U.S. Department of Energy
Livermore Site Office, Livermore, California 94551

Lawrence Livermore National Laboratory
Lawrence Livermore National Security, LLC Livermore, California 94551

UCRL-AR-126020-08

LLNL
Ground Water Project

2008 Annual Report

Technical Editors

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Environmental Restoration Department

This work performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344.

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Acknowledgements

The Lawrence Livermore National Laboratory Livermore Site Ground Water Project is supported by many people. The dedication and diverse skills of all these individuals have contributed to the ongoing success of the Environmental Restoration Department activities. The editors wish to collectively thank all the contributing people and companies.

Summary

When the final FY 2008 Omnibus Appropriations Bill was passed by Congress, the Livermore project received only about 50% of the requested budget. Although funding was ultimately restored in late July, the budget reduction necessitated a dramatic reduction in both staff and cleanup activities at the site. Consequently, enhanced source area remediation (ESAR) pilot tests begun in 2007 were put on hold and existing ground water and soil vapor treatment operations were significantly curtailed during the year. Despite the shortfall, 2008 restoration activities for the Lawrence Livermore National Laboratory (LLNL) Livermore Site Ground Water Project included:

- Removing approximately 38.5 kilograms (kg) of Volatile Organic Compounds (VOCs) from ground water and 52.9 kg from soil vapor (Table Summ-1).
- Maintaining 29 ground water treatment facilities and 9 soil vapor treatment facilities as long as budget, staffing and facility conditions allowed.
- 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.
- As funding permitted, continuing significant hydraulic control and treatment of plumes along the western margin of the site, where concentrations of VOCs 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 Maximum Contaminant Level (MCL) and continued to decline by radioactive decay.
- Submitting the 2007 Annual Report and 2008 quarterly reports in compliance with regulatory agreements.

Ground water concentration and hydraulic data collected and analyzed during 2008 indicates there was very little change in the VOC concentrations and areal extent of the contaminant plumes. Hydraulic containment along most portions of the western and southern boundaries of the site was maintained and limited progress was made towards cleanup of interior plumes and source areas.

Since funding was restored in July 2008, an intensive effort has been underway to restore operations at Livermore Site facilities that were shut down or now require repair due to deferred maintenance resulting from lack of sufficient funding. This effort is expected to accelerate during 2009. With the ongoing reactivation of treatment facilities in the last quarter of 2008 and the first quarter of 2009, hydraulic control is expected to be fully restored along both the western and southern boundaries of the site by the end of March 2009.

Since remediation began in 1989, nearly 3.6 billion gallons of ground water and more than 337 million cubic feet of soil vapor have been treated, removing an estimated 2,709 kg of VOCs (Table Summ-2) from the subsurface.

[1]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 Summ-1. Summary of 2008 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	51	2.4	na	na	2.4
TFB	17	1.6	na	na	1.6
TFC	31	4.2	na	na	4.2
TFD	47	24.1	0	0	24.1
TFE	22	5.0	5,392	0.9	5.9
TFG	6	0.5	na	na	0.5
TFH	3	0.7	14,725	52.0	52.7
Totals[d]	177	38.5	20,117	52.9	91.4

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 2 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, 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 the ground water.

[b] Volumes and VOC mass are from the sum of individual extraction wells shown in Table 4.

[c] VOC mass values are best estimate accounting for measurement uncertainties in both volume total 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	1,566	194	na	na	194
TFB	358	72	na	na	72
TFC	361	88	na	na	88
TFD	826	764	49,708	84	848
TFE	300	200	124,223	141	341
TFG	58	9	na	na	9
TFH	130	29	163,208	1,128	1,157
Totals[b]	3,599	1,356	337,139	1,353	2,709

Notes:

Mgal = Millions of gallons.

Kg = Kilograms.

Kft^3 = Thousands of cubic feet.

na = Not applicable.

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

[b] **The VOC mass values are a best estimate accounting for measurement uncertainties in both volume total 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 2008. 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 in Figures 1 and 2 (a, b, c, d). Table 1 presents the type and number of wells at the site, Table 2 defines the treatment facility abbreviations used in this report, Table 3 summarizes treatment facility discharge sampling locations, and Table 4 summarizes extraction well performance during 2008.

When the final FY 2008 Omnibus Appropriations Bill was passed by Congress, the Livermore project received only about 50% of the requested budget. Staffing was drastically reduced to remain within the remaining budget and a number of treatment facilities were shut down to meet this new, much-reduced funding and staffing level. Other facilities became non-operational during the year and were not repaired due to insufficient resources. In late July 2008, funding was restored and the process to re-start the treatment facilities began. During the first quarter of Fiscal Year (FY) 2009, TF406 and TFA-E were restarted. At the end of calendar year 2008, the following facilities were awaiting re-activation: TFA, TFC-E, TFC-SE, TFD, TFD-HPD, TFD-S, VTFD-ETCS, VTFD-HPD, VTFD-HS, TFE-E, TFE-HS, TFE-SE, VTFE-ELM, VTFE-HS, TFG-N, TF406-NW, VTF406-HS, VTF511, TF518 North, TF518-PZ, VTF518-PZ, TF5475-1, TF5475-2, TF5473-3, and VTF5475. The following facilities remained operational during calendar year 2008: TFB, TFC, TFD-E, TFD-SE, TFD-SS, TFD-W, TFE-NW, TFE-SW, TFE-W, and TFG-1. Details of 2008 treatment facility operations are described further in Section 4.1 of this report.

2. Regulatory Compliance

In 2008, the Department of Energy (DOE)/LLNL submitted the GWP 2007 Annual Report (Karachewski et al., 2008) and GWP quarterly self-monitoring reports (Yow and Wong 2008a, b, c, and 2009) on schedule. Livermore Site community relations activities in 2008 included communications with neighbors and community organizations on a periodic basis; maintaining the Environmental Information Repositories and the Administrative Record; conducting tours of site environmental activities on request; and responding to public and news media inquiries. In addition, DOE/LLNL met with the Community Work Group and members of Tri-Valley Communities Against a Radioactive Environment and their scientific advisor as part of the activities funded by a U.S. Environmental Protection Agency (EPA) Technical Assistance Grant. Community questions were also addressed via electronic mail, posted mail or by telephone, and project documents, letters, and public notices were posted on a public website: https://www-envirinfo.llnl.gov/

3. Field Activities

3.1. Ground Water Monitoring

During 2008, the FY08 budget reduction necessitated a change in the way that ground water levels and ground water chemistry were monitored at the Livermore Site. Due to staffing shortages, ground water level measurements were taken once a quarter rather than once a month, as in previous years. Because of limited funding, monitor well sampling was curtailed, and strict adherance to the quarterly sampling recommendations specified by the Cost Effective Sampling (CES) algorithm was not possible. Accordingly, a modified program based on the CES algorithm was developed. This program gave a high priority to sampling at a) wells downgradient of idled treatment facilities to monitor for any movement of contaminants out of areas where hydraulic containment was no longer being provided, and b) locations where contaminant concentrations were increasing. The modified sampling program was used through the fourth quarter of 2008. Quarterly sampling was once again fully compliant with the CES Algorithm in the first quarter of 2009.

3.1.1. Ground Water Level Measurements

Ground water level measurements are normally taken from approximately 590 wells on a monthly basis. These data are complimented by continuous ground water level measurements collected from extraction wells at the treatment facilities. In 2008, monthly ground water levels were taken for the first two months of the year. Due to the budget reduction, ground water level measurements were taken once per quarter rather than once a month, starting April of 2008. A total of 2,966 ground water level measurements were taken in 2008. Because of the discontinuous operations in 2008, ground water level measurement efforts required a higher degree of coordination than normal with the treatment facility operations to collect data representative of subsurface conditions. Monthly ground water level measurements are scheduled to resume during the second quarter of 2009.

3.1.2. Ground Water Sampling

LLNL Environmental Restoration Department (ERD) and Permits and Regulatory Affairs Division (PRAD) personnel evaluated data quality objectives, analytical results, historical trends, the 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 Volatile Organic Compounds (VOCs), fuel hydrocarbons, polychlorinated biphenyls, metals, radionuclides, or combinations thereof depending upon the location.

During 2008, the GWP was able to collect samples from 303 wells. There were a total of 586 successful sampling events. The samplers were unable to collect samples from 28 wells due to various circumstances, e.g., well was dry, had an inoperable pump, etc. The methods and numbers of samples collected were:

- Specific-Depth Grab Sampling (SDGS) using the Voss EasyPump: 451 events (79%).
- Three-volume purge using a dedicated electric submersible pump: 68 events (12%).
- Low-volume purge: 11 events (2%).
- Other (bailer, electronic submersible pump, etc.): 43 events (7%).

Ongoing and significant cost reduction was achieved again in 2008 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 2007, DOE/LLNL increased its efforts to identify and evaluate innovative technologies that could help accelerate cleanup of contaminant source areas at the Livermore Site. These efforts, which collectively are called Enhanced Source Area Remediation (ESAR) activities, include detailed hydrogeologic evaluation, numerical modeling, bench-scale laboratory tests, and field treatability tests (Karachewski et al., 2008). Because of the budget reduction in 2008, 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 largely limited to documenting activities that had occurred in 2007.

3.2.1. Source Area Cleanup Technology Evaluation

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, 2007). During early 2008, field data collected from ESAR treatability tests conducted at the TFE Eastern Landing Mat (TFE-ELM), Trailer T5475 (T5475), and TFD Helipad were analyzed to assess the effectiveness of the following cleanup technologies:

- Dynamic wellfield operations for removing residual contamination in the vadose zone (TFE-ELM and T5475),
- Hot air injection and ground water heating for accelerating contaminant mass removal from both the capillary fringe and the vadose zone (TFE-ELM), and
- Chemical oxidation and bioremediation for in-situ destruction of contaminant mass in the saturated zone (TFD Helipad).

Due to the budget reduction, these analyses were halted in February 2008. As staff resources become available, ERD plans to resume this evaluation. ESAR activities in the three source areas are discussed below.

3.2.2. Trailer 5475 Source Area

In 2007, two operational modes for testing dynamic wellfield operations (DWFOs) at T5475 were formulated. During a two-week period in September 2007, modes I and II were evaluated during facility start up. Mode I consisted of injecting treated vapor effluent into wells east of T5475 while simultaneously extracting soil vapor from wells on the western side of the trailer

(Fig. 2d). During mode II, the injection and extraction well locations were reversed. Concentrations consistently above those being removed using the original remedial wellfield and associated pipelines were measured (6 to 8 parts per million on a volume basis (ppmv) on average, versus, the previous average of 1 to 2 ppmv), suggesting improved removal of mass from the subsurface due to the additional soil vapor extraction wells and dynamic wellfield operations. A letter report summarizing these findings was submitted to DOE in July 2008 (Sicke et al., 2008a).

3.2.3. TFE Eastern Landing Mat Source Area

In late 2007, DWFOs were tested at TFE-ELM (Fig. 1) as a means of evaluating, and if necessary removing, residual contamination present in the eastern wellfield vadose zone. Over a two-month period, four modes of DWFO were tested. No total VOC concentrations above 2 ppb (by volume) were measured during the test period, confirming earlier findings indicating that the vadose zone in the vicinity of the VTFE-ELM eastern wellfield contains only very low concentrations of VOCs, and that present-day concentrations are unlikely to further impact ground water. These findings were summarized in a letter report to DOE in June 2008 (Sicke et al., 2008b).

3.2.4. TFD Helipad Source Area

During 2007, preliminary modeling was conducted to evaluate the TFD Helipad tracer test data (Karachewski et al., 2008) and to design the amount and rate of nutrient injection and bioaugmentation required for conducting a successful treatability test. The findings of this modeling are summarized in a letter report to DOE submitted in January 2008 (McNab, 2008).

4. Summary of Remedial Action Program

This section summarizes the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) remedial action program at the Livermore Site. In 2008, DOE/LLNL maintained 29 ground water treatment facilities, as funds allowed, in the TFA, TFB, TFC, TFD, TFE, TFG, and TFH areas (Fig. 1 and Table 2). The ground water extraction and dual extraction wells produced approximately 177 million gallons of ground water and the treatment facilities removed an estimated 38.5 kilograms (kg) of VOCs (Table Summ-1, Fig. 3, and Table 4). In 2007, the ground water treatment facilities removed approximately 71 kg of VOCs. The significantly lower mass removed in 2008 reflects the smaller number of facilities and extraction wells that operated for shorter periods of time due to the budget reduction. Since remediation began in 1989, more than 3.6 billion gallons of ground water have been treated, resulting in removal of an estimated 1,356 kg of VOCs (Table Summ-2 and Fig. 3).

In 2008, DOE/LLNL also operated 9 soil vapor treatment facilities in the TFD, TFE, and TFH areas (Fig. 1 and Table 2). The soil vapor extraction and dual extraction wells produced more than 20 million cubic feet of soil vapor, and the treatment facilities removed approximately 52.9 kg of VOCs (Table Summ-1, Fig. 3, and Table 4). In 2007 the soil vapor treatment facilities removed approximately 248 kg of VOCs. The significantly lower mass removal in 2008 is primarily due to a smaller number of facilities operating for shorter periods of time due to the budget reduction. Since initial operation, more than 337 million cubic feet of soil vapor

has been extracted and treated, removing an estimated 1,353 kg of VOCs (Table Summ-2 and Fig. 3).

Treatment facility performance is evaluated using multiple data sets. Figures 4 through 9 show the estimated hydraulic capture areas in Hydrostratigraphic Units (HSUs) 1B, 2, 3A, 3B, 4, and 5, respectively, based on ground water elevation data collected during the third quarter of 2008. Figures 10 through 15 are isoconcentration maps showing total VOCs above Maximum Contaminant Levels (MCLs) in the same six HSUs during the third quarter of 2008. The estimated hydraulic capture areas for third quarter 2008 have been superimposed on these figures to highlight where hydraulic containment of contaminant plumes was achieved during this time period. Contaminant concentration trends (Section 4.3) are also used to evaluate hydraulic capture and of treatment facility performance.

4.1. Summary of Treatment Facility Operations

During 2008, nineteen Livermore Site treatment facilities were shut down due to the FY 2008 budget reduction. Four treatment facilities were manually shut down to accommodate the budget reduction, and fifteen additional facilities became non-operational during the year due to failure or maintenance needs. Two other facilities were also shutdown during 2008. One facility was shutdown due to regulatory concerns and the other facility was shutdown because elevated tritium levels were detected in the extraction well.

When funding was restored in July 2008, ERD developed a process to restart facilities in a phased and deliberate fashion based on risk to human health and the environment, and importance to the cleanup effort. In accordance with the remedial objectives and selected remedies defined in the Livermore Site Record of Decision (DOE, 1992) and subsequent CERCLA documentation, western and southern site boundary control and offsite contaminant plume clean up were given the highest priority. Treatment facilities 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. The ERD process, known as the Remediation Evaluation (REVAL) process, is being used to carefully and systematically restart extraction wells and treatment facilities to ensure that each system operates in a safe and optimal manner to remove and treat contaminated soil vapor and ground water, and ultimately accomplish cleanup of the subsurface. ERD began using this process during 2008 to evaluate and restart facilities as expeditiously as possible, while maximizing the use of limited resources by prioritizing work scope and schedules.

In addition to the REVAL process, review and preliminary design work is underway to restart and improve the reliability of nine Livermore Site soil vapor treatment systems. Four vapor treatment facilities ceased operation due to blower motor failure, and the fifth was shut down as a precautionary measure. The cause of the blower failures is under investigation. One vapor treatment facility was shut down to avoid production of mixed waste. Another vapor treatment facility was shut down due to failure of the flow measurement equipment. One vapor treatment facility was shut down because of high operating costs. Another facility was shut down for an *in situ* bioremediation test. These facilities will be restarted once these issues have been resolved.

4.1.1. Treatment Facility A Area

Two treatment facilities, TFA and TFA East (Fig. 1), operated in compliance with all permit requirements during 2008. A third facility, TFA West, was shut down in early January due to regulatory concerns about using the Livermore Water Reclamation Plan (LWRP) for VOC treatment. A rebound test is being conducted there to determine if tetrachloroethylene (PCE) concentrations return to pre-test levels. Although self-monitoring reports continue to be submitted for this facility, there are no plans to restart it in its present configuration according to regulatory direction (Yow and Wong, 2008a, b, c, and 2009). A treatability summary report presenting cleanup alternatives will be submitted by the end of September 2009.

At TFA, the western pipeline was offline in early January due to rainwater intrusion into the mechanical vaults. Water was removed from the affected vaults and the wells were restarted. The facility was shut down intermittently in January to install electronic equipment and to conduct facility interlock checks. The south wellfield shut down for three days in late February due to heavy rain events flooding extraction well vaults. The facility was shut down from late May to mid June while the facility control system hardware underwent a complete replacement and upgrade, and during part of July while the facility control system software was updated. In early August, the facility was shut down due to multiple electronic control issues and has remained off since. An expedited REVAL process was initiated for TFA in early November to ensure rapid restart of the facility. Ground water extraction and treatment are scheduled to resume at TFA in January 2009.

TFA East shut down in early September due to electronics issues with the solar power charge controller and associated software. After completing the REVAL process, including replacement of the electrical power storage batteries and refurbishing the downhole pump equipment, the facility was restarted in early December. TFA East was temporarily shut down in mid-December for freeze protection during the year-end holidays, and was restarted on December 29, 2008.

4.1.2. Treatment Facility B Area

TFB (Fig. 1) operated in compliance with all permit requirements in 2008 except for the following discharge. Ground water was inadvertently extracted from well W-655 on February 1 and pumped to TFB while the air stripper was offline causing approximately 250 gallons of untreated ground water to discharge to the ground. The January 2008 total VOC concentration from well W-655 was 6.36 μg/L. About 125 gallons of the total volume is estimated to have infiltrated into the soil. Water did not reach the drainage ditch near TFB, and the quantity discharged was insufficient to reach ground water. The cause of the spill was a defective digital output module. The extraction well pumps were manually secured while the digital output module was replaced and corrections were made to the control system. TFB was shut down from early January to late March for electronic upgrades, and for one week in late July for flow totalizer repair.

4.1.3. Treatment Facility C Area

Three treatment facilities, TFC, TFC East, and TFC Southeast (Fig. 1), operated in compliance with all permit requirements during 2008. TFC was shut down intermittently in January due to scaling in the discharge pump, and for three days in November due to computer control issues. Ion-exchange columns were added in late November for rainy season hexavelent chromium treatment.

TFC East was shut down in late February and remained off the rest of the year due to operational cost and lack of available staff due to the budget reduction. This facility is currently undergoing the REVAL process in preparation for restart, which is scheduled for the second quarter of 2009.

TFC Southeast was shut down in early May due to control issues with the discharge pump and remained off the rest of the year due to the budget reduction. The REVAL process is underway at this facility and is expected to resume operating during first quarter of 2009.

4.1.4. Treatment Facility D Area

Five of ten treatment facilities, TFD, TFD East, TFD Southeast, TFD Southshore, and TFD West (Fig. 1), operated in compliance with all permit requirements during 2008. TFD South operated in compliance during 2008, except for the event described below. Four facilities, TFD Helipad, VTFD Helipad, VTFD East Traffic Circle South, and VTFD Hotspot, did not operate in 2008. TFD Helipad and VTFD Helipad were shut down for an ESAR bioremediation pilot test scheduled for the spring of 2008; however the test was put on hold due to the 2008 budget reduction. The Helipad facilities are scheduled to be restarted by the end of 2009. VTFD Hotspot and VTFD East Traffic Circle South did not operate due to liquid ring blower failures, and identification and resolution of the cause of failure was put on hold due to the 2008 budget reduction. These facilities are scheduled to be restarted by the end of September 2009.

TFD South was shut down in mid-May due to an extraction well transducer failure and remained off the rest of the year except for monthly compliance sampling. On May 14, a technician started the facility briefly for compliance sampling. A break in the piping from the extraction well was noticed and approximately 50 gallons of ground water was discharged from extraction well W-1503. The facility was shut down and the leak was repaired. Approximately 40 gallons was discharged onto asphalt, 5 gallons to the storm drain, and 5 gallons to the ground. The facility is still shut down for general overhaul and transducer replacement in wells W-1503 and W-1510. This facility is scheduled to undergo a REVAL-based reactivation by the end of second quarter of 2009.

The following facilities ran either continuously or intermittently throughout 2008:

- TFD was shut down in late July and remained off the rest of the year for required maintenance, including air stripper de-scaling, facility discharge pump repair, air blower exchange and Belsperse 161 sequestering agent optimization. This facility is scheduled to undergo a REVAL-based reactivation by the end of the second quarter of 2009.
- TFD East was shut down for two days in early January while the facility interface screen was replaced. The facility continued to operate throughout the year.
- TFD Southeast was shut down for four days in mid-February due to electronics problems. Well W-1403 was shut down in early July due to suspect flow meter readings and remained off the rest of the year. The facility continued operating throughout the year.
- TFD Southshore operated continuously throughout 2008.
- TFD West was shut down in late August due to a potential interlock failure in a secondary pipe leak detection system. Repairs were made and the facility was restarted in mid-September.

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 (Fig. 1), operated in compliance with all permit requirements during 2008. TFE East was shut down for a week in mid-January due to well modification activities in the East Landing Mat (ELM) area that caused activation of the watchdog timer interlock. This facility was not operated from late-January to mid-February to modify electrical equipment at wells W-1903, W-2305, and W-1909 for the ELM ground water heating and hot air injection ESAR project. In early April, this facility was shut down due to a failed facility discharge pump. The discharge pump was serviced and the facility was restarted four days later. In early June, this facility was shut down due to control system failure and remained off the rest of the year. This facility is currently undergoing the REVAL-based reactivation process, which is scheduled to be complete by the end of September 2009.

The following facilities ran either continuously or intermittently throughout 2008:

- TFE Hotspot was shut down in early June due to erratic extraction well operations (unexplained cyclic pumping) and remained off the rest of the year. This facility is currently undergoing the REVAL process and is projected to restart in the first quarter of 2009.
- TFE Northwest operated continuously throughout 2008.
- TFE Southeast was shut down in early April due to pump and control system failures and remained off the rest of the year. This facility is projected to restart by the end of the June 2009.
- TFE Southwest was shut down for three days in mid-February due to high sump water level. This facility operated continuously for the rest of 2008.
- TFE West was shut down for three days in mid-February due to high backpressure created by water-logged granular activated carbon (GAC). The issue was corrected and the facility restarted restarted the same day. This facility operated continuously for the rest of 2008.
- VTFE Eastern Landing Mat and VTFE Hotspot were shut down in early February due to liquid-ring blower motor failures. These facilities remained shut down for the rest of the year due to funding constraints and are projected to restart by the end of September 2009.

4.1.6. Treatment Facility G Area

Two treatment facilities, TFG-1 and TFG North (Fig. 1), operated in compliance with all permit requirements during 2008. The following facilities ran either continuously or intermittently throughout 2008:

- TFG-1 operated continuously throughout 2008. GAC was changed in December 2008.
- TFG North was shut down in late-June due to discharge pump control failure and remained off the rest of the year. This facility is scheduled for a REVAL-based restart by the end of third quarter of 2009.

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 (Fig. 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 (Fig. 1), operated in compliance with all permit requirements during 2008. TF406 was shut down in mid-March due to problems with the pump in extraction well W-1310. A REVAL-based reactivation was conducted, the pump was replaced, and ground water extraction resumed in late-October. As part of the reactivation, a step-drawdown test was conducted on W-1310 to determine its sustainable yield and to establish a baseline for determining the need for well redevelopment in the future. Normal, full-time operation of this facility resumed in December.

TF406 Northwest was shut down in early February due to low influent flow rate, possibly due to bio-fouling of the pump, and remained off the rest of 2008. This facility is currently scheduled for repair and re-activation by the end of June 2009.

VTF406 Hotspot was shut down in late-June due to instrumentation issues, and remained off the rest of 2008. This facility is currently undergoing a REVAL-based re-activation and is projected to restart by March 2009.

4.1.7.2. Treatment Facilities Near Building 518

Four treatment facilities, TF518 North, TF518 Perched Zone (PZ), VTF518-PZ, and VTF511 (Fig. 1), operated in compliance with all permit requirements during 2008. TF518 North was shut down in late-February due to elevated activities of tritium in ground water from extraction well W-1410, and remained off the rest of the year. ERD is currently evaluating the situation and will prepare a schedule for a focused feasibility study by September 2009.

TF518-PZ and VTF518-PZ were shut down in late-February due to operational costs and lack of staff, and remained off the rest of the year. These facilities are currently scheduled to be restarted in FY10.

VTF511 was shut down for one week in early February due to a broken discharge pipe and for two weeks in May due to elevated temperatures at the liquid-ring blower during a heat wave. In late July, this facility was shut down due to electronic issues, and remained off for the rest of the year. This facility is currently scheduled for reactivation by the end of June 2009.

4.1.7.3. Treatment Facilities Near Trailer 5475

TF5475-2 was shut down in 2007, awaiting resolution of disposal issues due to a reported detection of low alpha contamination in the GAC. However, the LLNL Radioactive and Hazardous Waste Division discovered that the reported alpha contamination was an error, and that no mixed waste was being generated at this location. Accordingly, the GAC from TF5475-2 was classified as RCRA waste (F-listed) and not mixed waste, and the facility was restarted in mid-January after addressing mechanical and electrical issues. In late-February, this facility was shut down due to operational cost and available staffing, and remained off the rest of the year. During the approximate 1-1/2 months it was operating, this facility was in compliance with

permit requirements. This facility is currently scheduled to restart by the end of second quarter of 2009.

Treatment facilities TF5475-1, TF5475-3, and VTF5475 were shut down in 2007 due to mixed waste disposal issues, and remained shut down throughout 2008 due to computer and control system issues, budget constraints and the mixed-waste disposition issues. A schedule for focused feasibility studies to address the mixed-waste issues will be prepared by September 2009.

4.2. Ground Water Discharges

In 2008, LLNL discharged nearly 178 million gallons (Mgal) of treated ground water to the ground surface. Specifically, nearly 105 Mgal were discharged to Arroyo Las Positas, nearly 43 Mgal to the West Perimeter Drainage Channel, and approximately 30 Mgal to Arroyo Seco. In addition, more than 0.6 Mgal of filtered ground water from well W-404 were discharged to the Livermore Water Reclamation Plant.

4.3. Remediation Performance Evaluation

In 2008, with a few notable exceptions, VOC concentrations remained relatively unchanged in most Livermore Site ground water plumes. This lack of change is attributed primarily to the fact that active remediation was curtailed in many places due to the FY08 budget reduction discussed previously in this report. The 91.4 kg of VOCs removed by the ground water, soil vapor, and dual extraction wells during the year (Tables Summ-1 and Table 4) is a 71% decrease compared to the total amount of contaminant mass removed in 2007 (319 kg). This temporary disruption in mass removal rates and concentration reduction is clearly not 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. Since funding was restored in July 2008, an intensive effort has been underway to restore operations at Livermore Site facilities that were shut down or now require repair due to deferred maintenance that could not be addressed during the budget reduction. This effort is expected to accelerate during 2009.

Ground water elevation contour maps for each HSU showing estimated capture areas for the third quarter of 2008 are presented on Figures 4 through 9. 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 Maximum Contaminant Levels (MCLs) by HSU (Figs. 10 through 15). Treatment facilities are shown on Figures 2a through 2d. Where available and relevant, concentration data more recent than third quarter 2008 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 2008. West of LLNL, at the one remaining offsite well with concentrations above MCLs (W-1425) (Fig. 10), PCE concentrations declined slightly from 11 ppb in August 2007 to 9 ppb in October 2008. However, east of Vasco Road in the TFA treatment area, PCE concentrations increased at wells W-254 (from 55 ppb in April 2008 to 73 ppb in November 2008) and W-604 (from 5 ppb in August 2007 to 12 ppb in

September 2008). These increases may be due to the cessation of ground water extraction at well W-254 during the months of September, October, and November 2008 (Fig. 10) and at TFA during May, June, and mid-August through December 2008 due to the budget reduction. Concentrations are expected to start declining again in these areas since pumping resumed at well W-254 (TFA East) in December and is scheduled to resume at well W-415 (TFA) in early 2009.

In the central TFB treatment area (Fig. 1), east of the western site boundary, TCE concentrations rose significantly at onsite monitor well W-218 (12 ppb, February 2007 to 89 ppb, October 2008) (Fig. 10). This increase coincides with a decrease in pumping at adjacent HSU 1B extraction well W-704 that occurred as part of an effort to optimize mass removal in underlying HSU 2 in the TFB area. The flow rate in well W-704 was increased from 6 to 18 gpm to ensure that concentrations decline at well W-218 during the next year. Further to the west, concentrations fell at downgradient monitor well W-269 (6.6 ppb, January 2008 to 2.6 ppb, October 2008).

Elsewhere in the TFB and TFC areas, concentrations did not change significantly during 2008, and no evidence of westward migration of the contaminant plumes was observed.

As shown on Figures 4 and 10, the HSU 1B contaminant plumes along the western LLNL margin were hydraulically contained at TFB, most of TFC, and part of TFA during third quarter of 2008. Hydraulic containment along the western margin is scheduled to be fully restored at TFC-SE and TFA by the end of March 2009 once the two facilities have been reactivated through the REVAL process.

4.3.2. Hydrostratigraphic Unit 2

VOC concentrations in HSU 2 declined or remained stable in most areas along the western LLNL margin during 2008 (Fig. 11), with a few notable exceptions. Concentrations declined in the western TFA area, despite the hiatus in pumping during May, June, and mid-August through December 2008. PCE concentrations decreased at several onsite wells along Vasco Road, including W-714 (from 16 ppb in August 2007 to 8 ppb in May 2008), W-605 (from 31 ppb in April 2007 to 22 ppb in May 2008), W-118 (from 27 ppb in March 2007 to 23 ppb in January 2008), and W-614 (from 11 ppb in April 2007 to 8 ppb in April 2008).

At well W-404, west of Vasco road, where a year-long treatability test occurred during 2007 (Karachewski et al., 2008), PCE concentrations rebounded slightly from a low of 7 ppb in January 2008 to 11 ppb in October 2008. Elsewhere, PCE concentrations remained stable or declined slightly, and the 10 ppb total VOC contour almost disappearing completely from the offsite area (Fig. 11). At well W-654, PCE concentrations declined from 12 ppb in September 2007 to 7 ppb in October 2008.

In the TFB area, along the western boundary of the site, TCE continued to slowly increase at monitor well W-422, despite continuous pumping at upgradient extraction well W-655 throughout the year (from 10 ppb in October 2007 to 13 ppb in October 2008). An additional HSU 2 extraction well has been proposed for this location to more effectively contain and treat VOCs there.

In the eastern portion of the site, concentrations also remained relatively unchanged, except in the TFD East and TFD Southeast areas, where TCE decline at wells SIP-ETC-201 (from 160 ppb in April 2007 to 60 ppb in December 2007), W-1303 (from 220 ppb in October 2007 to

150 ppb in October 2008), W-1223 (from 180 ppb in October 2007 to 100 ppb in October 2008), and W-1306 (from 140 ppb in May 2007 to 100 ppb in October 2008). The decrease in TCE concentrations in this area is likely due to pumping in HSU 2 extraction wells at these two facilities throughout the year. At HSU 2 extraction well W-1404, however, concentrations continued to fluctuate, increasing from 110 ppb in October 2007 to 360 ppb in October 2008. Well W-1404 only operated sporadically during the year due to the very low sustainable yield available at this location. Elsewhere in the TFE, TFH, and TFG areas, VOC concentrations in HSU 2 did not change appreciably during 2008.

Figure 5 shows the estimated hydraulic capture areas in HSU 2 during the third quarter of 2008. Most of the contaminant plumes in the TFA and TFB areas were hydraulically contained (Fig. 11). Two exceptions include the offsite plume at well W-404 and the area immediately west of monitor well W-422 in the TFB area. By the end of March 2009, when TFA is scheduled to begin operating again, hydraulic containment along the western plume margins should be fully restored. By then, the offsite W-404 PCE plume should be within the stagnation zone of TFA west pipeline extraction well W-109.

4.3.3. Hydrostratigraphic Unit 3A

During 2008, very little change was observed in the size and location of the contaminant plumes in HSU 3A (Fig. 12). At well W-276, in the westernmost TFE area, TCE continued to decline (from 94 ppb in August 2007 to 67 ppb in October 2008). This decline is likely a response to pumping at TF406 Northwest extraction well W-1801, which operated during the fourth quarter of 2007 and January 2008. Pumping operations are expected to be restored there by mid-2009. At TFE Hotspot, TCE in well W-1201 declined from 310 ppb in February 2007 to 120 ppb in August 2008. The decline is due to ground water extraction at well W-2012. Operations at TFE Hotspot were halted in June of 2008 due to the budget reduction, and are expected to be restored by March 2009. Elsewhere in the eastern part of the site, no significant HSU 3A concentration trends were observed during 2008.

To the west in the TFA area, carbon tetracholoride along the western site boundary remained unchanged (3 ppb at well W-712 throughout the year), and PCE remained slightly above its MCL at well W-310 in TFB (6 ppb, October 2008). A pumping test is planned to determine whether the PCE in well W-310 is due to a faulty completion in either well W-310 or an adjacent well.

Figure 6 shows the estimated hydraulic capture areas in HSU 3A during the third quarter of 2008. Hydraulic containment at the TFD South, TFE Hotspot, and TF406 Northwest areas is expected to be restored by mid-2009 once these facilities have been reactivated through the REVAL process.

4.3.4. Hydrostratigraphic Unit 3B

VOC concentrations remained predominantly stable in HSU 3B during 2008, with very few locations exhibiting declines. A decrease was noted in the southern TFD and Northern TFE areas, where TCE fell in wells W-1422 (Fig. 13) (from 100 ppb in August 2007 to 18 ppb in August 2008), W-1511 (from 200 ppb in August 2007 to 140 ppb in November 2008), and W-364 (from 72 ppb in August 2007 to 59 ppb in November 2008). These reductions are in response to pumping at TFD South, TFD Southshore, and TFE West during 2008. At TFE Southwest extraction well W-1522, which operated throughout the year, TCE increased from

141 ppb in July 2007 to 232 ppb in October 2008. This increase may be related to rising water levels in the area (8 ft during the year at nearby monitor well W-356). The rise in water levels appears to be in response to a cessation in pumping at many HSU 3B extraction wells during 2008.

As shown in Figure 7, large portions of TFD, TFE, and TFH remained under hydraulic control during third quarter 2008. The area under hydraulic containment is expected to expand considerably once pumping operations are fully restored at ground water extraction facilities in these three areas.

4.3.5 Hydrostratigraphic Unit 4

Although essentially unchanged from 2007, there were several notable concentration trends observed in HSU 4 during 2008. For the first time since pump and treat remediation of HSU 4 at TF406 ceased in 2000, TCE rose above its MCL at one location (8 ppb at well W-1309, October 2008) (Fig. 14). ERD will continue to monitor VOC concentrations in well W-1309 and may resume ground water extraction at this location in 2009. The increase appears to coincide with rising HSU 4 water levels in the area (a rise of about 7 ft was observed in area wells during the year). Ground water levels appear to be recovering from overdraft conditions caused by ground water extraction at the Livermore Site.

In the northeastern TFD area, carbon tetrachloride has slowly risen above its MCL in well W-372 (Fig. 14) over the last several years (2.6 ppb, January 2007). The source of this carbon tetrachloride is not known, but may be related to carbon tetrachloride detected in the borehole of well W-594, located about 1,100 ft upgradient to the northeast (Fig. 2c). Concentrations at well W-372 will be closely monitored to determine whether remedial action is required at this location.

In the TFD South area, which was shut down in May 2008, TCE rose sharply at extraction well W-1503 (from 55 ppb, in July 2007 to 440 ppb in November 2008), indicating a rebound has occurred in the area (Fig. 14). TFD South is currently scheduled to be reactivated by June 2009.

In the TFD East area, TCE at well W-1253 fell from 3,200 ppb in September 2007 to 2,300 ppb in February 2008. In the TFE Southwest area, TCE in monitor well W-354 increased from 27 ppb in May 2007 to 100 ppb in October 2008. Adjacent TFE Southwest HSU 4 extraction well W-1520 is currently not operating due to an increase in tritium activity that was observed there during 2008 (from 2,720 pCi/L in October 2007 to 3,860 pCi/L in October 2008). The source of the increasing tritium activity is currently under investigation.

Figure 8 shows the extent of the estimated hydraulic capture areas in HSU 4 during the third quarter of 2008. The area under hydraulic capture in HSU 4 expected to expand significantly once pumping resumes at TFD South in 2009.

4.3.6 Hydrostratigraphic Unit 5

Although the general configuration and location of contaminant plumes in HSU 5 during 2008 remained essentially unchanged from 2007, some differences were observed. In the TFH area, an increase in TCE was observed west of Building 419 at well W-1413, where concentrations rose from 5 ppb in July 2007 to 61 ppb in April 2008. The increase is likely related to a cessation in pumping at TFE Southeast extraction well W-359 that occurred in April 2008, or may be related to a local rise in water levels that has been observed during the last

year (10 ft since February 2008 in well W-1413). This rise in water levels may be affecting source areas previously isolated within the vadose zone. Further to the west in the TFH area, a slight decrease was observed at the leading edge of the TCE plume in well W-1519, where TCE declined from 11 ppb in May 2007 to 8 ppb in August 2008. To the south, TCE in ground water beneath the property managed by Sandia National Laboratories rose slightly in several wells, then declined once TF406 operations resumed in October (8 ppb in October 2007 to 1 ppb in November 2008 in W-750; 7 ppb in February 2008 to 1 ppb in November 2008 in W-1113).

To the west of TFE East, TCE declined in well W-1210 from 61 ppb in October 2007 to 25 ppb in October 2008. Elsewhere in the area, TCE remained essentially unchanged during 2008. Ground water extraction in HSUs 2 and 5 is scheduled to resume at TFE East during the third quarter of 2009.

Figure 9 shows that only the area around TFD was hydraulically controlled at the Livermore Site during the third quarter of 2008. Most of the eastern TFD, TFE, and TFH areas are expected to be back under hydraulic containment once operations resume at TFE East and TFE Southeast. Operations resumed to the south at TF406 in October 2008.

During 2008, tritium activities in ground water from all wells at the Livermore Site, including those in the Trailer 5475, Building 292, and Building 419 areas (Fig. 1), remained below the 20,000 pCi/L MCL and continued to decline by radioactive decay. In the former Building 412 area (Fig. 1), tritium was measured at 14,200 pCi/L in HSU 3A well W-2205 (August 2007) (Fig. 12). The source of tritium at this location is currently under investigation.

4.4. Decision Support Analysis

Over the last several years, ERD has used a variety of decision support tools and performed various analyses 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 2008, we continued to maintain our environmental database, and associated data entry and data review tools. 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 (Yow and Wong, 2008a, b, c, and 2009).

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 7,900 plume maps and 1,800 ground water elevation maps that span the entire 21 year project history are updated each quarter within

in a matter of hours. The map library was updated once per quarter in 2008 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 2008, predictive analysis activities were limited to Source Area Cleanup Technology Evaluation (SACTE) modeling, and Enhanced Source Area Remediation (ESAR) modeling associated with TFE Eastern Landing Mat, TFH Trailer 5475, and TFD Helipad Area activities. These analyses were discontinued in March due to staffing reductions caused by the budget reduction. Regional-scale flow and transport models were also used to evaluate the effectiveness of operating extraction well fields to prevent off-site migration of contaminant plumes. The results of these analyses allowed ERD personnel to prioritize the maintenance and operation of critical facilities to ensure hydraulic containment.

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Figures

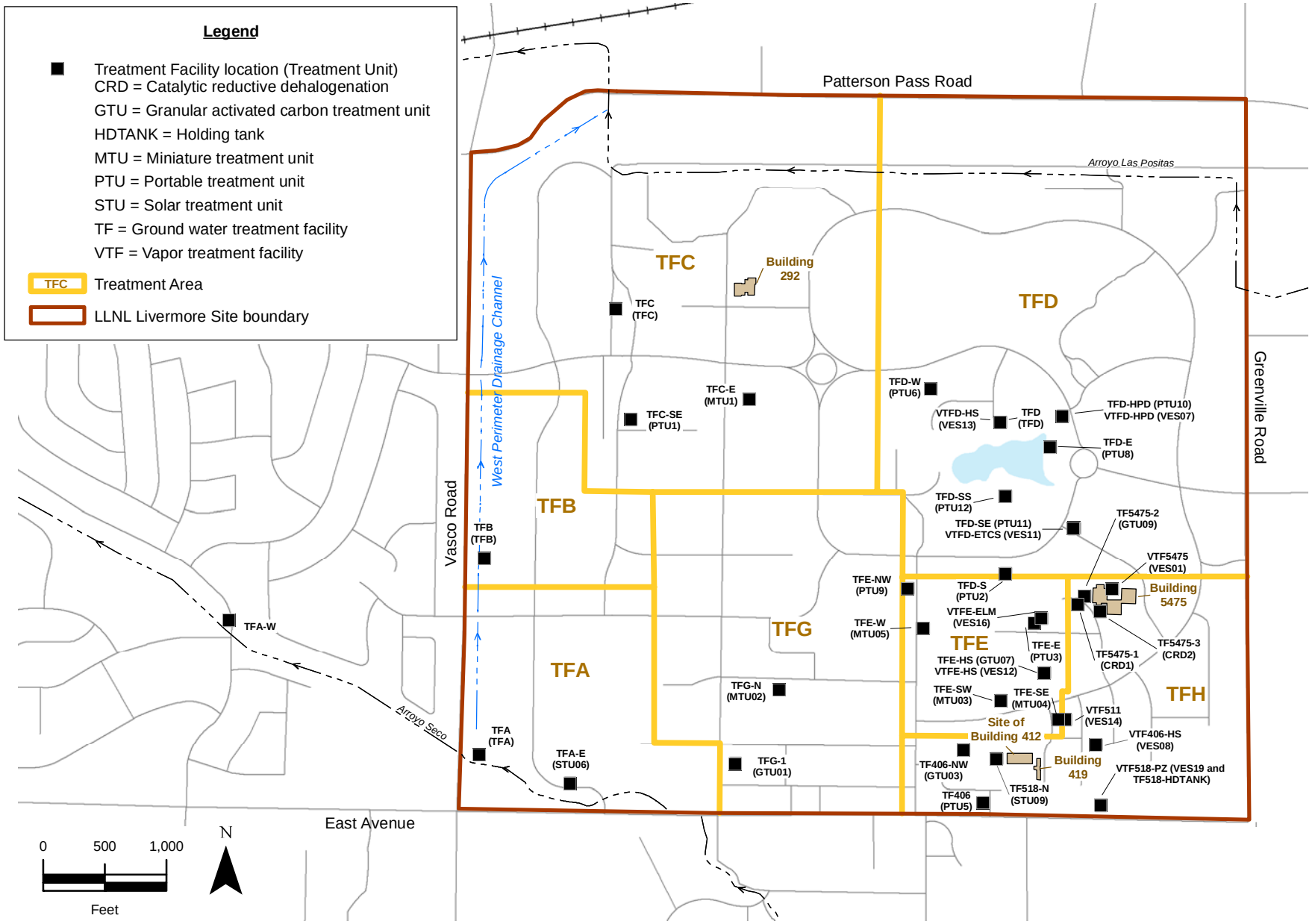

Figure 1. Livermore Site treatment areas and treatment facility locations.

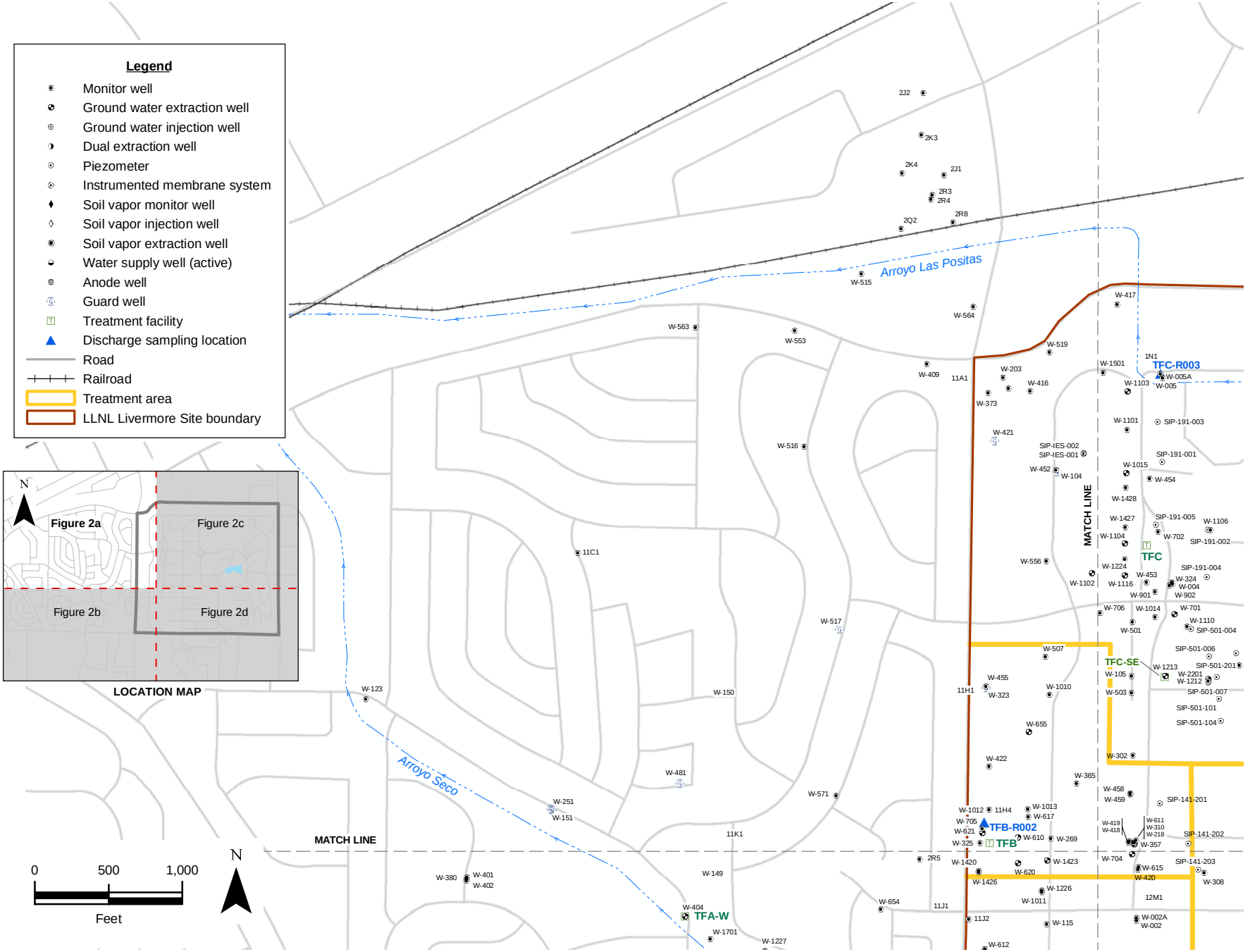

Figure 2a. Locations of Livermore Site wells and treatment facilities, December 2008.

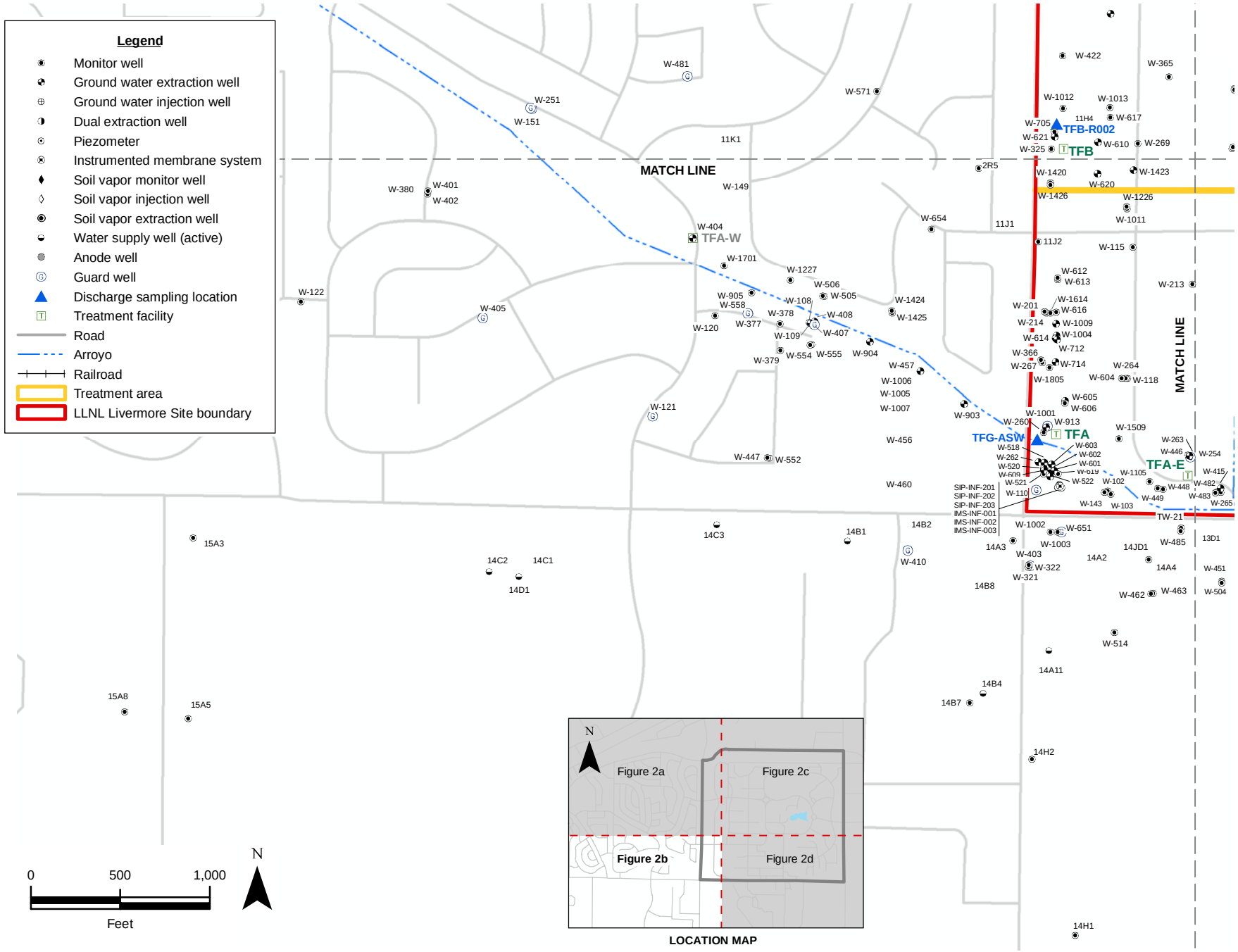

Figure 2b. Locations of Livermore Site wells and treatment facilities, December 2008.

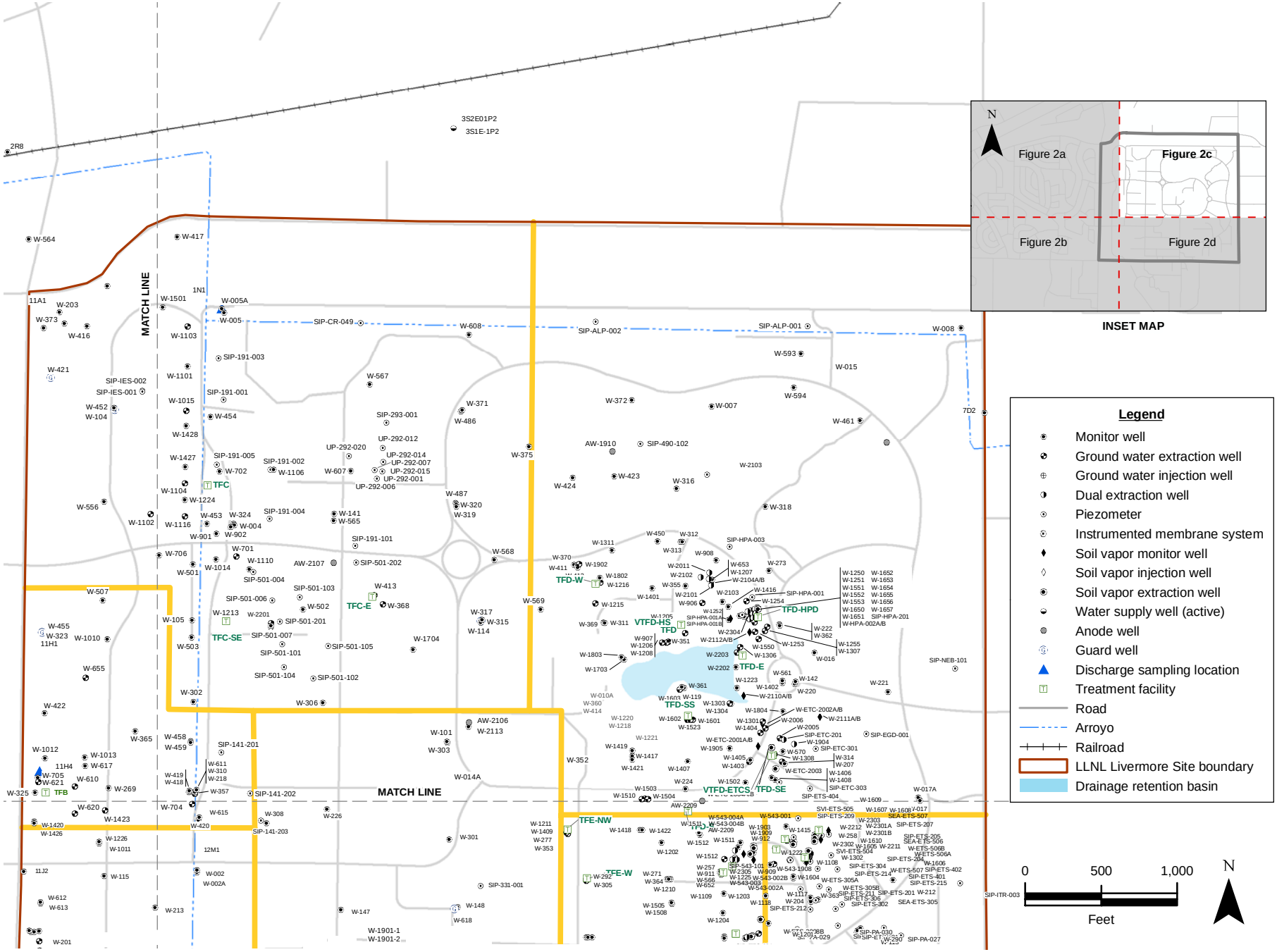

Figure 2c. Locations of Livermore Site wells and treatment facilities, December 2008.

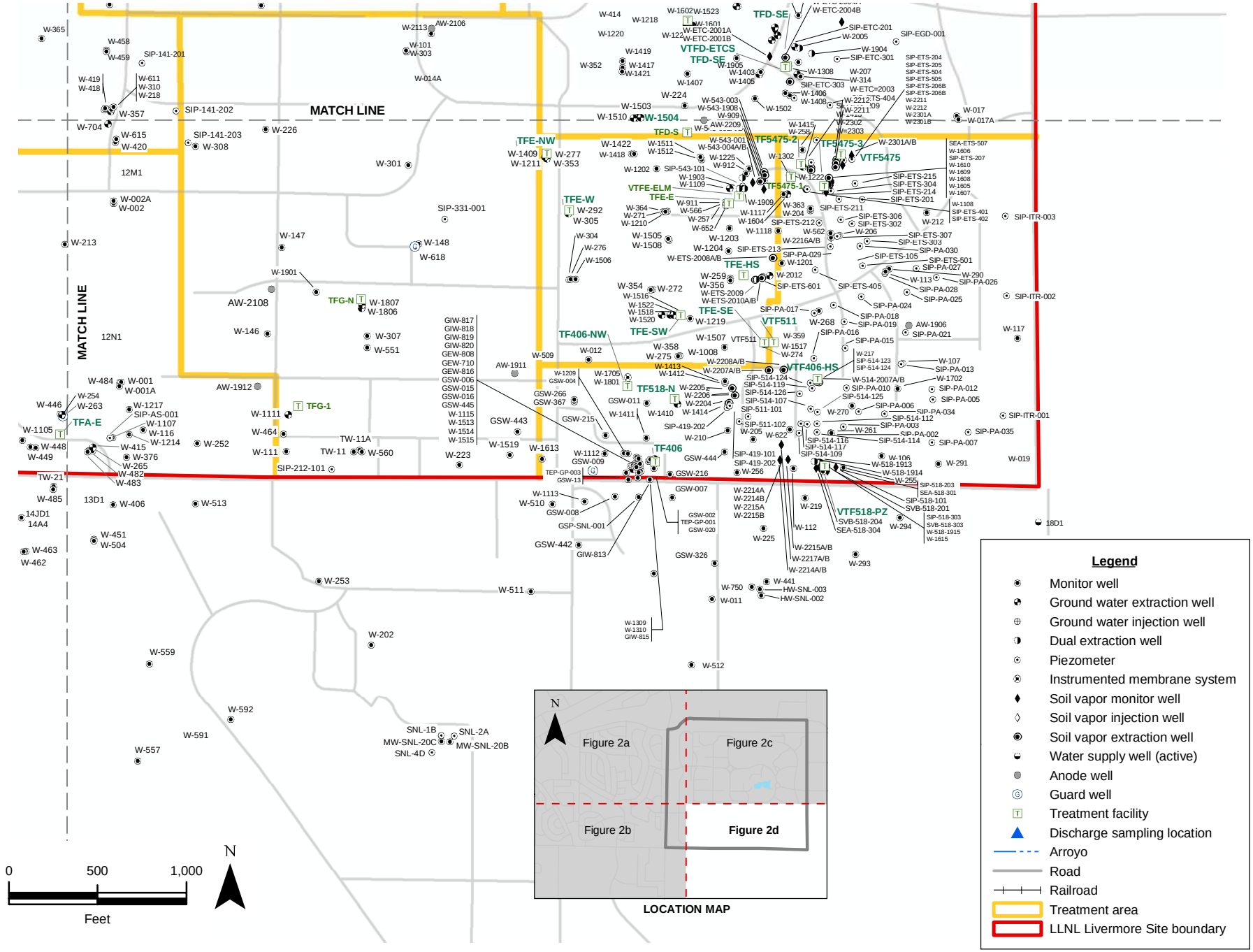

Figure 2d. Locations of Livermore Site wells and treatment facilities, December 2008.

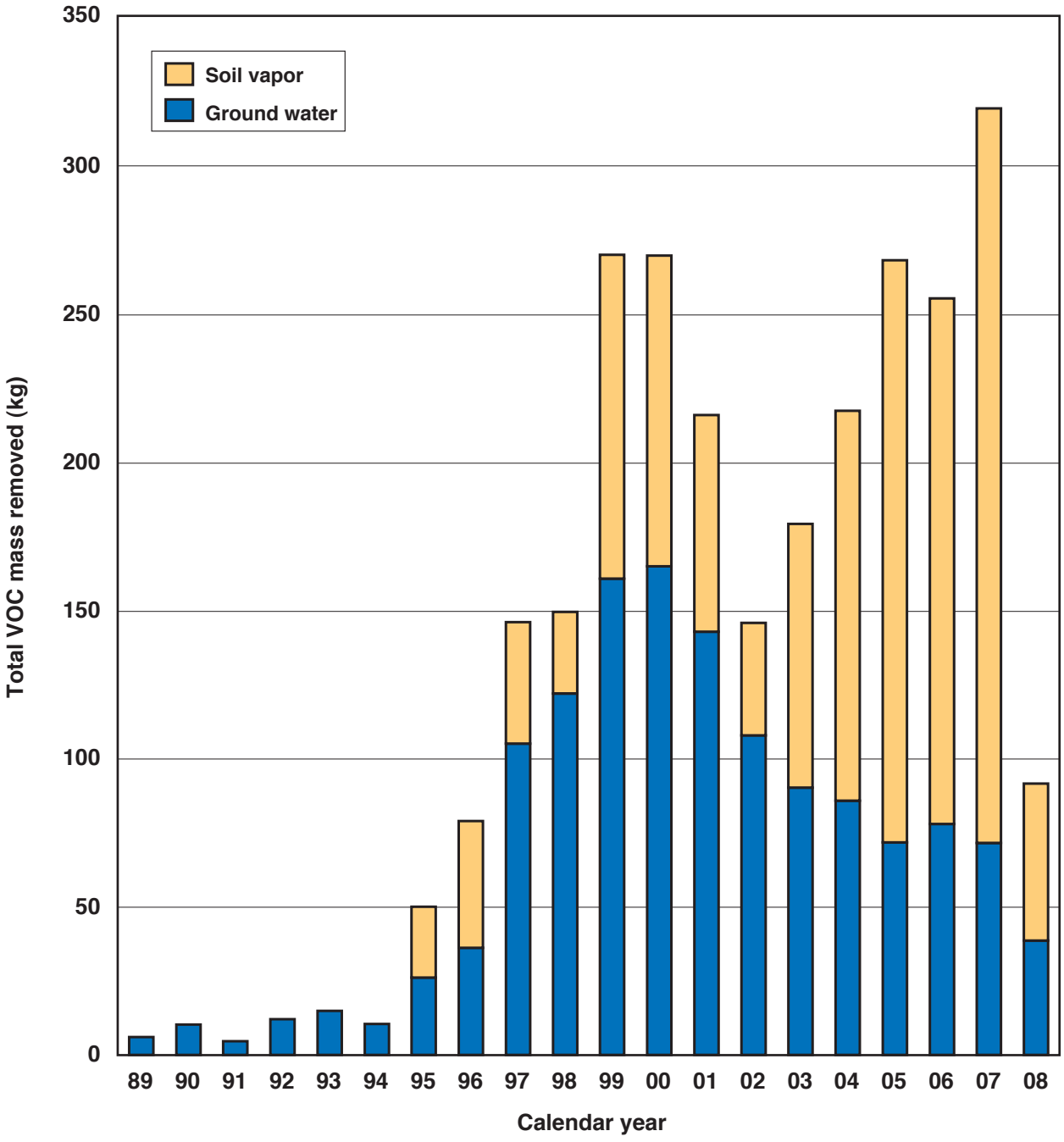

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Figure 3. Estimated total VOC mass removed from the Livermore Site subsurface since 1989.

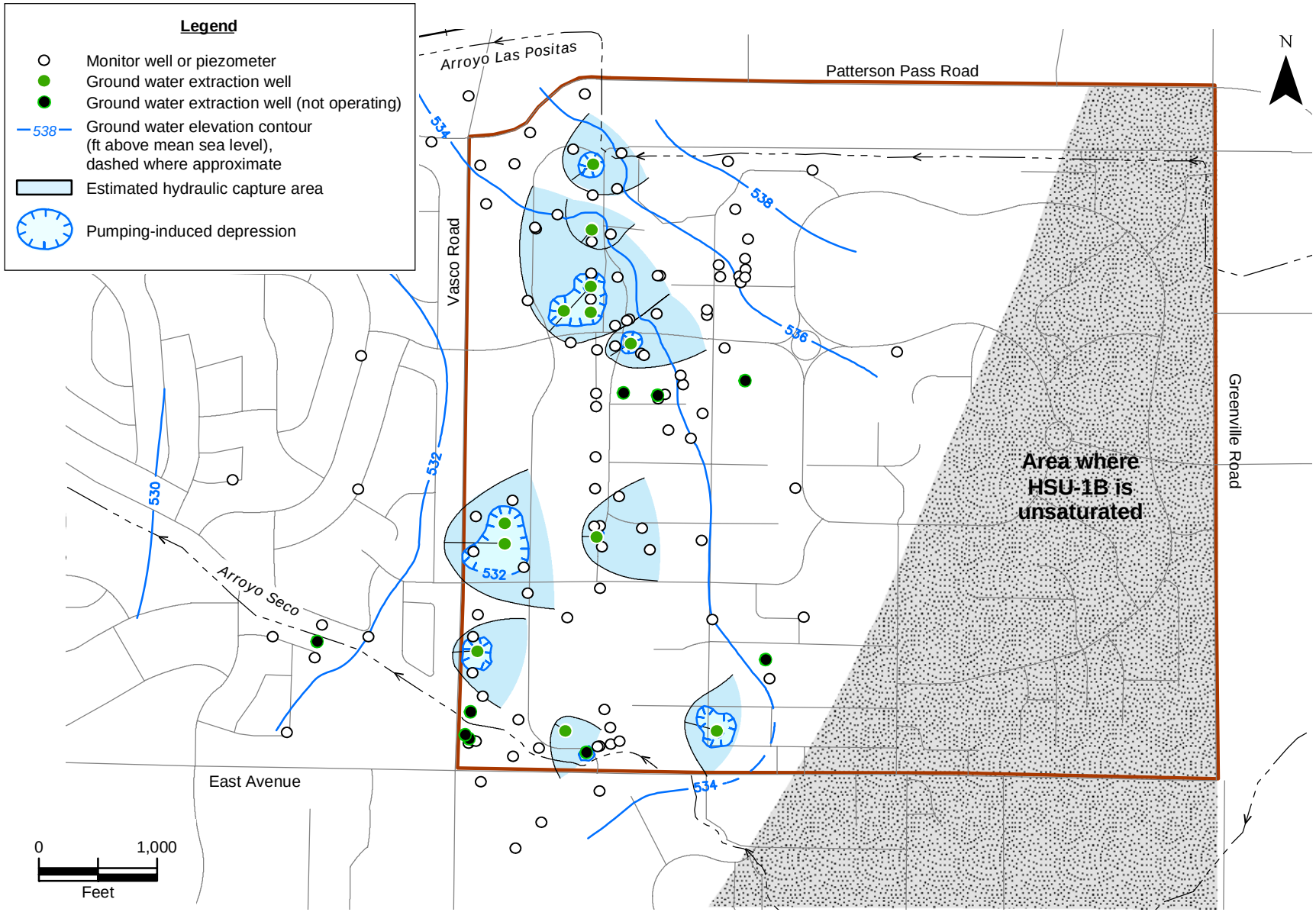

Figure 4. Ground water elevation contour map based on 127 wells completed within HSU-1B showing estimated hydraulic capture areas, LLNL and vicinity, July 2008.

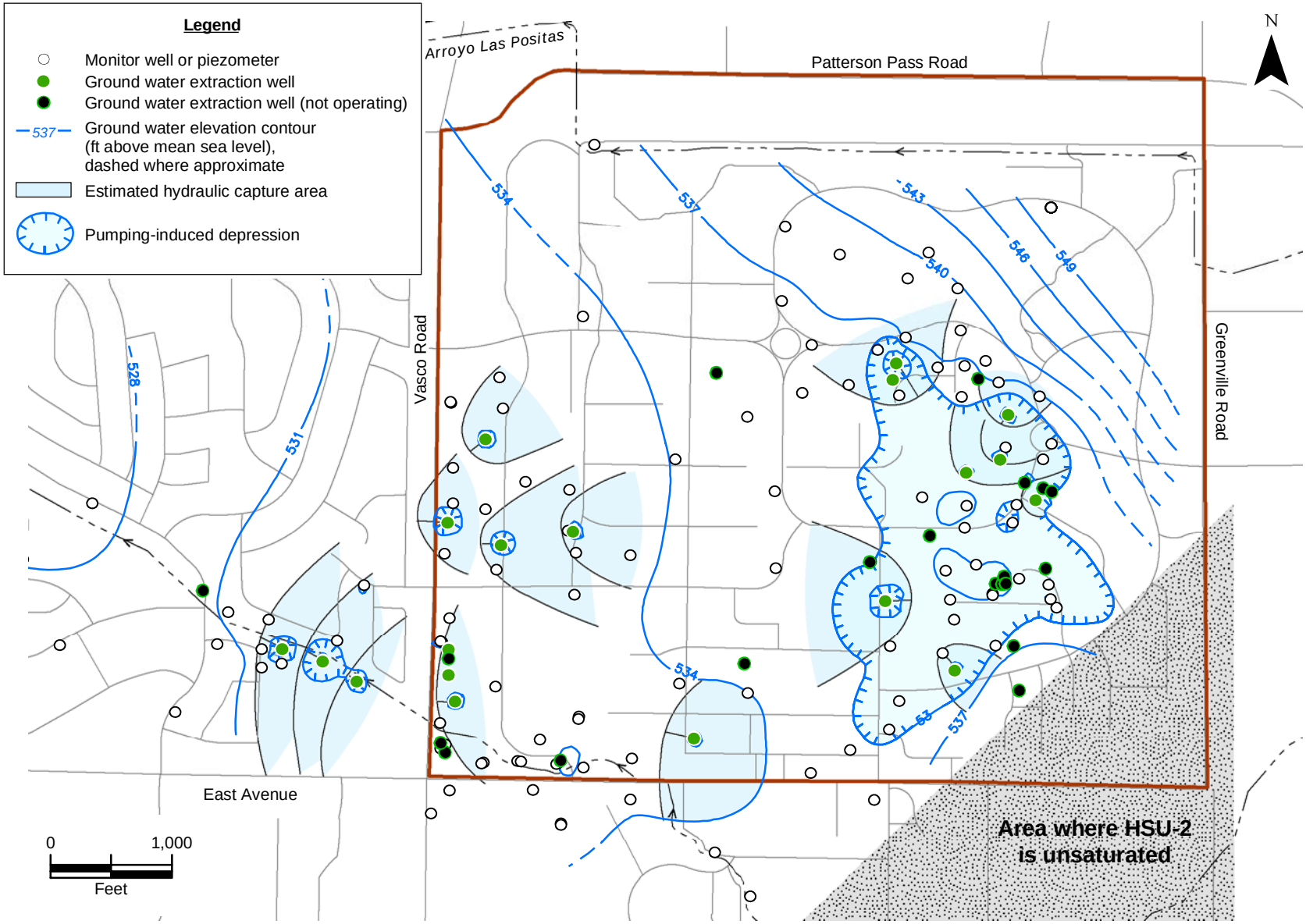

Figure 5. Ground water elevation contour map based on 145 wells completed within HSU-2 showing estimated hydraulic capture areas, LLNL and vicinity, July 2008.

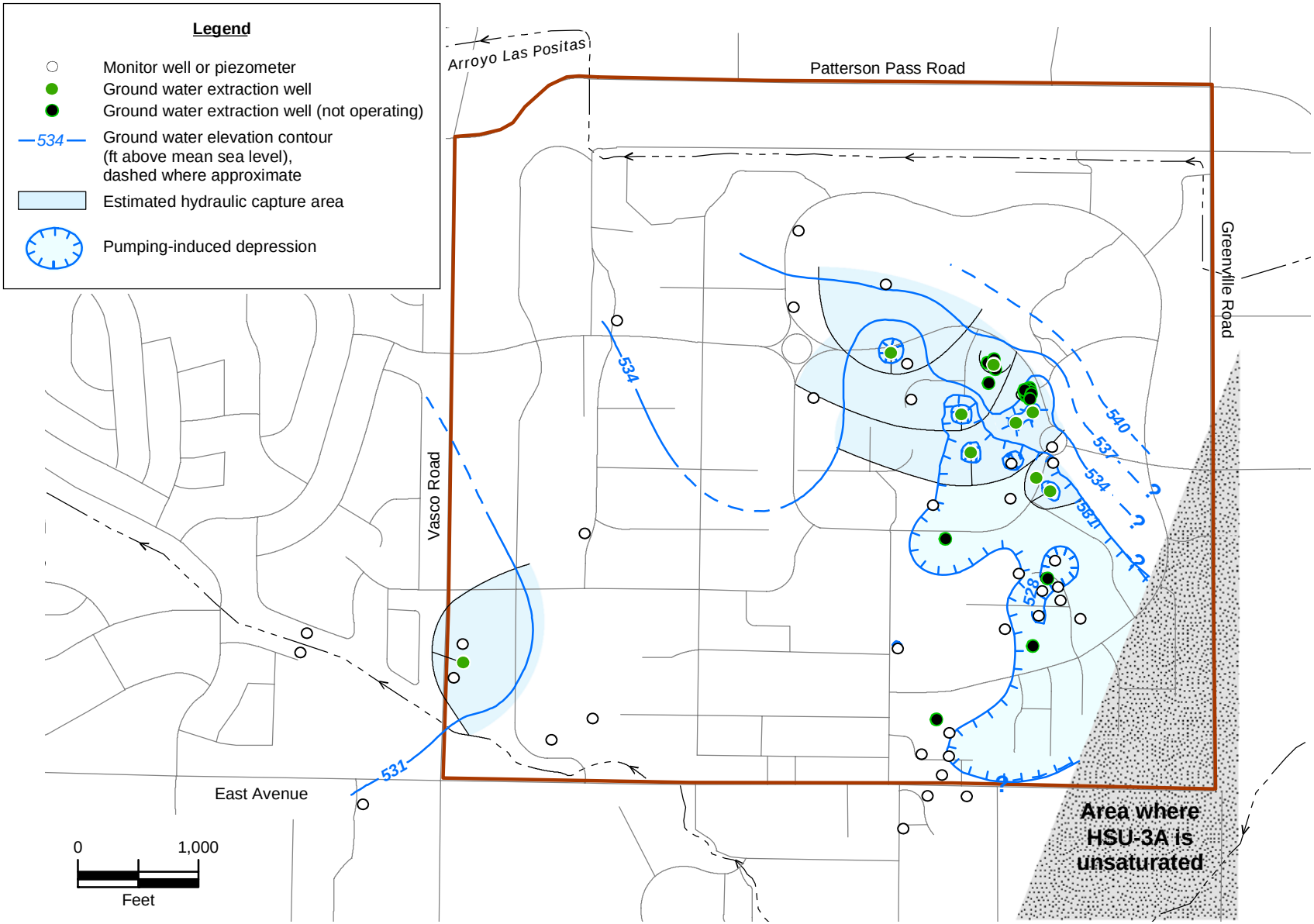

Figure 6. Ground water elevation contour map based on 61 wells completed within HSU-3A showing estimated hydraulic capture areas, LLNL and vicinity, July 2008.

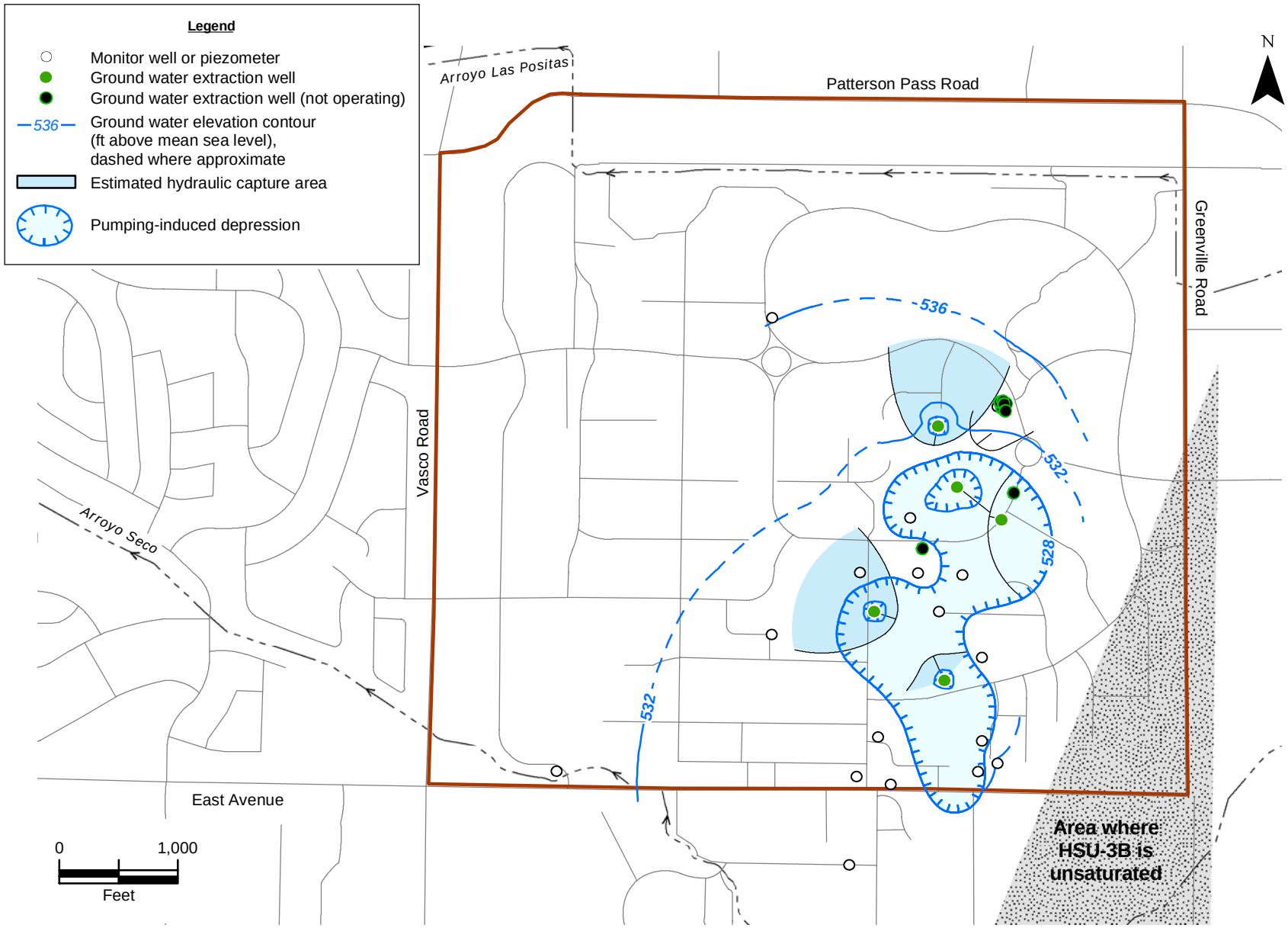

Figure 7. Ground water elevation contour map based on 29 wells completed within HSU-3B showing estimated hydraulic capture areas, LLNL and vicinity, July 2008.

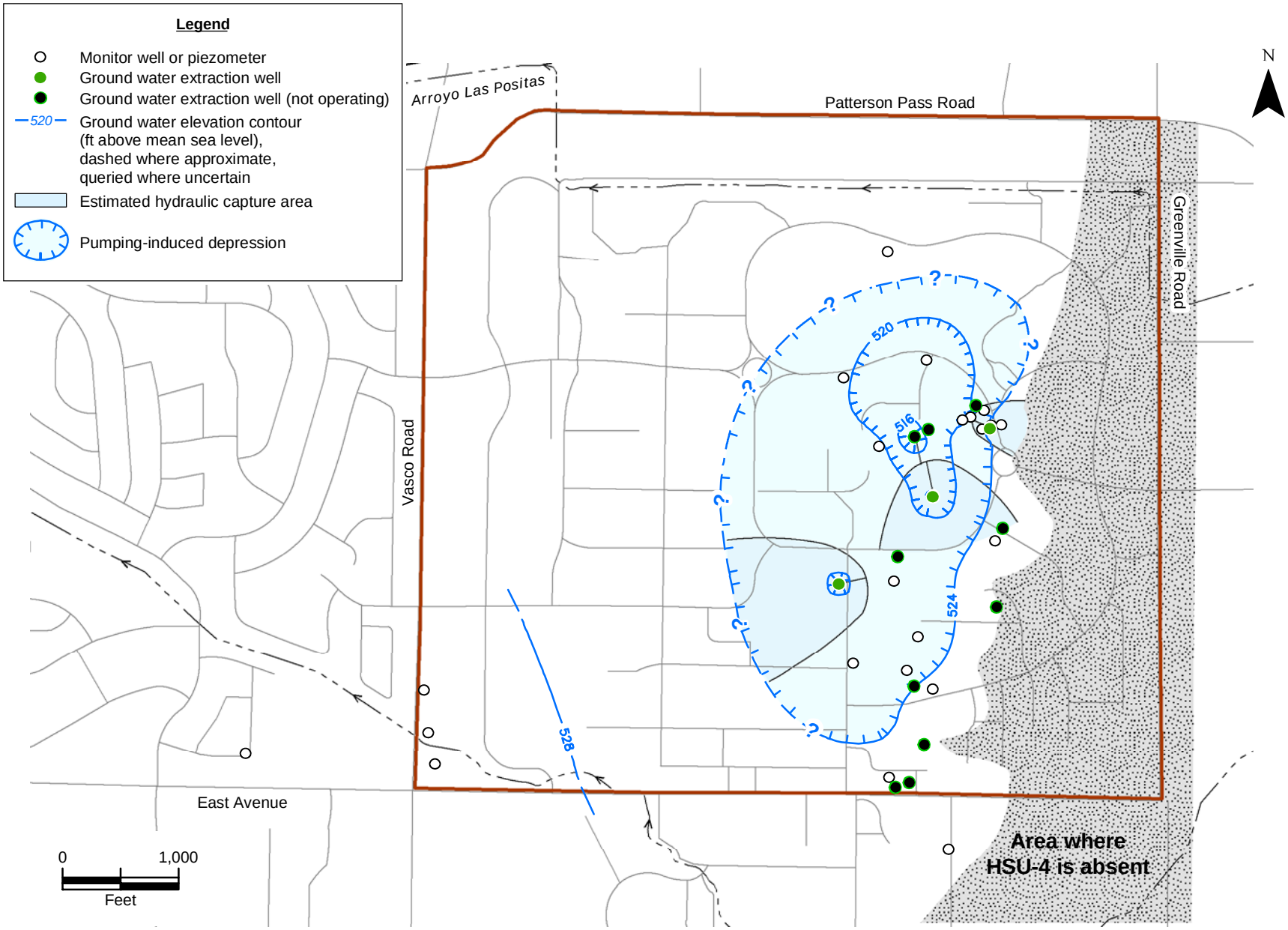

Figure 8. Ground water elevation contour map based on 35 wells completed within HSU-4 showing estimated hydraulic capture areas, LLNL and vicinity, July 2008.

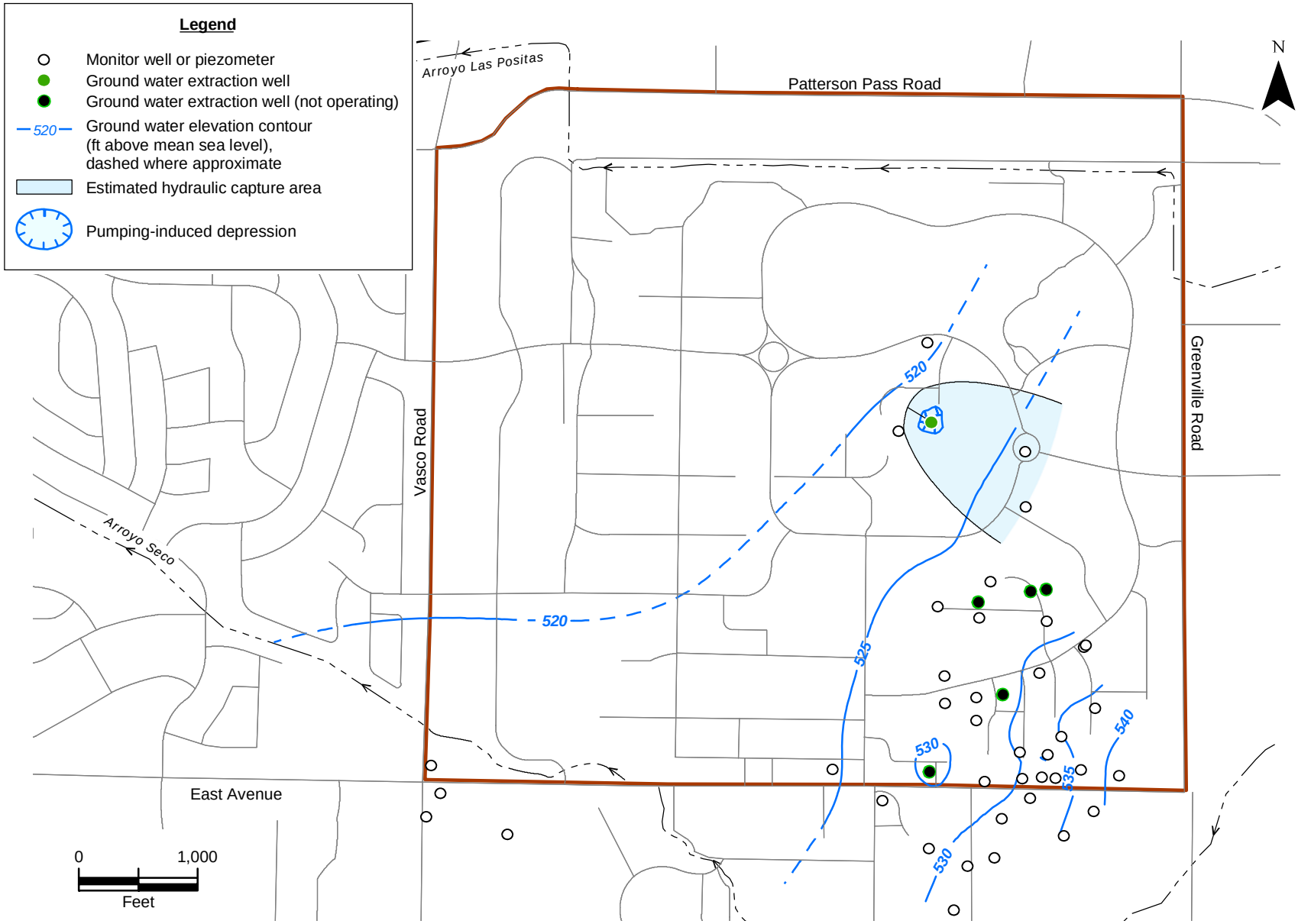

Figure 9. Ground water elevation contour map based on 45 wells completed within HSU-5 showing estimated hydraulic capture areas, LLNL and vicinity, July 2008.

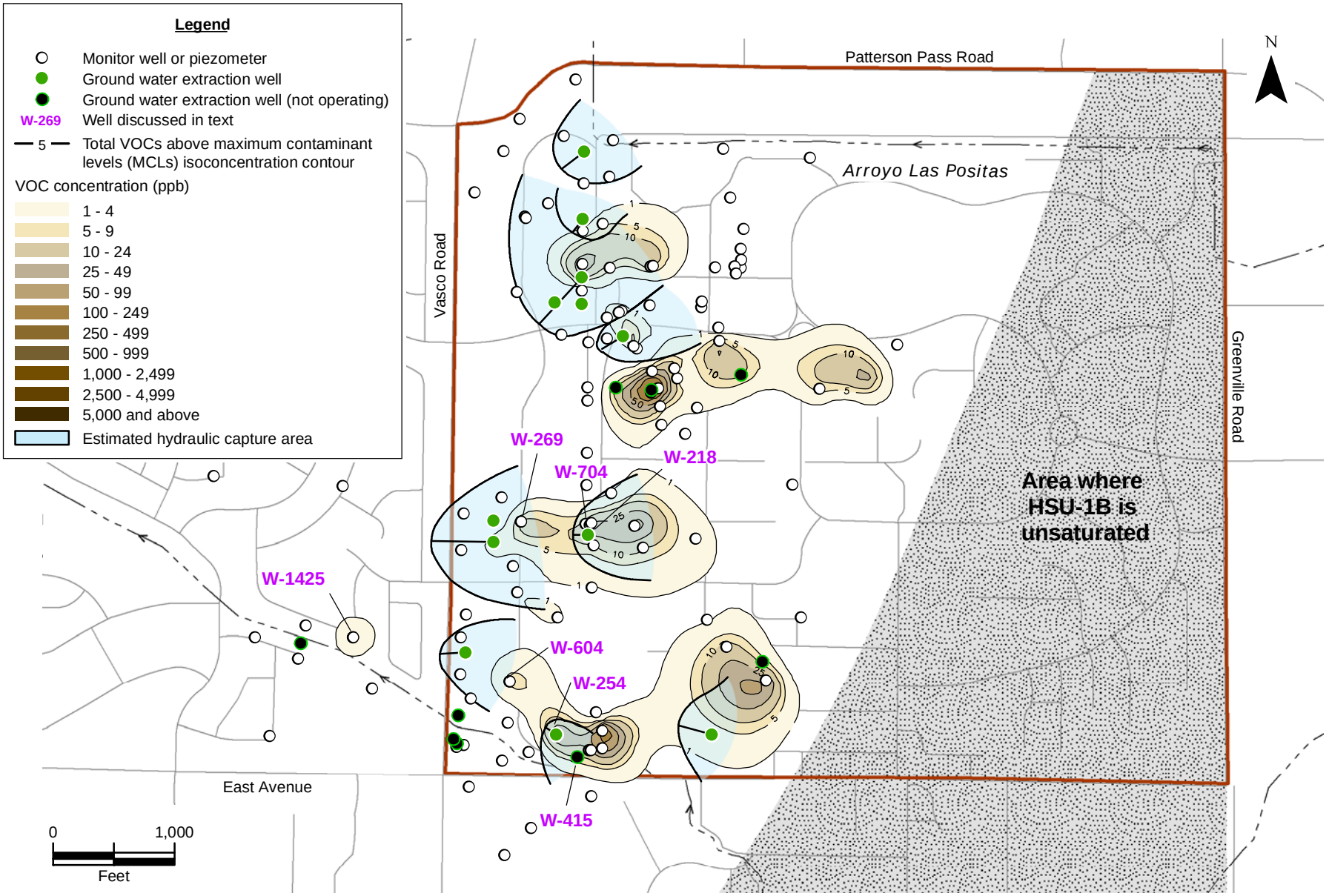

Figure 10. Isoconcentration contour map of total VOCs above MCLs from 129 wells completed within HSU-1B, third quarter 2008 (or the next most recent data), and supplemented with soil chemistry data from 38 borehole locations.

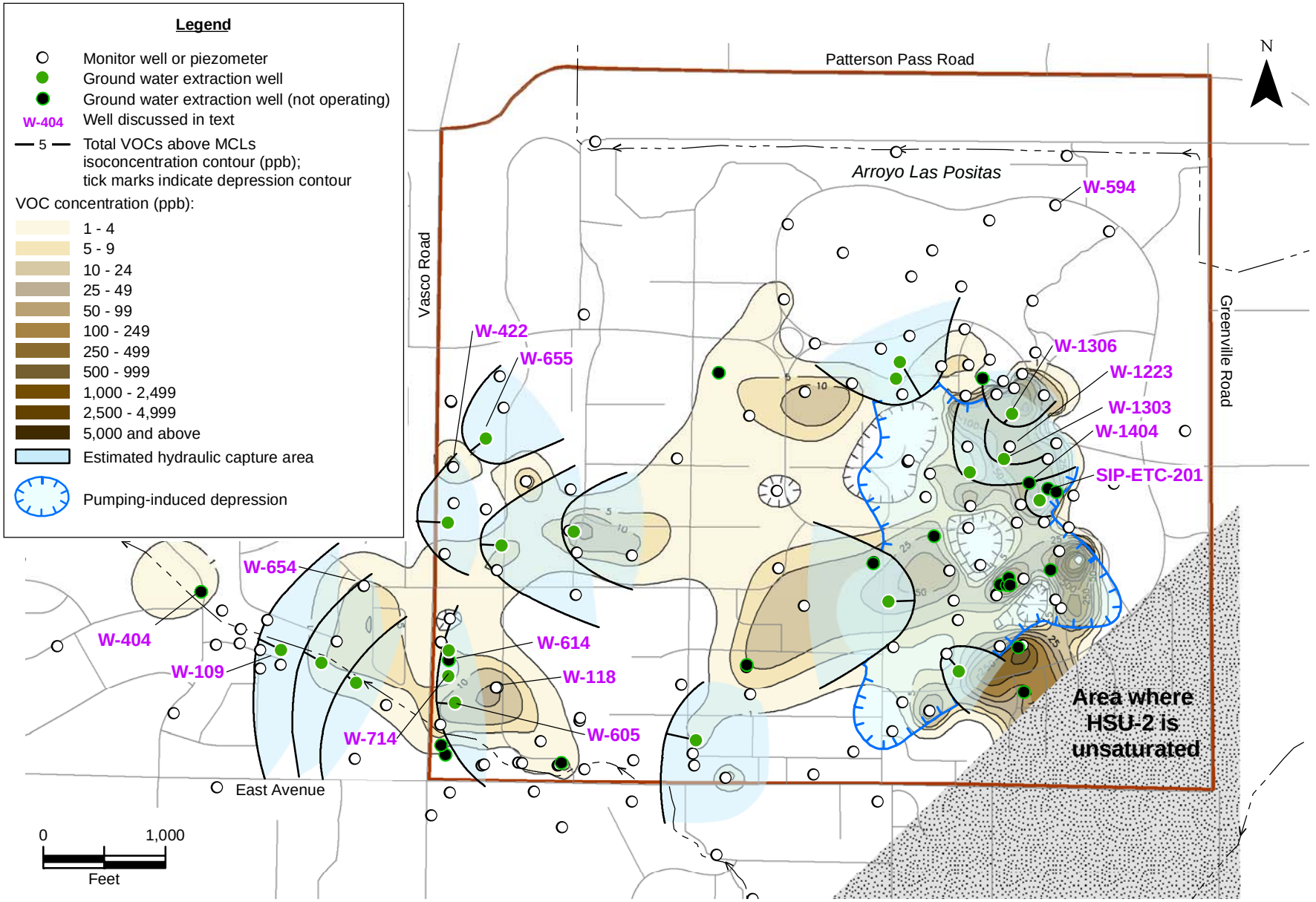

Figure 11. Isoconcentration contour map of total VOCs above MCLs from 187 wells completed within HSU-2, third quarter 2008 (or the next most recent data), and supplemented with soil chemistry data from 76 borehole locations.

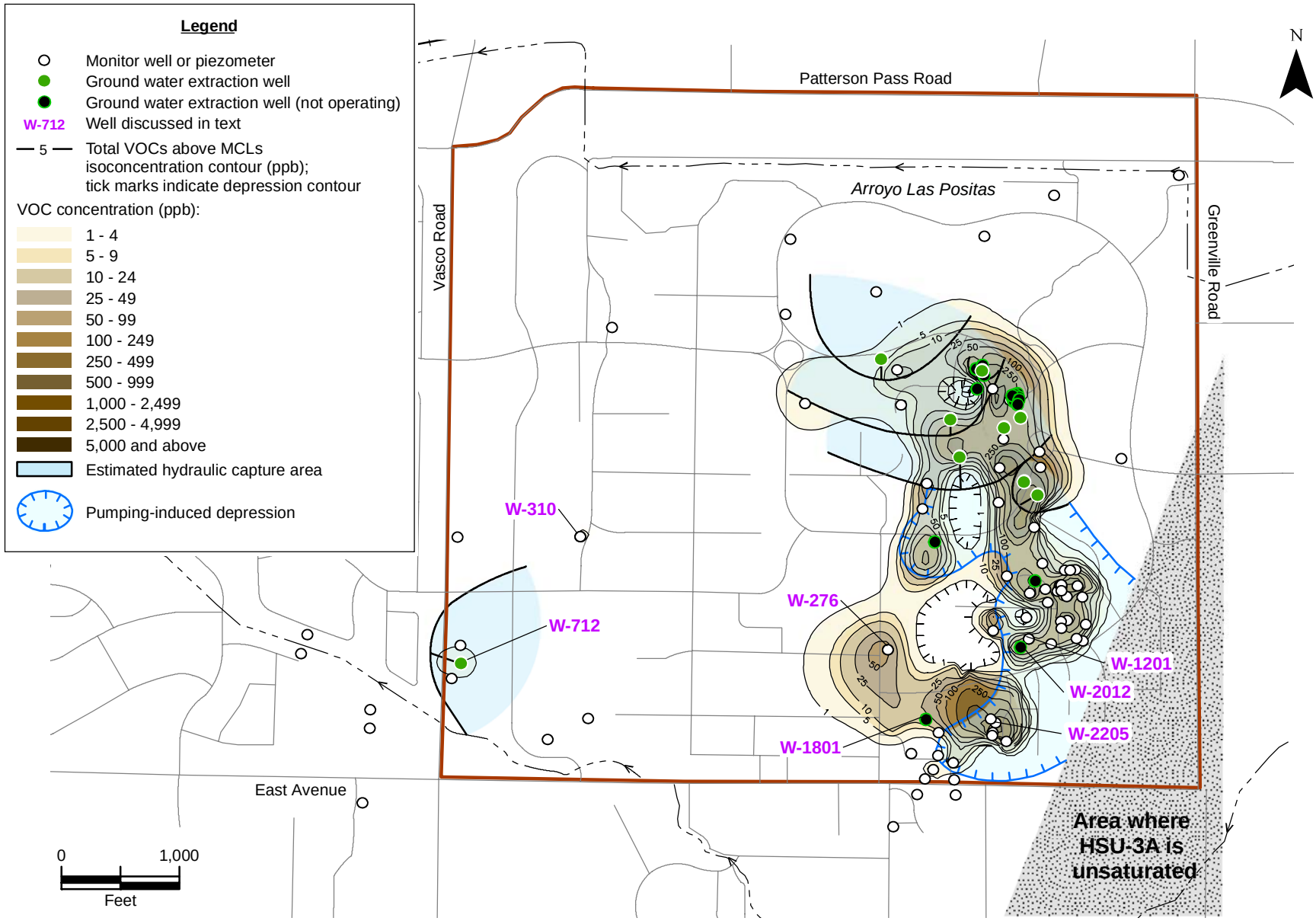

Figure 12. Isoconcentration contour map of total VOCs above MCLs from 108 wells completed within HSU-3A, third quarter 2008 (or the next most recent data), and supplemented with soil chemistry data from 142 borehole locations.

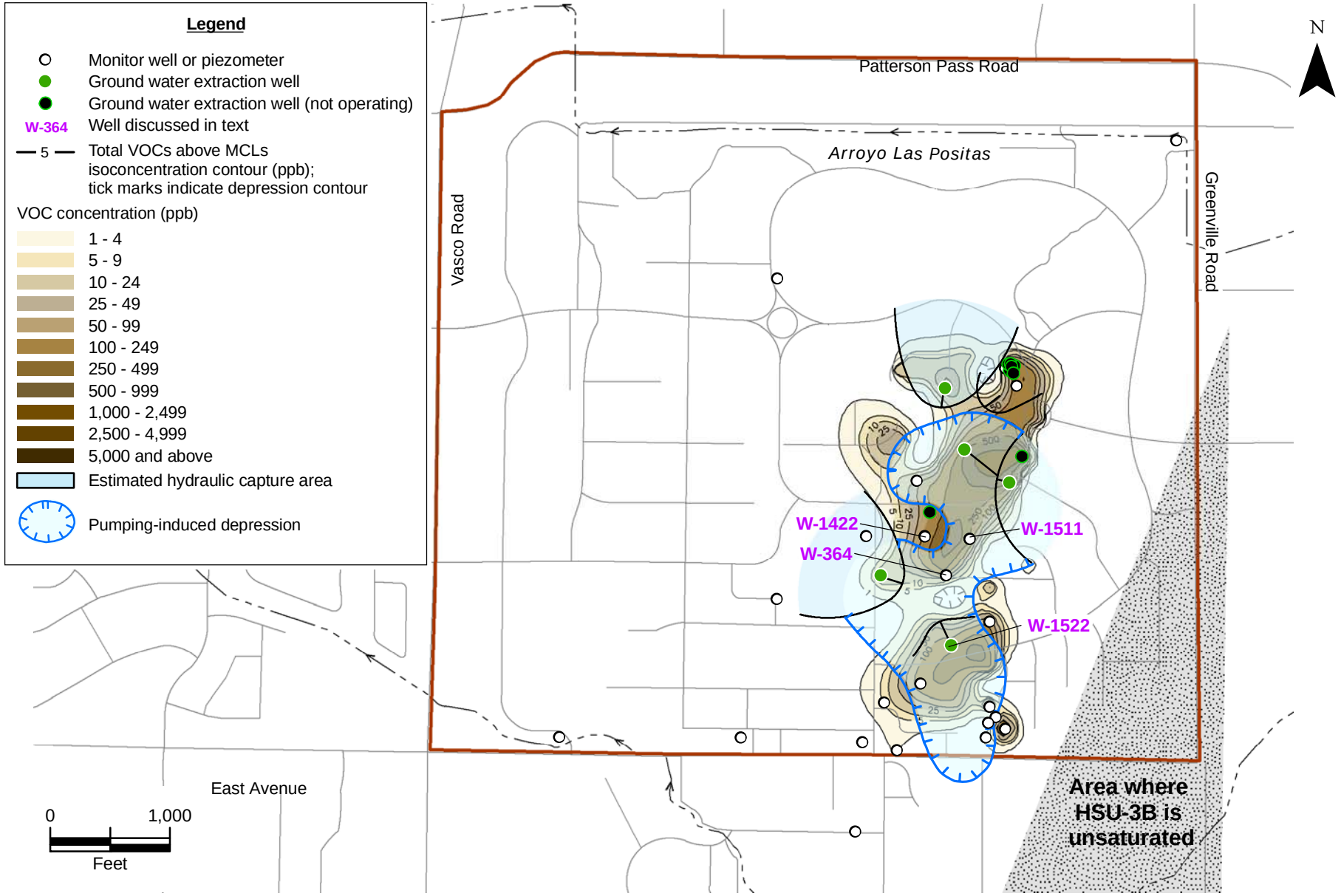

Figure 13. Isoconcentration contour map of total VOCs above MCLs from 40 wells completed within HSU-3B, third quarter 2008 (or the next most recent data), and supplemented with soil chemistry data from 108 borehole locations.

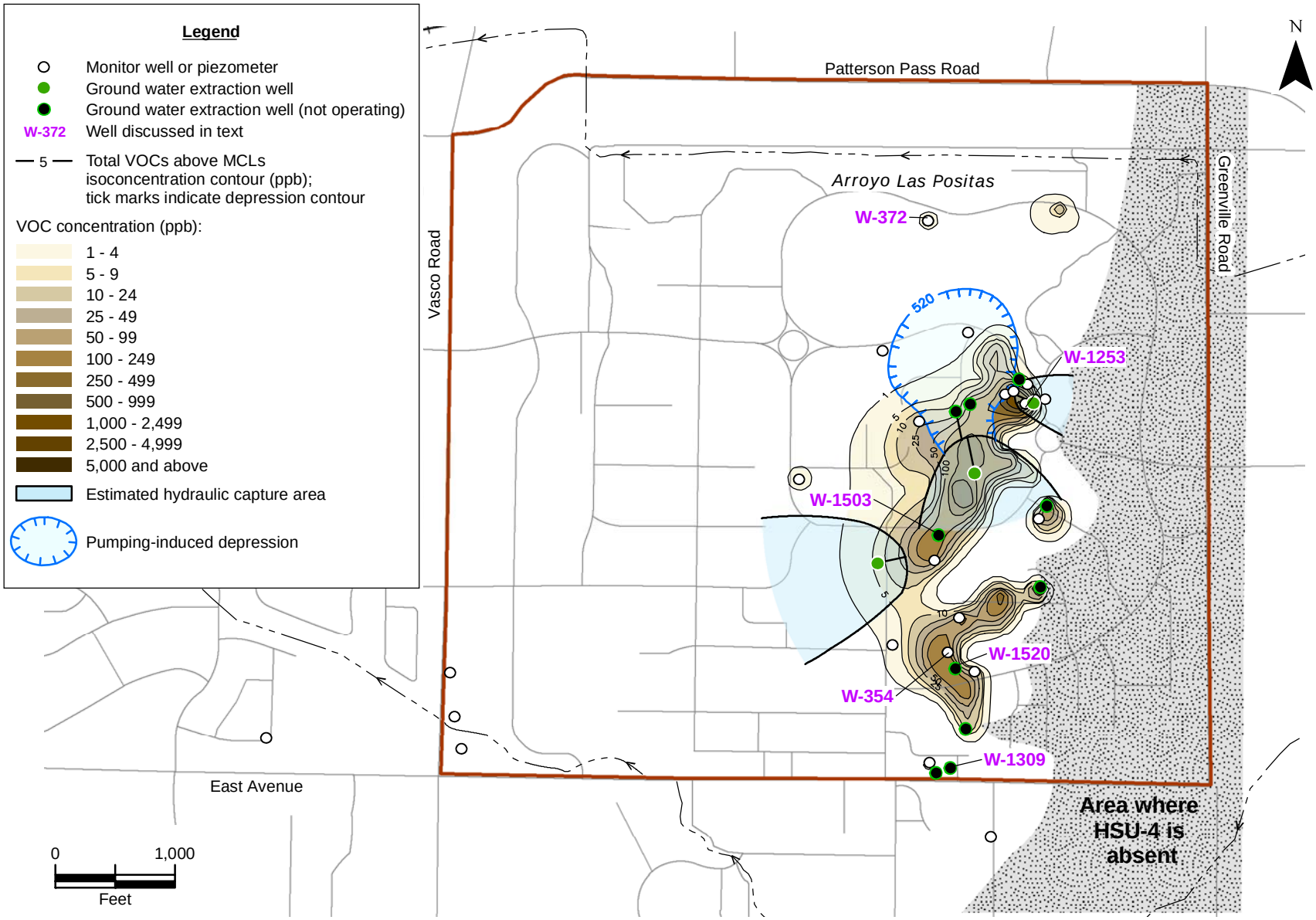

Figure 14. Isoconcentration contour map of total VOCs above MCLs from 42 wells completed within HSU-4, third quarter 2008 (or the next most recent data), and supplemented with soil chemistry data from 55 borehole locations.

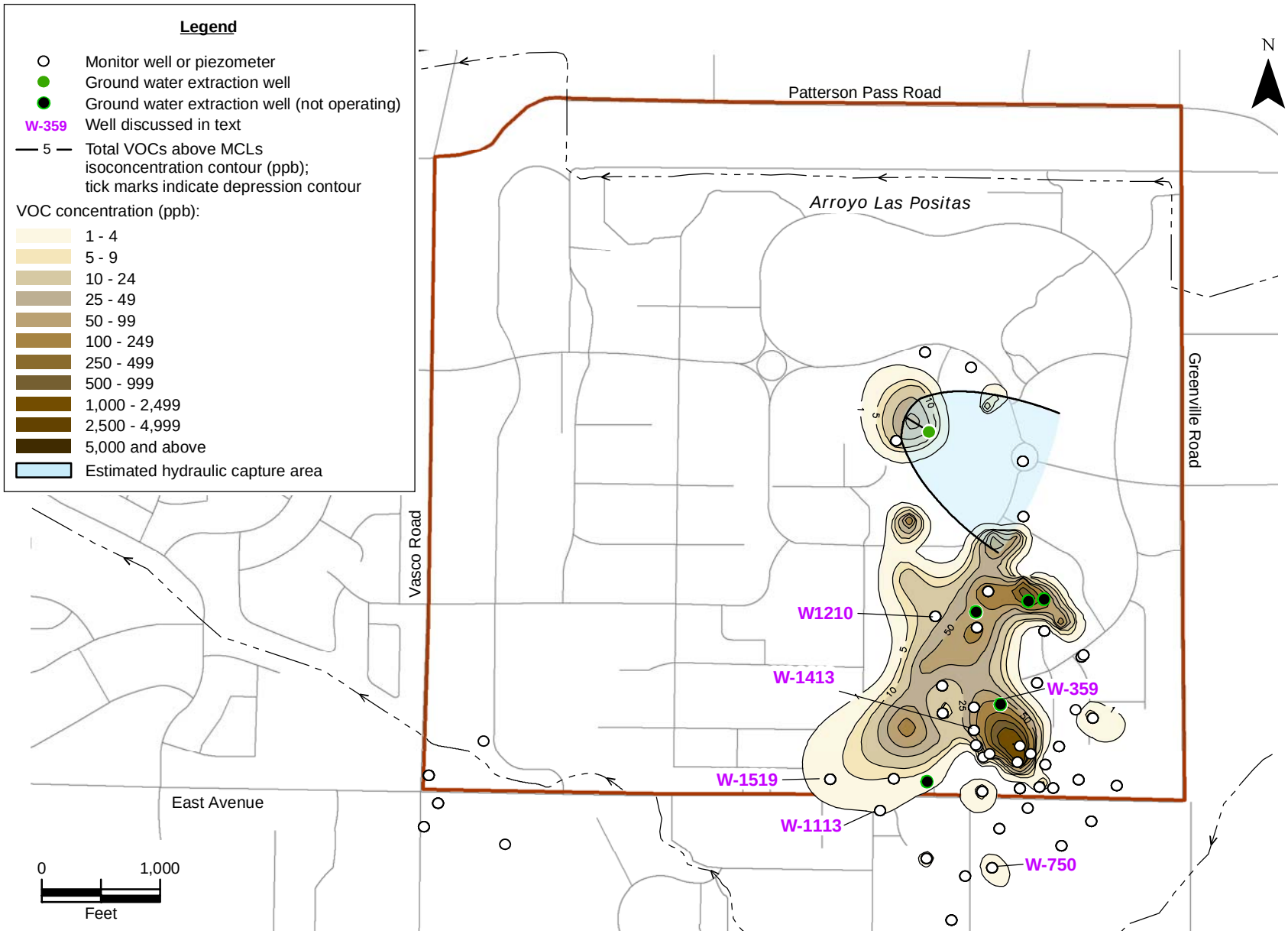

Figure 15. Isoconcentration contour map of total VOCs above MCLs from 56 wells completed within HSU-5, third quarter 2008 (or the next most recent data), and supplemented with soil chemistry data from 85 borehole locations.

Tables

Table 1. 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]	395
Ground Water Guard	20
Instrumented Membrane System	5
Piezometer	111
Soil Vapor Extraction	31
Soil Vapor Injection	1
Soil Vapor Monitor	41
Total	736

Notes:

The number of Livermore Site wells is current through the end of December 2008.

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 from 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 2. 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 3. 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 toTF406 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 3. Summary of treatment facility discharge sampling locations.

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 4. 2008 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	-	0.00	-	-	-
TFA	1B	TFA	W-408	4,492	0.01	-	-	-
TFA	1B	TFA	W-520	-	0.00	-	-	-
TFA	1B	TFA	W-601	-	0.00	-	-	-
TFA	1B	TFA	W-602	-	0.00	-	-	-
TFA	1B	TFA	W-1001	627	0.00	-	-	-
TFA	1B	TFA	W-1004	2,806	0.04	-	-	-
TFA	1B/2	TFA	W-415	6,601	0.45	-	-	-
TFA	2	TFA	W-109	6,267	0.05	-	-	-
TFA	2	TFA	W-457	1,833	0.08	-	-	-
TFA	2	TFA	W-518	1,668	0.10	-	-	-
TFA	2	TFA	W-522	4,889	0.13	-	-	-
TFA	2	TFA	W-603	-	0.00	-	-	-
TFA	2	TFA	W-605	2,305	0.24	-	-	-
TFA	2	TFA	W-609	-	0.00	-	-	-
TFA	2	TFA	W-614	2,120	0.07	-	-	-
TFA	2	TFA	W-714	1,293	0.06	-	-	-
TFA	2	TFA	W-903	2,705	0.11	-	-	-
TFA	2	TFA	W-904	5,344	0.23	-	-	-
TFA	2	TFA	W-1009	5,615	0.59	-	-	-
TFA	3A	TFA	W-712	1,744	0.10	-	-	-
TFA	1B	TFA East	W-254	310	0.07	-	-	-
TFA	2	TFA West	W-404	664	0.03	-	-	-
TFB	1B	TFB	W-610	2,136	0.07	-	-	-
TFB	1B	TFB	W-620	1,434	0.11	-	-	-
TFB	1B	TFB	W-704	2,570	0.42	-	-	-
TFB	2	TFB	W-357	2,376	0.53	-	-	-
TFB	2	TFB	W-621	3,111	0.09	-	-	-
TFB	2	TFB	W-655	2,688	0.07	-	-	-
TFB	2	TFB	W-1423	2,837	0.28	-	-	-
TFC	1B	TFC	W-701	6,398	1.14	-	-	-
TFC	1B	TFC	W-1015	3,328	0.13	-	-	-
TFC	1B	TFC	W-1102	1,413	0.07	-	-	-
TFC	1B	TFC	W-1103	1,111	0.01	-	-	-
TFC	1B	TFC	W-1104	13,295	2.14	-	-	-
TFC	1B	TFC	W-1116	865	0.04	-	-	-
TFC	1B	TFC East	W-368	358	0.07	-	-	-
TFC	2	TFC East	W-413	1,259	0.19	-	-	-
TFC	1B	TFC Southeast	W-1213	1,268	0.13	-	-	-
TFC	1B	TFC Southeast	W-2201	1,682	0.29	-	-	-

Table 4. 2008 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)
TFD	2/3A	TFD	W-906	751	0.03	-	-	-
TFD	3A	TFD	W-653	26	0.14	VTFD Hotspot	-	0.00
TFD	3A	TFD	W-2011	-	0.00	VTFD Hotspot	-	0.00
TFD	3A	TFD	W-2101	-	0.00	VTFD Hotspot	-	0.00
TFD	3A	TFD	W-2102	-	0.00	VTFD Hotspot	-	0.00
TFD	3A/3B	TFD	W-1208	6,419	3.08	-	-	-
TFD	4	TFD	W-351	37	0.02	-	-	-
TFD	4	TFD	W-1206	3,198	0.28	-	-	-
TFD	5	TFD	W-907-2	3,053	0.35	-	-	-
TFD	2	TFD East	W-1303	456	0.36	-	-	-
TFD	2	TFD East	W-1306	134	0.07	-	-	-
TFD	2	TFD East	W-1404	17	0.01	-	-	-
TFD	3A	TFD East	W-1301	581	1.20	-	-	-
TFD	3A	TFD East	W-1550	1,196	0.92	-	-	-
TFD	3A	TFD East	W-2203	468	0.33	-	-	-
TFD	3B	TFD East	W-2006	16	0.07	-	-	-
TFD	4	TFD East	W-1253	-	0.00	-	-	-
TFD	4	TFD East	W-1255	-	0.00	-	-	-
TFD	4	TFD East	W-1307	2,983	0.37	-	-	-
TFD	2/3A	TFD Helipad	W-1655	-	0.00	VTFD Helipad	-	0.00
TFD	2/3A/3B	TFD Helipad	W-1651	-	0.00	VTFD Helipad	-	0.00
TFD	3A	TFD Helipad	W-1551	-	0.00	-	-	-
TFD	3A	TFD Helipad	W-1552	-	0.00	VTFD Helipad	-	0.00
TFD	3A	TFD Helipad	W-1650	-	0.00	VTFD Helipad	-	0.00
TFD	3A	TFD Helipad	W-1653	-	0.00	VTFD Helipad	-	0.00
TFD	3A	TFD Helipad	W-1654	-	0.00	VTFD Helipad	-	0.00
TFD	3A	TFD Helipad	W-1656	-	0.00	VTFD Helipad	-	0.00
TFD	3A/3B	TFD Helipad	W-1652	-	0.00	VTFD Helipad	-	0.00
TFD	3A/3B	TFD Helipad	W-1657	-	0.00	VTFD Helipad	-	0.00
TFD	4	TFD Helipad	W-1254	-	0.00	-	-	-
TFD	2	TFD South	W-1510	387	0.06	-	-	-
TFD	3A/3B	TFD South	W-1504	394	0.17	-	-	-
TFD	4	TFD South	W-1503	2,865	0.67	-	-	-
TFD	2	TFD Southeast	W-1308	1,617	1.66	-	-	-
TFD	2	TFD Southeast	W-1904	-	0.00	VTFD East Traffic Circle South	-	0.00
TFD	2	TFD Southeast	SIP-ETC-201	-	0.00	VTFD East Traffic Circle South	-	0.00
TFD	3A	TFD Southeast	W-2005	565	0.52	-	-	-
TFD	3B	TFD Southeast	W-1403	854	2.04	-	-	-
TFD	4	TFD Southeast	W-314	1,174	0.98	-	-	-
TFD	2	TFD Southshore	W-1602	2,149	0.20	-	-	-

Table 4. 2008 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)
TFD	3A	TFD Southshore	W-1603	3,234	2.81	-	-	-
TFD	3B	TFD Southshore	W-1601	573	0.87	-	-	-
TFD	4	TFD Southshore	W-1523	4,441	3.71	-	-	-
TFD	2	TFD West	W-1215	1,904	0.33	-	-	-
TFD	2	TFD West	W-1216	2,698	0.81	-	-	-
TFD	3A	TFD West	W-1902	4,812	1.99	-	-	-
TFD	1B	-	W-ETC-2003	-	-	VTFD East Traffic Circle South	-	0.00
TFD	1B/2	-	W-ETC-2004A	-	-	VTFD East Traffic Circle South	-	0.00
TFD	2	-	W-ETC-2004B	-	-	VTFD East Traffic Circle South	-	0.00
TFD	1B	-	W-HPA-002A	-	-	VTFD Helipad	-	0.00
TFD	2	-	W-HPA-002B	-	-	VTFD Helipad	-	0.00
TFD	3A	TFD Helipad	W-1552	-	0.00	VTFD Helipad	-	0.00
TFE	2	TFE East	W-1109	274	0.33	-	-	-
TFE	2	TFE East	W-1903	-	0.00	VTFE Eastern Landing Mat	-	0.00
TFE	2	TFE East	W-1909	-	0.00	VTFE Eastern Landing Mat	-	0.00
TFE	2	TFE East	W-2305	-	0.00	VTFE Eastern Landing Mat	-	0.00
TFE	2/3A	TFE East	W-2305	-	0.00	VTFE Eastern Landing Mat	-	0.00
TFE	5	TFE East	W-566	1,055	0.32	-	-	-
TFE	2	TFE Hotspot	W-2105	19	0.02	VTFE Hotspot	340	0.01
TFE	3A	TFE Hotspot	W-2012	803	0.87	-	-	-
TFE	2	TFE Northwest	W-1409	332	0.03	-	-	-
TFE	4	TFE Northwest	W-1211	10,156	0.54	-	-	-
TFE	5	TFE Southeast	W-359	819	0.41	-	-	-
TFE	2	TFE Southwest	W-1518	593	0.06	-	-	-
TFE	3B	TFE Southwest	W-1522	684	0.59	-	-	-
TFE	4	TFE Southwest	W-1520	0.4	0.00	-	-	-
TFE	2	TFE West	W-305	4,517	1.46	-	-	-
TFE	3B	TFE West	W-292	3,074	0.38	-	-	-
TFE	1B	-	W-543-1908	-	-	VTFE Eastern Landing Mat	768	0.08
TFE	2	-	W-543-001	-	-	VTFE Eastern Landing Mat	446	0.10
TFE	2	-	W-543-003	-	-	VTFE Eastern Landing Mat	1,181	0.31
TFE	1B	-	W-ETS-2008A	-	-	VTFE Hotspot	508	0.01
TFE	1B/2	-	W-ETS-2010A	-	-	VTFE Hotspot	477	0.01
TFE	2	-	W-ETS-2008B	-	-	VTFE Hotspot	480	0.16
TFE	2	-	W-ETS-2009	-	-	VTFE Hotspot	516	0.01
TFE	2	-	W-ETS-2010B	-	-	VTFE Hotspot	675	0.16
TFG	1B	TFG North	W-1806	335	0.02	-	-	-
TFG	2	TFG North	W-1807	925	0.09	-	-	-
TFG	1B/2	TFG-1	W-1111	4,599	0.35	-	-	-

Table 4. 2008 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)
TFH	4	TF406	W-1309	1.4	0.00	-	-	-
TFH	4	TF406	GSW-445	1.3	0.00	-	-	-
TFH	5	TF406	W-1310	2,625	0.07	-	-	-
TFH	3A	TF406 Northwest	W-1801	182	0.02	-	-	-
TFH	4	TF518 North	W-1410	98	0.01	-	-	-
TFH	1B	TF518 Perched Zone	W-518-1914	0.02	0.00	VTF518 Perched Zone	235	0.05
TFH	1B/2	TF518 Perched Zone	W-1615	0.5	0.00	VTF518 Perched Zone	128	0.59
TFH	2	TF518 Perched Zone	W-518-1913	0.1	0.00	VTF518 Perched Zone	55	0.07
TFH	2	TF518 Perched Zone	W-518-1915	0	0.01	VTF518 Perched Zone	38	0.05
TFH	2	TF518 Perched Zone	SVB-518-201	0.004	0.00	VTF518 Perched Zone	290	0.23
TFH	2	TF518 Perched Zone	SVB-518-204	0.03	0.00	VTF518 Perched Zone	215	0.59
TFH	3A	TF5475-1	W-1302-2	-	0.00	-	-	-
TFH	2	TF5475-2	W-1415	9.2	0.00	-	-	-
TFH	5	TF5475-2	W-1108	255	0.53	-	-	-
TFH	3A	TF5475-3	W-1605	-	0.00	VTF5475	-	0.00
TFH	3A	TF5475-3	W-1608	-	0.00	VTF5475	-	0.00
TFH	4	TF5475-3	W-1604	-	0.00	-	-	-
TFH	5	TF5475-3	W-1609	-	0.00	-	-	-
TFH	1B/2	-	W-514-2007A	-	-	VTF406 Hotspot	1,323	0.02
TFH	2/5	-	W-514-2007B	-	-	VTF406 Hotspot	2,318	0.52
TFH	5	-	W-217	-	-	VTF406 Hotspot	4,766	1.24
TFH	1B	-	W-2207A	-	-	VTF511	0.1	0.00
TFH	2	-	W-274	-	-	VTF511	-	0.00
TFH	2	-	W-1517	-	-	VTF511	0.02	0.00
TFH	2	-	W-2204	-	-	VTF511	-	0.00
TFH	2	-	W-2206	-	-	VTF511	-	0.00
TFH	2	-	W-2207B	-	-	VTF511	2,730	5.06
TFH	2	-	W-2208A	-	-	VTF511	0.2	0.00
TFH	2	-	W-2208B	-	-	VTF511	2,626	43.57
TFH	2	-	W-2205	-	-	VTF511	-	0.00
TFH	1B/2	-	W-ETS-507	-	-	VTF5475	-	0.00
TFH	2	-	W-2211	-	-	VTF5475	-	0.00
TFH	2	-	W-2302	-	-	VTF5475	-	0.00
TFH	2	-	W-2303	-	-	VTF5475	-	0.00
TFH	2	-	SVI-ETS-504	-	-	VTF5475	-	0.00
TFH	3A	-	W-2212	-	-	VTF5475	-	0.00

Notes appear on the following page.

Table 4. 2008 Livermore Site performance summary.

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
W-368	GW Extraction	6-May-87	206	78	1	70-78	1B	3.5

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-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
W-441	GW Monitor	14-Oct-87	250	144	1	135-144	5	3

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-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
W-511	GW Monitor	31-Mar-89	316	176	1	167-176	3B	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-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
W-594	GW Monitor	27-Feb-89	156	61	1	55-61	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-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
W-712	GW Extraction	28-Aug-91	200	185.5	1	170-185.5	3A	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-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
W-1106	GW Monitor	17-Jan-95	245	86	1	76-85	1B	17.5

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-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
W-1226	GW Monitor	6-Aug-96	155	126.5	1	116-126	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-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
W-1417	GW Monitor	23-Apr-98	225	155	1	130-150	3A	8.9

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-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
W-1550	GW Extraction	24-Jun-99	200	130	1	98-125	3A	10

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-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
W-1802	GW Monitor	2-Apr-02	175	162.2	1	147-157	3A	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-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
W-2113	GW Monitor	21-Jul-05	220	201.5	1	190.5-200.5	4	9

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-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
SIP-141-201	Piezometer	2-Feb-96	77	74.2	1	57-74	1B	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)
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
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

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-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
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

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-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
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

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-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
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

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-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
					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

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)
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
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

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-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
					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

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)
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
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		
11R5	Other non-LLNL	19-Dec-83	NA	NA	NA	NA	26-Jul-85

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
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
					450-453		
					465-469		
					500-515		
					575-588		
3S2E01P2	Other non-LLNL	7-Oct-60	144	144	124-144	NA	22-May-86

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
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		
					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	

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
					32-33	1B/2	
					38-39	1B/2	
					47-48	1B/2	
					52-53	1B/2	
					59-60	1B/2	
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
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-PA-029	Piezometer	22-Jan-90	11.5	7	5-7	1B	18-Nov-93
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
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

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-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
				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

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
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
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

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-117	20-Feb-86	Slug	NA	2	0.4	Good
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-207	2-Mar-88	Slug	NA	380	32	Excel
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

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-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
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

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-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
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

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-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-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
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-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

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-368	31-Jul-01	Step	6.0	2,600	350	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
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-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

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-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
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

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-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
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-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

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-614	7-Jun-90	Drawdown	6.7	1,650	130	Good
W-615	21-Jun-90	Drawdown	1.3	130	19	Fair
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-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-1006	17-Jun-97	Drawdown	17.4	180	23	Fair
W-1007	23-Sep-95	Drawdown	1.6	13	1.3	Fair
W-1008	17-Jan-97	Drawdown	7.3	110	13	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-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-1109	26-Jun-95	Drawdown	8.7	460	33	Fair
W-1109	4-Jun-96	Longterm	6.8	760	40	Poor
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
W-1205	27-Nov-96	Slug	NA	330	33	Fair
W-1207	27-Nov-96	Slug	NA	900	45	Poor
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

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-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
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	1,132	57	Fair
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

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-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
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-1504	18-Feb-99	Drawdown	15.4	600	60	Fair
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-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

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-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
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-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-1902	19-Mar-03	Step	11.0	1,100	29	Good
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
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

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-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
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
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

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-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 or TO15-01 analysis.**

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

References

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Appendix D

2008 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 (Q1-08)
W-001	O	1-09	
W-001A	A	1-09	
W-002	O	3-09	
W-002A	E	4-10	
W-004	A	1-09	
W-005	O	3-09	
W-005A	E	4-10	
W-007	O	1-09	
W-008	O	1-09	PRAD
W-011	O	2-09	
W-012	S	1-09	
W-017	O	1-09	PRAD
W-017A	O	1-09	
W-101	E	2-10	
W-102	O	1-09	
W-103	O	1-09	
W-104	Q	1-09	
W-105	E	4-10	
W-106	O	1-09	
W-107	A	1-09	
W-108	O	3-09	
W-110	Q	1-09	
W-111	O	1-09	
W-113	O	3-09	
W-114	A	3-09	
W-115	E	4-10	
W-116	Q	1-09	
W-117	O	1-09	
W-118	A	1-09	
W-119	A	1-09	PRAD
W-120	Q	1-09	
W-121	Q	1-09	PRAD
W-122	E	1-10	
W-123	E	1-10	
W-141	A	4-09	
W-142	B	1-09	
W-143	E	2-10	
W-146	E	4-10	
W-147	E	2-10	
W-148	E	2-10	
W-151	Q	1-09	PRAD
W-201	A	3-09	
W-202	O	1-09	
W-203	E	2-10	
W-204	S	1-09	PRAD

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

Well number	VOC sampling frequency	Next quarter sample date	Additional analytes (Q1-08)
W-205	Q	1-09	
W-206	Q	1-09	
W-207	O	1-09	
W-210	O	1-09	
W-212	O	1-09	
W-213	O	2-09	
W-214	E	4-10	
W-218	S	2-09	
W-219	O	2-09	
W-220	A	2-09	
W-221	O	1-09	PRAD
W-222	Q	1-09	
W-223	O	2-09	
W-224	E	4-10	
W-225	E	4-10	
W-226	O	1-09	
W-251	Q	1-09	
W-252	O	3-10	
W-253	O	2-09	
W-255	O	1-09	
W-256	S	1-09	
W-257	Q	1-09	
W-258	Q	1-09	
W-259	Q	1-09	
W-260	E	4-10	
W-261	O	2-09	
W-263	Q	1-09	
W-264	A	4-10	
W-265	O	3-09	
W-267	E	4-10	
W-268	A	3-09	
W-269	A	4-09	
W-270	E	4-10	
W-271	A	3-09	
W-272	A	4-09	
W-273	O	4-09	
W-275	E	2-10	
W-276	Q	1-09	
W-277	O	2-09	
W-290	O	1-09	
W-291	O	1-09	
W-293	E	4-10	
W-294	E	4-10	
W-301	A	1-09	
W-302	O	3-09	
W-303	A	3-09	

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

Well number	VOC sampling frequency	Next quarter sample date	Additional analytes (Q1-08)
W-304	A	2-09	
W-306	O	2-09	
W-307	A	1-09	
W-308	O	1-09	
W-310	Q	1-09	
W-311	A	1-09	
W-312	E	4-10	
W-313	S	2-09	
W-315	Q	1-09	
W-316	S	2-09	
W-317	A	4-09	
W-319	O	3-09	
W-320	A	4-09	
W-321	E	1-10	
W-322	Q	1-09	
W-323	Q	1-09	
W-324	E	4-10	
W-325	O	1-09	
W-353	S	2-09	
W-354	Q	1-09	
W-355	S	2-09	
W-356	S	1-09	
W-361	A	3-09	
W-362	O	2-09	
W-363	Q	1-09	PRAD
W-364	O	1-09	
W-365	E	2-10	
W-366	O	4-09	
W-369	A	1-09	
W-370	O	2-09	
W-371	O	4-09	
W-372	O	1-09	
W-373	O	1-09	PRAD
W-375	A	1-09	
W-376	O	4-09	
W-377	O	4-09	
W-378	E	3-10	
W-379	S	2-09	
W-380	O	1-09	
W-401	E	2-10	
W-402	O	1-09	
W-403	O	2-09	
W-405	Q	1-09	
W-406	O	4-09	
W-407	Q	1-09	
W-409	A	4-09	

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

Well number	VOC sampling frequency	Next quarter sample date	Additional analytes (Q1-08)
W-410	Q	1-09	
W-411	A	2-09	
W-412	A	1-09	
W-416	O	2-09	
W-417	O	4-09	
W-418	E	4-10	
W-419	A	4-09	
W-420	E	4-10	
W-421	Q	1-09	
W-422	Q	1-09	
W-423	S	2-09	
W-424	Q	1-09	
W-446	O	1-09	
W-447	E	3-10	
W-448	E	4-10	
W-449	E	1-10	
W-450	S	2-09	
W-451	E	4-10	
W-452	E	2-10	
W-453	E	4-10	
W-454	S	1-09	
W-455	O	1-09	
W-458	A	2-09	
W-459	O	4-09	
W-462	O	4-09	
W-463	O	1-09	
W-464	A	4-09	
W-481	Q	1-09	
W-482	S	1-09	
W-483	E	3-10	
W-484	O	3-09	
W-485	O	1-09	
W-486	E	2-10	
W-487	E	2-10	
W-501	A	1-09	
W-502	E	3-10	
W-503	E	4-10	
W-504	O	4-09	
W-505	O	2-09	
W-506	S	1-09	
W-507	O	3-09	
W-509	E	4-10	
W-510	O	1-09	
W-511	O	2-09	
W-512	E	3-10	
W-513	O	1-09	

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

Well number	VOC sampling frequency	Next quarter sample date	Additional analytes (Q1-08)
W-514	O	4-09	
W-515	A	4-09	
W-516	A	1-09	
W-517	Q	1-09	
W-519	O	1-09	
W-520	O	1-09	
W-521	O	1-09	
W-551	O	4-10	
W-552	E	3-10	
W-553	O	1-09	
W-554	E	3-10	
W-555	E	3-10	
W-556	O	1-09	PRAD
W-557	O	1-09	
W-558	Q	1-09	
W-559	O	1-09	
W-560	O	1-09	
W-561	E	4-10	
W-562	O	1-09	
W-563	E	4-10	
W-564	A	4-09	
W-565	A	4-09	
W-567	O	2-09	
W-568	S	1-09	
W-569	A	4-09	
W-570	O	1-09	
W-571	A	1-09	PRAD
W-592	O	4-09	
W-593	O	1-09	
W-594	E	1-10	
W-601	A	1-09	
W-602	O	1-09	
W-603	O	1-09	
W-604	A	3-09	
W-606	A	4-09	
W-607	A	2-09	
W-608	O	1-09	
W-609	A	4-09	
W-611	S	2-09	
W-612	Q	1-09	
W-613	O	1-09	
W-615	E	4-10	
W-616	O	1-09	
W-617	E	4-10	
W-618	Q	1-09	
W-619	O	3-09	

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

Well number	VOC sampling frequency	Next quarter sample date	Additional analytes (Q1-08)
W-622	Q	1-09	
W-651	Q	1-09	
W-652	O	2-09	
W-654	Q	1-09	
W-702	O	2-09	
W-705	E	4-10	
W-706	E	1-10	
W-750	A	4-09	
W-901	O	1-09	
W-902	A	4-09	
W-905	E	4-10	
W-906	Q	1-09	PRAD
W-908	O	1-09	
W-909	Q	1-09	
W-911	A	1-09	
W-912	Q	1-09	
W-913	Q	1-09	
W-1002	O	1-09	
W-1003	O	4-09	
W-1008	O	1-09	
W-1010	E	1-10	
W-1011	O	2-09	
W-1012	O	1-09	PRAD
W-1013	A	1-09	
W-1014	A	1-09	
W-1101	E	3-10	
W-1105	E	4-10	
W-1106	E	3-10	
W-1107	Q	1-09	
W-1110	A	1-09	
W-1112	S	1-09	
W-1113	E	4-10	
W-1115	O	1-09	
W-1117	Q	1-09	
W-1118	A	4-09	
W-1201	Q	1-09	
W-1202	A	3-09	
W-1203	A	2-09	
W-1204	A	2-09	
W-1205	S	2-09	
W-1207	O	3-09	
W-1209	E	4-10	
W-1210	Q	1-09	
W-1212	Q	1-09	
W-1214	S	2-09	
W-1217	A	4-09	

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

Well number	VOC sampling frequency	Next quarter sample date	Additional analytes (Q1-08)
W-1219	A	2-09	
W-1222	Q	1-09	
W-1223	Q	1-09	
W-1224	E	3-10	
W-1225	A	4-09	
W-1226	A	2-09	
W-1227	A	1-09	
W-1250	S	3-09	
W-1251	Q	1-09	
W-1252	S	2-09	
W-1303	Q	1-09	PRAD
W-1304	S	2-09	
W-1306	Q	1-09	PRAD
W-1308	Q	1-09	PRAD
W-1311	A	1-09	
W-1401	S	1-09	
W-1402	S	2-09	
W-1405	Q	1-09	
W-1406	Q	1-09	
W-1407	Q	1-09	
W-1408	Q	1-09	
W-1411	O	3-09	
W-1412	Q	1-09	
W-1413	Q	1-09	
W-1414	Q	1-09	
W-1416	E	3-10	
W-1417	A	1-09	
W-1418	A	3-09	
W-1419	E	1-10	
W-1420	Q	1-09	
W-1421	A	1-09	
W-1422	Q	1-09	
W-1424	E	4-10	
W-1425	Q	1-09	
W-1426	E	4-10	
W-1427	S	1-09	
W-1428	A	1-09	
W-1501	A	1-09	
W-1502	A	4-09	
W-1505	A	4-09	
W-1506	A	3-09	
W-1507	Q	1-09	
W-1508	Q	1-09	
W-1509	E	3-10	
W-1511	Q	1-09	
W-1512	E	3-10	

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

Well number	VOC sampling frequency	Next quarter sample date	Additional analytes (Q1-08)
W-1513	O	1-09	
W-1514	O	1-09	
W-1515	O	1-09	
W-1516	A	3-09	
W-1519	S	1-09	
W-1553	Q	1-09	
W-1606	O	1-09	
W-1607	O	1-09	
W-1613	O	1-09	
W-1614	A	4-09	
W-1701	O	1-09	
W-1703	O	1-09	
W-1704	A	4-09	
W-1802	Q	1-09	
W-1803-1[a]	Q	1-09	
W-1803-2[a]	S	2-09	
W-1804-1[a]	S	2-09	
W-1804-2[a]	Q	1-09	
W-1805	E	4-10	
W-1901-1[a]	A	4-09	
W-1901-2[a]	Q	1-09	
W-1905-1[a]	Q	1-09	
W-1905-2[a]	S	2-09	
W-2103	Q	1-09	
W-2113	Q	1-09	
W-2202	Q	1-09	
W-2215A	Q	1-09	
W-2216B	Q	1-09	
W-2304	Q	1-09	
TW-11	O	2-09	
TW-11A	O	1-09	
TW-21	O	4-09	
11C1	O	1-09	
14A11	O	1-09	
14A3	O	1-09	
14B1	O	1-09	PRAD
14B4	O	3-09	
18D1	O	3-09	
GEW-710	A	1-09	
GSW-006	O	1-09	
GSW-007	O	1-09	
GSW-008	O	1-09	
GSW-009	Q	1-09	
GSW-011	A	2-09	
GSW-013	O	1-09	
GSW-215	E	3-10	

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

Well number	VOC sampling frequency	Next quarter sample date	Additional analytes (Q1-08)
GSW-216	O	2-09	
GSW-266	A	2-09	
GSW-326	O	2-09	
GSW-367	E	3-10	
GSW-442	O	1-09	
GSW-443	O	4-09	
GSW-444	O	1-09	

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.

PRAD = Permits and Regulatory Affairs Division. 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 with an underlying liner to prevent infiltration. It was re-surveyed in 2000 and shown to have a capacity of about 37 acre-ft (12 million gallons). Lake Haussmann 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* (Berg et al., 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 2008a, b, c, and 2009).

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 20 through November 10, 2008, to support this mitigation effort. Release samples for the 2007-2008 wet season were collected on October 8 and December 18, 2007. Release samples for the 2008–2009 wet season were collected on October 13, 2008, and January 22, 2009. An additional wet season sampling event occurred on December 1, 2008, to resample for chronic toxicity testing. Dry season samples were collected on June 24, July 23, August 19, and September 24, 2008. Data are not yet available for the January 22, 2009, sampling event from the analytical laboratories.

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 five reported wet and dry season monitoring events, with a maximum of 9.79. Corresponding samples collected at location WPDC exceeded the pH discharge limit in three of the five reported monitoring events. The maximum pH at WPDC was 8.83. 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 aquatic survival bioassay tests resulted in satisfactory

survival of the test species. One chronic toxicity test resulted in a significant reduction in reproduction for one of the three tested aquatic organisms, the water flea (*Ceriodaphnia dubia*) at the CDBX sampling location (October 13, 2008). The cause for this impaired reproduction in the one sample is unknown. A follow-up sample was collected at the CDBX location on December 1, 2008. This chronic toxicity test demonstrated a 100% survival and reproduction rate in the water flea.

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

E-2. References

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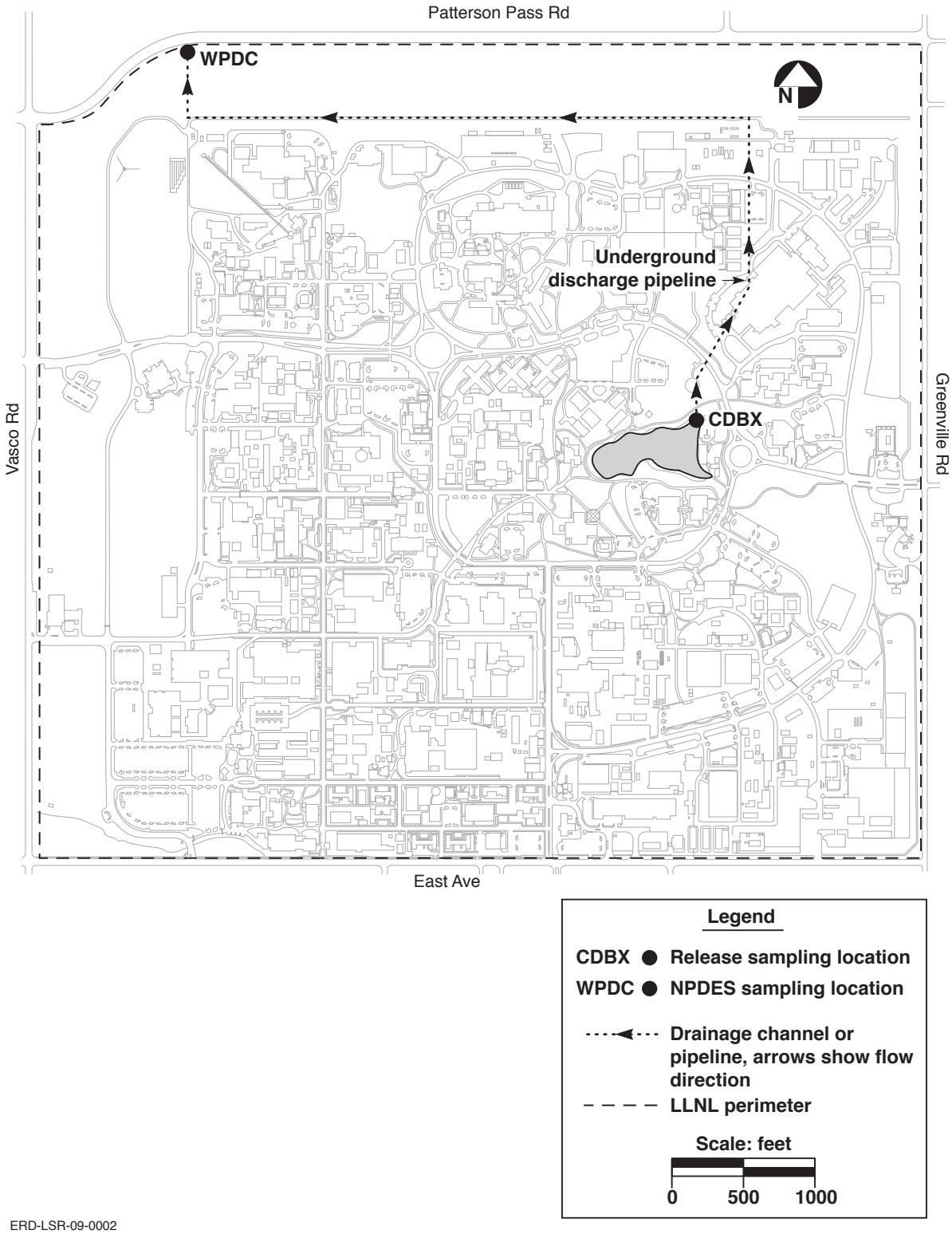

Figure E-1. Location of Lake Haussmann showing discharge sampling locations.

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