-Oct-86	Longterm	27.6	2,300	350	Good
W-217	15-Jul-86	Slug	NA	750	120	Good
W-218	17-Jun-86	Drawdown	11.7	6,400	1,100	Good
W-218	12-Nov-86	Longterm	7.7	4,000	670	Good
W-219	15-Jul-86	Drawdown	4.3	620	76	Good
W-219	23-Feb-87	Longterm	5.2	66	8.0	Fair
W-220	21-Aug-86	Slug	NA	28	5.5	Excel
W-221	5-Aug-86	Drawdown	2.1	120	16	Fair
W-222	12-Aug-86	Drawdown	16.0	1,700	160	Excel
W-222	8-Mar-85	Longterm	7.7	1,100	180	Good
W-223	27-Aug-86	Drawdown	4.0	510	110	Good
W-224	28-Oct-86	Drawdown	7.6	3,600	400	Excel
W-225	23-Oct-86	Drawdown	4.0	85	11	Good
W-225	12-Jan-87	Longterm	2.0	62	8.5	Fair
W-226	31-Mar-87	Slug	NA	1,700	160	Fair
W-252	4-Nov-85	Drawdown	4.0	920	50	Fair
W-252	19-Nov-85	Drawdown	5.6	800	43	Fair
W-254	27-Jan-86	Drawdown	4.2	340	38	Fair
W-254	27-Feb-86	Drawdown	3.2	370	41	Good
W-255	21-Jan-86	Drawdown	5.0	2,800	250	Fair
W-255	21-Jan-86	Drawdown	6.0	2,000	180	Fair
W-255	6-Jan-87	Longterm	2.0	400	36	Fair
W-256	11-Apr-86	Slug	NA	11	5.5	Good
W-257	15-Apr-86	Slug	NA	120	24	Good
W-258	5-Jun-86	Slug	NA	35	9.0	Excel
W-258	29-Oct-86	Slug	NA	32	8.0	Good
W-259	26-Mar-88	Slug	NA	15	5.0	Good
W-260	25-Mar-86	Drawdown	3.0	140	22	Good
W-260	1-Oct-86	Longterm	1.4	120	18	Good

Table B-1. Results of hydraulic tests[a].

Well	Date	Type of test[b]	Flow rate (Q) (gpm)	Transmissivity (T) (gpd/ft)	Hydraulic conductivity (K)[c] (gpd/sq ft)	Data quality[d]
W-261	27-May-86	Slug	0.0	7	2.3	Excel
W-262	11-Apr-86	Drawdown	12.5	2,000	250	Excel
W-262	23-Sep-86	Longterm	22.0	2,750	340	Good
W-262	27-Apr-87	Longterm	23.1	6,800	810	Good
W-263	22-Apr-86	Drawdown	1.2	37	7.4	Poor
W-263	4-Nov-86	Longterm	1.8	76	15	Excel
W-264	7-May-86	Drawdown	8.1	930	100	Good
W-264	29-Oct-86	Longterm	23.0	480	50	Good
W-265	19-May-86	Drawdown	0.7	180	34	Fair
W-267	2-Jun-86	Drawdown	0.5	420	85	Poor
W-268	14-Nov-86	Drawdown	5.0	230	18	Good
W-269	14-Jul-86	Drawdown	5.0	570	95	Good
W-270	30-Dec-86	Slug	NA	14	2.0	Good
W-271	4-Aug-86	Drawdown	5.5	340	76	Fair
W-272	19-Aug-86	Drawdown	0.8	150	30	Fair
W-273	27-Aug-86	Drawdown	3.2	600	90	Good
W-274	25-Mar-85	Slug	NA	38	7.6	Fair
W-274	2-Feb-99	Slug	NA	10	2	Fair
W-275	30-Oct-86	Drawdown	7.0	730	150	Fair
W-275	2-Mar-87	Longterm	5.5	830	170	Fair
W-276	21-Nov-86	Drawdown	13.0	960	110	Good
W-276	04-May-87	Longterm	24.0	2,700	300	Fair
W-277	3-Nov-86	Drawdown	0.9	74	25	Fair
W-290	5-Jan-87	Slug	NA	14	4.0	Excel
W-291	27-Jan-87	Slug	NA	25	7.1	Fair
W-292	28-Aug-86	Drawdown	6.0	400	56	Excel
W-294	29-Dec-86	Drawdown	5.3	5,300	29	Fair
W-294	29-Dec-86	Drawdown	5.9	5,400	300	Good
W-301	30-Oct-86	Drawdown	6.0	460	100	Good
W-302	18-Nov-86	Drawdown	1.0	100	27	Good
W-302	18-Nov-86	Drawdown	2.0	76	21	Fair
W-303	12-Nov-86	Drawdown	11.1	210	70	Good
W-304	13-Mar-87	Drawdown	0.9	74	25	Fair
W-305	26-Nov-86	Drawdown	19.0	720	72	Excel
W-305	18-May-87	Longterm	20.1	640	64	Excel

Table B-1. Results of hydraulic tests[a].

Well	Date	Type of test[b]	Flow rate (Q) (gpm)	Transmissivity (T) (gpd/ft)	Hydraulic conductivity (K)[c] (gpd/sq ft)	Data quality[d]
W-306	31-Mar-87	Drawdown	9.5	270	68	Good
W-307	26-Mar-87	Drawdown	0.9	66	33	Fair
W-308	4-Dec-87	Drawdown	2.6	27	5.4	Good
W-310	17-Feb-87	Drawdown	6.7	58	850	Good
W-311	19-Mar-87	Drawdown	9.8	130	12	Good
W-311	17-Nov-87	Longterm	9.9	370	26	Good
W-312	27-Mar-87	Drawdown	20.5	1,800	300	Poor
W-312	3-Nov-87	Longterm	18.8	1,700	280	Good
W-313	25-Mar-87	Drawdown	7.9	3,000	600	Good
W-313	5-Oct-87	Longterm	9.6	3,400	680	Good
W-314	10-Apr-87	Drawdown	26.4	2,900	390	Good
W-314	13-Jul-87	Longterm	13.6	2,500	330	Fair
W-314	14-Oct-97	Longterm	12	1,400	100	Fair
W-315	9-Apr-87	Drawdown	15.4	150	11	Good
W-315	5-Jan-85	Longterm	24.5	571	41	Excel
W-316	4-May-87	Drawdown	7.8	1,400	280	Good
W-317	12-May-87	Drawdown	12.1	300	43	Fair
W-317	15-Dec-87	Longterm	8.2	120	17.1	Good
W-318	7-Aug-87	Slug	NA	120	16	Good
W-319	29-Jul-87	Drawdown	48.0	7,200	1,500	Good
W-320	15-May-87	Drawdown	1.8	58	17	Fair
W-320	15-May-87	Drawdown	3.0	22	3.7	Fair
W-320	26-Jun-87	Drawdown	2.1	49	14	Fair
W-321	28-Jul-87	Drawdown	40.0	6,600	450	Good
W-322	3-Aug-87	Drawdown	3.1	85	15	Good
W-323	11-Aug-87	Drawdown	3.4	205	59	Good
W-324	10-Sep-87	Drawdown	6.6	200	50	Good
W-325	10-Sep-87	Drawdown	6.0	160	13	Excel
W-351	12-Nov-86	Drawdown	5.7	27	14	Poor
W-351	20-Jun-09	Step	2.7	200	34	Good
W-352	30-Dec-86	Drawdown	20.0	280	14	Good
W-352	7-Jul-87	Longterm	19.5	120	6.0	Excel
W-353	20-Nov-86	Drawdown	2.1	60	17	Good
W-354	30-Dec-86	Drawdown	17.6	2,000	220	Fair
W-354	30-Dec-86	Drawdown	18.0	2,400	260	Good

Table B-1. Results of hydraulic tests[a].

Well	Date	Type of test[b]	Flow rate (Q) (gpm)	Transmissivity (T) (gpd/ft)	Hydraulic conductivity (K)[c] (gpd/sq ft)	Data quality[d]
W-354	20-Apr-87	Longterm	17.8	310	34	Good
W-355	29-Dec-86	Drawdown	2.1	19	5.0	Fair
W-356	17-Mar-87	Drawdown	5.7	180	59	Good
W-356	16-Jul-96	Longterm	4.9	230	57	Poor
W-357	18-Feb-87	Drawdown	15.0	1,300	110	Good
W-357	21-Jul-87	Longterm	9.2	210	18	Good
W-358	18-Mar-87	Drawdown	9.2	210	32	Excel
W-359	9-Mar-87	Longterm	19.0	2,800	290	Fair
W-359	20-Mar-87	Drawdown	18.6	1,100	110	Good
W-359	5-Jun-09	Drawdown	10	1,200	95	Fair
W-360	22-May-87	Drawdown	30.0	4,800	210	Excel
W-361	16-Mar-87	Drawdown	4.3	67	11	Good
W-361	12-Jan-85	Longterm	5.3	178	30	Good
W-362	23-Mar-87	Drawdown	16.4	470	49	Good
W-362	21-Sep-87	Longterm	13.6	370	39	Good
W-363	24-Jul-87	Slug	NA	20	3.0	Excel
W-364	8-Apr-87	Drawdown	8.6	51	10	Fair
W-364	1-Jun-87	Longterm	4.8	110	22	Good
W-365	14-May-87	Drawdown	10.0	36	15	Fair
W-366	11-May-87	Drawdown	19.0	780	92	Fair
W-368	11-May-87	Drawdown	2.9	81	8.5	Fair
W-368	31-Jul-01	Step	6.0	2,600	350	Fair
W-368	15-Apr-09	Step	3.8	410	51	Fair
W-369	25-Jun-87	Drawdown	7.0	580	96	Good
W-369	10-Nov-87	Longterm	5.5	89	18	Good
W-370	23-Jun-87	Drawdown	4.4	84	10	Fair
W-371	24-Jun-87	Drawdown	3.3	15	3.0	Good
W-372	23-Nov-87	Slug	NA	310	62	Excel
W-373	28-Jul-87	Drawdown	4.0	660	77	Fair
W-373	28-Jul-87	Drawdown	6.5	50	6.0	Poor
W-376	26-Jan-88	Drawdown	2.9	65	8.5	Fair
W-380	23-Oct-87	Drawdown	4.0	33	4.7	Excel
W-401	23-Oct-87	Drawdown	42.0	950	24	Excel
W-402	22-Oct-87	Drawdown	41.0	13,500	1,400	Good
W-403	3-Dec-87	Drawdown	9.7	370	26	Good

Table B-1. Results of hydraulic tests[a].

Well	Date	Type of test[b]	Flow rate (Q) (gpm)	Transmissivity (T) (gpd/ft)	Hydraulic conductivity (K)[c] (gpd/sq ft)	Data quality[d]
W-404	4-Feb-85	Drawdown	45.0	3,200	530	Good
W-405	16-Feb-85	Drawdown	47.2	546	14	Good
W-406	28-Jan-85	Drawdown	7.4	7,500	940	Fair
W-407	23-Feb-85	Drawdown	14.4	75	7.5	Fair
W-408	5-Apr-85	Drawdown	45.0	43,000	3,100	Good
W-409	22-Mar-85	Drawdown	20.0	230	38	Good
W-410	28-Apr-85	Drawdown	35.0	6,800	570	Fair
W-411	5-May-85	Drawdown	14.0	50	83	Good
W-412	6-May-88	Drawdown	4.1	700	64	Fair
W-413	30-Aug-01	Drawdown	20.0	9,400	790	Good
W-413	15-Apr-09	Step	10	5,500	370	Good
W-414	27-Jul-85	Slug	NA	150	38	Good
W-415	31-Aug-85	Drawdown	10.0	3,100	78	Fair
W-416	11-Jul-85	Drawdown	50.0	2,600	330	Good
W-417	27Jun-88	Drawdown	5.3	340	57	Fair
W-420	16-Aug-85	Drawdown	3.5	710	100	Excel
W-421	12-Sep-85	Drawdown	4.8	320	27	Excel
W-422	19-Sep-85	Drawdown	8.6	230	42	Good
W-423	12-Oct-85	Drawdown	22.0	1,500	130	Good
W-424	17-Oct-85	Drawdown	4.5	130	19	Good
W-441	30-Oct-87	Drawdown	6.0	500	56	Good
W-441	13-Apr-88	Drawdown	13.0	2,200	240	Poor
W-441	19-Apr-88	Longterm	14.0	470	52	Good
W-447	26-Feb-88	Drawdown	7.1	124	850	Poor
W-448	24-Mar-85	Drawdown	24.5	4,200	600	Good
W-449	21-Mar-85	Drawdown	6.2	170	11	Good
W-450	14-Apr-88	Drawdown	3.3	38	650	Fair
W-451	27-Apr-88	Drawdown	2.1	80	16	Good
W-452	2-May-88	Drawdown	5.2	310	21	Excel
W-453	3-May-88	Drawdown	5.8	67	7.4	Fair
W-455	22-Jun-88	Drawdown	5.8	160	13	Good
W-456	14-Jul-85	Drawdown	4.5	260	33	Fair
W-457	29-Jul-85	Drawdown	20.5	450	24	Excel
W-458	2-Aug-85	Drawdown	0.8	24	150	Fair
W-460	1-Sep-85	Drawdown	17.0	1,900	380	Fair

Table B-1. Results of hydraulic tests[a].

Well	Date	Type of test[b]	Flow rate (Q) (gpm)	Transmissivity (T) (gpd/ft)	Hydraulic conductivity (K)[c] (gpd/sq ft)	Data quality[d]
W-461	7-Sep-85	Slug	NA	690	140	Good
W-462	27-Sep-85	Drawdown	19.0	360	60	Good
W-463	11-Oct-85	Drawdown	24.0	1,600	200	Good
W-464	8-Nov-88	Drawdown	9.0	370	53	Good
W-481	2-Dec-87	Drawdown	1.1	8	1.7	Good
W-486	23-Mar-85	Drawdown	6.0	230	30	Good
W-487	14-Apr-88	Drawdown	2.2	45	15	Good
W-501	21-Oct-85	Drawdown	9.7	170	21	Good
W-502	14-Nov-85	Slug	NA	12	30	Good
W-503	11-Nov-88	Drawdown	1.3	15	3.0	Fair
W-504	8-Dec-85	Drawdown	10.0	590	84	Good
W-505	21-Mar-89	Drawdown	34.2	653	76	Good
W-506	10-Feb-89	Drawdown	31.0	7,423	460	Good
W-507	6-Feb-89	Drawdown	39.0	2,900	290	Good
W-508	29-Mar-89	Drawdown	30.0	47,000	2,600	Good
W-509	11-May-89	Drawdown	0.9	10	2.0	Fair
W-510	11-May-89	Slug	NA	220	110	Good
W-511	11-May-89	Drawdown	1.7	63	11	Fair
W-512	27-Apr-89	Drawdown	2.9	85	9.4	Good
W-513	9-May-89	Drawdown	0.6	33	3.0	Fair
W-514	26-May-89	Drawdown	1.4	84	530	Fair
W-515	6-Jun-89	Drawdown	2.8	37	4.2	Fair
W-516	19-Jun-89	Drawdown	19.5	1,428	286	Good
W-517	27-Jun-89	Drawdown	7.3	370	53	Good
W-518	10-Aug-89	Drawdown	6.2	1,421	178	Good
W-519	31-Aug-89	Drawdown	31.5	5,700	475	Excel
W-520	24-Jan-90	Drawdown	22.8	3,300	560	Excel
W-521	1-Feb-90	Drawdown	0.6	44	4.9	Fair
W-522	5-Feb-90	Drawdown	20.0	3,700	620	Fair
W-551	8-Nov-85	Drawdown	37.0	350	88	Good
W-552	12-Dec-88	Drawdown	38.0	4,700	390	Good
W-553	17-Nov-85	Drawdown	2.2	55	7.9	Fair
W-554	10-Jan-89	Drawdown	21.5	1,800	150	Good
W-555	28-Dec-88	Drawdown	14.0	460	23	Fair
W-556	25-Jan-89	Drawdown	17.0	850	170	Fair

Table B-1. Results of hydraulic tests[a].

Well	Date	Type of test[b]	Flow rate (Q) (gpm)	Transmissivity (T) (gpd/ft)	Hydraulic conductivity (K)[c] (gpd/sq ft)	Data quality[d]
W-557	23-Jan-89	Drawdown	1.2	570	36	Poor
W-558	23-Mar-89	Drawdown	24.7	5,200	650	Good
W-560	8-Mar-89	Drawdown	1.7	30	7.6	Fair
W-561	13-Mar-89	Drawdown	1.1	12	2.1	Fair
W-562	28-Mar-89	Drawdown	1.0	16	2.3	Fair
W-563	31-Mar-89	Drawdown	1.1	14	2.3	Fair
W-564	26-Apr-89	Drawdown	1.6	44	5.0	Poor
W-565	18-Apr-89	Drawdown	15.6	1,600	260	Good
W-566	2-May-89	Drawdown	17.0	780	86	Good
W-566	31-Aug-93	Longterm	22.5	2,580	520	Fair
W-566	11-Aug-09	Step	8.2	860	86	Good
W-567	4-May-89	Drawdown	10.4	2,600	320	Excel
W-568	20-Jun-89	Drawdown	18.3	620	160	Fair
W-569	24-May-89	Drawdown	2.8	100	15	Fair
W-570	8-Jun-89	Drawdown	1.1	7	1.1	Fair
W-571	17-Jul-89	Drawdown	17.7	1,000	200	Excel
W-592	23-Jan-89	Drawdown	2.2	2,200	280	Poor
W-593	22-Feb-89	Drawdown	2.2	57	11.4	Good
W-594	16-Mar-89	Slug	NA	380	54	Excel
W-601	8-Feb-90	Drawdown	22.5	6,900	770	Excel
W-602	29-Jan-90	Drawdown	24.0	5,300	620	Good
W-603	7-Feb-90	Drawdown	6.1	100	20	Fair
W-604	20-Feb-90	Slug	NA	380	63	Good
W-605	28-Feb-90	Drawdown	4.8	50	12	Good
W-606	21-Feb-90	Slug	NA	120	20	Fair
W-607	22-Feb-90	Drawdown	1.4	800	100	Good
W-608	28-Feb-90	Drawdown	1.2	230	30	Fair
W-609	9-Mar-90	Drawdown	6.7	470	70	Good
W-610	28-Mar-90	Drawdown	5.8	5,500	380	Good
W-611	16-Apr-90	Drawdown	3.5	1,000	110	Fair
W-612	24-May-90	Drawdown	13.5	550	55	Good
W-612	5-Apr-94	Longterm	14	230	40	Good
W-613	23-May-90	Drawdown	4.8	2,550	360	Good
W-614	7-Jun-90	Drawdown	6.7	1,650	130	Good
W-615	21-Jun-90	Drawdown	1.3	130	19	Fair

Table B-1. Results of hydraulic tests[a].

Well	Date	Type of test[b]	Flow rate (Q) (gpm)	Transmissivity (T) (gpd/ft)	Hydraulic conductivity (K)[c] (gpd/sq ft)	Data quality[d]
W-616	27-Jun-90	Drawdown	2.0	390	40	Fair
W-617	12-Jul-90	Drawdown	2.8	53	6.8	Good
W-618	1-Aug-90	Drawdown	1.9	24	4.8	Fair
W-619	30-Aug-90	Drawdown	11.8	190	11	Good
W-620	1-Oct-90	Drawdown	5.8	6,500	650	Good
W-621	4-Oct-90	Drawdown	3.8	310	39	Good
W-622	12-Oct-90	Slug	NA	130	16	Fair
W-651	16-Mar-90	Slug	NA	530	180	Fair
W-652	22-Mar-90	Drawdown	1.0	11	3.8	Good
W-653	11-Apr-90	Drawdown	0.3	2	2.0	Fair
W-653	16-Mar-05	Drawdown	0.45	1.0	1.0	Good
W-654	25-Apr-90	Drawdown	21.7	390	25	Fair
W-655	12-May-90	Drawdown	12.2	1,000	220	Good
W-701	23-Oct-90	Drawdown	14.5	6,800	650	Good
W-701	3-Oct-92	Step	16.5	5,200	430	Good
W-701	1-Apr-93	Drawdown	24.0	3,700	370	Good
W-702	29-Nov-90	Drawdown	2.5	150	30	Good
W-702	25-Feb-93	Step	4.6	36	7	Poor
W-703	19-Dec-90	Drawdown	7.0	230	9.1	Good
W-704	4-Mar-91	Drawdown	19.0	1,800	140	Fair
W-705	20-Feb-91	Drawdown	0.8	40	6.1	Fair
W-706	29-Jan-91	Drawdown	0.2	8	1	Fair
W-712	25-Feb-92	Drawdown	7.8	750	48	Good
W-712	18-Mar-93	Longterm	15.1	1,440	93	Good
W-714	6-Dec-91	Drawdown	2.9	140	6.7	Good
W-902	25-Mar-93	Drawdown	0.6	6	2	Fair
W-906	20-Jun-09	Step	8.6	1,300	17	Good
W-909	18-Oct-95	Drawdown	2.7	150	5.1	Good
W-911	2-Feb-96	Drawdown	1.4	53	2.1	Good
W-912	10-Nov-95	Drawdown	4.1	65	11	Poor
W-913	16-Aug-95	Drawdown	23.5	730	36	Good
W-1001	13-Aug-95	Drawdown	1.3	170	25	Fair
W-1002	19-Jun-97	Drawdown	16.8	680	49	Good
W-1003	26-Jun-97	Drawdown	1.2	5.1	0.7	Poor
W-1005	16-Jun-97	Drawdown	17	110,000	91,000	Poor

Table B-1. Results of hydraulic tests[a].

Well	Date	Type of test[b]	Flow rate (Q) (gpm)	Transmissivity (T) (gpd/ft)	Hydraulic conductivity (K)[c] (gpd/sq ft)	Data quality[d]
W-1006	17-Jun-97	Drawdown	17.4	180	23	Fair
W-1007	23-Sep-95	Drawdown	1.6	13	1.3	Fair
W-1007	4-May-99	Drawdown	6.6	4,300	540	Fair
W-1008	17-Jan-97	Drawdown	7.3	110	13	Good
W-1010	10-Jul-95	Drawdown	20.3	1,650	140	Fair
W-1011	11-Jul-95	Drawdown	3.8	240	17	Good
W-1012	13-Jul-95	Drawdown	3.3	35	2.2	Fair
W-1013	13-Jul-95	Drawdown	2.7	2,000	250	Poor
W-1014	28-Aug-96	Drawdown	31.1	7,700	320	Good
W-1101	22-Nov-95	Drawdown	0.8	9.9	3.3	Good
W-1102	29-Jan-96	Drawdown	14.7	81	4.5	Fair
W-1103	29-Nov-95	Drawdown	3	19	1.6	Fair
W-1105	17-Jul-95	Drawdown	2.4	320	26	Fair
W-1106	24-Jul-96	Drawdown	7.1	5,200	580	Good
W-1107	9-Apr-97	Drawdown	6.7	3,500	250	Poor
W-1107	4-May-99	Drawdown	6.6	4,300	310	Fair
W-1108	3-Nov-95	Drawdown	12.3	950	68	Good
W-1108	25-Jun-96	Longterm	11.6	1,000	70	Poor
W-1108	1-Nov-05	Drawdown	7.1	800	57	Fair
W-1108	26-Jun-09	Step	2.9	1,300	89	Fair
W-1109	26-Jun-95	Drawdown	8.7	460	33	Fair
W-1109	4-Jun-96	Longterm	6.8	760	40	Poor
W-1109	11-Aug-09	Step	1.5	650	72	Good
W-1110	22-Jan-96	Drawdown	6.3	690	29	Fair
W-1111	20-Oct-95	Drawdown	15.8	2,100	95	Good
W-1111	9-Dec-96	Longterm	11.2	160	7.9	Poor
W-1112	24-May-96	Drawdown	6.4	94	10	Fair
W-1113	26-Aug-96	Drawdown	1	5.5	0.6	Good
W-1114	27-Oct-95	Longterm	15.1	270	12	Fair
W-1116	23-Feb-96	Drawdown	6.6	290	11	Fair
W-1117	23-Aug-96	Drawdown	0.7	3.4	0.34	Fair
W-1118	18-Jan-96	Drawdown	5.6	350	35	Good
W-1201	1-Nov-96	Drawdown	1	8.3	0.92	Poor
W-1203	2-May-96	Drawdown	18.8	900	90	Good
W-1204	22-Feb-96	Drawdown	1.3	17	2.2	Poor

Table B-1. Results of hydraulic tests[a].

Well	Date	Type of test[b]	Flow rate (Q) (gpm)	Transmissivity (T) (gpd/ft)	Hydraulic conductivity (K)[c] (gpd/sq ft)	Data quality[d]
W-1205	27-Nov-96	Slug	NA	330	33	Fair
W-1206	20-Jun-09	Step	18	1,900	160	Fair
W-1207	27-Nov-96	Slug	NA	900	45	Poor
W-1208	20-Jun-09	Step	19	660	34	Fair
W-1209	17-May-96	Drawdown	0.98	11	0.69	Good
W-1210	30-May-96	Drawdown	3.8	7.3	0.73	Fair
W-1211	26-Jul-96	Drawdown	28.6	5,000	330	Good
W-1212	14-May-96	Drawdown	1.9	35	2.5	Good
W-1212	10-Sep-96	Longterm	1.3	85	3.6	Poor
W-1213	22-Jul-96	Drawdown	11.6	500	42	Fair
W-1213	30-Jul-96	Longterm	9.6	440	37	Poor
W-1213	9-Feb-09	Step	3.3	4,400	360	Fair
W-1214	28-Apr-97	Drawdown	2.2	110	5.4	Fair
W-1215	15-Aug-96	Drawdown	11.6	610	61	Fair
W-1215	8-Oct-96	Longterm	9.8	3,000	300	Poor
W-1216	14-Aug-96	Drawdown	11.4	210	6.9	Good
W-1216	15-Oct-96	Longterm	11.1	160	5.4	Poor
W-1218	11-Nov-96	Drawdown	5.8	83	4.6	Fair
W-1218	8-Jul-97	Longterm	4.8	210	12	Fair
W-1219	27-May-97	Drawdown	0.4	2.5	0.63	Poor
W-1220	13-Nov-96	Drawdown	20.3	2,600	120	Good
W-1220	15-Jul-97	Longterm	20.0	4,700	210	Fair
W-1221	27-Dec-96	Drawdown	3.1	29	2.9	Fair
W-1222	31-Oct-96	Drawdown	6.1	430	43	Good
W-1224	22-May-97	Drawdown	5.0	55	11	Good
W-1225	31-Mar-97	Drawdown	4.1	83	10	Good
W-1226	27-Feb-97	Drawdown	2.2	14	1.4	Excel
W-1227	11-Apr-97	Drawdown	15.1	380	48	Fair
W-1254	19-Nov-96	Longterm	18.9	1,130	110	Fair
W-1301	10-Mar-97	Longterm	4.7	120	15	Fair
W-1303	18-Mar-97	Longterm	7.8	490	21	Fair
W-1304	2-Jul-97	Drawdown	0.7	2.6	0.52	Poor
W-1306	30-Apr-97	Drawdown	2.8	24	1.2	Good
W-1306	18-Jun-97	Longterm	1.6	54	2.7	Poor
W-1307	31-Jul-97	Drawdown	11.6	1,100	110	Good

Table B-1. Results of hydraulic tests[a].

Well	Date	Type of test[b]	Flow rate (Q) (gpm)	Transmissivity (T) (gpd/ft)	Hydraulic conductivity (K)[c] (gpd/sq ft)	Data quality[d]
W-1308	14-Aug-97	Drawdown	6.5	150	5.1	Good
W-1308	7-Oct-97	Longterm	4.0	530	18	Fair
W-1309	15-Oct-97	Drawdown	9.1	90	8.9	Fair
W-1310	10-Mar-97	Drawdown	27.9	1,060	53	Good
W-1310	17-Nov-08	Drawdown	5.1	1,200	62	Poor
W-1311	29-Oct-97	Drawdown	12.2	290	15	Good
W-1401	11-Nov-97	Drawdown	7.0	100	6.8	Excel
W-1402	12-Dec-97	Drawdown	2.6	100	10.2	Fair
W-1403	21-Jul-98	Drawdown	5.4	95	13	Good
W-1404	21-Apr-98	Drawdown	6.5	210	84	Good
W-1405	23-Apr-98	Drawdown	6.4	1,300	360	Fair
W-1406	17-Apr-98	Drawdown	11.1	3,600	360	Good
W-1407	3-Apr-98	Drawdown	1.1	8.7	1.0	Excellent
W-1408	15-Apr-98	Drawdown	2.7	85	28	Fair
W-1410	29-Jun-98	Drawdown	11.5	3,000	500	Poor
W-1410	8-Sep-99	Step	6.5	3,800	650	Poor
W-1411	15-May-98	Drawdown	12.3	14,700	1,300	Poor
W-1412	29-May-98	Slug	NA	2	0.67	Fair
W-1413	8-Jun-98	Drawdown	0.63	8.7	3.5	Fair
W-1415	11-Jun-98	Drawdown	0.87	18	1.2	Fair
W-1416	28-Jul-98	Drawdown	12.3	1,300	180	Good
W-1417	1-Jul-98	Drawdown	15.1	130	11	Good
W-1417	16-Jul-98	Step	5.9	150	13	Fair
W-1418	25-Sep-98	Drawdown	10.7	78	6.5	Excellent
W-1418	16-Dec-98	Step	10.5	490	41	Fair
W-1419	15-Jul-98	Step	6.1	47	3	Poor
W-1420	12-Aug-98	Drawdown	13.1	3,000	220	Poor
W-1421	14-Jul-98	Step	1.82	14	1.8	Poor
W-1421	17-Jul-98	Step	3.8	22	2.8	Poor
W-1422	18-Sep-98	Drawdown	12.0	170	33	Excellent
W-1422	18-Dec-98	Step	11.7	160	32	Good
W-1423	12-Nov-98	Drawdown	24.6	540	39	Fair
W-1424	1-Oct-98	Drawdown	6	48	6.9	Excellent
W-1425	1-Oct-98	Drawdown	1.4	15	2.4	Fair
W-1426	13-Nov-98	Drawdown	6.5	840	56	Good

Table B-1. Results of hydraulic tests[a].

Well	Date	Type of test[b]	Flow rate (Q) (gpm)	Transmissivity (T) (gpd/ft)	Hydraulic conductivity (K)[c] (gpd/sq ft)	Data quality[d]
W-1427	11-Jan-99	Drawdown	7.9	2,100	300	Good
W-1428	13-Jan-99	Drawdown	8.1	8,200	550	Good
W-1501	20-Nov-98	Drawdown	7.2	68	11	Good
W-1502	17-May-99	Drawdown	1.5	360	60	Good
W-1503	12-Feb-99	Drawdown	17.6	1,700	180	Good
W-1503	21-Apr-09	Step	14	1,000	100	Fair
W-1504	18-Feb-99	Drawdown	15.4	600	60	Fair
W-1504	21-Apr-09	Step	3.2	370	18	Good
W-1505	29-Apr-99	Drawdown	11.2	280	35	Fair
W-1506	19-Apr-99	Drawdown	3.1	50	5.4	Good
W-1507	27-Apr-99	Drawdown	0.65	15	1.9	Fair
W-1508	28-Jun-01	Slug	NA	160	16	Good
W-1509	9-Apr-99	Drawdown	7.2	7,000	700	Good
W-1510	14-Apr-99	Drawdown	6.6	280	20	Fair
W-1510	21-Apr-09	Step	4.5	3,200	160	Fair
W-1512	21-Jun-01	Slug	NA	230	23	Good
W-1514	23-Jun-99	Longterm	5.8	440	90	Good
W-1515	18-Jan-00	Drawdown	1.5	26	1.5	Poor
W-1515	2-Feb-00	Longterm	1.1	75	4.1	Fair
W-1518	22-Mar-00	Step	6.0	440	19	Good
W-1520	21-Mar-00	Longterm	4.0	165	20	Poor
W-1522	20-Mar-00	Step	10.5	3,500	235	Good
W-1550	28-Dec-99	Drawdown	10.0	330	35	Fair
W-1601	25-Feb-00	Drawdown	3.0	35	3.6	Good
W-1602	3-Mar-00	Drawdown	8.3	3,100	310	Fair
W-1604	2-Apr-01	Drawdown	4.0	1,600	220	Fair
W-1609	14-Dec-05	Injection	0.30	1.90	0.10	Fair
W-1610	14-Jul-00	Injection	2.0	17	0.8	Good
W-1610	17-Jul-00	Injection	3.0	17	0.8	Excel
W-1610	7-Dec-05	Injection	1.5	17	0.80	Fair
W-1614	25-Aug-00	Drawdown	1.9	75	8.3	Good
W-1654	20-Apr-00	Drawdown	0.5	12	2.0	Good
W-1655	21-Apr-00	Drawdown	1.5	27	4.9	Good
W-1701	23-Jul-01	Drawdown	9.0	160	40	Good
W-1701	26-Sep-01	Longterm	15.0	60	15	Fair

Table B-1. Results of hydraulic tests[a].

Well	Date	Type of test[b]	Flow rate (Q) (gpm)	Transmissivity (T) (gpd/ft)	Hydraulic conductivity (K)[c] (gpd/sq ft)	Data quality[d]
W-1703	25-Oct-01	Drawdown	12.0	16,000	2,300	Fair
W-1801	3-May-02	Drawdown	10.0	6,600	660	Fair
W-1801	18-Jun-09	Step	7	1,100	110	Good
W-1802	30-Sep-02	Drawdown	1.3	11	1.1	Fair
W-1805	22-Jan-03	Drawdown	11.1	13,000	800	Fair
W-1806	15-Apr-03	Drawdown	3.1	450	77	Good
W-1807	24-Aug-09	Step	3	3,200	320	Good
W-1902	19-Mar-03	Step	11.0	1,100	29	Good
W-2201	9-Feb-09	Step	3.0	12,000	680	Fair
W-2202	2-Mar-06	Drawdown	0.95	65	6.5	Poor
W-2203	23-Feb-06	Drawdown	1.04	15	1.4	Fair
SIP-ETC-201	1-Apr-04	Drawdown	1.0	200	10	Fair
SIP-ETS-201	13-Mar-96	Drawdown	0.0	430	89	Fair
SIP-ETS-204	13-Mar-96	Drawdown	0.0	150	15	Poor
SIP-ETS-207	26-Oct-93	Drawdown	0.58	710	68	Fair
SIP-ETS-207	10-Nov-93	Drawdown	2.7	440	51	Fair
SIP-ETS-207	13-Mar-96	Slug	0.0	1,800	200	Poor
TW-11	24-Jan-85	Drawdown	0.3	200	20	Good
TW-11A	24-Jan-85	Drawdown	10.0	3,100	110	Fair
GSW-01	11-Dec-85	Slug	NA	72	0.2	Fair
GSW-01A	14-Jul-86	Drawdown	13.4	12,000	790	Good
GSW-02	17-Dec-85	Slug	NA	240	10	Good
GSW-03	23-Dec-85	Slug	NA	510	41	Good
GSW-04	19-Dec-85	Slug	NA	17	0.9	Good
GSW-05	12-Feb-86	Slug	NA	99	9	Excel
GSW-06	23-Iun-86	Drawdown	25.0	4,800	310	Good
GSW-06	16-Jun-87	Longterm	20.0	5,500	350	Good
GSW-07	3-Apr-86	Drawdown	4.3	230	23	Excel
GSW-08	19-Nov-86	Drawdown	2.0	230	38	Good
GSW-09	28-May-86	Drawdown	1.9	500	63	Poor
GSW-10	22-May-86	Drawdown	14.3	21,000	2,000	Good
GSW-11	2-Jun-86	Drawdown	4.7	390	45	Excel
GSW-12	7-Jun-86	Drawdown	0.8	51	11	Fair
GSW-13	4-Aug-86	Slug	NA	110	13	Excel
GSW-13	8-Aug-86	Slug	NA	62	7	Good

Table B-1. Results of hydraulic tests[a].

Well	Date	Type of test[b]	Flow rate (Q) (gpm)	Transmissivity (T) (gpd/ft)	Hydraulic conductivity (K)[c] (gpd/sq ft)	Data quality[d]
GSW-15	23-Feb-88	Drawdown	25.8	1,500	190	Good
GSW-208	8-May-86	Drawdown	1.9	440	80	Good
GSW-209	8-May-86	Drawdown	6.1	1,200	120	Good
GSW-215	4-Jun-86	Drawdown	1.9	220	40	Poor
GSW-216	16-Jan-92	Drawdown	10.5	3,500	440	Fair
GSW-266	20-Jun-86	Drawdown	2.1	470	72	Good
GSW-266	18-Nov-86	Drawdown	3.0	450	64	Good
GSW-266	18-Nov-86	Drawdown	4.7	410	59	Good
GSW-367	11-May-87	Drawdown	6.9	200	29	Fair
GSW-403-6	8-Dec-85	Slug	NA	4	0.2	Good
GSW-442	23-Nov-87	Drawdown	1.2	32	4.6	Good
GSW-443	30-Nov-87	Drawdown	10.3	260	8.7	Good
GSW-444	28-Jan-88	Slug	NA	9	0.86	Good
GSW-445	26-Jan-85	Drawdown	4.7	43	4.30	Fair
GEW-710	23-Sept-91	Step	36.0	4,800	220	Excel
GEW-816	15-Aug-92	Drawdown	39.0	12,000	1,100	Good
11H4	15-Jan-85	Drawdown	24.6	2,000	77	Good
11H4	19-Jan-85	Longterm	29.5	1,780	18	Good
11J4	10-Jun-88	Drawdown	17.0	1,000	15	Excel
11J4	14-Jun-85	Longterm	16.0	1,100	16	Good
13D1	9-Feb-85	Longterm	50.0	4,800	48	Excel

Notes and footnotes appear on the following page.

Table B-1. Results of hydraulic tests[a].

Notes:

gpd = Gallons per day.
gpm = Gallons per minute.
NA = Not applicable.
sq ft = Square feet.

[a] The pumping test results were obtained by using the analytic techniques of Theis (1935), Cooper and Jacob (1946), Papadopulos and Cooper (1967), Hantush and Jacob (1955), Hantush (1960), or Boulton (1963). The particular method used depends on the character of the data obtained. The slug test results were obtained using the method of Cooper et al. (1967) (See references below).

[b] "Drawdown" denotes 1-hr pumping tests; "Longterm" denotes 24- to 48-hr pumping tests; "Slug" denotes monitoring and recovery after an instantaneous change in ground water elevations; "Step" denotes a step-drawdown test, flow rate given is the maximum or final step. "Injection" denotes the introduction of treated ground water under gravity into a well.

[c] K is calculated by dividing T by the thickness of permeable sediments intercepted by the sand pack of the well. This thickness is the sum of all sediments with moderate to high estimated conductivities determined from the geologic and geophysical logs of the well.

[d] Hydraulic test quality criteria:

Excel: High confidence that type curve match is unique. Data are smooth and flow rate well controlled.

Good: Some confidence that curve match is unique. Data are not too "noisy." Well bore storage effects, if present, do not significantly interfere with the curve match. Boundary effects can be separated from properties of the pumped zone.

Fair: Low confidence that curve match is unique. Data are "noisy." Multiple leakiness and other boundary effects tend to obscure the curve match.

Poor: Unique curve match cannot be obtained due to multiple boundaries, well bore storage, uneven flow rate, or equipment problems. Usually, the test is repeated.

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Appendix C

Soil Vapor Extraction Test Results

Table C-1. Soil vapor extraction test results.

Well	Date	HSU	Duration test (hours)	Flow rate (scfm)	Vacuum, inches (Hg)	Max. conc.[a] (ppm_v)	Air permeability (cm^2)
W-543-001	22-Apr-03	2	6	19.3	3.7	296	3E-08
W-543-002A	30-Apr-03	2	6	10	5.1	138	8E-09
W-543-002B	1-May-03	2	6	14	5.1	145	2E-08
W-543-003	29-Apr-03	2	6	31	5.1	236	7E-08
W-543-004A	23-Apr-03	2	6	37	3.7	198	2E-08
W-543-004B	28-Apr-03	2	6	36.5	5.1	188	2E-08
W-HPA-001B	13-May-03	2	1.5	9.3	6.6	31	1E-08
W-HPA-002A	20-May-03	1B	2	0.8	6.6	4.3	1E-08
W-1552	6-Oct-03	3A/B	1.8	1	15	NM	9E-11
W-1650	9-Oct-03	3A/B	2.8	0.8	12	22.7[b]	1E-10
W-1651	9-Oct-03	3A/B	3	0.9	12	31[b]	1E-10
W-1652	7-Oct-03	3A/B	6	1.1	12	29[b]	2E-10
W-1653	10-Oct-03	3A/B	2	0.8	12	17.7[b]	3E-10
W-1654	10-Oct-03	3A/B	2.5	0.8	12	10[b]	3E-11
W-1655	8-Oct-03	3A/B	1	1.5	12	NM	4E-10
W-1656	13-Oct-03	3A/B	0.5	NM	12	10[b]	2E-10
W-1657	8-Oct-03	3A/B	2.8	1	12	20[b]	3E-10
SIP-518-201	26-Jan-04	2	6	4.5	13	102	7E-10
SVB-518-204	22-Jan-04	2	6	0.9	25	1,944	2E-11
W-518-1913	21-Jan-04	2	6	0.5	26	106	2E-11
W-518-1914	23-Jan-04	1B	6	5.5	16	44	1E-09
W-518-1915	28-Jan-04	2	6	0.03	25	193	2E-12
W-1615	29-Jan-04	2	6	1.4	24	478	4E-11
W-ETC-2001A	16-Mar-04	1B	6	8.3	5	52.5	2E-08
W-ETC-2001B	19-Mar-04	2	6	0.7	5	145.3	1E-09
W-ETC-2002A	11-Mar-04	1B/2	6	6	5	22.6	3E-09
W-ETC-2002B	15-Mar-04	2	6	4	5.5	26	NC
W-ETC-2003	22-Mar-04	1B	6	17	4.5	77.4	8E-09
W-ETC-2004A	5-Mar-04	1B/2	6	12	8	82.8	3E-09
W-ETC-2004B	9-Mar-04	2	6	18	3.8	188	3E-09
SIP-ETC-201	4-Mar-04	2	6	8	7	185.5	7E-09
W-1904	2-Mar-04	2	6	23	4	63.3	2E-08
W-514-2007A	19-Apr-04	1B	96	14	7.5	17.6	NC
W-514-2007B	26-Apr-04	5	96	21	3.3	39.6	NC
W-217	3-May-04	5	96	20	3	63.2	NC
W-ETS-2008A	28-Sep-04	1B	6	50	7	23.7	NC

Table C-1. Soil vapor extraction test results.

Well	Date	HSU	Duration test (hours)	Flow rate (scfm)	Vacuum, inches (Hg)	Max. conc.[a] (ppm_v)	Air permeability (cm^2)
W-ETS-2008B	29-Sep-04	2	6	33	9.5	67.8	NC
W-ETS-2009	30-Nov-04	2	6	76	4.8	16.4	NC
W-ETS-2010A	7-Oct-04	1B	6	70	3	20.5	NC
W-ETS-2010B	11-Oct-04	2	6	63	4.5	39.8	NC
SIP-ETS-601	13-Oct-04	2	2.5	0.5	10	153.7	NC
W-653	16-Mar-05	3A	2	0	NA	9.6	NC
W-2011	18-Mar-05	3A	2	0	NA	1.5	NC
W-2101	6-Apr-05	3A	1.75	0	NA	8.1	NC
W-2102	25-Apr-05	3A	5	0.46	28	4.7	NC
W-2103	14-Apr-05	3A	1.25	0.35	28.2	NM	NC
W-2104A	9-Mar-05	1B	24	43	10	0.13	NC
W-2104B	14-Mar-05	2	24	43	10	0.16	NC
W-2110A	8-Nov-05	1B/2	3	37	6.4	5.2	NC
W-2110B	9-Nov-05	2	3	32	6.5	8.4	NC
W-2111A	3-Nov-05	1B	3	39	5.4	4.0	NC
W-2111B	4-Nov-05	2	3	28	3.0	4.1	NC
W-2112A	15-Nov-05	1B/2	3	44	2.9	0.75	NC
W-2112B	17-Nov-05	2	3	51	2.8	15	NC
W-2204	22-Feb-06	2	26.25	16.7	6.1	62.5	4.16E-09
W-2205	9-May-06	2/3A	71.75	18	6.5	25.2	NC
W-2206	28-Feb-06	2/3A	24	13.3	8.9	37.9	2.70E-09
W-2207A	20-Apr-06	2	23.75	20	6.1	87.8	1.07E-08
W-2208A	13-Apr-06	1B	24	23	2.44	394.8	2.52E-08

Notes:

cm^2 = Square centimeters.

Hg = Mercury.

HSU = Hydrostratigraphic unit.

Max. conc. = Maximum concentration.

NM = Not measured.

ppm_v = Parts per million by volume.

scfm = Standard cubic feet per minute.

NC = Not computed due to insufficient data for analysis.

NA = Not applicable.

[a] **Sample collected in Tedlar bag for TO-14 analysis.**

[b] **Sample measured with organic vapor analyzer.**

References

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Appendix D

2009 Ground Water Sampling Schedule

Table D-1. 2009 LLNL Livermore Site VOC ground water sampling schedule.

Well number	VOC sampling frequency	Next quarter sample date	Additional analytes (Q1-10)
W-001	O	1-11	
W-001A	A	1-10	
W-002	A	3-10	
W-002A	E	4-10	
W-004	A	2-10	
W-005	O	3-11	
W-005A	E	4-10	
W-007	O	1-11	
W-008	O	1-11	WGMD
W-011	O	3-11	
W-012	S	1-10	
W-017	E	1-10	WGMD
W-017A	O	1-11	
W-101	O	3-11	
W-102	O	1-11	
W-103	O	1-11	
W-104	Q	1-10	
W-105	O	4-11	
W-106	O	1-11	
W-107	A	1-10	
W-108	O	3-11	
W-110	Q	1-10	
W-111	A	1-10	
W-113	A	3-10	
W-114	A	1-10	
W-115	E	4-10	
W-116	S	1-10	
W-117	O	1-11	
W-118	A	2-10	
W-119	S	1-10	WGMD
W-120	Q	1-10	
W-121	Q	1-10	WGMD
W-122	E	1-10	
W-123	E	1-10	
W-141	A	2-10	
W-142	O	1-11	
W-143	S	1-10	
W-146	O	2-11	
W-147	O	2-11	
W-148	E	2-10	
W-151	Q	1-10	WGMD
W-201	O	4-11	
W-202	O	2-11	
W-203	E	2-10	

Table D-1. 2009 LLNL Livermore Site VOC ground water sampling schedule.

Well number	VOC sampling frequency	Next quarter sample date	Additional analytes (Q1-10)
W-204	S	1-11	WGMD
W-205	Q	1-10	
W-206	Q	1-10	
W-207	O	2-11	
W-210	A	1-10	
W-212	O	1-11	
W-213	S	1-10	
W-214	A	1-10	
W-218	Q	1-10	
W-219	O	3-11	
W-220	A	2-10	
W-221	A	1-10	WGMD
W-222	A	3-10	
W-223	O	3-11	
W-224	E	4-10	
W-225	A	1-10	
W-226	O	1-11	
W-251	Q	1-10	
W-252	E	3-10	
W-253	O	3-11	
W-255	A	1-10	
W-256	A	3-10	
W-257	S	2-10	
W-258	Q	1-10	
W-259	A	4-10	
W-260	O	4-11	
W-261	O	2-11	
W-263	Q	1-10	
W-264	A	4-10	
W-265	O	3-11	
W-267	S	1-10	
W-268	A	3-10	
W-269	A	1-10	
W-270	E	4-10	
W-271	O	4-11	
W-272	S	1-10	
W-273	E	1-10	
W-275	O	4-11	
W-276	Q	1-10	
W-277	A	1-10	
W-290	O	1-11	
W-291	O	1-11	
W-293	E	4-10	
W-294	E	4-10	
W-301	A	2-10	

Table D-1. 2009 LLNL Livermore Site VOC ground water sampling schedule.

Well number	VOC sampling frequency	Next quarter sample date	Additional analytes (Q1-10)
W-302	E	1-10	
W-303	A	3-10	
W-304	S	1-10	
W-306	O	2-11	
W-307	S	1-10	
W-308	A	2-10	
W-310	Q	1-10	
W-311	A	1-10	
W-312	E	4-10	
W-313	A	2-10	
W-315	Q	1-10	
W-316	S	2-10	
W-317	S	1-10	
W-319	A	3-10	
W-320	O	4-11	
W-321	E	1-10	
W-322	Q	1-10	
W-323	Q	1-10	
W-324	E	4-10	
W-325	O	2-11	
W-353	S	1-10	
W-354	Q	1-10	
W-355	S	1-10	
W-356	A	1-10	
W-361	A	1-10	
W-362	A	1-10	
W-363	Q	1-10	WGMD
W-364	Q	1-10	
W-365	O	3-11	
W-366	O	4-11	
W-369	A	1-10	
W-370	O	2-11	
W-371	O	4-11	
W-372	O	1-11	
W-373	O	3-11	WGMD
W-375	A	1-10	
W-376	O	2-11	
W-377	O	4-11	
W-378	O	4-11	
W-379	S	2-10	
W-380	O	2-11	
W-401	E	4-10	
W-402	O	2-11	
W-403	O	2-11	
W-405	Q	1-10	

Table D-1. 2009 LLNL Livermore Site VOC ground water sampling schedule.

Well number	VOC sampling frequency	Next quarter sample date	Additional analytes (Q1-10)
W-406	E	1-10	
W-407	Q	1-10	
W-409	A	4-10	
W-410	Q	1-10	
W-411	S	2-10	
W-412	A	1-10	
W-416	O	3-11	
W-417	O	4-11	
W-418	O	4-11	
W-419	A	2-10	
W-420	A	1-10	
W-421	Q	1-10	
W-422	Q	1-10	
W-423	A	4-10	
W-424	S	2-10	
W-446	O	2-11	
W-447	O	4-11	
W-448	O	4-11	
W-449	E	1-10	
W-450	E	4-10	
W-451	E	4-10	
W-452	E	2-10	
W-453	E	4-10	
W-454	S	1-10	
W-455	O	2-11	
W-458	O	2-11	
W-459	O	4-11	
W-462	E	1-10	
W-463	O	2-11	
W-464	O	4-11	
W-481	Q	1-10	
W-482	A	2-10	
W-483	O	4-11	
W-484	O	3-11	
W-485	O	2-11	
W-486	E	2-10	
W-487	E	2-10	
W-501	A	1-10	
W-502	O	4-11	
W-503	O	4-11	
W-504	E	1-10	
W-505	O	3-11	
W-506	O	4-11	
W-507	O	4-11	
W-509	S	1-10	

Table D-1. 2009 LLNL Livermore Site VOC ground water sampling schedule.

Well number	VOC sampling frequency	Next quarter sample date	Additional analytes (Q1-10)
W-510	O	2-11	
W-511	O	3-11	
W-512	O	3-11	
W-513	O	2-11	
W-514	O	4-11	
W-515	A	4-10	
W-516	O	4-11	
W-517	Q	1-10	
W-519	O	1-11	
W-520	A	2-10	
W-521	A	1-10	
W-551	O	4-11	
W-552	O	4-11	
W-553	O	4-11	
W-554	O	4-11	
W-555	O	4-11	
W-556	O	2-11	WGMD
W-557	E	4-10	
W-558	Q	1-10	
W-559	O	1-11	
W-560	O	1-11	
W-561	E	4-10	
W-562	O	2-11	
W-563	E	4-10	
W-564	A	4-10	
W-565	A	4-10	
W-567	O	3-11	
W-568	A	1-10	
W-569	A	2-10	
W-570	O	1-11	
W-571	A	1-10	WGMD
W-592	E	1-10	
W-593	O	1-11	
W-594	E	1-10	
W-601	O	2-11	
W-602	A	2-10	
W-603	A	2-10	
W-604	Q	1-10	
W-606	A	1-10	
W-607	O	3-11	
W-608	O	1-11	
W-609	A	2-10	
W-611	Q	1-10	
W-612	A	1-10	
W-613	A	1-10	

Table D-1. 2009 LLNL Livermore Site VOC ground water sampling schedule.

Well number	VOC sampling frequency	Next quarter sample date	Additional analytes (Q1-10)
W-615	E	4-10	
W-616	O	2-11	
W-617	A	4-10	
W-618	Q	1-10	
W-619	O	3-11	
W-622	Q	1-10	
W-651	Q	1-10	
W-652	O	2-11	
W-654	S	1-10	
W-702	O	3-11	
W-705	A	1-10	
W-706	E	1-10	
W-750	S	1-10	
W-901	O	2-11	
W-902	A	4-10	
W-905	E	4-10	
W-906	Q	1-10	WGMD
W-907-1	Q	1-10	
W-908	O	1-11	
W-909	Q	1-10	
W-911	Q	1-10	
W-912	Q	1-10	
W-913	Q	1-10	
W-1002	O	2-11	
W-1003	E	1-10	
W-1008	O	1-11	
W-1010	E	1-10	
W-1011	O	2-11	
W-1012	O	3-11	WGMD
W-1013	A	1-10	
W-1014	A	1-10	
W-1101	O	3-11	
W-1105	O	4-11	
W-1106	O	3-11	
W-1107	S	1-10	
W-1110	A	1-10	
W-1112	S	2-10	
W-1113	O	2-11	
W-1115	O	1-11	
W-1117	S	1-10	
W-1118	S	1-10	
W-1201	Q	1-10	
W-1202	S	1-10	
W-1203	Q	1-10	
W-1204	S	2-10	

Table D-1. 2009 LLNL Livermore Site VOC ground water sampling schedule.

Well number	VOC sampling frequency	Next quarter sample date	Additional analytes (Q1-10)
W-1205	A	4-10	
W-1207	O	3-11	
W-1209	O	3-11	
W-1210	Q	1-10	
W-1212	S	1-10	
W-1214	S	1-10	
W-1217	S	2-10	
W-1219	S	2-10	
W-1222	S	2-10	
W-1223	S	2-10	
W-1224	O	3-11	
W-1225	A	2-10	
W-1226	O	2-11	
W-1227	A	1-10	
W-1250	S	1-10	
W-1251	S	1-10	
W-1252	A	2-10	
W-1303	Q	1-10	WGMD
W-1304	Q	1-10	
W-1306	Q	1-09	WGMD
W-1308	Q	1-09	WGMD
W-1311	S	1-10	
W-1401	A	2-10	
W-1402	A	2-10	
W-1405	Q	1-10	
W-1406	Q	1-10	
W-1407	S	2-10	
W-1408	A	1-10	
W-1411	E	1-10	
W-1412	S	1-10	
W-1413	Q	1-10	
W-1414	Q	1-10	
W-1416	O	4-11	
W-1417	Q	1-10	
W-1418	Q	1-10	
W-1419	O	1-11	
W-1420	Q	1-10	
W-1421	A	4-10	
W-1422	Q	1-10	
W-1424	Q	1-10	
W-1425	O	4-11	
W-1426	O	4-11	
W-1427	Q	1-10	
W-1428	A	1-10	
W-1501	A	1-10	

Table D-1. 2009 LLNL Livermore Site VOC ground water sampling schedule.

Well number	VOC sampling frequency	Next quarter sample date	Additional analytes (Q1-10)
W-1502	S	2-10	
W-1505	A	1-10	
W-1506	Q	1-10	
W-1507	Q	1-10	
W-1508	A	1-10	
W-1509	O	4-11	
W-1511	Q	1-10	
W-1512	O	3-11	
W-1513	A	1-10	
W-1514	O	1-11	
W-1515	O	1-11	
W-1516	A	2-10	
W-1519	A	4-10	
W-1553	Q	1-10	
W-1606	O	4-11	
W-1607	E	4-10	
W-1613	O	1-11	
W-1614	A	4-10	
W-1701	O	3-11	
W-1703	O	1-11	
W-1704	A	1-10	
W-1802	S	1-10	
W-1803-1[a]	Q	1-10	
W-1803-2[a]	S	1-10	
W-1804-1[a]	S	2-10	
W-1804-2 [a]	Q	1-10	
W-1805	A	1-10	
W-1901-1[a]	Q	1-10	
W-1901-2[a]	Q	1-10	
W-1905-1[a]	Q	1-10	
W-1905-2[a]	A	4-10	
W-2103	Q	1-10	
W-2113	A	3-10	
W-2202	Q	1-10	
W-2215A	A	4-10	
W-2216B	Q	1-10	
W-2304	S	1-10	
W-2501	Q	1-10	
W-2502	Q	1-10	
TW-11	O	3-11	
TW-11A	A	3-10	
TW-21	E	1-10	
11C1	O	1-11	
14A11	O	2-11	
14A3	O	2-11	

Table D-1. 2009 LLNL Livermore Site VOC ground water sampling schedule.

Well number	VOC sampling frequency	Next quarter sample date	Additional analytes (Q1-10)
14B1	O	3-11	WGMD
14B4	O	3-11	
14C2	O	2-11	
18D1	E	1-10	
GEW-710	A	3-10	
GSW-006	A	1-10	
GSW-007	O	1-11	
GSW-008	E	1-10	
GSW-009	Q	1-10	
GSW-011	S	2-10	
GSW-013	O	1-11	
GSW-215	O	4-11	
GSW-216	O	2-11	
GSW-266	A	2-10	
GSW-326	O	3-11	
GSW-367	O	3-11	
GSW-442	O	1-11	
GSW-443	O	4-11	
GSW-444	O	1-11	

Notes:

All analyses are by EPA Method 601 for purgeable halocarbons.

E = Even years.

O = Odd years.

A = Annual.

S = Semiannual.

Q = Quarterly.

Q1 = First Quarter.

WGMD = Water Guidance and Monitoring Department. Analyses are for the environmental surveillance monitoring programs carried out at DOE sites to complement restoration activities.

[a] **Wells completed with two discrete screened intervals which are hydraulically isolated from one another by a packer and are sampled individually.**

Appendix E

Lake Haussmann
Annual Monitoring Program

Appendix E

Lake Haussmann Annual Monitoring Program Summary

This appendix summarizes the LLNL Environmental Protection Department discharge data for Lake Haussmann. Lake Haussmann is an artificial water body that has a 37 acre-ft capacity. It is located in the central portion of the Livermore Site (Fig. E-1) and receives storm water runoff and treated ground water. Discharge from Lake Haussmann flows north through a culvert into Arroyo Las Positas.

Samples are collected from water discharge from Lake Haussmann and analyzed as outlined in Jackson (2002). The discharge samples are used to determine compliance with discharge limits in the *Record of Decision* (DOE, 1992), and the subsequent *Explanation of Significant Differences for Metals Discharge Limits* (1997).

Dry season (June, July, August, September) discharges are sampled during each manual release or monthly during periods of continual release. Wet season (October through May) discharge samples are collected during the first release of the wet season and one other discharge in conjunction with a storm water monitoring event. Analytical results of discharge samples collected at sampling location CDBX are compared with the LLNL Arroyo Las Positas outfall sample results collected at sampling location WPDC (Fig. E-1).

The analytical results for release samples were reported in the LLNL Livermore Site Quarterly Self-Monitoring Reports (Yow and Wong 2009, a, b, and 2010).

E-1. Lake Haussmann Discharge Monitoring

Releases from Lake Haussmann remained continuous throughout the year, with one exception. Invasive species mitigation in Arroyo Las Positas required the temporary cessation of upstream discharges. No discharge from Lake Haussmann occurred from October 30 through November 9, 2009, to support this mitigation effort. Release samples collected during the wet season occurred on January 22, October 12, and October 13, 2009. Dry season samples were collected on June 25, August 5, August 26, and September 29, 2009. The July sampling event occurred on August 5, 2009 due to the availability of water sampling staff.

Samples from Lake Haussmann were within discharge limits for all parameters except pH. Samples collected at CDBX exceeded the pH 8.5 limit in all reported wet and dry season monitoring events except for the January 22 sampling event, with a maximum of 9.79. Corresponding samples collected at location WPDC did not exceed the pH discharge limit in any of the monitoring events. Since 1998, the pH has averaged 8.8 at CDBX and 8.5 at WPDC and is typically higher during the summer due to increased photosynthesis. Several metals were detected above detection limits at both CDBX and WPDC; however, all of the analytical results were below discharge limits. All acute and chronic aquatic toxicity tests resulted in satisfactory survival, reproduction, and/or growth of the test species.

Lake Haussmann release samples were also analyzed for VOCs, herbicides, polychlorinated biphenyl compounds, and radiological activity. All analytical results were below detection limits.

E-2. References

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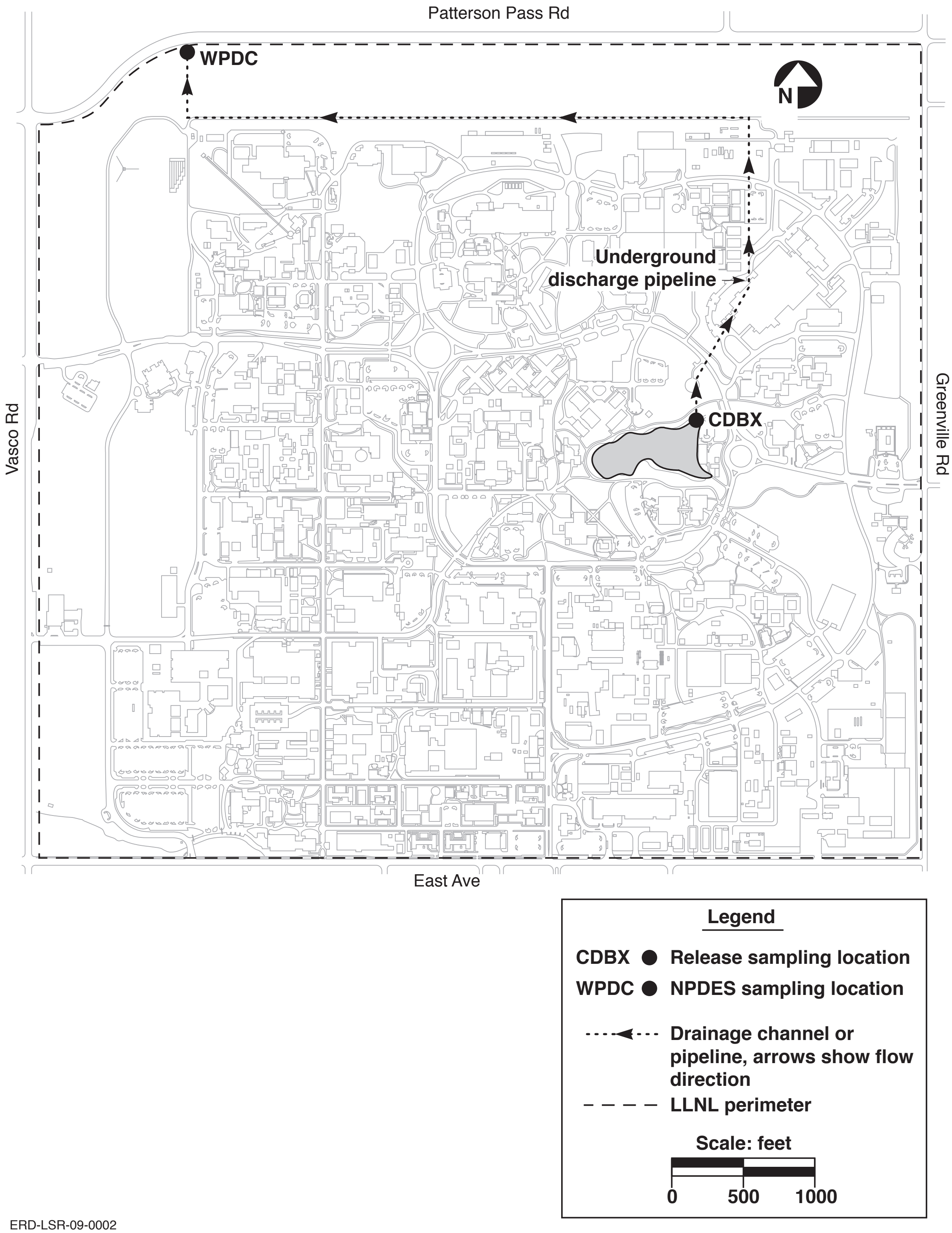

Figure E-1. Location of Lake Haussmann showing discharge sampling locations.

Appendix F

The Remediation Evaluation (REVAL) Process

Appendix F

The Remediation Evaluation (REVAL) Process

In 2009, ERD instituted the REVAL process for systematically restarting treatment facilities shutdown in 2008. The process was designed to conduct the following activities at each facility:

- Track maintenance and repair work that was required for each facility;
- Document existing facility, pipeline and extraction well conditions;
- Standardize equipment and instrumentation;
- Collect groundwater analytical data from extraction and performance monitoring wells to assess potential rebound during the hiatus in operations;
- Collect information on the specific capacity of extraction wells; and
- Collect subsurface hydraulic and pneumatic interference information during extraction well field startup.

Table F-1. Summary of the Remedial Evaluation (REVAL) Process.

REVAL Process Step	Description of Activities
1 - Project Initiation	The project is initiated with a document that identifies the project personnel and details individual roles and responsibilities. The document also refers to all applicable site safety and security procedures, standard operating procedures, and all relevant regulatory documentation.
2 - Remedial System Review/Design	The hydrogeologist reviews the effectiveness of the extraction well field and recommends adjustments. The engineering team performs a treatment facility assessment to identify necessary repairs, modifications, and recommend upgrades. During this step, all facility design, operation, and maintenance documentation is reviewed and updated as necessary.
3 - Facility Repairs, Modifications, and Construction	The engineering team performs the necessary repairs and modifications to the facility and documents 'as-built' drawings.
4 - Initial Well Field Sampling	The hydrogeologist identifies the extraction and monitoring wells that require sampling. Field personnel sample these wells prior to the startup of the facility. The analytical results are used to evaluate potential rebound in concentrations while the facility was shutdown.
5 - Facility Testing and Verification	The engineering team performs testing and verification of the treatment facility components. The facility is then operated on a day-only (test) basis until all facility systems are verified. Once all the interlocks are verified, the facility is run on a 24-hour basis.
6 - Extraction Well Field Startup	The hydrogeologist prepares an extraction well field startup plan using data gathered during the testing and verification step. The startup plan includes specific capacity testing of each well followed by a phased startup of the entire extraction well field to determine hydraulic or pneumatic interference.
7 - Project Completion, Verification and Review	The project is completed and the facility is continuously operated beginning with this step. A feedback meeting is held to review lessons learned and to apply them to the next project.

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