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Lawrence Livermore National Laboratory

University of California, Livermore, California 94550

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LLNL
Ground Water Project

2004 Annual Report

Technical Editors

J. Karachewski*
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E. Folsom
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Environmental Protection Department

Environmental Restoration Program and Division

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Acknowledgements

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Summary

In 2004, significant restoration activities for the Lawrence Livermore National Laboratory (LLNL) Livermore Site Ground Water Project (GWP) included:

- Operating 26 ground water treatment facilities and four soil vapor treatment facilities.
- Operating 80 ground water extraction wells, 16 dual extraction[1] wells, nine soil vapor extraction wells, and one soil vapor injection well.
- Installing six ground water monitor wells and seven soil vapor monitor wells. In 2005, most of these wells will be converted to extraction wells and connected to treatment facilities.
- Decommissioning one anode well for Plant Engineering.
- Conducting one hydraulic test.
- Conducting 24 soil vapor extraction (SVE) tests.
- Meeting all regulatory/DOE milestones by starting to operate:
  - Soil Vapor Treatment Facility D Helipad (VTFD-HPD) and
  - Soil Vapor Treatment Facility 518 Perched Zone (VTF518-PZ).
- Removing 219 kilograms (kg) of volatile organic compounds (VOCs) from ground water and soil vapor (Table Summ-1).

Since remediation began in 1989, approximately 2.5 billion gallons of ground water and nearly 92 million cubic feet of soil vapor have been treated, removing more than 1,778 kg of VOCs (Table Summ-2).

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

Table Summ-1. Summary of Livermore Site 2004 VOC remediation.

Treatment facility area[a]	Volume of ground water treated (Mgal)[b]	VOC mass removed from ground water (kg)	Volume of soil vapor treated (kft^3)[b]	VOC mass removed from soil vapor (kg)	Estimated total VOC mass removed (kg)
TFA	126.8	8.9	–	–	8.9
TFB	26.1	3.3	–	–	3.3
TFC	28.8	5.6	–	–	5.6
TFD	82.3	53.9	5,347	7.6	61.5
TFE	28.1	11.2	24,186	45.3	56.5
TFG	6.2	1.1	–	–	1.1
TF406	12.1	1.2	–	–	1.2
TF518	1.3	0.5	1,015	34.1	34.6
TF5475	0.1	0.2	11,293	46.2	46.4
Total	312[c]	86[c]	41,841	133[c]	219[c]

Notes:

Mgal = Millions of gallons.

kft^3 = Thousands of cubic feet.

kg = Kilograms.

– = Not applicable.

[a] Treatment areas and facilities (Refer to Table 2 for abbreviations):
TFA area: TFA, TFA-E
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-HPD
TFE area: TFE-E, TFE-NW, TFE-SE, TFE-SW, TFE-W, VTFE-ELM
TFG area: TFG-1, TFG-N
TF406 area: TF406, TF406-NW
TF518 area: TF518-N, VTF518-PZ
TF5475 area: TF5475-1, TF5475-2, TF5475-3, VTF5475

[b] Total volumes for each treatment facility area.

[c] Rounded number.

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

Treatment facility area	Volume of ground water treated (Mgal)[a]	VOC mass removed from ground water (kg)	Volume of soil vapor treated (kft^3)[a]	VOC mass removed from soil vapor (kg)	Estimated total VOC mass removed (kg)
TFA	1,191.3	171.6	–	–	171.6
TFB	267.1	62.5	–	–	62.5
TFC	218.1	66.1	–	–	66.1
TFD	549.6	607.1	5,347	7.6	614.7
TFE	197.7	162.5	27,475	95.7	258.2
TFG	30.4	5.9	–	–	5.9
TF406	81.4	10.2	–	–	10.2
TF518	12.6	5.3	16,101	187.1	192.4
TF5475	0.8	5.5	43,509	390.4	395.9
Total	2,549[b]	1,097[b]	92,432[b]	681[b]	1,778[b]

Notes:

kg = Kilograms.

kft^3 = Thousands of cubic feet.

Mgal = Millions of gallons.

– = Not applicable.

[a] Total volumes for each treatment facility area.

[b] Rounded number.

1. Introduction

This report summarizes the Lawrence Livermore National Laboratory (LLNL) Livermore Site Ground Water Project (GWP) activities for calendar year 2004 in six sections: Regulatory Compliance; Field Investigations; Flow and Transport Modeling; Summary of Remedial Action Program, including discussions of treatment facility activities; Ground Water Discharges; and Trends in Ground Water Analytical Results. The GWP quarterly self-monitoring reports (Yow and Wong, 2004a,b,c; and Yow and Wong, 2005) were issued separately.

Figures 1 and 2 (a, b, c, d) show the treatment facilities and related areas and wells at the Livermore Site. Table 1 summarizes the types and numbers of wells. Table 2 summarizes the abbreviations for each treatment facility, including those with upcoming 2005 milestones. For example, ground water Treatment Facilities A, B, C, D, etc. are abbreviated as TFA, TFB, TFC, and TFD and a soil vapor treatment facility in the 5475 area is referred to as VTF5475. Table 3 lists the 13 wells that were installed in 2004. In addition, one anode well was decommissioned for Plant Engineering in 2004. Tables 4 and 5 list the wells where hydraulic and soil vapor extraction (SVE) tests were conducted in 2004. Table 6 shows achievement of the 2004 Remedial Action Implementation Plan (RAIP) milestones. Table 7 summarizes discharge sampling locations and extraction wells for each treatment facility.

Appendices A through E present Well Construction and Closure Data, Hydraulic Test Results, Soil Vapor Extraction Test Results, the 2005 Ground Water Sampling Schedule, and the Drainage Retention Basin (DRB) Annual Monitoring Program Summary, respectively. Water level elevations, volatile organic compound (VOC) analytical results, and the TF406 area fuel hydrocarbon analyses are available on request.

2. Regulatory Compliance

In 2004, the U.S. Department of Energy (DOE)/LLNL submitted the GWP 2003 Annual Report (Karachewski et al., 2004) and GWP quarterly self-monitoring reports on schedule. In addition, DOE/LLNL completed two 2004 RAIP milestones (Table 6) prior to the milestone dates (Dresen et al. 1993).

Livermore Site community relations activities in 2004 included communications and meetings with neighbors and local, regional, and national interest groups and other community organizations; making public presentations; producing and distributing the Environmental Community Letter; maintaining the Information Repositories and the Administrative Record; conducting tours of the site environmental activities; and responding to public and news media inquiries. In addition, DOE/LLNL met with the Community Work Group, and met with 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, and project documents, letters, and public notices were posted on a public website at www-envirinfo.llnl.gov.

3. Field Investigations

3.1. Ground Water Samples

In 2004, the GWP collected 1,013 ground water samples during 847 events from 364 wells. The samples were collected using the following methods:

- Specific-Depth Grab Sampling (SDGS) using a Voss EasyPump or Geotech Specific Depth Sampler (SDS) pump: 524 events (62%),
- Three-volume purge: 125 events (15%),
- Low-volume purge: 66 events (8%), and
- Other (bailer, electronic submersible pump, etc.): 132 events (15%).

The ground water samples were analyzed for VOCs, fuel hydrocarbons, polychlorinated biphenyls, metals, radionuclides, or combinations thereof depending upon well location.

The GWP Subproject Leaders evaluated data quality objectives, historical analytical results, the cost-effective sampling algorithm, and hydraulic data to determine the frequency and method for collecting ground water samples.

Significant cost reduction was achieved once again in 2004 through the use of SDGS and low-volume purge methods. The benefits of these methods include:

- Ongoing cost savings by eliminating the need to replace dedicated pumps and related sampling equipment,
- Increased technician efficiency and reduction in sampling time,
- Increased personnel safety, and
- Elimination of 50,000 gallons of purge water that could have required treatment and disposal.

Approximately 8,000 of the 50,000 gallons of purge water is considered mixed waste as it contains both VOCs and tritium. The SDGS no-purge sampling method has eliminated the need to collect, treat, and dispose mixed waste water, resulting in significant cost savings.

3.2. Source Investigations

Gore-Sorber® investigations and drilling activity will continue to focus on source areas for upcoming milestones (Fig. 3).

During 2004, a passive soil vapor investigation using Gore-Sorber® modules was conducted in two areas at TFD to fill in data gaps from previous studies (Hodny, 2000; 2003). Fifty-four Gore-Sorber® modules were concurrently deployed at the TFD Hotspot area, northwest of the helipad, and in the TFD East Traffic Circle North area (Fig. 3). The Gore-Sorber® modules were installed to a depth of approximately three feet below the surface and were left in the ground for three weeks prior to retrieval and submission for VOC analysis.

VOCs were not detected at 50 of the 54 locations and where present, the trichloroethylene (TCE) or tetrachloroethylene (PCE) concentrations were very low (maximum 3.31 micrograms). Results of this study and previous soil vapor investigations were used to plan drilling locations at the TFD Hotspot and TFD East Traffic Circle North areas for 2005 milestones.

3.3. Soil Vapor Extraction Tests

SVE and/or dual extraction tests were conducted at TFD East Traffic Circle South, TFE Hotspot, TF406 Hotspot, and VTF518-PZ (Figs. 2 and 3) to prepare for RAIP milestones. The SVE test wells are listed in Table 5 and the results are summarized in Appendix C.

Six-hour SVE and dual extraction tests were conducted on nine wells in the TFD East Traffic Circle South area to assess their pneumatic communication, radius of influence, and operational parameters. The vacuum applied to the wells ranged from 3.8 to 8 inches of mercury (Hg) and the vapor flow rates ranged from 0.7 to 23 standard cubic feet per minute (scfm). Soil vapor samples collected from wellheads in Tedlar bags contained maximum VOC concentrations ranging from 22.6 to 188 parts per million by volume (ppm_v).

Six-hour SVE and dual extraction tests were conducted on six wells in the TFE Hotspot area. The vacuum applied to the wells ranged from 3 to 10 inches of Hg and the vapor flow rates ranged from 0.5 to 76 scfm. Soil vapor samples collected from wellheads in Tedlar bags contained maximum VOC concentrations ranging from 20.5 to 153.7 ppm_v.

Four-day (96-hour) SVE tests were conducted on three wells in the TF406 Hotspot area. The vacuum applied to the wells ranged from 3 to 7.5 inches of Hg and the vapor flow rates ranged from 14 to 21 scfm. Soil vapor samples collected from wellheads in Tedlar bags contained maximum VOC concentrations ranging from 17.6 to 63.2 ppm_v.

Six-hour high-vacuum dual extraction tests were conducted on six wells in the TF518 area. The vacuum applied to the wells ranged from 13 to 26 Hg and the vapor flow rates ranged from 0.03 to 5.5 scfm. Soil vapor samples collected from wellheads in Tedlar bags contained maximum VOC concentrations ranging from 44 to 1,944 ppm_v. The results of these tests were incorporated into planning the startup and operation of Vapor Treatment Facility 518 Perched Zone for the September 2004 milestone.

4. Flow and Transport Modeling

Ground water flow and contaminant transport models are used at the Livermore Site to optimize the design and operation of remediation systems; to support ongoing subsurface characterization activities; and to improve our ability to forecast, monitor, and interpret the progress of the remediation program. An existing production model for the western portion of the site is currently used to optimize ground water remediation. In 2004, we continued development of a three-dimensional (3-D) basin-scale ground water flow and transport model that incorporates the Livermore Site hydrostratigraphic unit (HSU) framework. The model is updated by incorporating remediation system improvements and hydrogeologic information from new wells. We are currently improving this 3-D model to simulate the extensive extraction well field and the resultant dewatering observed at the eastern portion of the site. We are also using this model to understand contaminant migration between adjacent HSUs and the role of source areas in affecting cleanup time.

In addition to ground water flow and transport models, we also developed a one-dimensional vadose zone model for the Building 514 Area to determine the potential impact from residual contamination in soil to ground water. This model is used to support Resource Conservation and Recovery Act (RCRA) activities currently underway in the Building 514 Area.

5. Summary of Remedial Action Program

This section summarizes activities performed in 2004 to support the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Remedial Action Program at the Livermore Site. These activities included designing and constructing new treatment facilities, modifying existing systems, monitoring performance of treatment facilities, conducting treatability tests, installing wells, and performing hydraulic and SVE tests.

In 2004, DOE/LLNL operated ground water treatment facilities in the TFA, TFB, TFC, TFD, TFE, TFG, TF406, TF518, and TF5475 areas (Fig. 1). A total of 80 ground water extraction wells supplied water to 26 treatment facilities at a combined average flow rate of about 590 gallons per minute (gpm). In 2004, these facilities treated nearly 312 million gallons of ground water and removed about 86 kilograms (kg) of VOCs (Table Summ-1) compared to 90 kg in 2003. The slightly lower quantity of mass removed in 2004 is partially due to decreasing concentrations in the TFD and TFE areas and declining extraction well flow rates due to remediation-induced dewatering at the site. Since remediation began in 1989, approximately 2.5 billion gallons of ground water have been treated, resulting in removal of about 1,097 kg of VOCs (Fig. 4 and Table Summ-2).

In 2004, DOE/LLNL also operated four soil vapor treatment facilities: VTFD Helipad, VTFE Eastern Landing Mat, VTF518 Perched Zone, and VTF5475 (Fig. 1). In 2004, these facilities treated nearly 42 million standard cubic ft (scf) of soil vapor and removed an estimated 133 kg of VOCs (Table Summ-1) compared to about 84 kg in 2003. The significantly higher rate of mass removal in 2004 (a 57% increase) is due to the activation of VTFD Helipad and VTF518 Perched Zone, as well as continued operations of VTFE Eastern Landing Mat and VTF5475. Since initial operation, more than 92 million cubic feet of soil vapor have been treated, resulting in a mass removal of over 681 kg of VOCs (Fig. 4 and Table Summ-2). Well construction and closure data are presented in Table A-1 and Table A-2 of Appendix A, respectively. Only one hydraulic test was conducted in 2004 (Table 4). The results of this test and all previous hydraulic tests are summarized in Appendix B. SVE well tests conducted in 2004 are listed in Table 5 and the results are presented in Appendix C. Table 7 summarizes discharge sampling locations and extraction wells for each treatment facility.

Treatment facility performance is evaluated using multiple data sets. Figures 5 through 10 show the estimated hydraulic capture areas in HSUs 1B, 2, 3A, 3B, 4, and 5, respectively, based on 2004 ground water elevation data. Figures 11 through 16 show third quarter 2004 total VOC isoconcentration maps in the same six HSUs. Contaminant concentration trends (Section 7) are also used to evaluate treatment facility performance and hydraulic capture. Schematic diagrams of new or modified treatment facilities are shown in Figures 17 through 19.

5.1. Treatment Facility A Area

Two treatment facilities, TFA and TFA East (Figs. 1 and 2b), operated in compliance with all permits throughout 2004.

Since December 2002, TFA has been discharging some treated ground water directly to Arroyo Seco. In June 2003, TFA also began discharging to Arroyo Las Positas via the Western Perimeter Drainage Channel (WPDC) near TFB. TFA ceased discharging treated effluent to the

Recharge Basin after June 2003 due to significantly reduced infiltration capacity of the percolation ponds (Dibley et al., 2003).

With the exception of westernmost offsite plume in HSU-2 (Fig. 12) and an area immediately around HSU-1B well W-552, which is below Maximum Contaminant Levels (MCLs) for all contaminants of concern, the TFA area extraction wells hydraulically control all of the VOC plumes in HSUs 1B and 2, based on the capture zone analysis shown on the ground water elevation contour maps (Figs. 5 and 6) and total VOC isoconcentration maps (Figs. 11 and 12). Pumping continues at offsite extraction well W-408 to ensure hydraulic control of the residual HSU-1B plume at wells W-506 and W-1425 (Fig. 11), where the PCE concentrations were 6 parts per billion (ppb) and 11 ppb, respectively in July 2004. Capture zone analysis and slowly declining concentrations at well W-404 suggest that the offsite HSU-2 plume remained immobilized within a stagnant zone west of the TFA West extraction wellfield (Figs. 6 and 12).

5.2. Treatment Facility B Area

In 2004, TFB (Figs. 1 and 2a) operated in compliance except for 14 hours on September 24, 2004, when an electronics technician performing an interlock check restarted the facility without starting the air blower, which is required for treatment of VOCs. A total of 48,000 gallons of ground water and an estimated mass of 5.7 grams of VOCs were discharged to the unlined WPDC and concrete-lined channel flowing into Arroyo Las Positas. The untreated discharge from TFB also mixed with 431 gpm of treated ground water from other facilities at the Livermore Site. The low VOC concentrations in water in the untreated discharge were further reduced on site through evaporation, landscape irrigation run-off, and infiltration. Based on conservative assumptions and calculations, this resulted in a maximum concentration of 3.7 ppb VOCs in surface water leaving the Livermore Site.

As a result of this accidental release, all interlock checks were halted until corrective actions were implemented. These included modifying the interlock so that the well pumps cannot be started until the blower is enabled. Additionally, administrative controls were implemented on who is authorized to initiate unmanned operations.

Except for two small offsite areas in HSU-1B that are below MCLs for all contaminants of concern (wells W-517 and W-571), the TFB area extraction wells hydraulically control the VOC plumes in HSUs 1B and 2, based on the capture zone analysis shown on the ground water elevation contour maps (Figs. 5 and 6), the total VOC isoconcentration maps (Figs. 11 and 12), and stable or declining VOC concentrations in the area. Extraction well W-655 did not operate again in 2004 since all contaminants of concern continued to remain below MCLs in this area.

5.3. Treatment Facility C Area

Three treatment facilities, TFC, TFC East, and TFC Southeast, (Figs. 1 and 2c), operated in compliance with all permits throughout 2004. TFC East was modified to conduct a test using iron wool to reduce hexavalent chromium to trivalent chromium. To ensure compliance with chromium effluent discharge requirements, ion-exchange columns and a particulate filter were also installed prior to the test. The iron wool test appears to effectively reduce hexavalent chromium concentrations at a lower operational cost relative to the ion-exchange system. Additional testing is planned.

In the central and western TFC area, VOCs are confined to HSU-1B. In the eastern TFC area, VOCs are in both HSU-1B and HSU-2. The TFC area extraction wells hydraulically control the VOC plumes in HSU-1B and HSU-2, based on the capture zone analysis shown on the ground water elevation contour maps (Figs. 5 and 6), and the total VOC isoconcentration maps (Figs. 11 and 12).

5.4. Treatment Facility D Area

Eight treatment facilities operated in the TFD area during 2004 (Figs. 1 and 2c): TFD, TFD East, TFD Helipad, TFD South, TFD Southeast, TFD Southshore, TFD West, and VTFD Helipad. The treatment facilities operated in compliance with all permits throughout the year.

The TFD Helipad wells were originally installed in 2000 to support electro-osmosis (EO) tests. In 2004, the nine HSU-3A/3B EO wells were converted into dual extraction wells and connected to VTFD Helipad (Figs. 2c and 17) in order to expedite VOC mass removal and source area cleanup through vacuum-enhanced ground water extraction and soil vapor extraction. Under this higher vacuum (20 to 28 inches of Hg), ground water flow and mass removal rates from these wells have nearly doubled compared to pumping without high vacuum enhancement earlier in the year. VTFD Helipad also treats vapor from one SVE well. VTFD Helipad was activated on June 8, 2004. TFD Helipad treats ground water from the nine dual extraction wells and two HSU-3A and HSU-4 ground water extraction wells. The results of SVE tests are presented in Section 3.3 and Appendix C.

Five new ground water monitor wells were installed in the TFD area in 2004 (Fig. 2c). Many of these will be converted to extraction wells and connected to treatment facilities after further data evaluation. HSU-3A well W-2005 and HSU-3B well W-2006 were completed in the TFD East Traffic Circle South area (Fig. 3) for an upcoming September 2005 milestone. HSU-3A wells W-2011, W-2101, and W-2102 were completed in the TFD Hotspot area northwest of the Helipad for another upcoming September 2005 milestone.

A passive soil vapor survey using Gore-Sorber® modules was also conducted in the TFD Hotspot and TFD East Traffic Circle North areas in 2004 (see Section 3.2).

The TFD area extraction wells exert significant hydraulic control over VOC plumes in HSUs 3A, 3B, and 4 and over large portions of VOC plumes in HSU-2 based on the capture zone analysis shown on the ground water elevation contour maps (Figs. 6, 7, 8, and 9) and the total VOC isoconcentration maps (Figs. 12, 13, 14, and 15). Distal portions of VOC plumes in HSUs 1B and 2 (Figs. 5, 6, 11 and 12) in the western TFD area are being hydraulically contained by TFC East. Distal portions of the VOC plume in HSU-3A in the northwestern TFD area are being hydraulically contained by extraction wells at TFD West and TFD (Figs. 7 and 13).

5.5. Treatment Facility E Area

Six treatment facilities, TFE East, TFE Northwest, TFE Southeast, TFE Southwest, TFE West, and VTFE-ELM (Figs. 1 and 2d), operated in compliance with all permits throughout 2004. PTU-4, a portable hydraulic test unit in the TFE North area, did not operate in 2004 due to the lack of a permanent power supply.

Five soil vapor wells and one ground water extraction well were installed in the TFE area in 2004 (Fig. 2d). Wells SVW-ETS-2008A, SVW-ETS-2008B, SVW-ETS-2009, SVW-ETS-2010A, and SVW-ETS-2010B were installed to evaluate soil vapor anomalies identified during a

previous Gore-Sorber® survey (Hodny, 2002). The soil vapor wells in the TFE Hotspot area (Fig. 3) were designed to remediate a vadose zone source area for a September 2005 milestone. HSU-3A ground water extraction well W-2012 was completed in the same source area. The results of SVE tests are presented in Section 3.3 and Appendix C.

The TFE East, TFE Northwest, TFE Southeast, TFE Southwest, and TFE West extraction wells hydraulically contain portions of the VOC plume in HSU-3A and most of the VOC plumes in HSUs 2, 3B, 4, and 5 based on the capture zone analysis shown on the ground water elevation contour maps (Figs. 6, 7, 8, 9, and 10) and the total VOC isoconcentration maps (Figs. 12, 13, 14, 15, and 16).

5.6. Treatment Facility G Area

Two treatment facilities, TFG-1 and TFG North (Figs. 1 and 2d), operated in compliance with all permits throughout 2004.

Extraction well W-1111 hydraulically controls most of the VOC plume in HSU-2 in the southern TFG-1 area based on the capture zone analysis shown on the ground water elevation contour map (Fig. 6) and the total VOC isoconcentration map (Fig. 12). Extraction wells W-1806 and W-1807 hydraulically control a significant portion of the VOC plumes in HSUs 1B and 2, respectively, in the northern portion of the TFG area (Figs. 5 and 6; Figs. 11 and 12).

5.7. Treatment Facility 406 Area

Two treatment facilities, TF406 and TF406 Northwest (Figs. 1 and 2d), operated in compliance with all permits in 2004. Passive bioremediation of fuel hydrocarbons in HSUs 3A and 3B continued during 2004.

Two new soil vapor wells, SVW-514-2007A and SVW-514-2007B, were installed in the TF406 Hotspot area (Fig. 3) in 2004. These wells are designed to pneumatically capture and treat elevated VOC concentrations as part of a September 2005 milestone. The results of SVE tests are presented in Section 3.3 and Appendix C.

The TF406, TF406 Northwest, and adjacent TF518 North (see Section 5.9) extraction wells hydraulically control most of the VOC plumes in HSUs 4 and 5 and provide significant hydraulic control of VOC plumes in HSUs 3A and 3B based on the capture zone analysis shown on the ground water elevation contour maps (Figs. 7, 8, 9, and 10), the total VOC isoconcentration maps (Figs. 13, 14, 15 and 16), and stable or declining VOC concentrations.

5.8. Treatment Facility 518 Area

The two treatment facilities, TF518 North and VTF518 Perched Zone (Figs. 1 and 2d), were in compliance with all permits in 2004.

Former vapor treatment facility 518 (VTF518) has not operated at the Building 518 location since 2001. Soil vapor remediation in this area has been hindered by a perched ground water plume with elevated VOC concentrations (Dibley et al., 2002; 2003). As part of the September 2004 milestone to remediate this source area, the SVE system was upgraded to include a liquid-ring pump capable of achieving relatively high vacuums over 20 inches of Hg. VTF518 Perched Zone (Fig. 18) treats soil vapor and perched ground water from up to six dual

extraction wells through vacuum-enhanced extraction. Because of the very low flow rates, the ground water from the dual extraction wells is collected in a 500-gallon tank and transferred to TF406 Northwest for treatment. VTF518 Perched Zone was activated on September 3, 2004. The results of SVE tests conducted to evaluate capture areas and mass removal rates are presented in Section 3.3 and Appendix C.

HSU-4 extraction well W-1410 at TF518 North and HSU-5 extraction wells at TF406 and TFE Southeast continue to hydraulically control most of the VOC plumes based on the capture zone analysis shown on the ground water elevation contour maps (Figs. 9 and 10) and the total VOC isoconcentration maps (Figs. 15 and 16). HSU-5 remained dewatered throughout 2004 in the area where TF518 was formerly located. The sustained dewatering in HSU-5 impacts hydraulic control by widening the capture areas of existing extraction wells.

5.9. Treatment Facility 5475 Area

Three ground water treatment facilities, TF5475-1, TF5475-2, TF5475-3, and one vapor treatment facility, VTF5475 (Figs. 1 and 2d), operated in compliance with all permits throughout 2004 except for one occasion noted below. TF5475-1 and TF5475-3 use catalytic reductive dehalogenation (CRD) to remediate the VOCs in ground water. TF5475-2 and VTF5475 use granular activated carbon to remediate VOCs. VTF5475 (Fig. 19) extracts soil vapor from an HSU-2 vadose zone well and dewatered HSU-3A extraction wells.

A 90% VOC destruction efficiency is specified in Remedial Design Report No. 4 (Berg et al., 1998) for the CRD units. In 2004, the VOC destruction efficiency was greater than 98% at TF5475-1 (CRD-1). The VOC destruction efficiency was also greater than 98% at TF5475-3 (CRD-2), except for one sample on November 17, 2004, which had a removal efficiency of 10% based on comparison of influent and effluent concentrations. The reason for the low removal efficiency is not known, but possible causes include inadequate hydrogen flow and inadvertent collection of an effluent sample from the influent port. Problems with hydrogen flow and measurement equipment have been previously encountered during very cold weather. CRD-2 was shut down until corrective actions are completed on the hydrogen flow system.

Wells W-1606 and W-1608 did not operate as ground water extraction wells at TF5475-3 because HSU-3A is dewatered in the TF5475 area. In November 2004, wells W-1605, W-1606, W-1607, and W-1608 were converted to SVE wells resulting in a doubling of flow rates and mass removal for VTF5475 at the end of the year.

6. Ground Water Discharges

In 2004, approximately 241.5 millions of gallons (Mgal) of treated ground water was discharged to Arroyo Las Positas, and an estimated 70.4 Mgal of treated ground water was discharged to Arroyo Seco. Treated ground water was not discharged to the Recharge Basin because of its greatly diminished infiltration capacity.

7. Trends in Ground Water Analytical Results

In 2004, concentrations continued to decrease in most Livermore Site VOC plumes. The decline in VOC concentrations is primarily attributed to active remediation and reflects the 86 kg

of VOCs removed by the ground water extraction wells during 2004 (Table Summ-1). Notable trends and results from the fourth quarter 2003 through the third quarter 2004 are discussed below.

VOC concentrations on the western margin of the site generally remained unchanged or declined slightly, indicating continued effective hydraulic control of the boundary plumes in the TFA, TFB, and TFC areas. The offsite HSU-1B VOC plumes were below MCLs except at two wells, where slight increases in PCE concentrations (from 5.4 ppb to 5.9 ppb at well W-506 and from 8.8 ppb to 11.0 ppb at well W-1425 in July 2004) were observed. The entire offsite and onsite TFA HSU-2 VOC plume remained below 50 ppb. All offsite TFA HSU-3A wells were also below MCLs for all VOCs. VOC concentrations in the TFA, TFB, and TFC source areas remained virtually unchanged. Fluctuations in Freon 113 were observed north of TFC Southeast where concentrations at piezometer SIP-501-004 have increased from 2.9 ppb in 2001 to 260 ppb in April 2004. This Freon 113 plume, which historically had concentrations above 2,000 ppb (well W-501, October 1989), is within the capture area of TFC Southeast (Figs. 5 and 11).

VOC concentrations in a mobile HSU-2 plume located in the western TFE area continued to decline. Downgradient from the source area, total VOC concentrations decreased below 100 ppb in 2004, except at TFE-W extraction well W-305. Total VOCs in piezometer SIP-331-001, located in the distal part of the plume, declined from 80 ppb in September 2003 to 69 ppb in March 2004. Concentrations further downgradient to the west declined slightly, probably in response to continued pumping of TFG North extraction well W-1807, located at the leading edge of the plume. Total VOC concentrations in the TFE Hotspot source area remained elevated, e.g., 1,815 ppb at piezometer SIP-ETS-601 (July 2004). Remediation of the TFE Hotspot source area (Fig. 3) will be addressed as part of an upcoming 2005 milestone.

Total VOC concentrations in TFD Helipad HSU-3A source area extraction wells continued to decline, in part due to the start of vacuum-enhanced ground water extraction. For example, the VOC concentrations in well W-1651 declined from 1,125 ppb in October 2003 to 400 ppb in July 2004. In the TFE and TF5475 areas, slight declines in VOC concentrations were observed in HSU-3A wells. Elsewhere in HSU-3A, VOC concentrations remained largely unchanged.

In HSU-3B, variations in the TCE concentrations suggest the VOC plume may be migrating from the TFD East Traffic Circle South toward the TFD South area. TCE in HSU-3B well W-1511 at the leading edge of the plume declined from 750 ppb in November 2003 to 380 ppb in July 2004. Hydraulic containment of the HSU-3B source area and associated ground water plume in the TFD East Traffic Circle South source area (Fig. 3) will be addressed as part of an upcoming 2005 milestone. PCE and TCE appeared in the eastern TFG area at well W-618 for the first time (3.5 ppb, and 1.3 ppb, respectively, November 2004). Appearance of these VOCs may represent the leading edge of an HSU-3B plume emanating from the TFE area. Continued ground water extraction from TFE West HSU-3B extraction well W-292 should minimize further westward migration of this plume. Elsewhere in HSU-3B, VOC concentrations remained largely unchanged.

Concentrations in both HSU-4 and HSU-5 remained relatively unchanged. In HSU-4, slight decreases in total VOC concentrations were noted in the western TFE area at wells W-304 and W-1211 and in the TFD area. Concentrations continue to decline on Sandia Properties in the TF406 South area, with only TCE remaining above MCLs in offsite wells (13 ppb in well W-509, August 2004, and 8 ppb in well W-1113, November 2004). The ongoing plume

capture cleanup at the TF406 South location in HSU-5 indicates that construction of a new facility is not warranted at this time.

During 2004, tritium activities in ground water from all wells in the TF5475 area were below the 20,000 picocuries per liter (pCi/L) MCL and continued to decrease by natural decay. Except for one sample at piezometer UP-292-007 (21,700 pCi/L, May 2004), tritium activities in ground water in the Building 292 area were below the MCL in all wells.

8. References

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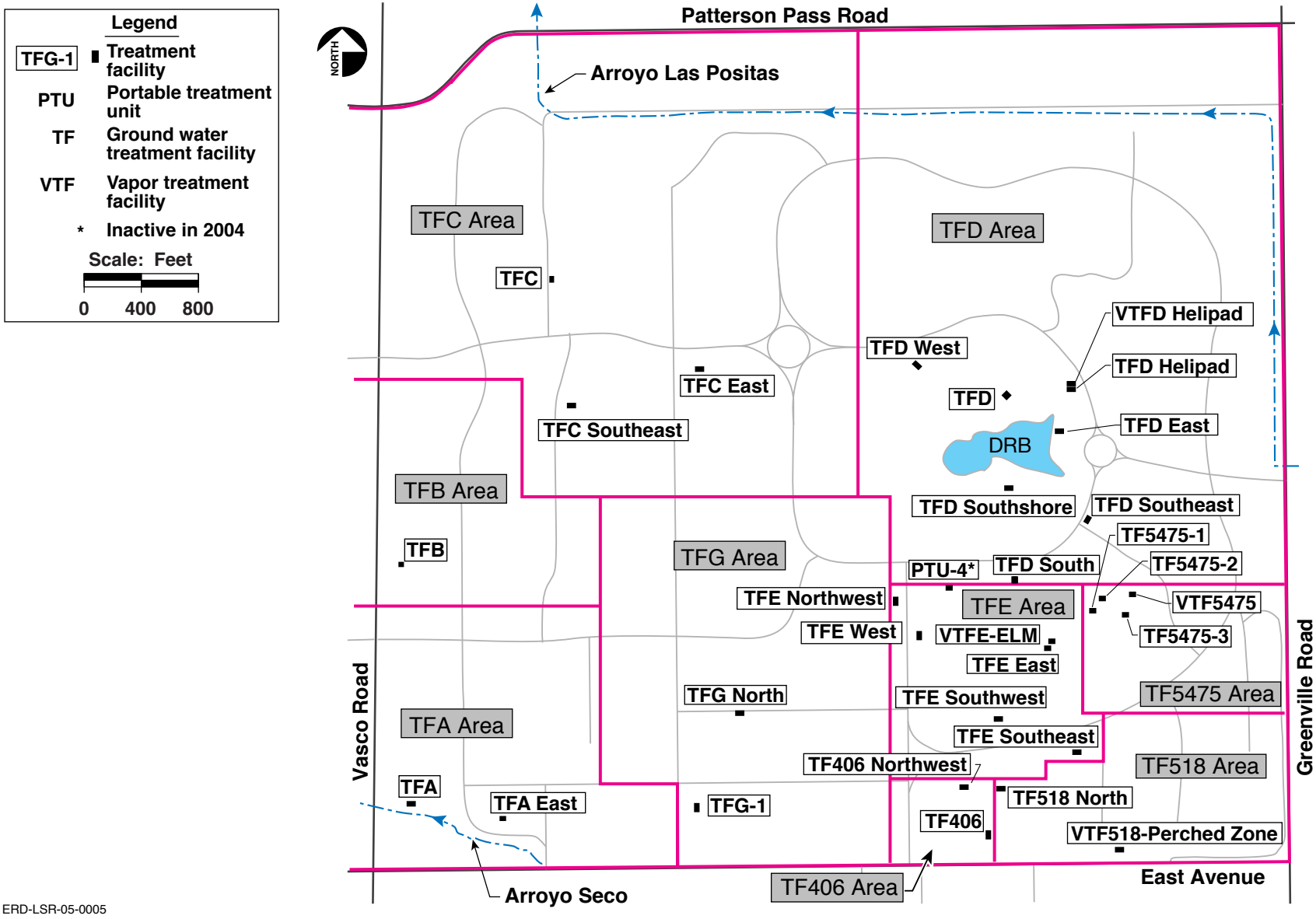
Yow, J.L., and P.W. Wong (2005), Letter Report: LLNL Livermore Site Fourth Quarter Self-Monitoring Report, February 28, 2005.

Figures



ERD-LSR-05-0005

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

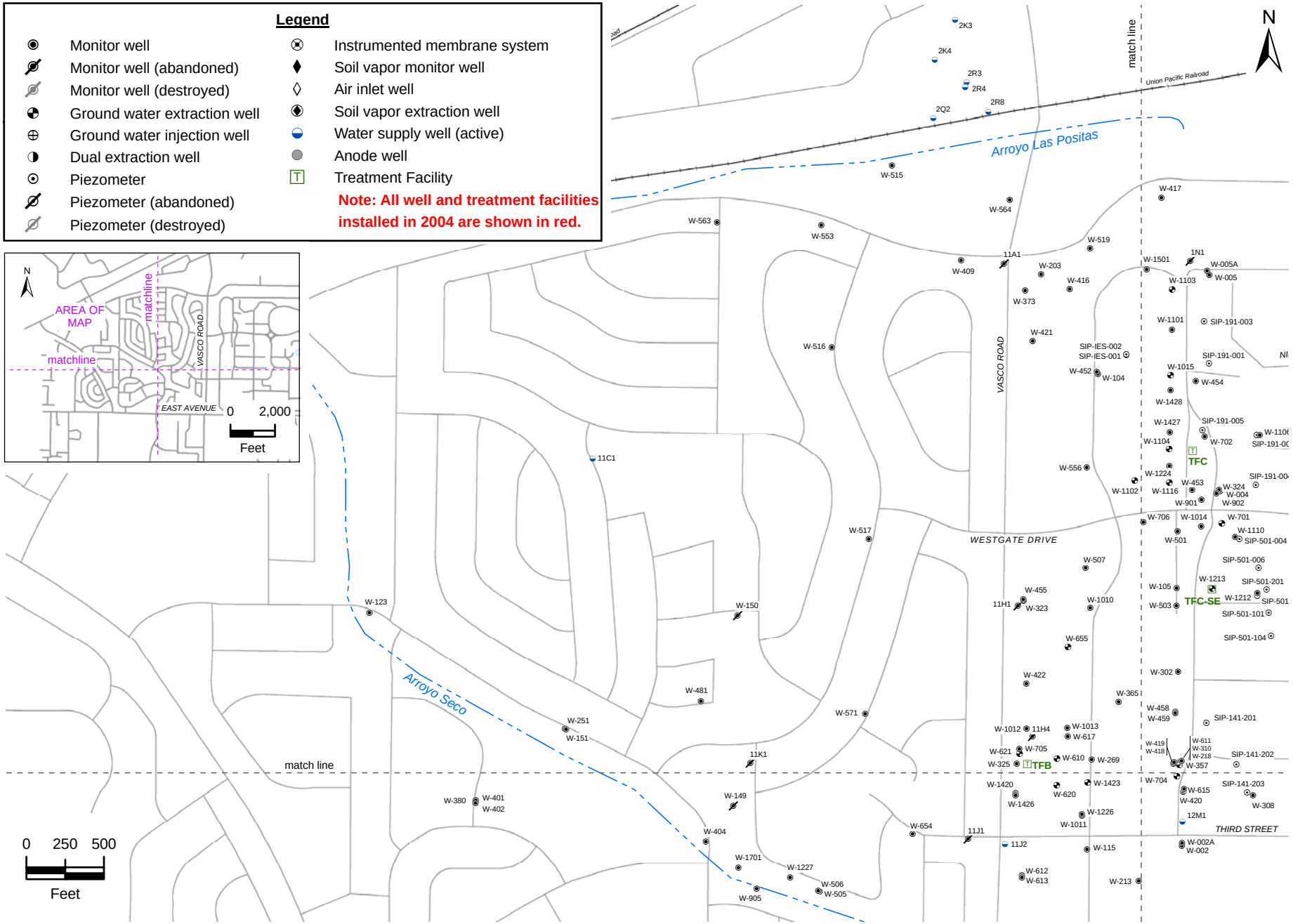


Figure 2a. Locations of Livermore Site wells and treatment facilities, December 2004.

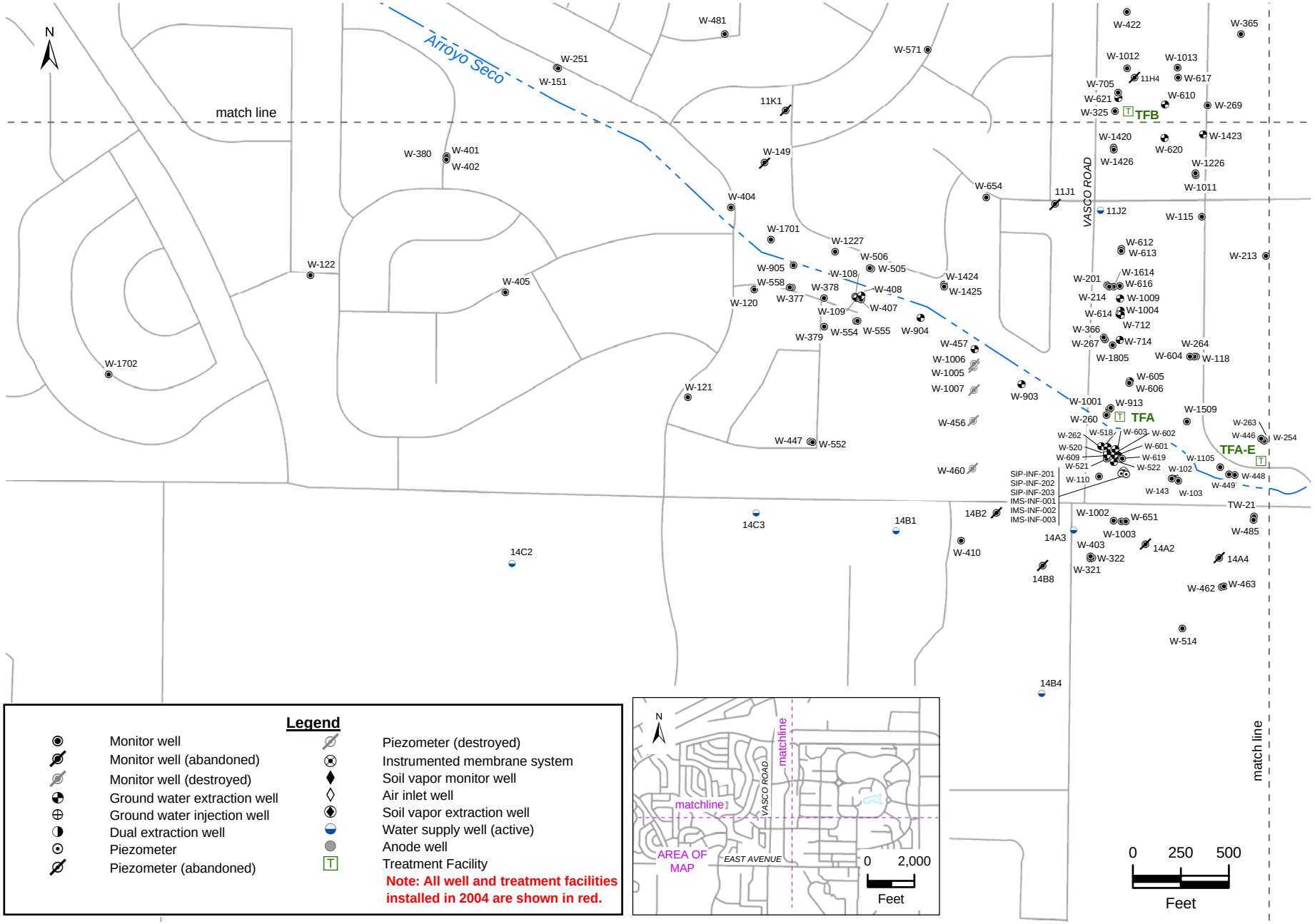


Figure 2b. Locations of Livermore Site wells and treatment facilities, December 2004.

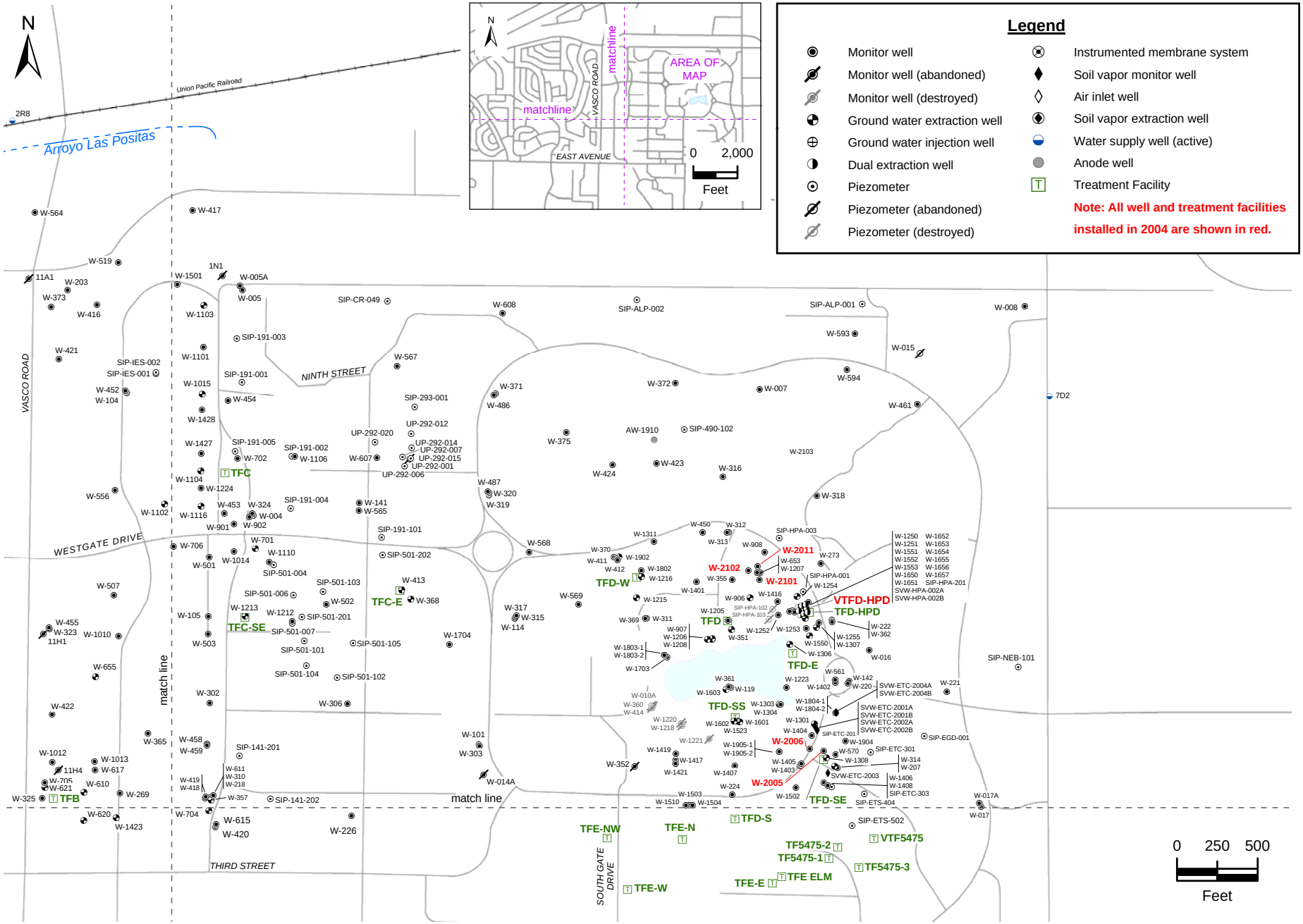


Figure 2c. Locations of Livermore Site wells and treatment facilities, December 2004.

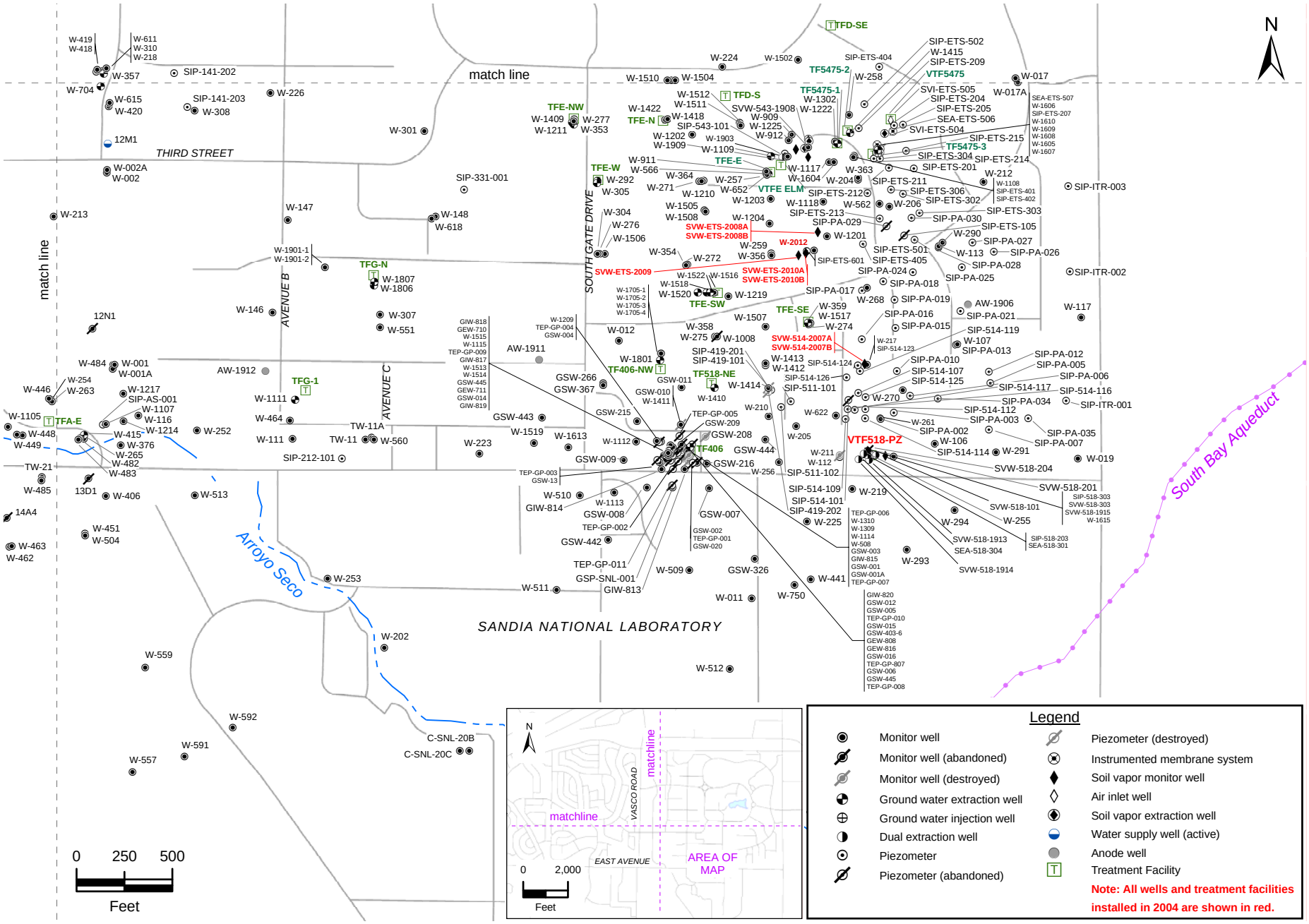
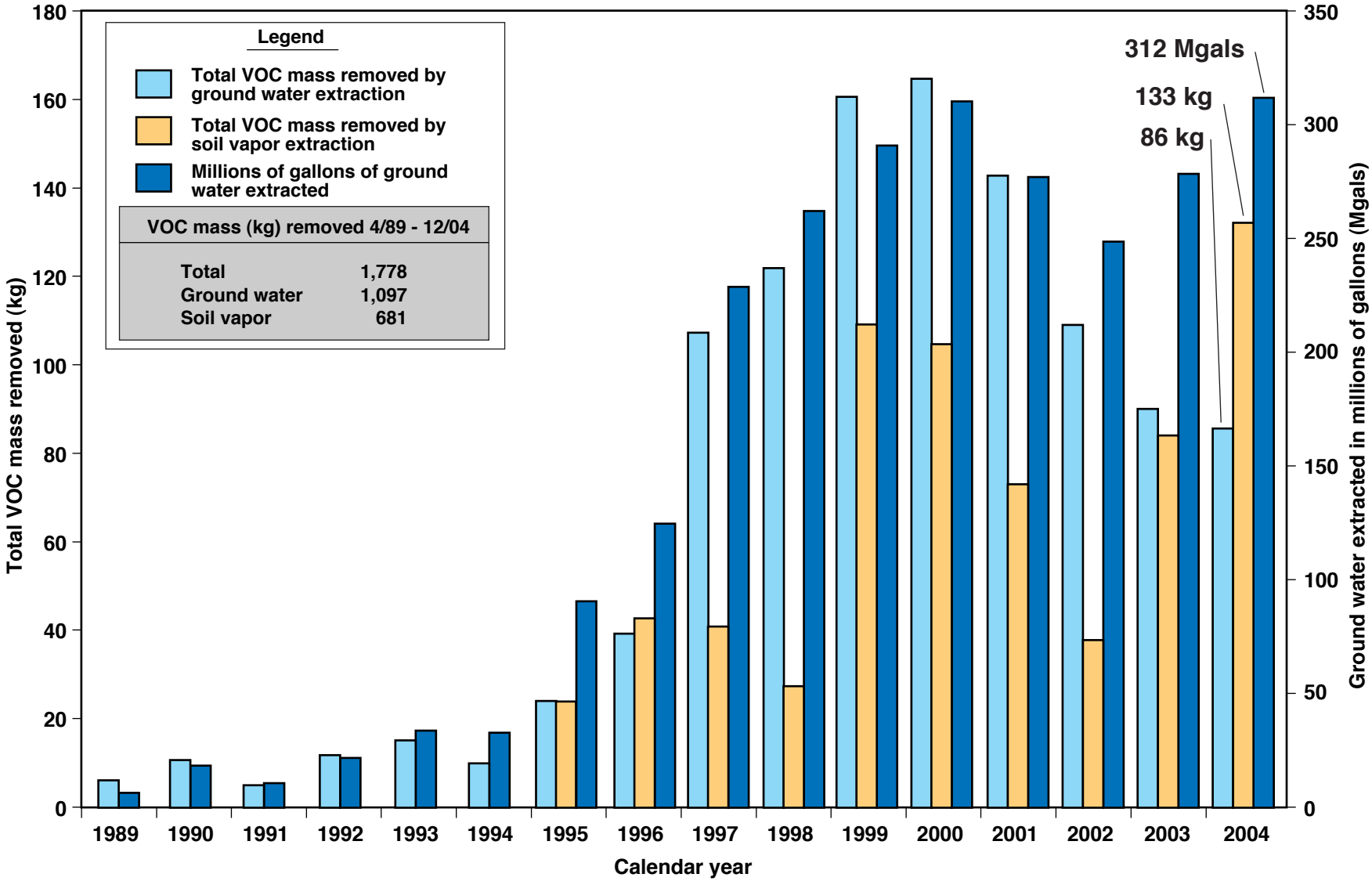


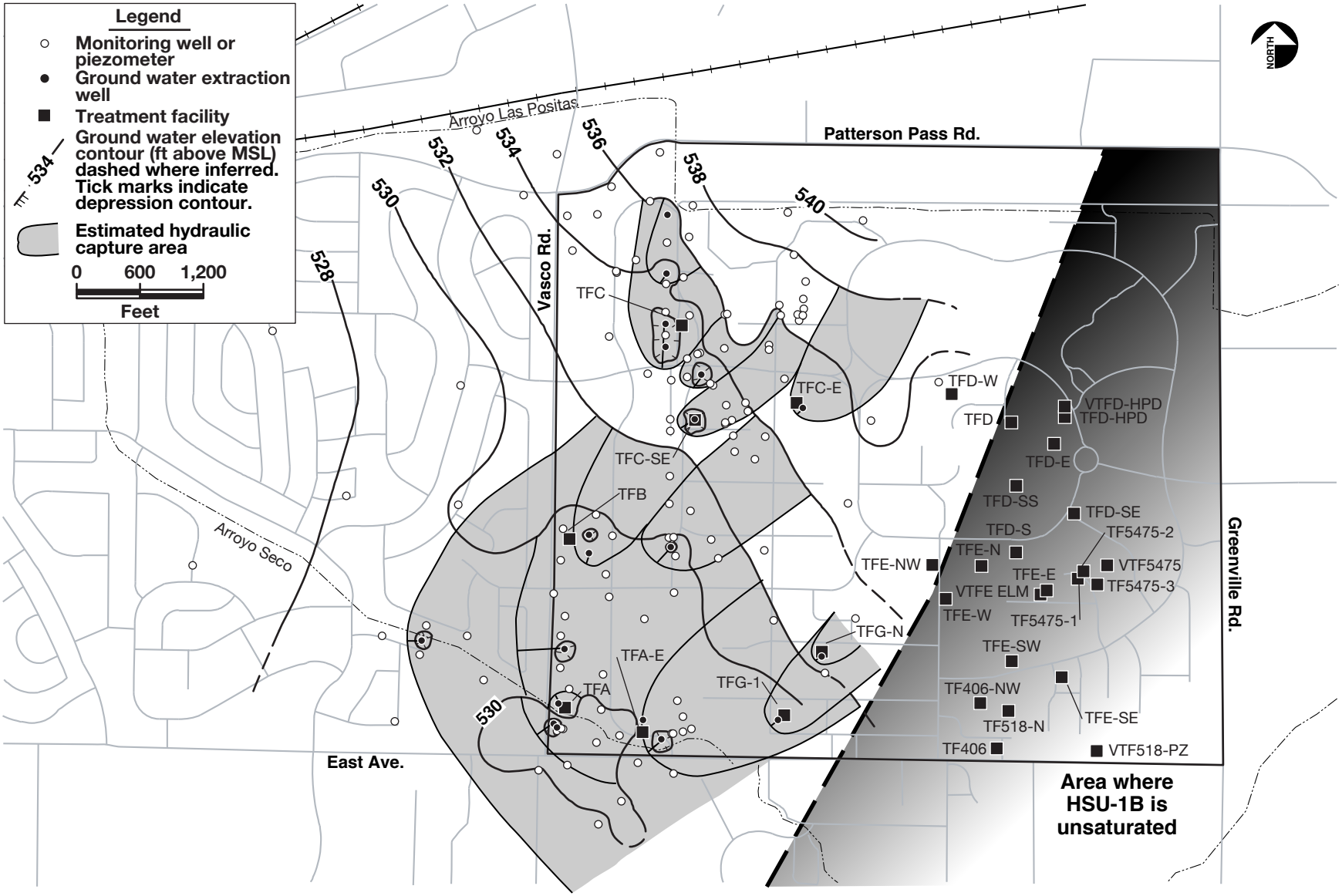
Figure 2d. Locations of Livermore Site wells and treatment facilities, December 2004.

Figure 3. Proposed FY 2005 and FY 2006 milestone locations on the Livermore Site.



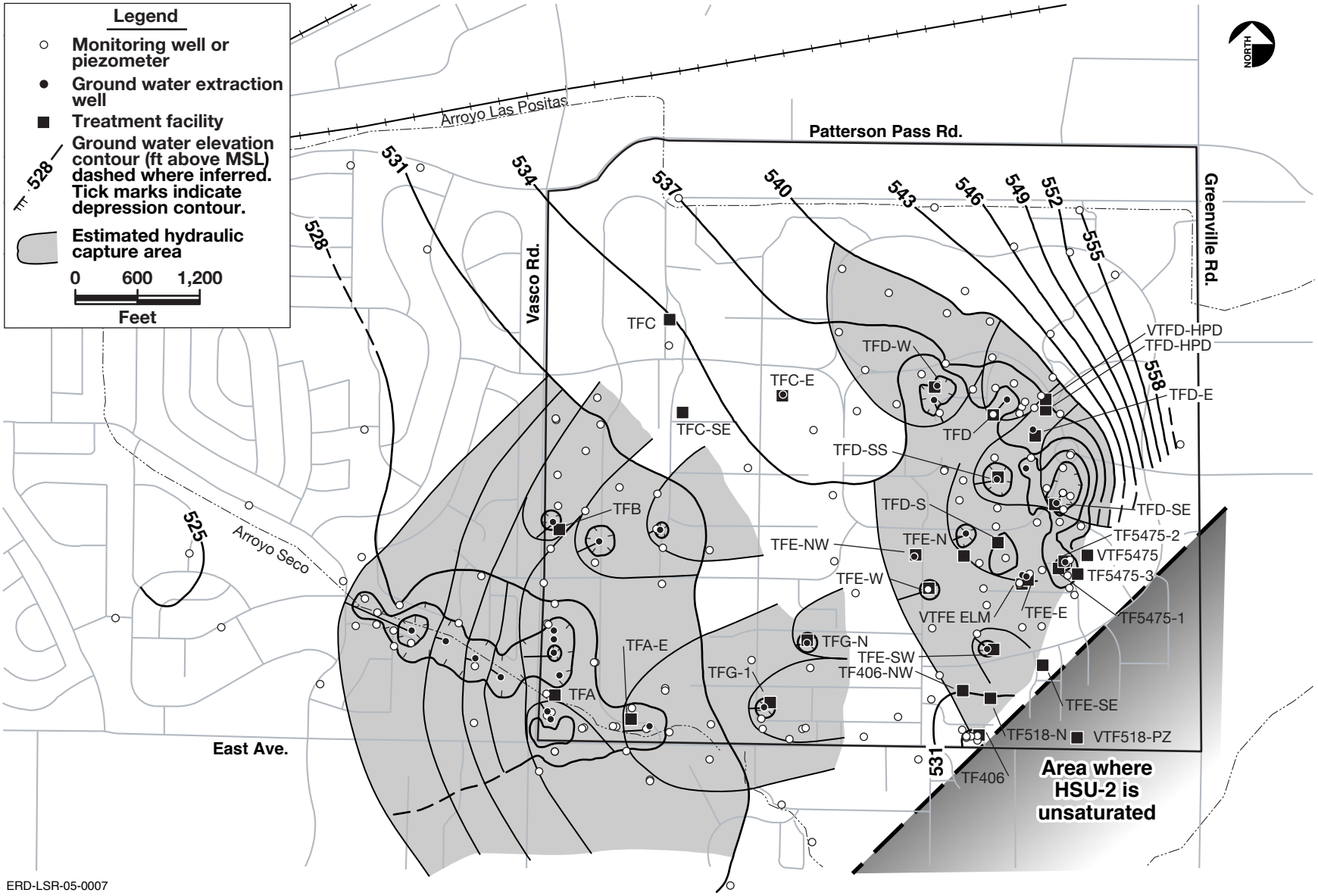
ERD-LSR-05-0028

Figure 4. Total VOC mass removed from the Livermore Site subsurface since 1989.



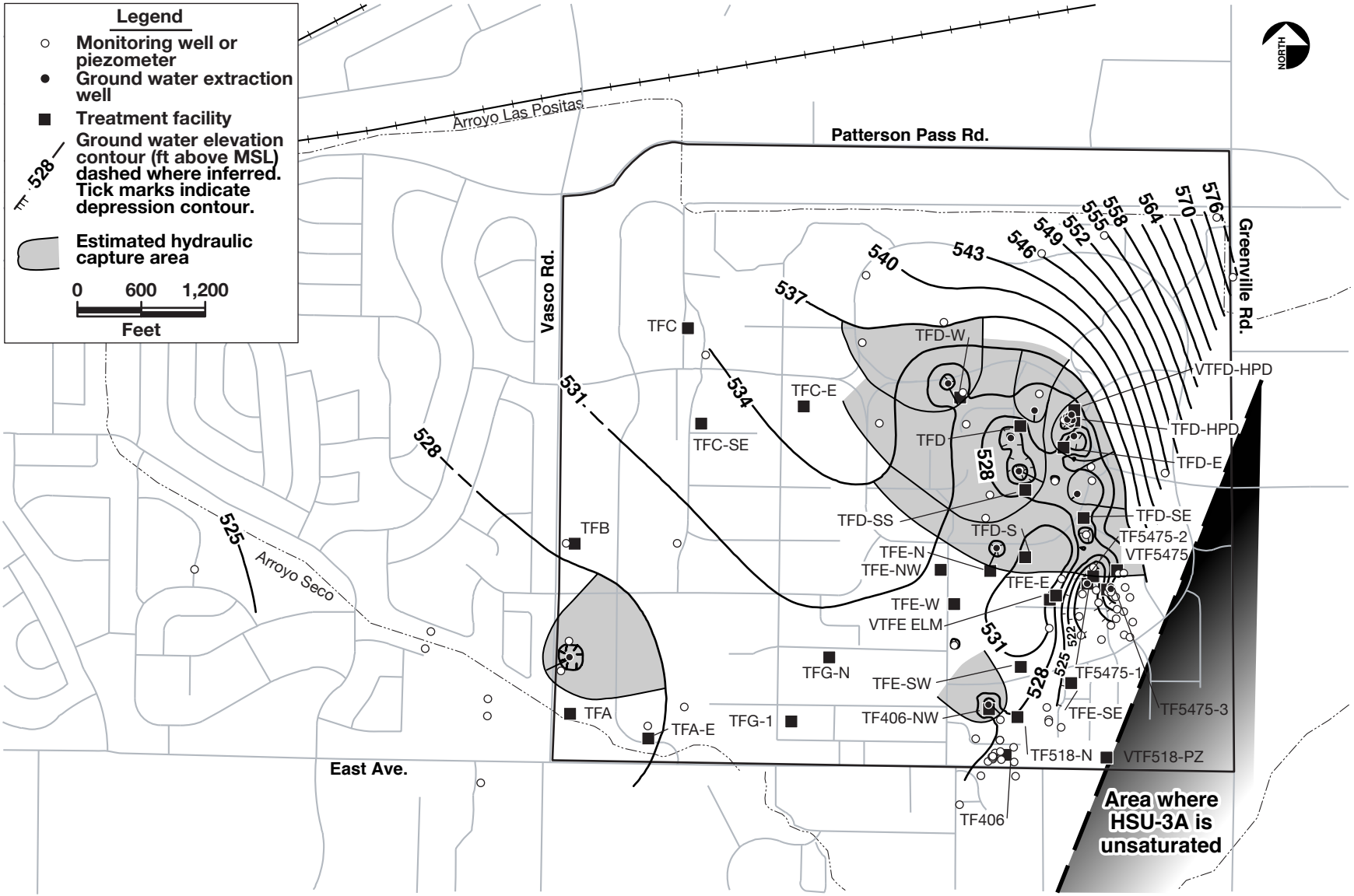
ERD-LSR-05-0006

Figure 5. Ground water elevation contour map based on water levels collected from 132 wells completed within HSU-1B showing estimated hydraulic capture areas, LLNL and vicinity, December 2004.



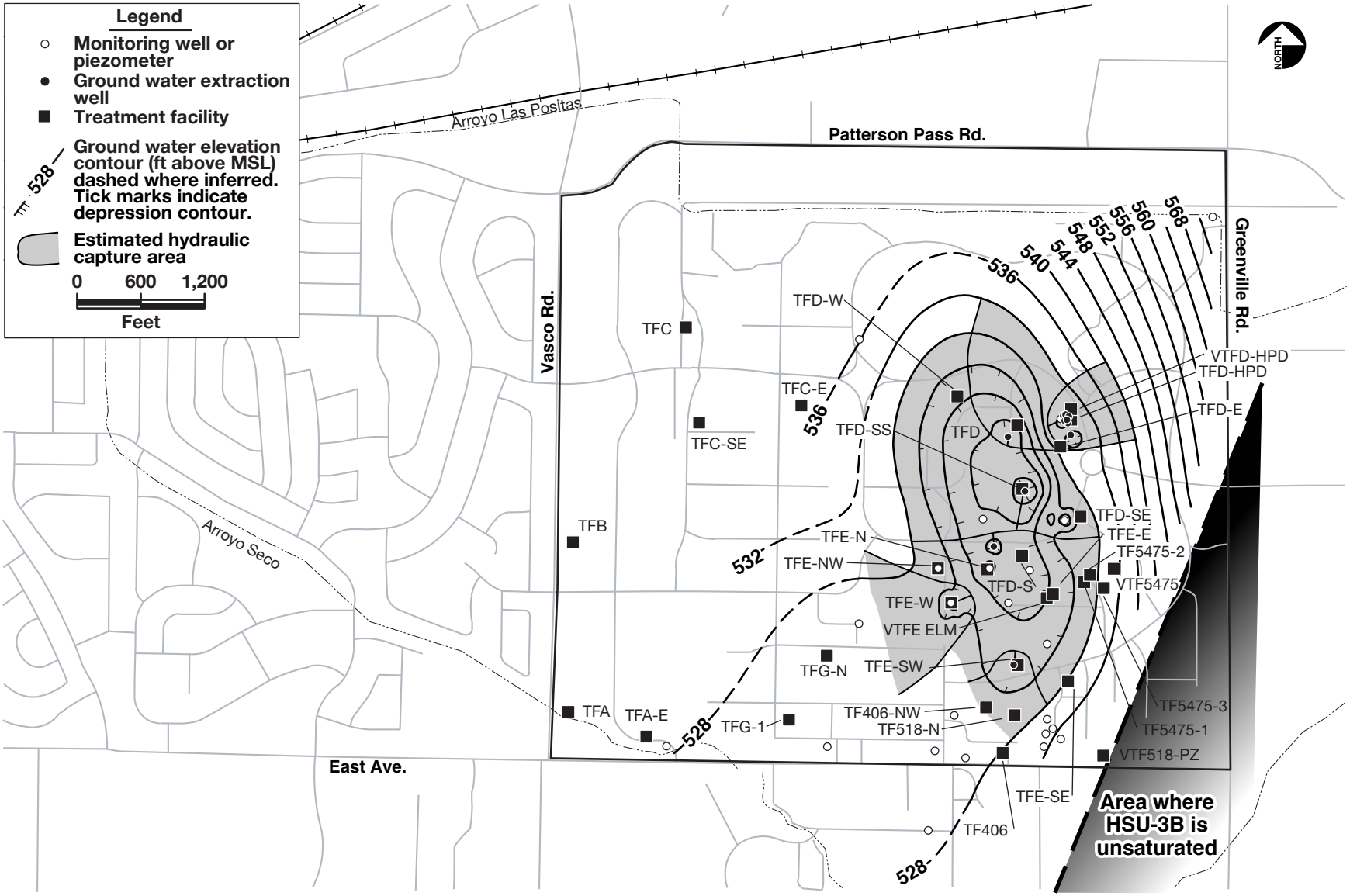
ERD-LSR-05-0007

Figure 6. Ground water elevation contour map based on water levels collected from 167 wells completed within HSU-2 showing estimated hydraulic capture areas, LLNL and vicinity, November 2004.



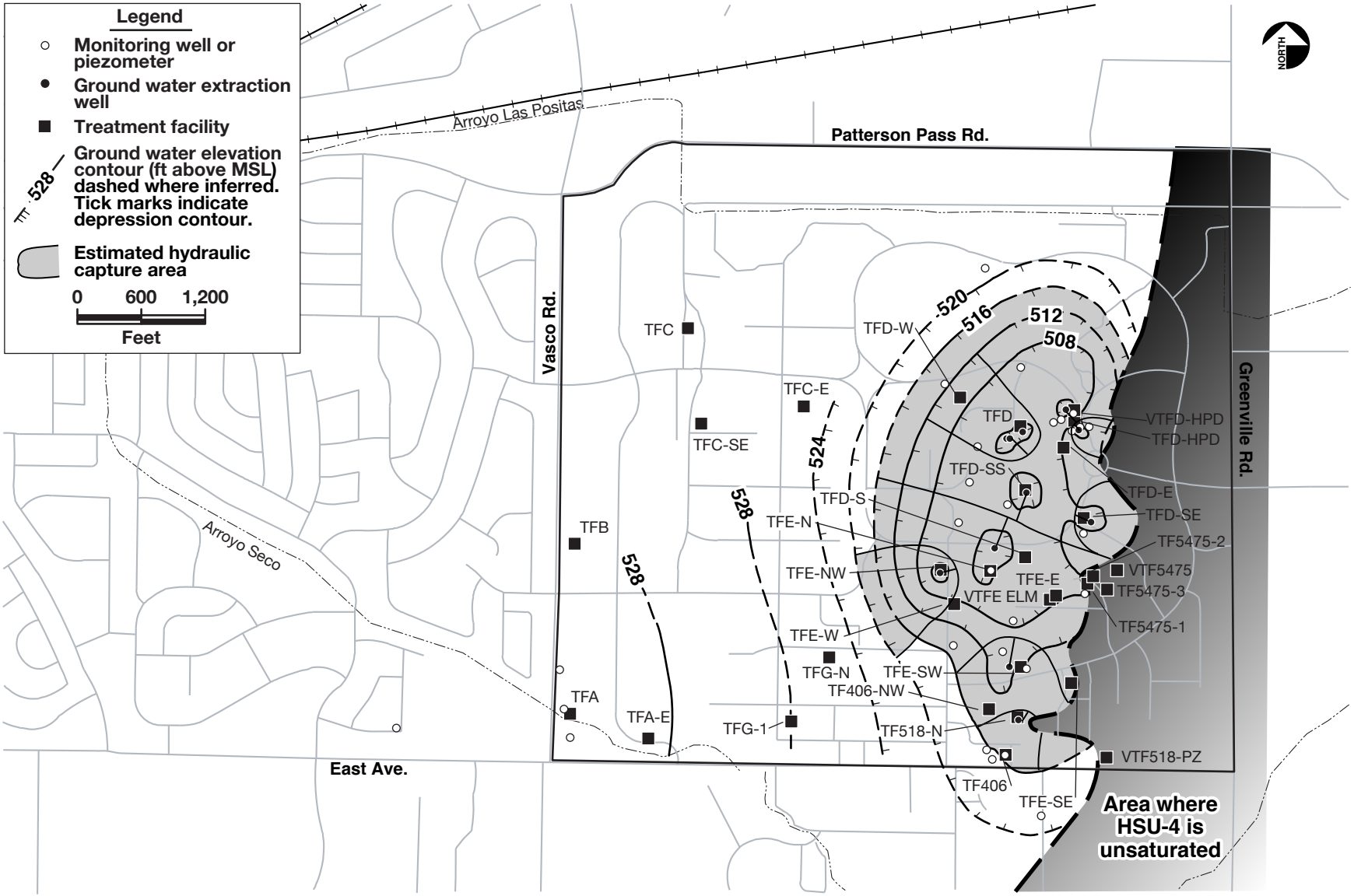
ERD-LSR-05-0008

Figure 7. Ground water elevation contour map based on water levels collected from 74 wells completed within HSU-3A showing estimated hydraulic capture areas, LLNL and vicinity, November 2004.



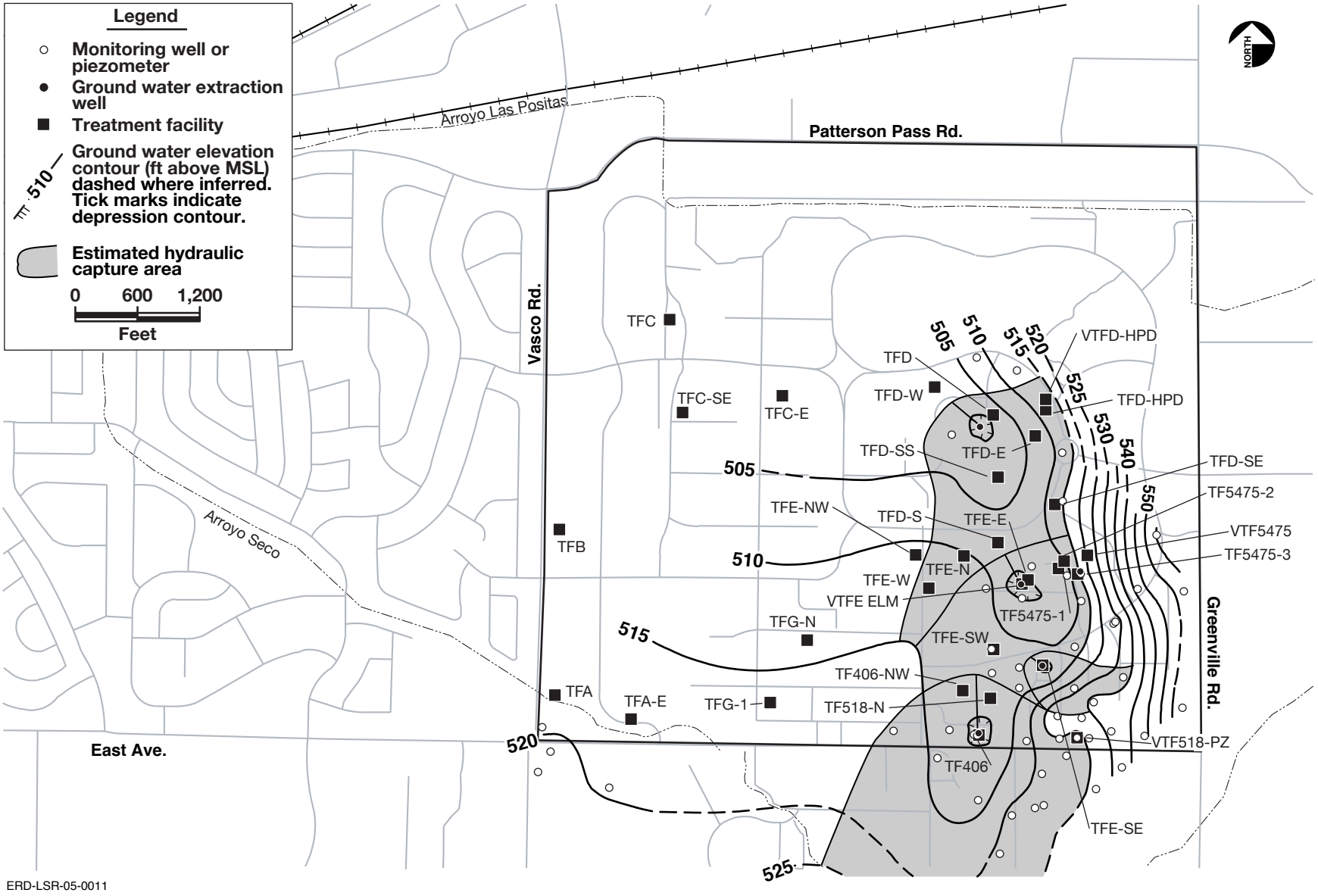
ERD-LSR-05-0009

Figure 8. Ground water elevation contour map based on water levels collected from 31 wells completed within HSU-3B showing estimated hydraulic capture areas, LLNL and vicinity, November 2004.



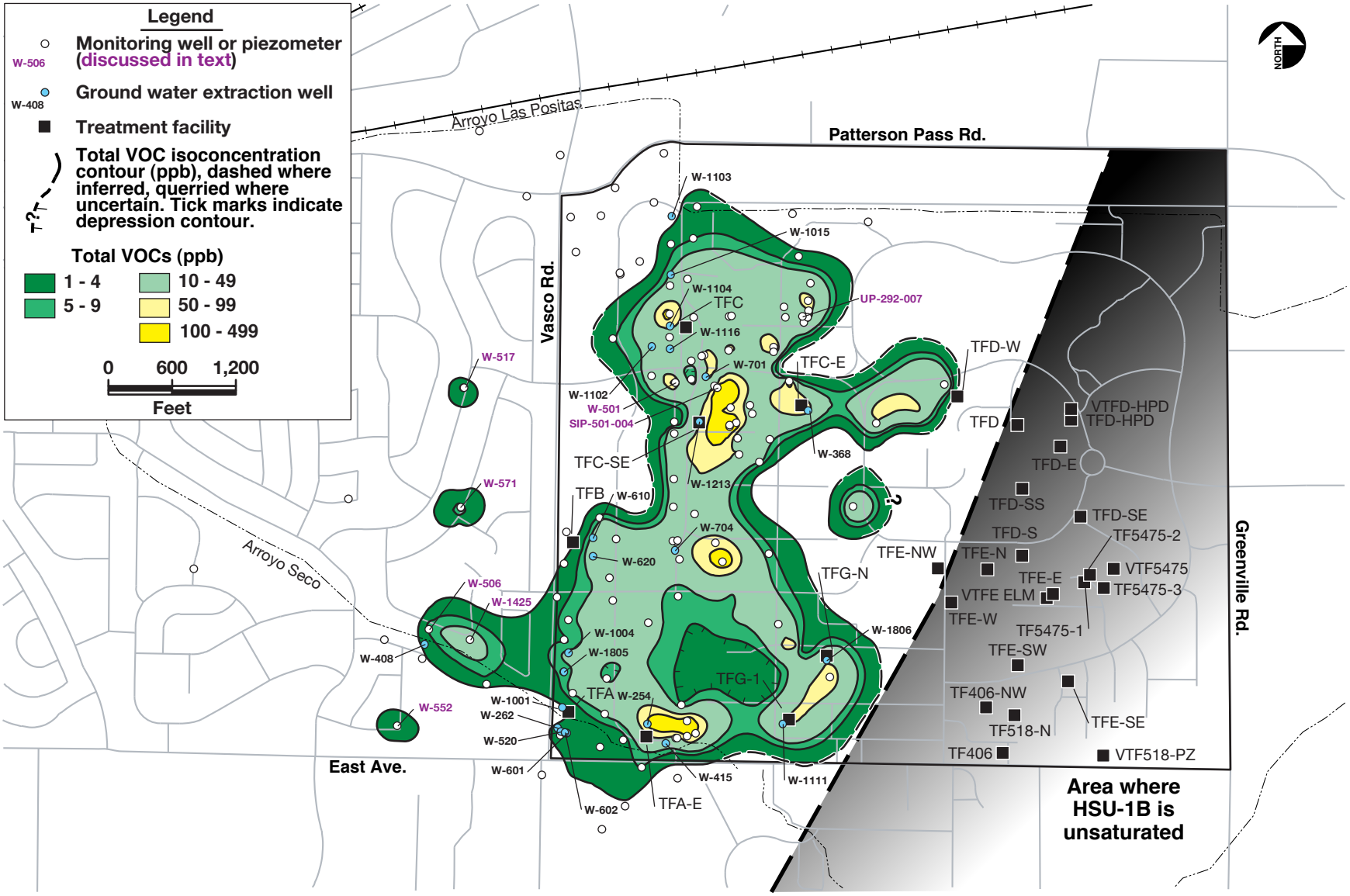
ERD-LSR-05-0010

Figure 9. Ground water elevation contour map based on water levels collected from 35 wells completed within HSU-4 showing estimated hydraulic capture areas, LLNL and vicinity, November 2004.



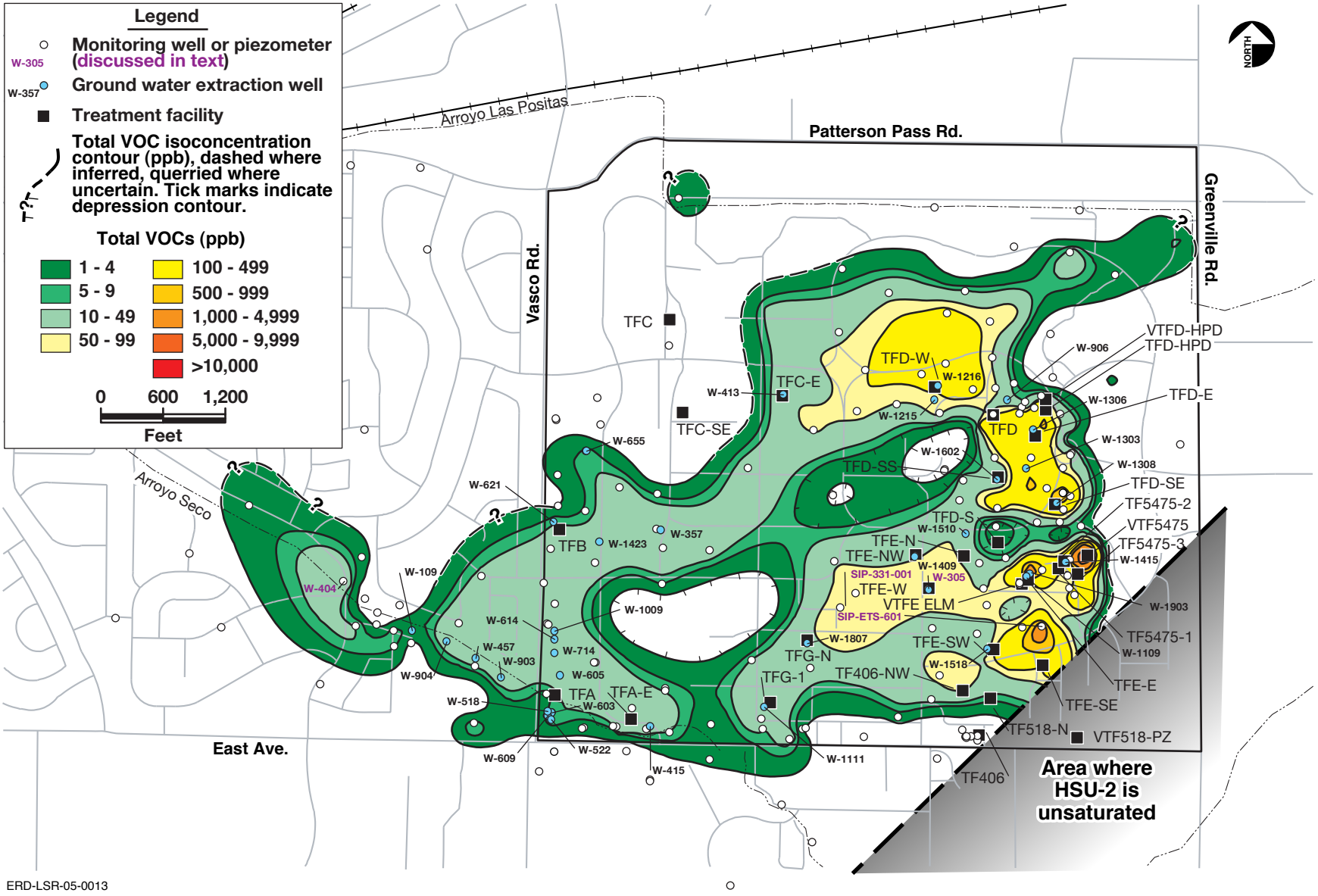
ERD-LSR-05-0011

Figure 10. Ground water elevation contour map based on water levels collected from 50 wells completed within HSU-5 showing estimated hydraulic capture areas, LLNL and vicinity, November 2004.



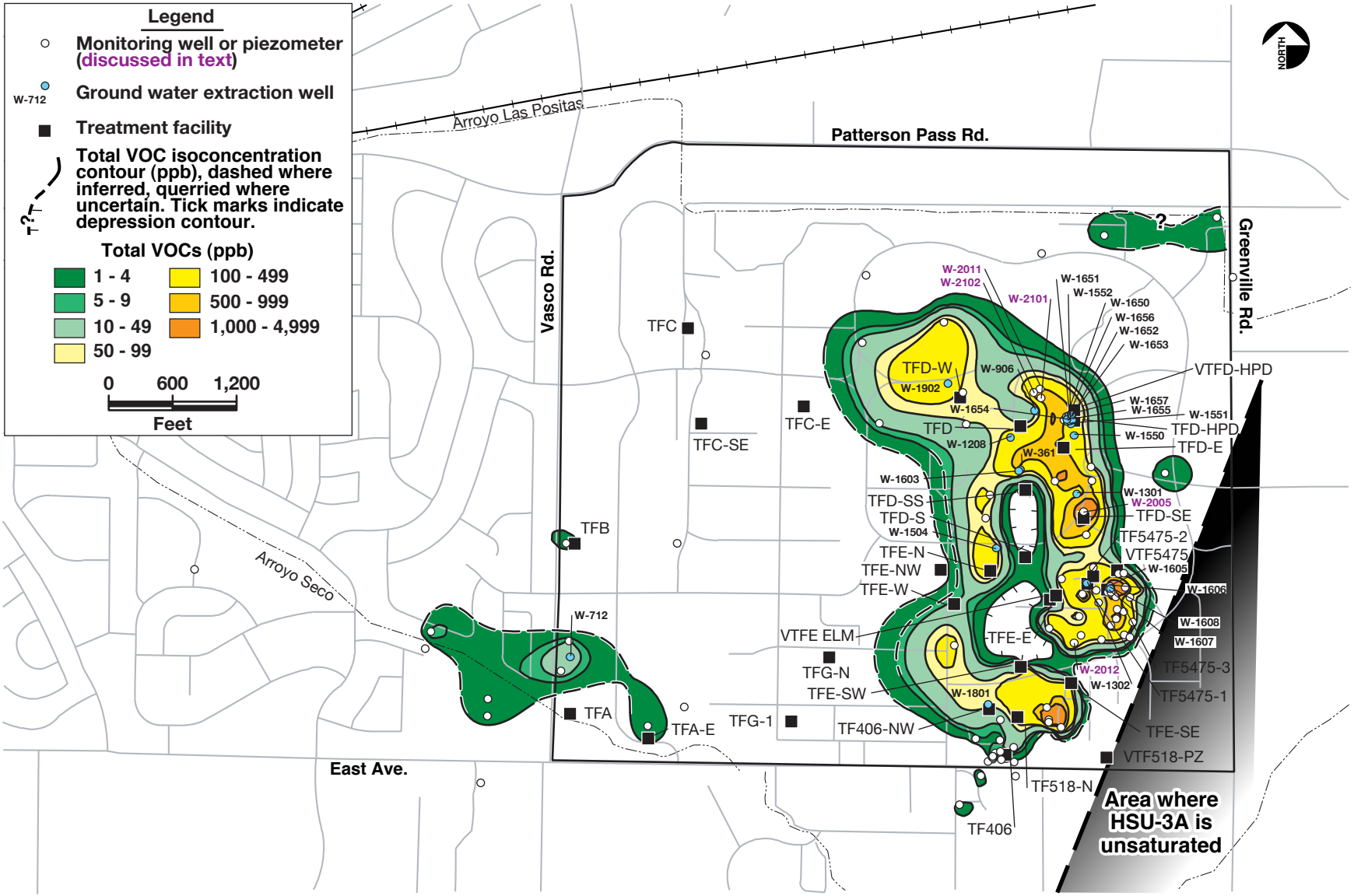
ERD-LSR-05-0012

Figure 11. Isoconcentration contour map of total VOCs for 137 wells completed within HSU-1B based on samples collected in the fourth quarter of 2004 (or the next most recent data), and supplemented with soil chemistry data from 41 borehole locations.



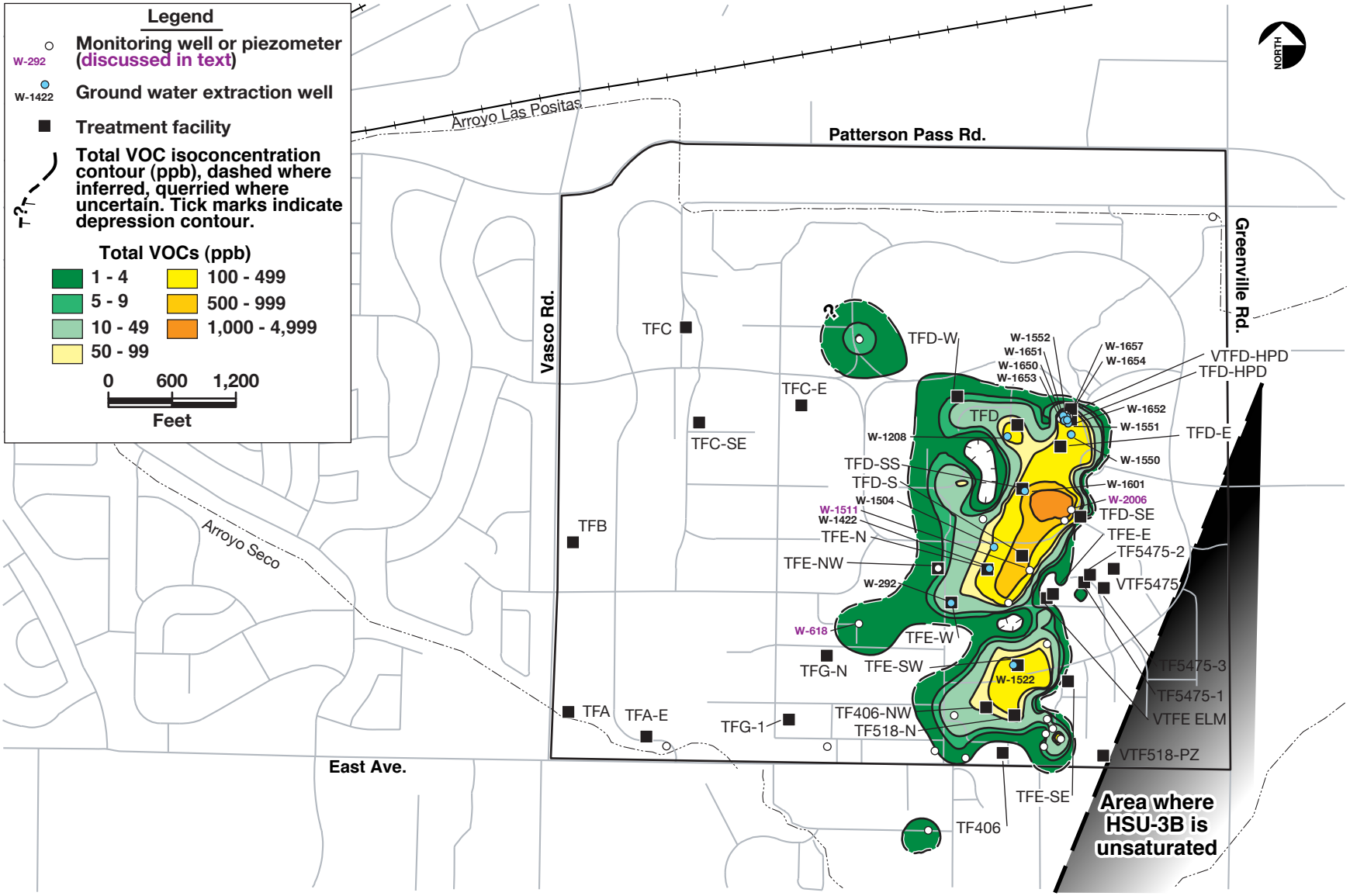
ERD-LSR-05-0013

Figure 12. Isoconcentration contour map of total VOCs for 194 wells completed within HSU-2 based on samples collected in the fourth quarter of 2004 (or the next most recent data), and supplemented with soil chemistry data from 101 borehole locations.



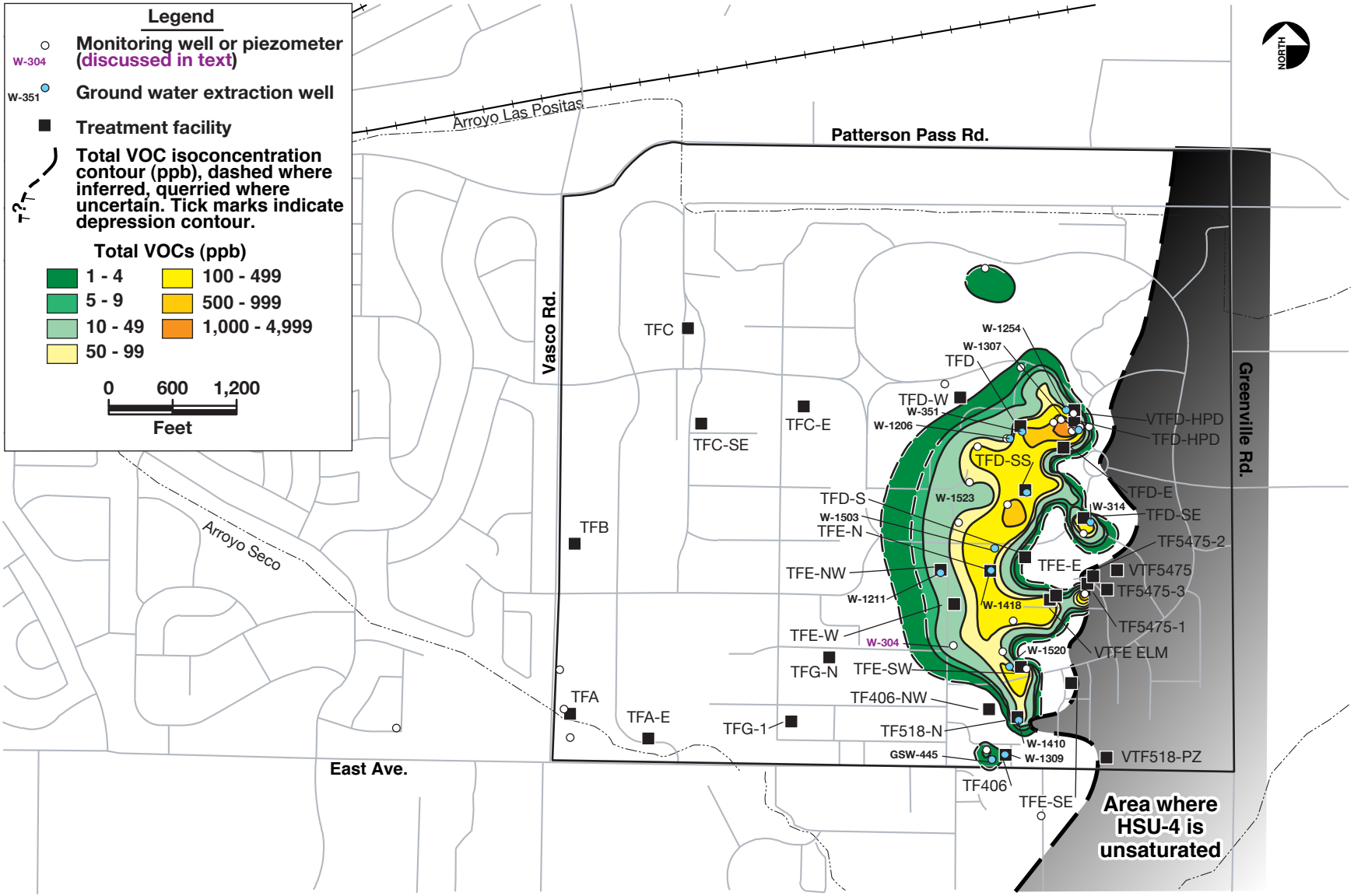
ERD-LSR-05-0014

Figure 13. Isoconcentration contour map of total VOCs for 109 wells completed within HSU-3A based on samples collected in the fourth quarter of 2004 (or the next most recent data), and supplemented with soil chemistry data from 143 borehole locations.



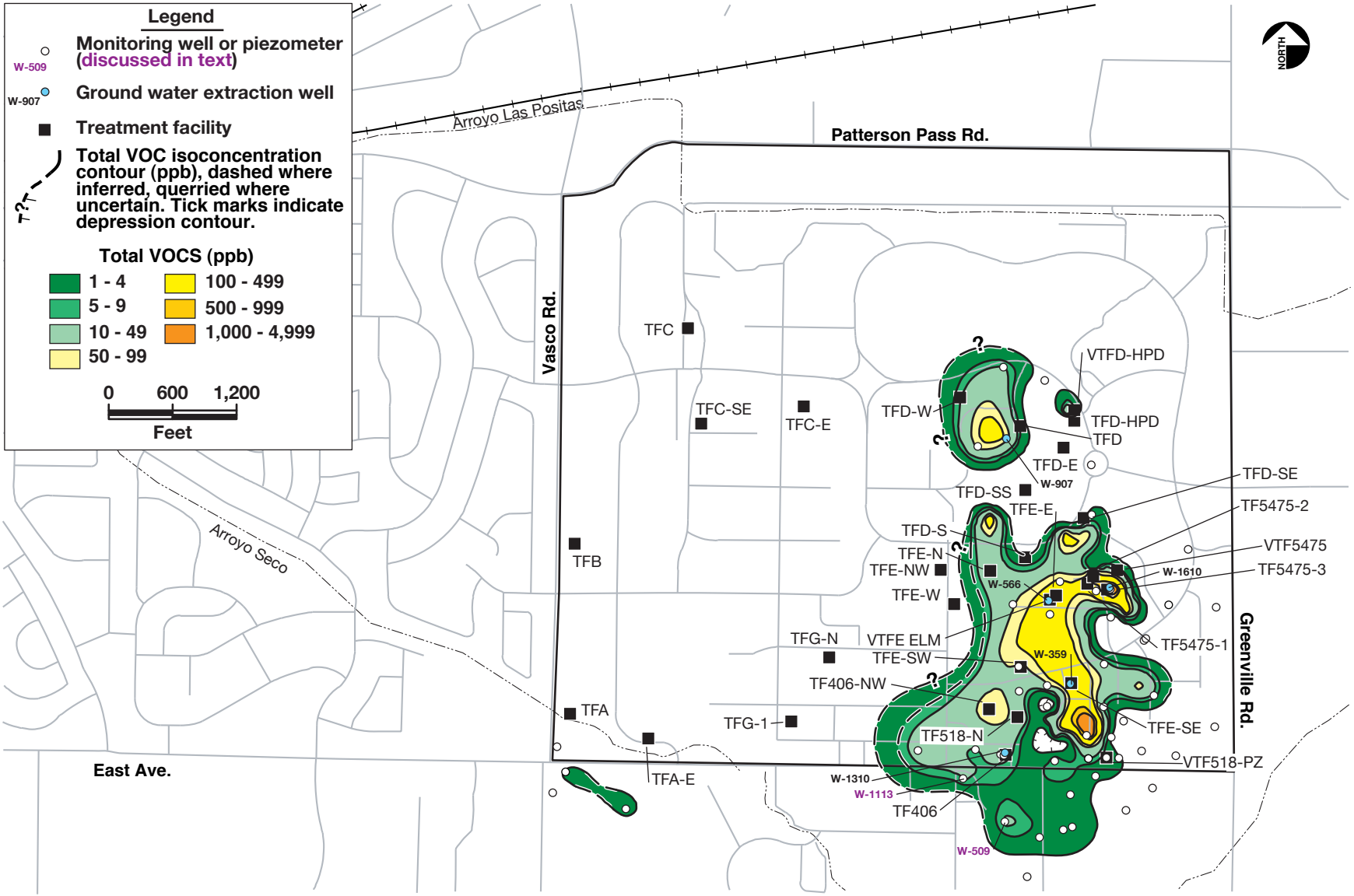
ERD-LSR-05-0015

Figure 14. Isoconcentration contour map of total VOCs for 43 wells completed within HSU-3B based on samples collected in the fourth quarter of 2004 (or the next most recent data), and supplemented with soil chemistry data from 112 borehole locations.



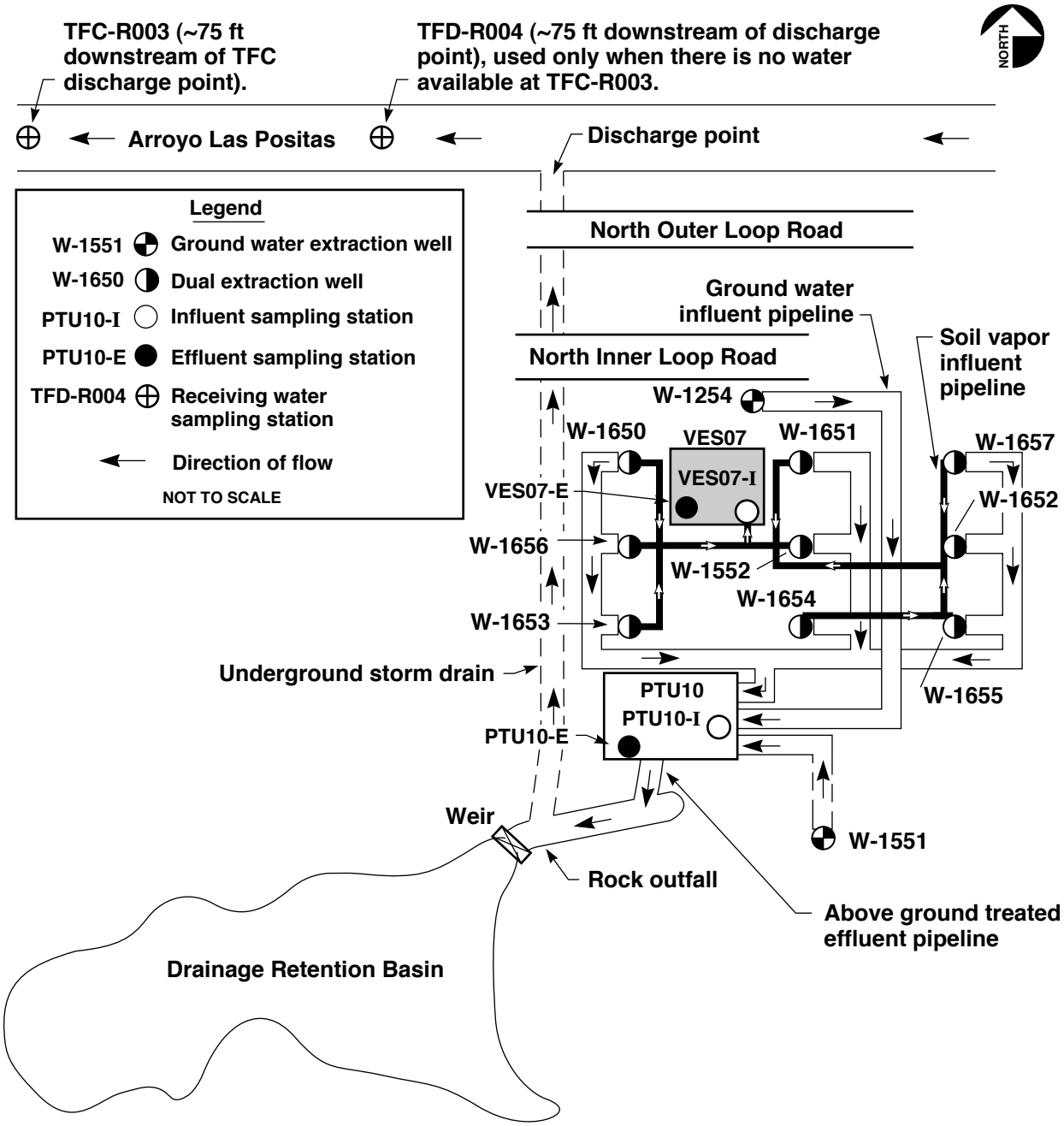
ERD-LSR-05-0016

Figure 15. Isoconcentration contour map of total VOCs for 45 wells completed within HSU-4 based on samples collected in the fourth quarter of 2004 (or the next most recent data), and supplemented with soil chemistry data from 58 borehole locations.



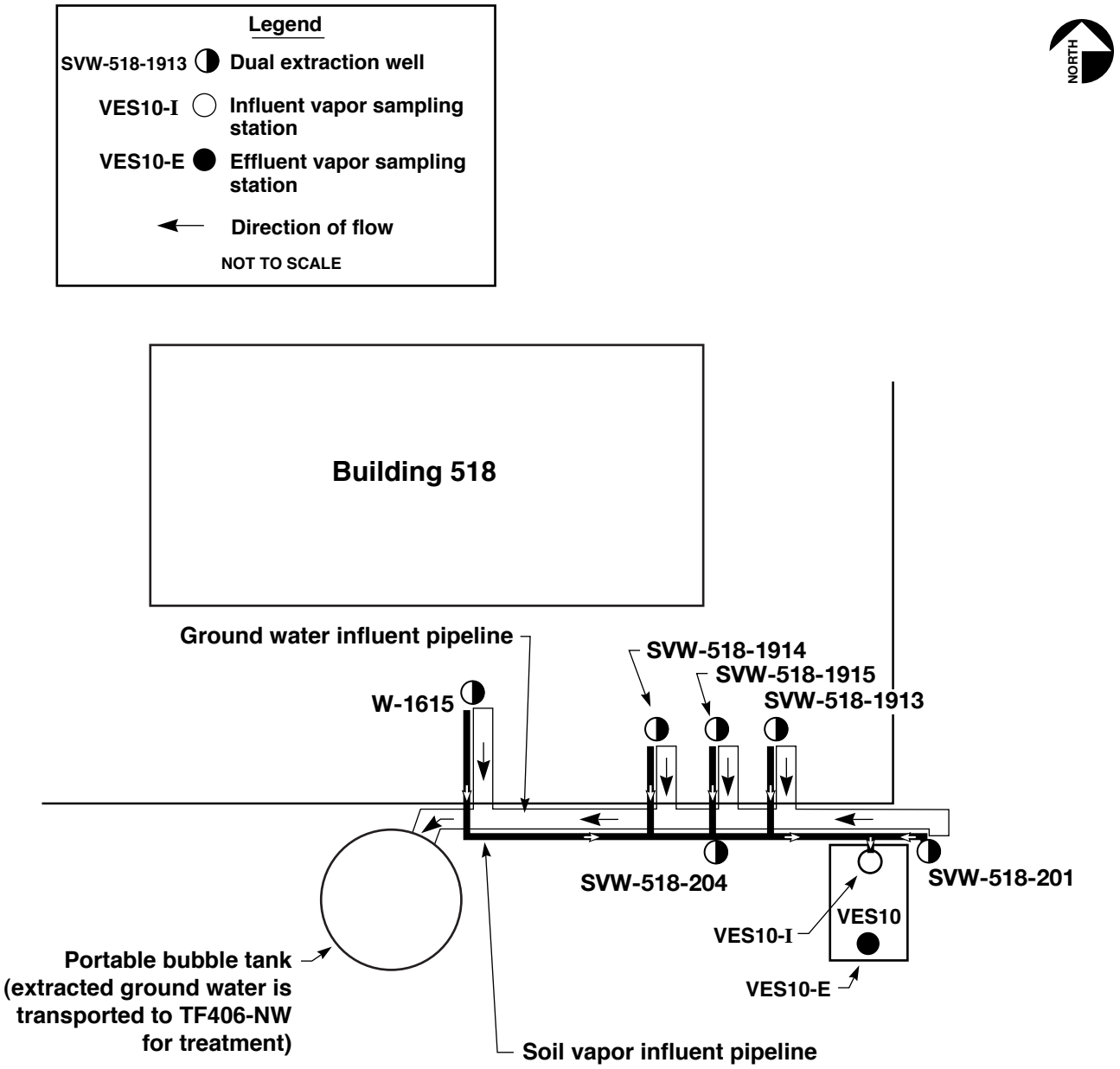
ERD-LSR-05-0017

Figure 16. Isoconcentration contour map of total VOCs for 55 wells completed within HSU-5 based on samples collected in the fourth quarter of 2004 (or the next most recent data), and supplemented with soil chemistry data from 97 borehole locations.



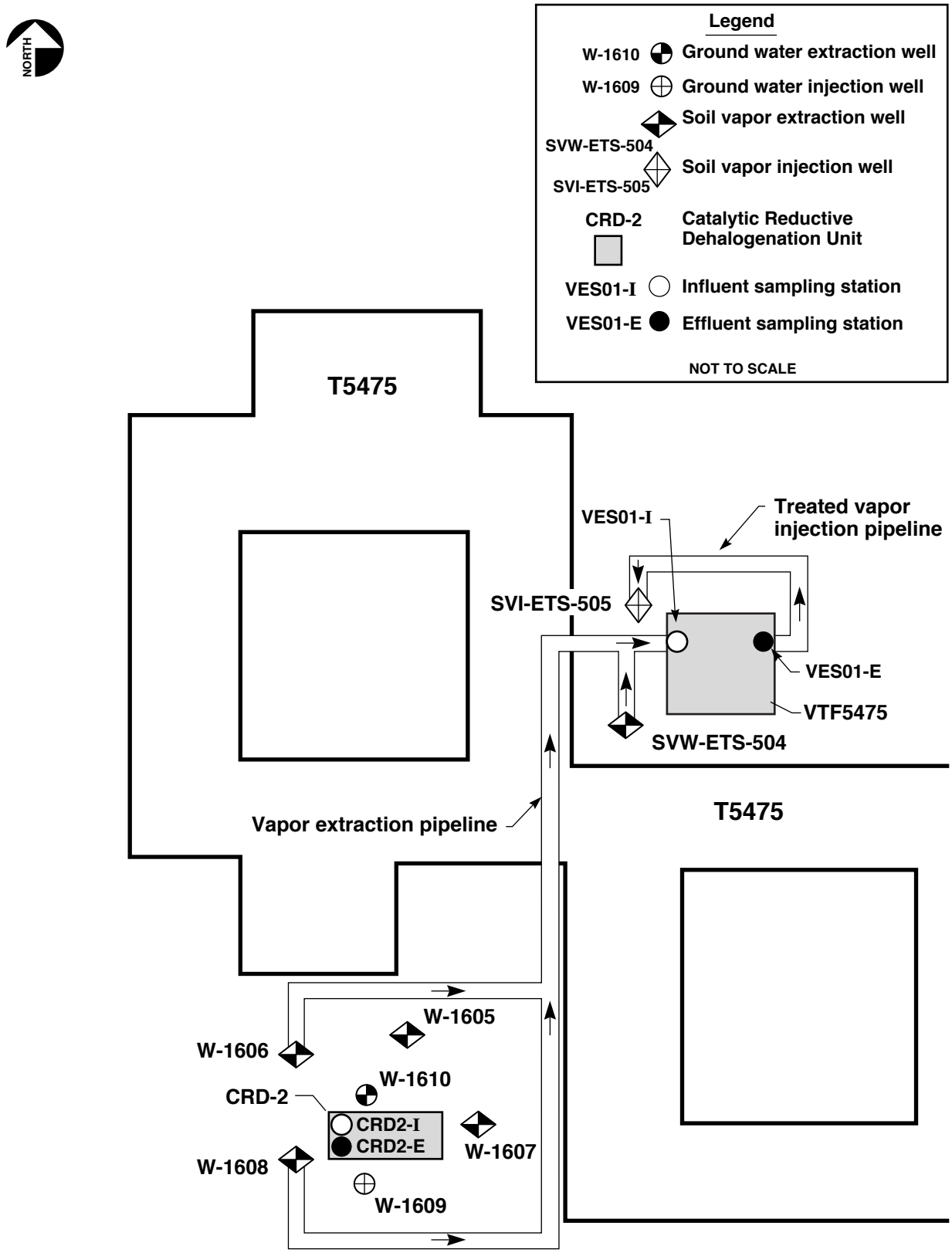
ERD-LSR-05-0001

Figure 17. TFD (PTU10) and VTFD Helipad extraction well, pipeline and discharge locations.



ERD-LSR-05-0002

Figure 18. VTF518-PZ dual extraction well and pipeline locations.



ERD-LSR-05-0003

Figure 19. TF5475-3 (CRD-2) and VTF5475 extraction and injection well and pipeline locations.

Tables

Table 1. Types and numbers of wells.

Well type	Number of wells
Air Injection	1
Dual Extraction	16
Ground Water Extraction	85[a]
Ground Water Injection	1
Instrumented Membrane System	6
Monitor	398[b]
Piezometer	110
Soil Vapor Extraction	10[c]
Soil Vapor Injection	1
Soil Vapor Monitor	23
Total	651

Note:
See Table 7 for a list of extraction wells and Table A-1 of Appendix A for a detailed list of all wells.

[a] **Includes five wells that did not operate in 2004.**

[b] **Includes former Dynamic Stripping wells.**

[c] **Includes one well that did not operate in 2004.**

Table 2. Treatment facility abbreviations.

Treatment facility	Abbreviation
TFA	TFA
TFA East	TFA-E
TFB	TFB
TFC	TFC
TFC East	TFC-E
TFC Southeast	TFC-SE
TFD	TFD
TFD East	TFD-E
TFD Helipad	TFD-HPD
TFD Hotspot[a]	TFD-HS
TFD South	TFD-S
TFD Southeast	TFD-SE
TFD Southshore	TFD-SS
TFD West	TFD-W
VTFD East Traffic Circle South[a]	VTFD-ETCS
VTFD Helipad	VTFD-HPD
VTFD Hotspot[a]	VTFD-HS
TFE East	TFE-E
TFE Hotspot[a]	TFE-HS
TFE North	TFE-N (PTU-4)
TFE Northwest	TFE-NW
TFE Southeast	TFE-SE
TFE Southwest	TFE-SW
TFE West	TFE-W
VTFE Eastern Landing Mat	VTFE-ELM
VTFE Hotspot[a]	VTFE-HS
TF406	TF406
TF406 Northwest	TF406-NW
VTF406 Hotspot[a]	VTF406-HS
TFG-1	TFG-1
TFG North	TFG-N
TF518 North	TF518-N
VTF518 Perched Zone	VTF518-PZ
TF5475-1	TF5475-1
TF5475-2	TF5475-2
TF5475-3	TF5475-3
VTF5475	VTF5475

Note:

TF = Ground water treatment facility.

VTF = Soil vapor treatment facility.

[a] September 2005 milestone.

Table 3. Wells installed in 2004.

Treatment facility area	Wells
TFA	None
TFB	None
TFC	None
TFD	W-2005, W-2006, W-2011, W-2101, W-2102
TFE	SVW-ETS-2008A, SVW-ETS-2008B, SVW-ETS-2009, SVW-ETS-2010A, SVW-ETS-2010B, W-2012
TF406	SVW-514-2007A, SVW-514-2007B
TFG	None
TF518	None
TF5475	None

Note:
See Figure 2 for well locations.

Table 4. Hydraulic test conducted in 2004.

Treatment facility area	Well(s)
TFA	None
TFB	None
TFC	None
TFD	SIP-ETC-201
TFE	None
TF406	None
TFG	None
TF518	None
TF5475	None

Note:
See Figure 2 for well location.

Table 5. Soil vapor extraction tests conducted in 2004.

Treatment facility area	Wells
TFD	SVW-ETC-2001A, SVW-ETC-2001B, SVW-ETC-2002A, SVW-ETC-2002B, SVW-ETC-2003, SVW-ETC-2004A, SVW-ETC-2004B, SIP-ETC-201, W-1904
TFE	SVW-ETS-2008A, SVW-ETS-2008B, SVW-ETS-2009, SVW-ETS-2010A, SVW-ETS-2010B, SIP-ETS-601
TF406	SVW-514-2007A, SVW-514-2007B, W-217
TF518-PZ	SVW-518-201, SVW-518-204, SVW-518-1913, SVW-518-1914, SVW-518-1915, W-1615

Note:
See Figure 2 for well locations.

Table 6. 2004 Livermore Site Remedial Action Implementation Plan milestones.

Milestone	Completion date	Milestone date
Begin TFD Helipad source area remediation	6-8-04	9-30-04
Begin TF518 perched-zone remediation	9-3-04	9-30-04

Table 7. Summary of treatment facilities, discharge sampling locations, and extraction wells.

Treatment facility	Discharge sampling location	Hydrostratigraphic unit	Extraction wells
TFA	Arroyo Las Positas (TFC-R003), Arroyo Seco (TFG-ASW), West Perimeter Drainage Channel (TFB-R002)	1B	W-262, W-408, W-520, W-601, W-602, W-1001, W-1004
		1B/2	W-415
		2	W-109, W-457, W-518, W-522, W-603[a], W-605, W-609, W-614, W-714, W-903, W-904, W-1009
		3A	W-712
TFA East	Arroyo Seco (TFG-ASW)	1B	W-254
TFB	West Perimeter Drainage Channel (TFB-R002)	1B	W-610, W-620, W-704
		2	W-357, W-621, W-655, W-1423
TFC	Arroyo Las Positas (TFC-R003)	1B	W-701, W-1015, W-1102, W-1103, W-1104, W-1116
TFC East	Arroyo Las Positas (TFC-R003)	1B	W-368
		2	W-413
TFC Southeast	Arroyo Las Positas (TFC-R003)	1B	W-1213
TFD	Arroyo Las Positas (TFC-R003) via DRB	2/3A	W-906
		3A/3B	W-1208
		4	W-351, W-1206
		5	W-907-2
TFD East	Arroyo Las Positas (TFC-R003) via DRB	2	W-1303, W-1306
		3A	W-1301, W-1550
		4	W-1307
TFD Helipad	Arroyo Las Positas (TFC-R003), Arroyo Las Positas (75 ft from DRB outfall) (TFD-R004)	2/3A	W-1655[b]
		3A	W-1551, W-1552[b], W-1650[b], W-1653[b], W-1654[b], W-1656[b]
		3A/3B	W-1651[b], W-1652[b], W-1657[b]
		4	W-1254

Table 7. Summary of treatment facilities, discharge sampling locations, and extraction wells.

Treatment facility	Discharge sampling location	Hydrostratigraphic unit	Extraction wells
TFD South	Arroyo Las Positas (TFC-R003) via DRB	2	W-1510
		3A/3B	W-1504
		4	W-1503
TFD Southeast	Arroyo Las Positas (TFC-R003) via DRB	2	W-1308
		4	W-314
TFD Southshore	Arroyo Las Positas (TFC-R003) via DRB	2	W-1602
		3A	W-1603
		3B	W-1601
		4	W-1523
TFD West	Arroyo Las Positas (TFC-R003)	2	W-1215, W-1216
		3A	W-1902
VTFD Helipad	Treated vapor to atmosphere	2	SVW-HPA-002A[a], SVW-HPA-002B
		2/3A	W-1655[b]
		3A	W-1552[b], W-1650[b], W-1653[b], W-1654[b], W-1656[b]
		3A/3B	W-1651[b], W-1652[b], W-1657[b]
TFE East	Arroyo Las Positas (TFC-R003) via DRB	2	W-1109, W-1903[b]
		5	W-566
TFE Northwest	Arroyo Las Positas (TFC-R003)	2	W-1409
		4	W-1211
TFE Southeast	Arroyo Las Positas (TFC-R003)	5	W-359
TFE Southwest	Arroyo Las Positas (TFC-R003) via DRB	2	W-1518
		3B	W-1522
		4	W-1520
TFE West	Arroyo Las Positas (TFC-R003)	2	W-305
		3B	W-292

Table 7. Summary of treatment facilities, discharge sampling locations, and extraction wells.

Treatment facility	Discharge sampling location	Hydrostratigraphic unit	Extraction wells
VTFE Eastern Landing Mat	Treated vapor to atmosphere	1B	SVW-543-1908
		2	SVW-543-001, SVW-543-003
		2	W-1903[b]
TFG North	Arroyo Las Positas (TFC-R003)	1B	W-1806
		2	W-1807
TFG-1	Arroyo Seco (TFG-ASW)	1B/2	W-1111
TF5475-1	CRD-1 injection (W-1302-1)	3A	W-1302-2
TF5475-2	Arroyo Las Positas (TFC-R003) via DRB	2	W-1415
TF5475-3	CRD-2 injection (W-1609)	3A	W-1605[a], W-1606[a], W-1607[a], W-1608[a]
		5	W-1610
VTF5475	Injection (SVI-ETS-505)	2	SVI-ETS-504
		3A	W-1605, W-1606, W-1607, W-1608
TF406	Arroyo Las Positas (TFC-R003), Arroyo Seco (TFG-ASW)	4	GSW-445[a], W-1309[a]
		5	W-1310
TF406 Northwest	Arroyo Las Positas (TFC-R003)	3A	W-1801
TF518 North	Arroyo Las Positas (TFC-R003)	4	W-1410
VTF518 Perched Zone[c]	Treated vapor to atmosphere	1B	SVW-518-1914[b]
		1B/2	W-1615[b], SVW-518-201[b]
		2	SVW-518-204[b], SVW-518-1913[b], SVW-518-1915[b]

Note:

DRB = Drainage Retention Basin, located in the central portion of the Livermore Site (Fig. 1).

[a] Extraction well did not operate in 2004.

[b] Dual extraction[1] well.

[c] Ground water is treated at TF406-NW.

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

Appendix A

Well Construction and Closure Data

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

Well number	Well type	Date completed	Borehole depth (ft)	Casing depth (ft)	Screen interval(s) (ft)	HSU[a] monitored	Initial well development flow rate (gpm)[b]
11C1	Other non-LLNL	08-Jun-76	68	66	56.2-61.2	1B	NA
11J2	Other non-LLNL	26-Apr-79	112	112	90-92	1B	NA
					102-108	2	NA
14A11[c]	Other non-LLNL	20-Dec-83	NA	NA	NA	NA	NA
14A3	Other non-LLNL	07-Dec-77	110	110	100-105	1B	NA
14B1	Other non-LLNL	13-Aug-59	300	300	146-149	2	NA
					192-195	3A	NA
					198	3A	NA
					200	3A	NA
					203	3A	NA
					205	3A	NA
					207	3A	NA
					209-213	3A	NA
					226	3A	NA
					230	3B	NA
					234	3B	NA
14B4	Other non-LLNL	01-Aug-60	260	260	143-148	2	NA
					155-159	2	NA
					186-189	3A	NA
					205-215	3A	NA
					245-250	4	NA
14B7	Other non-LLNL	25-Aug-87	NA	NA	NA	NA	NA
14C1	Other non-LLNL	31-Jul-91	523	NA	NA	2/3A/4	NA
14C2	Other non-LLNL	07-Jan-88	217	NA	135-150	2	NA
14C3	Other non-LLNL	19-Jan-88	405	NA	160-388	2/3A/3B/4/5	NA
14H1	Other non-LLNL	21-Dec-83	NA	288	NA	NA	NA
14H2[c]	Other non-LLNL	28-Aug-87	NA	NA	NA	NA	NA
18D1[c]	Other non-LLNL	20-Apr-84	NA	NA	NA	7	NA
2J2	Other non-LLNL	04-Jan-90	NA	NA	NA	NA	NA
2K3	Other non-LLNL	06-Mar-91	35	NA	NA	NA	NA
2K4	Other non-LLNL	06-Mar-91	35	NA	NA	1B	NA
2Q2	Other non-LLNL	06-Mar-91	40	NA	NA	1B	NA
2R3	Other non-LLNL	05-Mar-91	37	NA	NA	1B	NA
2R4	Other non-LLNL	05-Mar-91	37	NA	NA	NA	NA
2R8	Other non-LLNL	06-Mar-91	40	NA	NA	1B	NA
5F1	Other non-LLNL	19-Feb-85	NA	NA	NA	NA	NA
7D2	Other non-LLNL	07-Jun-76	74	72.3	63.2-67.3	3A	NA
C-SNL-20B	Monitor	28-Jun-84	140	140	90-105	NA	NA
C-SNL-20C	Monitor	16-Jul-84	165	156	140-155	NA	NA
AW-1906	Anode Well	17-Jun-03	270	258	NA	NA	NA
AW-1910	Anode Well	23-Jul-03	270	258	NA	NA	NA
AW-1911	Anode Well	13-Aug-03	290	258	NA	NA	NA
AW-1912	Anode Well	10-Sep-03	280	258	NA	NA	NA
GEW-710	Monitor	23-Sep-91	140	158	94-137	2/3A	25
GEW-808	Dynamic Stripping[d]	05-Jun-92	150	150	50-140	2/3A	25
GEW-816	Dynamic Stripping[d]	04-Aug-92	161.7	150	50-140	2/3A	40
GIW-813	Dynamic Stripping[d]	05-Aug-92	140.7	127	67-87	2/3A	NA
					89-99	2/3A	NA
					107-127	2/3A	NA

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

Well number	Well type	Date completed	Borehole depth (ft)	Casing depth (ft)	Screen interval(s) (ft)	HSU[a] monitored	Initial well development flow rate (gpm)[b]
GIW-814	Dynamic Stripping[d]	05-Aug-92	149.6	141	86.5-106.5	2/3A	NA
					110-120	2/3A	NA
					121-141	2/3A	NA
GIW-815	Dynamic Stripping[d]	05-Aug-92	143	137.5	77-97	2/3A	NA
					102-112	2/3A	NA
					112.8-132.5	2/3A	NA
GIW-817	Dynamic Stripping[d]	29-Jun-92	150.1	102	82-102	2/3A	NA
				122	107-117	3A	NA
				141	121-141	3B	NA
GIW-818	Dynamic Stripping[d]	05-Aug-92	150	140	82-102	2/3A	NA
					110-120	2/3A	NA
					120-140	2/3A	NA
GIW-819	Dynamic Stripping[d]	05-Aug-92	150	141	78.6-98.6	2/3A	NA
					108-118	2/3A	NA
					121-141	2/3A	NA
GIW-820	Dynamic Stripping[d]	05-Aug-92	143.3	132	85-105	3A	NA
					112-132	3A	NA
GSP-SNL-001	Dynamic Stripping[d]	07-Jan-92	147	104	99-104	2	NA
				131	118-131	3A	NA
GSW-004	Monitor	22-Feb-85	112	106	86-106	2	NA
GSW-006	Monitor	28-Feb-86	212	137	121-137	3A	6
GSW-007	Monitor	14-Mar-86	176.5	123.4	110.8-123.4	3A	2
GSW-008	Monitor	01-Apr-86	176	133	127.5-133	3A	2
GSW-009	Monitor	14-Apr-86	197.5	152.5	147-152.5	3A	1
GSW-011	Monitor	07-May-86	182.5	126	116-126	3A	2
GSW-013	Monitor	27-Jun-86	198	134.5	125-134.5	3A	1
GSW-016	Monitor	19-Oct-87	146	145	23-28	1B	20.5-30
					38-43	1B	NA
					50-55	2	NA
					61-66	2	NA
					78-83	2	NA
					95-105	2	NA
					120-130	3A	NA
GSW-215	Monitor	22-Apr-86	214	133.5	127-133.5	3A	2
GSW-216	Monitor	09-May-86	193	120.5	110.5-120.5	3A	3
GSW-266	Monitor	08-May-86	220	166	159-166	3B	1
GSW-326	Monitor	02-Oct-87	230	134	129-134	4	0.5
GSW-367	Monitor	29-Apr-87	159	124	114-124	2	2
GSW-442	Monitor	27-Oct-87	270	145	138-145	3A	0.5
GSW-443	Monitor	09-Nov-87	291	141	123-141	2	5
GSW-444	Monitor	20-Nov-87	278	120	110-120	3B	0.3
GSW-445	GW Extraction	09-Dec-87	319	161	155-161	4	3
HW-GP-001	Dynamic Stripping[d]	17-Apr-92	120	77	67-77	2	NA
				113	103-113	3A	NA
HW-GP-002	Dynamic Stripping[d]	13-May-92	120	78	68-78	2	NA
				117	107-117	3A	NA
HW-GP-003	Dynamic Stripping[d]	20-May-92	119	76.5	66.5-76.5	2	NA
				119	109-119	3A	NA

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Well number	Well type	Date completed	Borehole depth (ft)	Casing depth (ft)	Screen interval(s) (ft)	HSU[a] monitored	Initial well development flow rate (gpm)[b]
HW-GP-102	Dynamic Stripping[d]	13-Aug-93	140	137.5	72.5-133.5	2/3A	NA
HW-GP-103	Dynamic Stripping[d]	23-Aug-93	138	137.5	71.5-132.5	2/3A	NA
HW-GP-104	Dynamic Stripping[d]	02-Sep-93	138	137.2	72.2-132.2	2/3A	NA
HW-GP-105	Dynamic Stripping[d]	28-Sep-93	138	137.5	72.5-132.5	2/3A	NA
IMS-518-1616	Monitor	16-Aug-00	55	NA	NA	1B/2	NA
IMS-INF-203[e]	IMS	08-Jul-98	63	63	NA	1A	NA
MW-NLF-1	Monitor	13-Mar-91	NA	NA	NA	NA	NA
MW-NLF-2	Monitor	13-Mar-91	NA	NA	NA	NA	NA
MW-NLF-3	Monitor	13-Mar-91	NA	NA	NA	NA	NA
MW-NLF-4	Monitor	13-Mar-91	NA	NA	NA	NA	NA
SEA-518-301[e]	IMS	11-Sep-95	102.6	100	NA	1B/2/5	NA
SEA-518-304[e]	IMS	11-Sep-95	100	50	NA	1B/2/5	NA
SEA-ETS-305[e]	IMS	03-Sep-92	85	85	NA	1B/2	NA
SEA-ETS-506[e]	IMS	24-Jul-96	75	66	NA	1B/2	NA
SEA-ETS-507[e]	IMS	30-Jul-96	75	66	NA	1B/2	NA
SIP-141-201	Piezometer	02-Feb-96	77	74.2	57-74	1B	NA
SIP-141-202	Piezometer	12-Feb-96	80	74	64-74	1B	NA
SIP-141-203	Piezometer	20-Feb-96	87	83	72-83	1B	NA
SIP-191-001	Piezometer	15-Apr-94	50	45	40-45	1A	NA
SIP-191-002	Piezometer	21-Apr-94	66	61	45-61	1B	NA
SIP-191-003	Piezometer	26-Apr-94	50.5	45	35-45	1B	NA
SIP-191-004	Piezometer	29-Apr-94	57.5	53.5	47.5-53.5	1B	NA
SIP-191-005	Piezometer	04-May-94	54	48	42-48	1A	NA
SIP-191-101	Piezometer	18-Nov-94	68.5	64	58-64	1B	NA
SIP-212-101	Piezometer	14-Mar-96	94	90.5	87-90.5	2	NA
SIP-292-001	Piezometer	03-Dec-90	NA	NA	44.5-49.5	NA	NA
SIP-293-001	Piezometer	05-Dec-90	56.5	50	45-50	1B	NA
SIP-331-001	Piezometer	21-Sep-95	122	116.5	106.5-116.5	2	NA
SIP-419-101	Piezometer	08-Sep-95	127	123	112-123	3B	NA
SIP-490-102	Piezometer	08-Nov-95	75	73.5	53.5-73.5	2	NA
SIP-501-004	Piezometer	20-Oct-92	60	56.9	48.5-56.9	1B	NA
SIP-501-006	Piezometer	11-Nov-92	59.5	56	50-56	1B	NA
SIP-501-007	Piezometer	16-Nov-92	64	59	53-59	1B	NA
SIP-501-101	Piezometer	10-May-94	77	73	69-73	1B	NA
SIP-501-102	Piezometer	16-May-94	77	73	67-73	1B	NA
SIP-501-103	Piezometer	20-May-94	63	57.5	51-57.5	1B	NA
SIP-501-104	Piezometer	15-Jul-94	67	62	50-62	1B	NA
SIP-501-105	Piezometer	01-Sep-94	73	68	63-68	1B	NA
SIP-501-201	Piezometer	29-Nov-94	65	58.5	54-58.5	1B	NA
SIP-501-202	Piezometer	01-Jul-95	70	64.5	58-64.5	1B	NA
SIP-511-101	Piezometer	25-Jan-96	110	106.7	100-106.7	3A	NA
SIP-511-102	Piezometer	02-Apr-96	114	110	108-110	3B	NA
SIP-514-107	Piezometer	03-Jan-90	21.5	17	9-17	1B	NA
SIP-514-109	Piezometer	05-Jan-90	21.5	21.5	7-21.5	1B	NA
SIP-514-112	Piezometer	08-Jan-90	21.5	18	7-18	1B	NA
SIP-514-114	Piezometer	09-Jan-90	21.5	17	4-17	1B	NA
SIP-514-116	Piezometer	10-Jan-90	21.5	17	7-17	1B	NA
SIP-514-117	Piezometer	11-Jan-90	21.5	17.5	6-17.5	1B	NA
SIP-514-119	Piezometer	12-Jan-90	21.5	16	5-16	1B	NA
SIP-514-123	Piezometer	17-Jan-90	26.5	23	11.5-23	1B	NA
SIP-514-124	Piezometer	18-Jan-90	21.5	17	6-17	1B	NA
SIP-514-125	Piezometer	19-Jan-90	21.5	15	6-15	1B	NA
SIP-514-126	Piezometer	19-Jan-90	26.5	21.5	4-21.5	1B	NA

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

Well number	Well type	Date completed	Borehole depth (ft)	Casing depth (ft)	Screen interval(s) (ft)	HSU[a] monitored	Initial well development flow rate (gpm)[b]
SIP-518-203	Piezometer	19-Sep-95	132.1	127	121-127	5	NA
SIP-543-101	Piezometer	31-Jan-95	111	104	43-103	2	NA
SIP-ALP-001	Piezometer	03-May-90	66.5	60	45-60	2	NA
SIP-ALP-002	Piezometer	07-May-90	62	57.5	47.5-57.5	2	NA
SIP-AS-001	Piezometer	30-Apr-90	100.5	90.5	81-90.5	1B	NA
SIP-CR-049	Piezometer	26-Feb-90	41.5	40	36-40	1B	NA
SIP-EGD-001	Piezometer	16-Oct-90	101.5	85	75-85	2	NA
SIP-ETC-201	Piezometer	26-Mar-96	106	100	80-100	2	NA
SIP-ETC-301	Piezometer	12-Apr-99	102	83	76-82	2	NA
SIP-ETC-303	Piezometer	24-May-99	111	88.1	82-88	2	NA
SIP-ETS-101	Piezometer	15-Sep-95	100	NA	NA	NA	NA
SIP-ETS-201	Piezometer	05-Feb-91	95	90	85-90	3A	NA
SIP-ETS-204	Piezometer	07-May-91	102.5	97	87-97	3A	NA
SIP-ETS-205	Piezometer	20-Jun-91	103	95	89.5-95	3A	NA
SIP-ETS-209	Piezometer	25-Jul-91	96.6	90	79.75-90	2	NA
SIP-ETS-211	Piezometer	06-Aug-91	103	98.5	95-98.5	3A	NA
SIP-ETS-212	Piezometer	14-Aug-91	106.5	102.5	97.5-102.25	2	NA
SIP-ETS-213	Piezometer	15-Nov-91	118.5	116.5	108.5-116.5	3A	NA
SIP-ETS-214	Piezometer	22-Nov-91	101	101	86-101	3A	NA
SIP-ETS-215	Piezometer	03-Dec-91	94.5	94.5	84.5-94.5	3A	NA
SIP-ETS-302	Piezometer	30-Mar-92	117.4	113	97-113	3A	NA
SIP-ETS-303	Piezometer	02-Apr-92	110.7	102	95-102	3A	NA
SIP-ETS-304	Piezometer	27-Aug-92	100	97	90-97	3A	NA
SIP-ETS-306	Piezometer	11-Sep-92	101	93	80.5-93	3A	NA
SIP-ETS-401	Piezometer	02-Aug-95	122	122	116-121	3A	NA
SIP-ETS-402	Piezometer	08-Aug-95	110	110	97-107	2	NA
SIP-ETS-404	Piezometer	22-Aug-95	99	99	83.5-95.5	2	NA
SIP-ETS-405	Piezometer	29-Aug-95	126	126	114.5-123	3A	NA
SIP-ETS-501	Piezometer	16-Nov-95	110	106.5	100-106.5	3A	NA
SIP-ETS-502	Piezometer	05-Dec-95	95	88	80-88	2	NA
SIP-ETS-601	Piezometer	07-Jun-99	115.5	104.8	98.3-104.8	2	NA
SIP-HPA-001	Piezometer	20-Apr-90	92.75	75	65-75	2	NA
SIP-HPA-003	Piezometer	19-Apr-90	91.5	66	61-66	2	NA
SIP-HPA-201	Piezometer	14-May-96	97.5	76	71-76	2	NA
SIP-IES-001	Piezometer	16-Sep-92	50	46.5	44-46.5	1B	NA
SIP-IES-002	Piezometer	05-Oct-92	41.5	39.2	33-39.2	1A	NA
SIP-INF-201	Piezometer	30-Jun-98	85.9	85	64.9-84.6	1B	NA
SIP-INF-202	Piezometer	02-Jul-98	86.3	85.2	64.9-84.8	1B	NA
SIP-INF-301	Piezometer	24-Mar-99	97	95.4		1B	NA
SIP-INF-302	Piezometer	29-Mar-99	97	88.4		1B	NA
SIP-ITR-001	Piezometer	19-Apr-91	121.5	115	105-115	5	NA
SIP-ITR-002	Piezometer	02-Apr-91	100	84	79-84	5	NA
SIP-ITR-003	Piezometer	25-Apr-91	121.5	106	98.7-106	5	NA
SIP-NEB-101	Piezometer	23-Sep-92	68.7	66	57-66	2	NA
SIP-PA-002	Piezometer	29-Jan-90	16.5	16.5	4-16.5	1B	NA
SIP-PA-003	Piezometer	26-Jan-90	18	14	4-14	1B	NA
SIP-PA-005	Piezometer	04-Jan-90	11.5	8	3-8	1B	NA
SIP-PA-006	Piezometer	04-Jan-90	13.5	12	5-12	1B	NA
SIP-PA-007	Piezometer	04-Jan-90	11.5	5	1-5	1B	NA
SIP-PA-010	Piezometer	25-Jan-90	11.5	9	3-9	1B	NA
SIP-PA-012	Piezometer	29-Jan-90	11.5	9	2-9	1B	NA
SIP-PA-013	Piezometer	24-Jan-90	16.5	13	8-13	1B	NA
SIP-PA-015	Piezometer	25-Jan-90	21.5	17.5	2-17.5	1B	NA
SIP-PA-016	Piezometer	24-Jan-90	11.5	11.5	7-11.5	1B	NA
SIP-PA-017	Piezometer	24-Jan-90	16.5	14	7-14	1B	NA

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Well number	Well type	Date completed	Borehole depth (ft)	Casing depth (ft)	Screen interval(s) (ft)	HSU[a] monitored	Initial well development flow rate (gpm)[b]
SIP-PA-018	Piezometer	25-Jan-90	11.5	8	6-8	1B	NA
SIP-PA-019	Piezometer	26-Jan-90	16.5	12	2-12	1B	NA
SIP-PA-021	Piezometer	23-Jan-90	11.5	10	2-10	1B	NA
SIP-PA-024	Piezometer	23-Jan-90	16.5	15	5-15	1B	NA
SIP-PA-025	Piezometer	23-Jan-90	11.5	7	4-7	1B	NA
SIP-PA-026	Piezometer	29-Jan-90	11.5	10	2-10	1B	NA
SIP-PA-027	Piezometer	29-Jan-90	8.5	7	2-7	1B	NA
SIP-PA-028	Piezometer	23-Jan-90	11	8	5-8	1B	NA
SIP-PA-030	Piezometer	24-Jan-90	11.5	8	4-8	1B	NA
SIP-PA-034	Piezometer	04-Jan-90	6.5	5	3-5	1B	NA
SIP-PA-035	Piezometer	04-Jan-90	11.5	11.5	6.5-11.5	1B	NA
SVI-518-101	SV Monitor	20-Sep-90	125	61	55-61	2	NA
SVI-518-201	Dual Extraction	03-Mar-93	59.8	50	34-50	1B/2	NA
SVI-518-202	SV Monitor	03-Nov-93	120.6	73.8	19-73.8	1B/2	NA
SVI-518-204	Dual Extraction	05-Nov-93	121.5	46	24-46	2	NA
SVI-518-302	SV Monitor	22-Jun-95	104.5	39.3	11-39	1B	NA
SVI-ETS-504	SV Monitor	09-Jul-96	76.5	67	42-67	2	NA
SVI-ETS-505	SV Injection	18-Jul-96	80	77.5	45-75	2	NA
SVW-514-2007A	SV Monitor	18-Mar-04	110	45.5	15-45	2	NA
SVW-514-2007B	SV Monitor	18-Mar-04	110	102.5	72-102	5	NA
SVW-518-1913	Dual Extraction	08-Oct-03	63	61	50.5-60.5	2	NA
SVW-518-1914	Dual Extraction	09-Oct-03	18	16	5.5-15.5	1B	NA
SVW-518-1915[f]	Dual Extraction	15-Oct-03	44	41	30.5-40.5	2	NA
SVW-543-001	SV Extraction	25-Feb-03	71.5	67.5	52-67	NA	NA
SVW-543-002A	SV Monitor	10-Mar-03	96	65	45-65	1B/2	NA
SVW-543-002B	SV Monitor	10-Mar-03	96	82.5	72-82	2	NA
SVW-543-003	SV Extraction	20-Mar-03	95	80	69-79	2	NA
SVW-543-004A	SV Monitor	02-Apr-03	95	64.5	49-64	1B/2	NA
SVW-543-004B	SV Monitor	02-Apr-03	95	80.5	70-80	2	NA
SVW-543-1908	SV Extraction	12-Jun-03	40.8	40.4	20-40	1B	NA
SVW-ETC-2001A	SV Monitor	10-Nov-03	95	23.5	18-23	2	NA
SVW-ETC-2001B	SV Monitor	10-Nov-03	95	88.5	78-88	2	NA
SVW-ETC-2002A	SV Monitor	25-Nov-03	95	64.5	34-64	1B	NA
SVW-ETC-2002B	SV Monitor	25-Nov-03	95	85.5	75-85	2	NA
SVW-ETC-2003	SV Monitor	09-Dec-03	95	45.5	20-45	1B	NA
SVW-ETC-2004A	SV Monitor	17-Dec-03	95	53.5	28-53	NA	NA
SVW-ETC-2004B	SV Monitor	17-Dec-03	95	88.5	63-68	NA	NA
SVW-ETS-2008A	SV Monitor	07-Apr-04	110	40.25	20-40	2	NA
SVW-ETS-2008B	SV Monitor	07-Apr-04	110	85.25	50-85	2	NA
SVW-ETS-2009	SV Monitor	03-May-04	120	79.5	54-79	2	NA
SVW-ETS-2010A	SV Monitor	19-May-04	110.3	70	35-70	2	NA
SVW-ETS-2010B	SV Monitor	19-May-04	110.3	100.5	80-100	2	NA
SVW-HPA-001A	SV Monitor	15-Apr-03	80	45.5	30-45	2	NA
SVW-HPA-001B	SV Monitor	15-Apr-03	80	73.5	63-73	2	NA
SVW-HPA-002A	SV Extraction	29-Apr-03	80	43	32.5-42.5	2	NA
SVW-HPA-002B	SV Extraction	29-Apr-03	80	72.5	52-72	2	NA
TW-11	Monitor	09-Jun-81	112.5	107	97-107	2	NA
TW-11A	Monitor	16-Mar-84	163	160	133-160	2	NA
TW-21	Monitor	12-Jun-81	111.5	95	85-95	1B	NA
UP-292-006	Piezometer	07-Jan-91	74	57.5	47.5-57.5	1B	NA
UP-292-007	Piezometer	07-Jan-91	71	56	46-56	1B	NA
UP-292-012	Piezometer	29-Jan-92	67.7	60	45-60	1B	NA
UP-292-014	Piezometer	29-Jan-92	66	66	50-66	1B	NA
UP-292-015	Piezometer	29-Jan-92	61.5	60.5	49.5-60.5	1B	NA
UP-292-020	Piezometer	03-Feb-93	68.5	64	56.5-64	1B	NA

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

Well number	Well type	Date completed	Borehole depth (ft)	Casing depth (ft)	Screen interval(s) (ft)	HSU[a] monitored	Initial well development flow rate (gpm)[b]
W-001	Monitor	21-Oct-80	122.5	116	95-100	1B	NA
					104-114	2	
W-001A	Monitor	12-Apr-84	180	156	145-156	2	NA
W-002	Monitor	29-Aug-80	102.5	101	86-101	1B	NA
W-002A	Monitor	02-Apr-84	185	164	150-164	2	NA
W-004	Monitor	28-Jul-80	92	92	75-90	1B	NA
W-005	Monitor	24-Oct-80	93.5	90	56-71	1B	NA
					81-86		
W-005A	Monitor	09-Apr-84	115	105	95-105	2	NA
W-007	Monitor	03-Oct-80	110.5	100	76-81	2	NA
					88-98	3A	NA
W-008	Monitor	14-May-81	110	105	72-77	3A	NA
					92-102	3B	NA
W-011	Monitor	03-Jun-81	252	191	136-141	5	NA
					177-187		
W-012	Monitor	14-Aug-80	115.8	115	99-114	2	NA
W-017	Monitor	08-Oct-80	114	109	94-109	5	NA
W-017A	Monitor	20-May-81	181.4	160	127-132	7	NA
					147-157		
W-019	Monitor	19-Sep-80	164.8	161	147-157	7	NA
W-101	Monitor	25-Jan-85	77	72	62-72	1B	1
W-102	Monitor	14-Feb-85	396.5	171.5	151.5-171.5	2	40
W-103	Monitor	14-Feb-85	96	89.5	79.5-89.5	1B	5
W-104	Monitor	21-Feb-85	61.5	56.5	38.75-56.5	1B	2.5
W-105	Monitor	26-Feb-85	69	62	42-62	1B	0.7
W-106	Monitor	06-Mar-85	144	134.5	127.5-134.5	5	0.1-0.2
W-107	Monitor	13-Mar-85	128	122	115-122	5	NA
W-108	Monitor	21-Mar-85	113.5	69	57-69	1A	10
W-109	GW Extraction	02-Apr-85	289	147	137-147	2	12
W-110	Monitor	26-Apr-85	371	365	340-365	5	6
W-111	Monitor	02-May-85	122	117	97-117	2	1.5
W-112	GW Extraction	10-May-85	129	123.5	111-123.5	5	4
W-113	Monitor	16-May-85	124	115	100-115	5	0.9
W-114	Monitor	23-May-85	70.5	66	51-63	1B	0.5
W-115	Monitor	03-Jun-85	106	95	88-95	1B	1.1
W-116	Monitor	14-Jun-85	181	92.6	86-91	1B	0.3
W-117	Monitor	27-Jun-85	202	150.1	138-148	7	0.2
W-118	Monitor	19-Jul-85	206.5	110	99-110	2	8
W-119	Monitor	02-Aug-85	139	102.5	87.5-102.5	2	3.3
W-120	Monitor	19-Aug-85	195	153	147-153	2	1
W-121	Monitor	23-Aug-85	194	171	159-171	2	3.75
W-122	Monitor	17-Aug-85	189	132	125-132	2	15
W-123	Monitor	01-Oct-85	174	47.7	37.3-47.7	1A	5
W-141	Monitor	23-Mar-85	61.5	60	45-60	1B	0.8
W-142	Monitor	29-Mar-85	74.2	72	62-72	2	0.8
W-143	Monitor	12-Apr-85	130	126	121-126	2	0.8
W-146	Monitor	16-Jul-85	225	125	115-125	2	5
W-147	Monitor	26-Jul-85	137	87	77-87	1B	0.5
W-148	Monitor	08-Aug-85	152	98	83-98	1B	0.5
W-151	Monitor	30-Sep-85	237	157	148.5-157.5	2	1.5
W-201	Monitor	17-Oct-85	211	161	151-161	2	14
W-202	Monitor	07-Nov-85	191	109	99-109	2	0.5
W-203	Monitor	15-Nov-85	87	41	31-41	1A	3
W-204	Monitor	22-Nov-85	160	110	100-110	2	>5
W-205	Monitor	09-Dec-85	180	117	107-117	3B	<0.1

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Well number	Well type	Date completed	Borehole depth (ft)	Casing depth (ft)	Screen interval(s) (ft)	HSU[a] monitored	Initial well development flow rate (gpm)[b]
W-206	Monitor	19-Dec-85	188	118	106-118	3A	<0.5
W-207	Monitor	24-Jan-86	150	85	69-85	2	<0.5
W-210	Monitor	11-Mar-86	176	113	108-113	3B	<0.5
W-212	Monitor	28-Mar-86	183	136	124-136	5	1
W-213	Monitor	04-Apr-86	174	100	94-100	1B	2
W-214	Monitor	11-Apr-86	146	141.5	134-141.5	2	>20
W-217	Monitor	20-May-86	200	112.5	98.5-112.5	5	<0.5
W-218	Monitor	30-May-86	201	71	64.5-71	1B	6
W-219	Monitor	13-Jun-86	214	148	141-148	5	2
W-220	Monitor	25-Jun-86	196	92.5	82.5-92.5	2	<0.5
W-221	Monitor	07-Jul-86	178	95	82-95	3A	2
W-222	Monitor	17-Jul-86	197	83	63-83	2	5
W-223	Monitor	15-Aug-86	202	153	146-153	2	5.2
W-224	Monitor	26-Aug-86	199	88	78-88	2	3
W-225	Monitor	09-Sep-86	238	166	152-166	5	2.5
W-226	Monitor	25-Sep-86	173	86	71-86	1B	<0.25
W-251	Monitor	03-Oct-85	50	47.5	35.5-47.5	1A	2
W-252	Monitor	18-Oct-85	197	126	108-126	2	3
W-253	Monitor	30-Oct-85	180	128	112.5-128	2	1
W-254	GW Extraction	21-Nov-85	277	89	82-89	1B	5
W-255	Monitor	05-Dec-85	187	124	115-124	5	1
W-256	Monitor	19-Dec-85	187	137	132-137	5	<0.5
W-257	Monitor	15-Jan-86	197	96.5	82.5-96.5	2	<0.5
W-258	Monitor	31-Jan-86	157	121.5	116.5-121.5	3A	0.5
W-259	Monitor	07-Feb-86	200	99	93.5-99	2	<0.5
W-260	Monitor	27-Feb-86	215	151	141-151	2	3.5
W-261	Monitor	12-Mar-86	225	118.5	109-118.5	5	<0.5
W-262	GW Extraction	20-Mar-86	256	100	91-100	1B	7
W-263	Monitor	07-Apr-86	146	130	123-130	2	2
W-264	Monitor	14-Apr-86	170	151	141-151	2	>20
W-265	Monitor	25-Apr-86	216	211	205-211	3A	3
W-267	Monitor	27-May-86	196	179	172.5-179	3A	1
W-268	Monitor	04-Jun-86	213	150.5	138-150.5	5	1
W-269	Monitor	16-Jun-86	185	92	79-92	1B	2
W-270	Monitor	26-Jun-86	185	127	113-127	5	<0.5
W-271	Monitor	07-Jul-86	201	112	105-112	2	2.1
W-272	Monitor	18-Jul-86	226	110	95-110	2	1
W-273	Monitor	11-Aug-86	203	84	64-84	2	3
W-274	Monitor	21-Aug-86	217	95	90-95	2	<0.5
W-275	Monitor	05-Sep-86	262	184	179-184	5	4
W-276	Monitor	17-Sep-86	267	170	153.5-169.5	3A	12
W-277	Monitor	03-Oct-86	254	169	163-169	3B	1.1
W-290	Monitor	08-Jul-86	181	126	119.5-126	5	<0.5
W-291	Monitor	24-Jul-86	194	137	127-137	5	<0.5
W-292	GW Extraction	10-Aug-86	250	184.5	176-184.5	3B	9
W-293	Monitor	27-Aug-86	229	155	145-155	5	<1
W-294	Monitor	15-Sep-86	251	139	122-139	5	1
W-301	Monitor	07-Oct-86	203	141	136-141	2	5.5
W-302	Monitor	22-Oct-86	191	83.5	78-83.5	1B	2
W-303	Monitor	28-Oct-86	197	128	124-128	2	15
W-304	Monitor	12-Nov-86	207	200	195-200	4	1
W-305	GW Extraction	18-Nov-86	146	138	128-138	2	20
W-306	Monitor	04-Dec-86	207	110	98-110	2	8.5
W-307	Monitor	15-Dec-86	214	102	93-102	1B	1
W-308	Monitor	13-Jan-87	194	113	107-113	2	2

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

Well number	Well type	Date completed	Borehole depth (ft)	Casing depth (ft)	Screen interval(s) (ft)	HSU[a] monitored	Initial well development flow rate (gpm)[b]
W-309	Monitor	20-Jan-87	73	NA	NA	NA	NA
W-310	Monitor	04-Feb-87	202	184.5	176.5-184.5	3A	10
W-311	Monitor	20-Feb-87	226.5	147.5	134.5-147.5	3A	5
W-312	Monitor	05-Mar-87	224.5	168	160-168	4	25
W-313	Monitor	12-Mar-87	99	85	80-85	2	5.5
W-314	GW Extraction	20-Mar-87	228	142	129-142	4	9.5
W-315	Monitor	03-Apr-87	215	156	141-156	3A	15
W-316	Monitor	15-Apr-87	196	72	68-71	2	3
W-317	Monitor	20-Apr-87	100	95	88-95	2	7
W-318	Monitor	28-Apr-87	200	81	74-81	2	0.5
W-319	Monitor	05-May-87	198	125	119-125	3A	25
W-320	Monitor	11-May-87	106	99	94-99	2	3
W-321	Monitor	29-May-87	356	321.5	305-321.5	5	60
W-322	Monitor	01-Jul-87	565.5	152	142-152	2	4
W-323	Monitor	04-Aug-87	200	127	122-127	2	7
W-324	Monitor	17-Aug-87	219	189	184-189	3A	15
W-325	Monitor	28-Aug-87	312	170	158-170	3A	4
W-351	GW Extraction	17-Oct-86	191	152	146-152	4	2.9
W-353	Monitor	12-Nov-86	205	101	95.5-101	2	1
W-354	Monitor	24-Nov-86	185	179	163-179	4/5	8
W-355	Monitor	05-Dec-86	202	107	102-107	2	2
W-356	Monitor	18-Dec-86	237	137	133-137	3B	6
W-357	GW Extraction	12-Jan-87	197	123	107-123	2	8
W-359	GW Extraction	10-Feb-87	195	150.5	138-150.5	5	10
W-361	Monitor	05-Mar-87	257	135	125-135	3A	4
W-362	Monitor	13-Mar-87	151	145	131-145	4	12
W-363	Monitor	24-Mar-87	195	129	117-129	3A	<0.5
W-364	Monitor	31-Mar-87	195	165	155-165	3B	5
W-365	Monitor	09-Apr-87	187	125	120-125	2	8.5
W-366	Monitor	20-Apr-87	273	251	240-251	4	13
W-368	GW Extraction	06-May-87	206	78	70-78	1B	3
W-369	Monitor	14-May-87	204	113	107-113	2	2
W-370	Monitor	29-May-87	286	208	196.5-208	4	5
W-371	Monitor	12-Jun-87	233	162	155-162	3A	1.5
W-372	Monitor	25-Jun-87	218	152.5	147.5-152.5	4	1
W-373	Monitor	06-Jul-87	178	99	89-99	1B	7
W-375	Monitor	29-Jul-87	223	71	65-71	2	0.75
W-376	Monitor	27-Aug-87	249	172	162-172	2	2
W-377	Monitor	04-Sep-87	159	144	141.5-144	2	2.5
W-378	Monitor	09-Sep-87	155	150	146-150	2	5
W-379	Monitor	14-Sep-87	155	182	146-150	2	5
W-380	Monitor	01-Oct-87	195	182	170-182	3A	10
W-401	Monitor	05-Nov-87	159	153	109-153	2	25
W-402	Monitor	13-Oct-87	104	102	92-102	1B	40
W-403	Monitor	16-Nov-87	585	495	485-495	7	3
W-404	Monitor	04-Dec-87	245	158	150-158	2	33
W-405	Monitor	04-Jan-88	244	162	132-162	2	50
W-406	Monitor	20-Jan-88	213	94	79-84	1B	2
W-407	Monitor	04-Feb-88	215	205	192-205	3A	4
W-408	GW Extraction	16-Feb-88	131	122.5	101-122.5	1B	35
W-409	Monitor	07-Mar-88	272	78	71-78	1B	30
W-410	Monitor	30-Mar-88	369	205	193-205	3A	35
W-411	Monitor	12-Apr-88	192	138	131-138	2	8
W-412	Monitor	18-Apr-88	104	74	67-74	1B	2.5
W-413	GW Extraction	28-Apr-88	163	115	100-115	2	25

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Well number	Well type	Date completed	Borehole depth (ft)	Casing depth (ft)	Screen interval(s) (ft)	HSU[a] monitored	Initial well development flow rate (gpm)[b]
W-415	GW Extraction	12-Aug-88	205	183.7	79-179	1B/2	>50
W-416	Monitor	10-Jun-88	152	80.5	72-80.5	1B	30
W-417	Monitor	20-Jun-88	152	60	51-60	1B	5
W-418	Monitor	24-Jun-88	124	124	108-118	2	2.5
W-419	Monitor	29-Jun-88	82	82	62.5-75.5	1B	3
W-420	Monitor	26-Jul-88	127	111	105-111	2	5
W-421	Monitor	23-Aug-88	181	90	75-90	1B	4.5
W-422	Monitor	02-Sep-88	203	139.5	133-139.5	2	5
W-423	Monitor	09-Sep-88	308	118	106-118	2	14
W-424	Monitor	04-Oct-88	208	144	137-144	3A	3
W-441	Monitor	14-Oct-87	250	144	135-144	5	2.5
W-446	Monitor	18-Dec-87	202	196	186-196	3A	3
W-447	Monitor	05-Feb-88	353	274	256-274	4	5
W-448	Monitor	17-Feb-88	235	127.5	120.5-127.5	2	15
W-449	Monitor	07-Mar-88	172	165	152-165	2	3
W-450	Monitor	21-Mar-88	300	200	193-200	5	2
W-451	Monitor	06-Apr-88	202	112	106-112	2	1.5
W-452	Monitor	15-Apr-88	210	79.5	64-79.5	1B	5
W-453	Monitor	27-Apr-88	185	130	121-130	2	4
W-454	Monitor	09-May-88	196	83	73-83	1B	3
W-455	Monitor	19-May-88	184	162.5	148-162.5	2	5
W-457	GW Extraction	22-Jun-88	289	149.5	130-149.5	2	20
W-458	Monitor	30-Jun-88	212.5	116	108-116	2	2
W-459	Monitor	20-Jul-88	76	73	59.5-73	1B	1.5
W-461	Monitor	16-Aug-88	133	50.5	41.5-50.5	2	<0.5
W-462	Monitor	12-Sep-88	385	337	331-336.5	5	5
W-463	Monitor	16-Sep-88	93	93.8	87-92.5	1B	5
W-464	Monitor	30-Sep-88	253	104.5	96-104.5	2	3.5
W-481	Monitor	04-Nov-88	224.5	105	100-105	1B	2
W-482	Monitor	15-Jan-88	218	170	165-170	2	<0.5
W-483	Monitor	26-Jan-88	140	130	115-130	2	2.5
W-484	Monitor	11-Feb-88	255	188	185-188	3A	0.5
W-485	Monitor	25-Feb-88	249	157	151-157	2	2
W-486	Monitor	11-Mar-88	167	110	100-108	2	2
W-487	Monitor	17-Mar-88	180	151	148-151	3B	1
W-501	Monitor	13-Oct-88	174	92	84-92	1B	6.5
W-502	Monitor	25-Oct-88	158	59	55-59	1B	<0.5
W-503	Monitor	02-Nov-88	187	80	74-80	1B	1
W-504	Monitor	21-Nov-88	358	167	157-167	2	3
W-505	Monitor	15-Dec-88	278	180	167-180	2/3A	60
W-506	Monitor	22-Dec-88	120	115	101-115	1B	30
W-507	Monitor	18-Jan-89	158	139	129-139	2	50
W-509	Monitor	03-Mar-89	305	184	179-184	5	1
W-510	Monitor	15-Mar-89	300	119.1	111-119	2	<0.5
W-511	Monitor	31-Mar-89	316	176	167-176	3B	1
W-512	Monitor	13-Apr-89	261	176.5	166-176	5	2.5
W-513	Monitor	26-Apr-89	259	115	102-115	2	1
W-514	Monitor	17-May-89	386	115.5	92-115.5	1B	2
W-515	Monitor	30-May-89	211	78	68-78	1B	3.5
W-516	Monitor	09-Jun-89	203	119	114-119	2	15
W-517	Monitor	20-Jun-89	215	88.2	80-88	1B	6.7
W-518	GW Extraction	08-Aug-89	251	139.3	131-139	2	2.5
W-519	Monitor	14-Aug-89	186.5	80.6	60-80.5	1B	25
W-520	GW Extraction	30-Aug-89	160	101.5	94-101.5	1B	12
W-521	Monitor	13-Sep-89	166	95.4	86-95	1B	1

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

Well number	Well type	Date completed	Borehole depth (ft)	Casing depth (ft)	Screen interval(s) (ft)	HSU[a] monitored	Initial well development flow rate (gpm)[b]
W-522	GW Extraction	05-Oct-89	145.5	141.5	134-141.5	2	25
W-551	Monitor	18-Oct-88	308	155.5	151-155.5	2	20
W-552	Monitor	25-Oct-88	70.5	64.5	48.5-64	1B	3
W-553	Monitor	03-Nov-88	186	106.5	99-106.5	2	1
W-554	Monitor	22-Nov-88	239	141.5	126.5-141.4	2	60
W-555	Monitor	05-Dec-88	122	116.5	102.5-116.5	1B	20
W-556	Monitor	15-Dec-88	192	81.5	76-81.5	1B	6
W-557	Monitor	22-Dec-88	122.5	118	102-118	2	2
W-558	Monitor	17-Jan-89	117	110.5	101-110.5	1B	20
W-559	Monitor	24-Jan-89	105	100	93-100	1B	0.75
W-560	Monitor	07-Feb-89	263	206.5	201-206.5	3B	10
W-561	Monitor	23-Feb-89	180	152	143-152	5	4
W-562	Monitor	08-Mar-89	263	158.5	145-158	5	2
W-563	Monitor	17-Mar-89	192	105.5	95-105	2	2
W-564	Monitor	30-Mar-89	184	85	79.5-85	1B	3
W-565	Monitor	06-Apr-89	177	82.5	75-82.5	1B	15
W-566	GW Extraction	19-Apr-89	317	207.5	197-207	5	12
W-567	Monitor	27-Apr-89	194	61.5	51-61	1B	10
W-568	Monitor	05-Jun-89	156	101	97-101	2	30
W-569	Monitor	16-May-89	215	109.5	101-109.5	2	4
W-570	Monitor	09-Jun-89	180	175	161-175	5	1
W-571	Monitor	15-Jun-89	223.5	107.5	102-107	1B	22
W-591	Monitor	29-Nov-88	112	107.5	97-107.5	2	<0.5
W-592	Monitor	12-Dec-88	136.5	113	101-112	2	1.5
W-593	Monitor	06-Feb-89	159	92.5	82-92.5	3A	1.5
W-594	Monitor	27-Feb-89	156	61	55-61	2	0.5
W-601	GW Extraction	13-Oct-89	146	96	88-96	1B	15
W-602	GW Extraction	06-Nov-89	268	100.2	90-100	1B	10
W-603	GW Extraction	15-Nov-89	150	147	141-147	2	5
W-604	Monitor	27-Nov-89	111	83	76-82	1B	0.5
W-605	GW Extraction	08-Dec-89	246	136	130-136	2	10
W-606	Monitor	21-Dec-89	145	89	73-89	1B	2
W-607	Monitor	24-Jan-90	186	55.1	49-55	1B	3
W-608	Monitor	07-Feb-90	162	66.3	55-66	1B	3
W-609	GW Extraction	21-Feb-90	120	112	104-112	2	4
W-610	GW Extraction	16-Mar-90	453	84.5	69-84.5	1B	4
W-611	Monitor	04-Apr-90	161	98	87.5-98	1B	2
W-612	Monitor	19-Apr-90	222	137	126-136	2	10
W-613	Monitor	02-May-90	93	88	81.5-88	1B	7
W-614	GW Extraction	18-May-90	262	123	100-123	2	12
W-615	Monitor	01-Jun-90	121	99.3	91-99	1B	3
W-616	Monitor	14-Jun-90	255	188	178-188	3A	8
W-617	Monitor	26-Jun-90	200	110	103-110	2	6
W-618	Monitor	17-Jul-90	357	205	201-205	3B	10
W-619	Monitor	07-Aug-90	330	252	232-252	3B/4	30
W-620	GW Extraction	30-Aug-90	206	88.5	75-88.5	1B	5
W-621	GW Extraction	09-Sep-90	149	120	113-120	2	4
W-622	Monitor	28-Sep-90	206	112	113-120	5	<0.5
W-651	Monitor	22-Feb-90	155	89	82-89	1B	0.5
W-652	Monitor	15-Mar-90	318	256	245-256	7	2
W-653	Monitor	29-Mar-90	225	128	122-128	3A	0.5
W-654	Monitor	11-Apr-90	240	158	140-158	2	20
W-655	GW Extraction	25-Apr-90	193	130	121-129.5	2	2
W-701	GW Extraction	10-Oct-90	159	86	74-86	1B	10
W-702	Monitor	24-Oct-90	180.5	95	77-95	1B	10

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

Well number	Well type	Date completed	Borehole depth (ft)	Casing depth (ft)	Screen interval(s) (ft)	HSU[a] monitored	Initial well development flow rate (gpm)[b]
W-703	Monitor	03-Dec-90	586	325	298-325	5	10
W-704	GW Extraction	02-Feb-91	135	107	67-76	1B	20
	GW Extraction	02-Feb-91	135	107	88-97	1B	20
W-705	Monitor	26-Dec-90	126	90	77-90	1B	2
W-706	Monitor	25-Jan-91	178	85	71-85	1B	2
W-712	GW Extraction	19-Feb-92	200	NA	170-185.5	3A	8
W-714	GW Extraction	05-Dec-91	128.5	NA	107-128	2	7.5
W-750	Monitor		152	150	130-150	5	
W-901	Monitor	24-Feb-93	97.8	88	80-83	1B	1
W-902	Monitor	22-Jan-93	95.5	88	80-83	1B	1
W-903	GW Extraction	09-Feb-95	223	145	132-140	2	20
W-904	GW Extraction	09-Feb-95	212	154	121-133	2	20
W-905	Monitor	16-Nov-94	221	144.5	134-144	2	4
W-906	GW Extraction	23-Jul-93	200	132	58-132	2/3A	10
W-907	GW Extraction	03-Aug-93	239	222	172.7-188.7	4/5	25
					204.5-215	4/5	NA
W-908	Monitor	17-Aug-93	239	197	180-197	5/6	<0.5
W-909	Monitor	04-Nov-93	252	113.5	80.5-113.5	2	2
W-911	Monitor	20-Oct-93	180	113.7	73.7-108.7	2	3
W-912	Monitor	07-Oct-93	239	174	168-174	5	3
W-913	Monitor	24-Nov-93	454	255	235-255	4	25
W-1001	GW Extraction	15-Dec-93	105	92	85-92	1B	1.4
W-1002	Monitor	12-Nov-93	293	260	246-260	5	16
W-1003	Monitor	02-Feb-94	184	147	140-147	2	1.5
W-1004	GW Extraction	23-Feb-94	100	97	71-91	1B	7
W-1008	Monitor	13-Apr-94	246	238	229.5-238	7	10
W-1009	GW Extraction	02-May-94	191	140	134-140	2	20
W-1010	Monitor	24-May-94	463	142	130-142	2	20
W-1011	Monitor	06-Jun-94	106	89	75-89	1B	3
W-1012	Monitor	20-Jun-94	161	117	96-112	2	5
W-1013	Monitor	29-Jun-94	147	73	65-73	1B	1.4
W-1014	Monitor	12-Jul-94	99	89	65-89	1B	30
W-1015	GW Extraction	10-Aug-94	437	94	84-94	1B	20
W-1101	Monitor	10-Nov-94	200	79	76-79	1B	0.5
W-1102	GW Extraction	29-Nov-94	163	95.6	76-94	1B	8
W-1103	GW Extraction	15-Dec-94	200	82	70-82	1B	3.5
W-1104	GW Extraction	18-Jan-95	165	99.3	77-87	1B	>35
	GW Extraction	18-Jan-95	165	99.3	92-98	1B	>35
W-1105	Monitor	18-Jan-95	105	93	78-93	1B	3.5-4
W-1106	Monitor	17-Jan-95	245	86	76-85	1B	15
W-1107	Monitor	06-Mar-95	199.5	93	74-88	1B	<0.5
W-1108	Monitor	27-Mar-95	250	156	142-156	5	12
W-1109	GW Extraction	11-Apr-95	121	113	94-113	2	3
W-1110	GW Extraction	04-May-95	252	92.9	68-92	1B	7
W-1111	GW Extraction	01-Jun-95	152	129	88-108	1B/2	10.5
	GW Extraction	01-Jun-95	152	129	120-124	1B/2	10.5
W-1112	Monitor	28-Jun-95	263	210	201-210	5	3
W-1113	Monitor	12-Jul-95	260	214	204-214	5	2.5
W-1115	Monitor	12-Oct-95	126.5	118	108-118	3A	1
W-1116	GW Extraction	17-Aug-95	214.8	101	72-98	1B	9
W-1117	Monitor	21-Aug-96	154	132.2	122-132	3A	1
W-1118	Monitor	27-Sep-95	225	125	115-125	3A	3.5
W-1201	Monitor	18-Oct-95	225	133	125-133	3A	1
W-1202	Monitor	25-Oct-95	99.3	99	83-99	2	>5
W-1203	Monitor	07-Nov-95	224	206.2	196-206	5	>18

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

Well number	Well type	Date completed	Borehole depth (ft)	Casing depth (ft)	Screen interval(s) (ft)	HSU[a] monitored	Initial well development flow rate (gpm)[b]
W-1204	Monitor	20-Nov-95	225	126.2	118-126	3A	2.5
W-1205	Monitor	27-Nov-95	91	82	72-82	2	<0.5
W-1206	GW Extraction	06-Dec-95	220	191	174-186	4	>40
W-1207	GW Extraction	13-Dec-95	92	90	70-90	2	<0.5
W-1208	GW Extraction	09-Jan-96	166	163	135-163	3A/3B	40
W-1209	Monitor	26-Jan-96	210	164	148-164	4	3
W-1210	Monitor	12-Feb-96	250	223	213-223	5	3
W-1211	GW Extraction	05-Mar-96	273	205	185-200	4	>25
W-1212	Monitor	19-Mar-96	150	75	52-75	1B	3
W-1213	GW Extraction	02-Apr-96	129	76	64-76	1B	>5
W-1214	Monitor	22-Apr-96	180	100	80-100	1B	2
W-1215	GW Extraction	17-Apr-96	175	120	108-118	2	8.5
W-1216	GW Extraction	07-May-96	200	124	94-124	2	14
W-1217	Monitor	15-May-96	182	98.5	78-98	1B	<0.5
W-1219	Monitor	04-Jun-96	201	142	138-142	4	<0.5
W-1222	Monitor	26-Jun-96	175	125.2	115-125	3A	6
W-1223	Monitor	23-Jul-96	175	102	87-97	2	4
W-1224	Monitor	05-Sep-96	125	104.5	99-104	1B	4.3
W-1225	Monitor	14-Aug-96	150	121.2	113-121	3A	2
W-1226	Monitor	06-Aug-96	155	126.5	116-126	2	1
W-1227	Monitor	09-Oct-96	200	134	126-134	2	11
W-1250	Monitor	07-Jun-96	210	200.3	130-135	4	0.85
W-1251	Monitor	03-Jul-96	210	200.3	134-139	4	1.3
W-1252	Monitor	25-Jul-96	208	202.3	135-140	4	<0.5
W-1253	Monitor	15-Aug-96	206	200.3	127-132	4	<0.5
W-1254	GW Extraction	28-Aug-96	210	200	131-141	4	26
W-1255	Monitor	27-Aug-96	208	200.7	124-129	4	<0.5
W-1301	GW Extraction	04-Dec-96	180	120.3	112-120	3A	15
W-1302	GW Extraction	21-Jan-97	145	138.9	116.5-121.2 125.8-133.8	3A	7.5
W-1303	GW Extraction	06-Feb-97	199.5	107	78-102	2	10
W-1304	Monitor	20-Feb-97	149.5	125	120-125	3A	0.75
W-1306	GW Extraction	06-May-97	200	106	81-101	2	3.3
W-1307	GW Extraction	02-Jul-97	150	141	126-136	4	20
W-1308	GW Extraction	13-Aug-97	154	116	81-111	2	7
W-1309	GW Extraction	13-Oct-97	220	157	142-152	4	6
W-1310	GW Extraction	01-Oct-97	220	198	173-193	5	28
W-1311	Monitor	26-Oct-97	150	120.5	100-120	2	14
W-1401	Monitor	17-Nov-97	254	120	105-120	2	7
W-1402	Monitor	10-Dec-97	135	112	102-112	3A	4
W-1403	Monitor	16-Jul-98	175	142.5	132-142	3B	3.5
W-1404	Monitor	30-Mar-98	162	97.7	87-97	2	3.1
W-1405	Monitor	30-Mar-98	100	97.8	87-97	2	4.5
W-1406	Monitor	02-Apr-98	201	150	139.2-149.2	4	9.2
W-1407	Monitor	27-Mar-98	224	118	105-118	2	1.5
W-1408	Monitor	27-Mar-98	134	128	118-128	3A	3.8
W-1409	GW Extraction	11-Jun-98	143	140	80-135	2	20
W-1410	GW Extraction	13-May-98	208.5	131.1	126-131	4	8
W-1411	Monitor	13-May-98	133	128.1	114-128	3A	10
W-1412	Monitor	21-May-98	201	108	92-107	3A	0.75
W-1413	Monitor	01-Jun-98	163.5	163.5	147-157	5	1
W-1414	Monitor	06-Apr-98	128	107.5	97-107	3A	0.1
W-1415	GW Extraction	03-Jun-98	182	104.7	74.5-104.5	2	2
W-1416	Monitor	19-Jun-98	194.5	105	85-100	2	10
W-1417	Monitor	25-Jun-98	225	155	130-150	3A	20

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

Well number	Well type	Date completed	Borehole depth (ft)	Casing depth (ft)	Screen interval(s) (ft)	HSU[a] monitored	Initial well development flow rate (gpm)[b]
W-1418	GW Extraction	22-Sep-98	252.5	190	176-190	4	9
W-1419	Monitor	15-Jul-98	175	115.5	90-110	2	4.5
W-1420	Monitor	29-Jun-98	175.5	112.5	102-112	2	10
W-1421	Monitor	29-Jun-98	230	172	157-167	3B	3
W-1422	GW Extraction	28-Aug-98	173.5	169.1	162-169	3B	10
W-1423	GW Extraction	21-Oct-98	175	134.5	99.5-109.5 119.5-129.5	2	22.4
W-1424	Monitor	25-Sep-98	225.3	146	126-146	2	6.2
W-1425	Monitor	25-Sep-98	115	100.5	88.5-100.5	1B	1
W-1426	Monitor	28-Sep-98	89	85	70-85	1B	8
W-1427	Monitor	06-Jan-99	104	80.2	70-80	1B	17
W-1428	Monitor	11-Jan-99	104	78.2	63-78	1B	25
W-1501	Monitor	12-Nov-98	126.1	88	72-88	1B	7.5
W-1502	Monitor	11-Mar-99	204	98.7	88-98	2	1.7
W-1503	GW Extraction	10-Feb-99	234	181.5	171-181	4	25
W-1504	GW Extraction	17-Feb-99	165.2	162.5	140-160.4	3A/3B	21.7
W-1505	Monitor	21-Apr-99	276	184.5	174-184	4	15
W-1506	Monitor	12-Apr-99	160	120.5	110-120	2	3
W-1507	Monitor	16-Apr-99	201.5	169.5	159-169	5	0.5
W-1508	Monitor	3-Mar-99	135	128.5	118-128	2	0.75
W-1509	Monitor	24-Mar-99	175	88.5	73-88	1B	8
W-1510	GW Extraction	9-Apr-99	114.5	113.5	93-113	2	5
W-1511	Monitor	27-apr-99	229	146	138-146	3B	15
W-1512	Monitor	3-May-99	100	100	88-98	2	0.5
W-1513	Monitor	11-May-99	122	120	108-120	2/3A	0.1
W-1514	Monitor	24-May-99	127.5	126	103-121	2/3A	6.5
W-1515	Monitor	8-Jun-99	130	121.5	102-120	2/3A	3
W-1516	Monitor	17-Jun-99	204.5	200	188-200	5	10
W-1517	Monitor	6-Jul-99	154	122.4	87-97	2	0.1
W-1518	GW Extraction	8-Jul-99	184	115	84-107	2	3
W-1519	Monitor	3-Aug-99	245	238	222-237	5	30
W-1520	GW Extraction	27-Jul-99	178.3	173	160-168	4	3.5
W-1522	GW Extraction	11-Aug-99	169	161	141-156	3B	9
W-1523	GW Extraction	7-Sep-99	216	172.3	164-172	4	15
W-1550	GW Extraction	24-Jun-99	200	130	98-125	3A	10
W-1551	GW Extraction	15-Jul-99	153	129	93-124	3A	10.5
W-1552	Dual Extraction	24-Jun-99	153.5	130	97.2-124.5	3A/3B	2
W-1553	Monitor	17-Aug-99	153	130	98-125	3A/3B	0.5
W-1601	GW Extraction	13-Oct-99	169	160	150-155	3B	3.5
W-1602	GW Extraction	2-Nov-99	115.5	110.7	80-90	2	8
W-1603	GW Extraction	16-Nov-99	144	140	130-135	3A	17.2
W-1604	Monitor	2-Dec-99	194	148.7	138-148	4	8
W-1605	SV Extraction	07-Mar-00	120.5	112	90-107	3A	<0.5
W-1606	SV Extraction	27-Jan-00	175	112	90-107	3A	<0.5
W-1607	SV Extraction	10-Feb-00	155.4	112	90-107	3A	<0.5
W-1608	SV Extraction	28-Feb-00	155	112	90-107	3A	<0.5
W-1609	GW Injection	17-Apr-00	155	135	110-130	5	0.5
W-1610	GW Extraction	04-May-00	155.3	135	110-130	5	0.5
W-1613	Monitor	27-Apr-00	219	173	168.5-172.5	3B	7
W-1614	Monitor	18-May-00	100	89.8	79-89	1B	3
W-1615	Dual Extraction	15-Aug-00	55	48	15-48	1B/2	NA
W-1650	Dual Extraction	19-Jan-00	145	126	96-121	3A/3B	2
W-1651	Dual Extraction	27-Jan-00	145	129	94-124	3A/3B	1
W-1652	Dual Extraction	09-Feb-00	145	127	92-122	3A/3B	0.33
W-1653	Dual Extraction	24-Feb-00	144	124	94-119	3A/3B	1.2

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

Well number	Well type	Date completed	Borehole depth (ft)	Casing depth (ft)	Screen interval(s) (ft)	HSU[a] monitored	Initial well development flow rate (gpm)[b]
W-1654	Dual Extraction	25-Feb-00	146.5	128	93-123	3A/3B	0.8
W-1655	Dual Extraction	08-Mar-00	145	125	90-120	3A/3B	1.3
W-1656	Dual Extraction	14-Mar-00	145	125.3	95.1-120.1	3A	5
W-1657	Dual Extraction	23-Mar-00	145	128	95-123	3A/3B	<1
W-1701	Monitor	03-Jul-01	185	180.8	140-155	2	10.5
					165-175		
W-1702	Monitor	15-Jun-01	15	14.25	4-13	1B	NA
W-1703	Monitor	23-Aug-01	358	341.5	331-341	LL	36
W-1704	Monitor	19-Sep-01	240	118.8	98-118	2	1
W-1705	Monitor	16-Oct-01	225	208.8	93-103	2	5
					123-128	3A	
					138-143	3B	
					203-208	5	
W-1801	GW Extraction	18-Mar-02	143	134.4	124-134	3A	>12
W-1802	Monitor	02-Apr-02	175	162.2	147-157	3A	1.5
W-1803	Monitor	24-Apr-02	245	240.8	175-185	4	3
					225-235	5	>8
W-1804	Monitor	22-May-02	155	110.8	80-95	2	<0.5
					100-105	3A	
W-1805	Monitor	20-Aug-02	110	100.8	70-80	1B	>10
					85-95		
W-1806	GW Extraction	12-Sep-02	260	106.2	80.7-101.2	1B	NA
W-1807	GW Extraction	07-Oct-02	165	130	115-125	2	10
W-1901	Monitor	31-Oct-02	175	127	92-97	1B	8
					107-122	2	
W-1902	GW Extraction	21-Nov-02	175	165	140-145	3A	20
					150-160		
W-1903	Dual extraction	16-Dec-02	120	109	84-104	2	<1
W-1904	Monitor	23-Jan-03	120	101	75-100	2	0.5-1
W-1905	Monitor	20-May-03	210	123.5	103-113	3	1.2-2.5
					118-123		
W-1909	Air Injection	24-Jun-03	110	106.3	86-106	2	1-1.5
W-2005	Monitor	03-Feb-04	160	125	109-119	3A	2
W-2006	Monitor	24-Feb-04	160	132	122-132	3B	0.3
W-2011	Monitor	29-Feb-04	155	116.3	106-116	3A	<1/2
W-2012	Monitor	21-Oct-04	155	136.6	111-116	3A	4
					126-131		
W-2101	Monitor	18-Nov-04	160	135.3	110-130	3A	0.25
W-2102	Monitor	14-Dec-04	160	138.5	118-133	3A	0.3

Notes and footnotes appear on following page.

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

Notes:

Boreholes B-707, B-708, B-709, B-713, B-715, and B-750 were drilled for the Dynamic Underground Stripping Demonstration Project Clean Site.

ft = Feet.
gpm = Gallons per minute.
GW = Ground Water.
IMS = Instrumented Membrane System.
NA = Not applicable or not available.
SV = Soil Vapor.

[a] **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.**

[b] **Flow rate after 4 hours of air-lift pumping/surging.**

[c] **Well number was 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

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

[e] **Instrumented membrane systems (IMS) (formerly FLUTe/SEAMIST membranes) with vapor ports set at varying depths.**

[f] **Piezometer SVI-518-303 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	08-Jun-76	66	64.7	54.7-59.7	NA	18-Aug-88
11BA[a]	Other non-LLNL	02-Mar-87	NA	NA	NA	NA	10-Jun-87
11H1	Other non-LLNL	04-Nov-41	481	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	05-Apr-60	272	272	166-170	3/4/5	07-Oct-88
					174-176		
					183-185		
					200-202		
					211-214		
					224-230		
					250-252		
					260-265		
11J1	Other non-LLNL	01-Jan-41	160	160	NA	2	03-Aug-88
11J4[a]	Other non-LLNL	01-Jan-65	NA	NA	NA	NA	11-Oct-88
11K1	Other non-LLNL	06-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	17-Jun-88	NA	232	NA	NA	03-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[b]	Other non-LLNL	20-Dec-83	NA	280	NA	NA	11-Jan-89
11R3	Other non-LLNL	08-May-61	140	117	NA	NA	03-Sep-85
11R4	Other non-LLNL	13-Mar-84	NA	NA	NA	NA	03-Sep-85
11R5[b]	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	10-Mar-54	702	702	375-657		14-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[b]	Other non-LLNL	29-Oct-56	402	400	200-400	3B/4/5/6	23-Aug-88
14A1[b]	Other non-LLNL	12-Jul-43	246	227	102-107	NA	13-Sep-88
					113-119	NA	
					144-148	NA	
					176-179	NA	
					188-190	NA	
					192-194	NA	
					219-222	NA	
					223-227	NA	
14A2[b]	Other non-LLNL	15-Nov-56	229	229	122-130	2/3A	12-Sep-88
					140-150		
					160-180		
14A4[b]	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	03-May-88	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	03-May-88	385	306	NA	NA	NA
1N1	Other non-LLNL	15-Jan-48	600	600	427-442	7	21-Oct-88
					450-453		
					465-469		
					500-515		
					575-588		
2R9 (11A5)[c]	Other non-LLNL	NA	NA	NA	NA	NA	19-Jul-88

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

Well number	Well type	Date installed	Borehole depth (ft)	Casing depth (ft)	Screen interval(s) (ft)	HSU monitored	Closure date
GEW-711	Extraction	24-May-91	167.5	157	94-137	3A/3B	16-Jun-92
GSW-001	Monitor	05-Feb-85	112	109	85-106	2	06-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	07-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	01-Nov-92
GSW-015	Monitor	14-Aug-87	148	145	20.5-28	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	03-Sep-87
GSW-208	Monitor	06-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
SIP-419-201	Monitor	29-Feb-96	126	107	97-107	3A/3B	NA
SIP-419-202	Piezometer	06-Mar-96	110	106.5	97-106.5	3A	NA
SIP-490-101	Piezometer	01-Nov-95	59	56	53–56	2	21-Dec-95
SIP-514-101	Piezometer	28-Dec-89	26	22	7-22	1B	03-Sep-96
SVI-518-303[d]	Monitor	29-Jun-95	104.5	40	6-40	1B	NA
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	06-Dec-93
SIP-ETS-207	Piezometer	11-Jul-91	103	98.5	89.75-98.5	3A	05-Jan-00
SIP-HPA-102	Piezometer	08-Dec-94	76	72	67-72	2	09-Apr-02
SIP-HPA-103	Piezometer	01-Mar-95	77	73.5	67-72.5	2	09-Apr-02
SIP-PA-029	Piezometer	22-Jan-90	11.5	7	5-7	1B	18-Nov-93
UP-292-001	Piezometer	07-Jan-91	54.5	49.5	44.5-49.5	1B	25-Sep-95
W-010A	Monitor	08-Sep-80	110.7	110	85-95	2	26-Feb-02
					100-105		
W-014A	Monitor	26-Aug-80	112.8	109	79	2	11-Dec-87
					94		
					104		

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-015	Monitor	17-Nov-80	285	267	239-265	7	13-May-88
W-018	Monitor	22-Aug-80	161	152.5	80-90	2	11-Nov-85
					100-105	2	
					112-117	3A	
					128-133	5	
					142-152	5	
W-149	Monitor	23-Aug-85	201	169	161-169	2	03-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	05-Jan-98
W-358	Monitor	04-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	09-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-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	07-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	01-Jul-96	220	172	162-172	4	28-Feb-02
TEP-GP-001	Dynamic Stripping[e]	21-Jan-92	165	97	88-97	2	09-Feb-93
				117	107-117	2/3A	
				160.5	NA	NA	
TEP-GP-002	Dynamic Stripping[e]	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[e]	28-Jan-92	161	129.5	124.5-129.5	3A	13-Feb-93
				161	NA	NA	
TEP-GP-004	Dynamic Stripping[e]	05-Feb-92	161	106	96-106	2	13-Feb-93
				134	124-134	3A	
				161	NA	NA	
TEP-GP-005	Dynamic Stripping[e]	18-Feb-92	161	124.5	114.5-124.5	3A	13-Feb-93
				161	NA	NA	
TEP-GP-006	Dynamic Stripping[e]	26-Feb-92	161	127	107-127	2/3A	13-Feb-93
				161	NA	NA	

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
TEP-GP-007	Dynamic Stripping[e]	13-Mar-92	161	125.5	115.5-125.5	3A	13-Feb-93
				161	NA	NA	
TEP-GP-008	Dynamic Stripping[e]	03-Mar-92	161	110	100-110	2	13-Feb-93
				129	119-129	3A	
				161	NA	NA	
TEP-GP-009	Dynamic Stripping[e]	06-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[e]	24-Mar-92	161	124.5	114.5-124.5	3A	12-Feb-93
				161	NA	NA	
TEP-GP-011	Dynamic Stripping[e]	07-Apr-92	161	108	98-108	2	13-Feb-93
				161	NA	NA	
TEP-GP-106	Dynamic Stripping[e]	21-Sep-93	137.5	135.5	NA	NA	NA
CPRS-03 (B482)	Anode Well	NA	180	NA	NA	NA	26-Sep-03
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
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	01-Jul-96	220	172	162-172	4	28-Feb-02

Notes and footnotes appear on following page.

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

Notes:

Boreholes B-707, B-708, B-709, B-713, B-715, and B-750 were drilled for the Dynamic Underground Stripping Demonstration Project Clean Site.

ft = Feet.

HSU = Hydrostratigraphic unit.

NA = Not applicable or not available.

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

[b] **Well number was 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

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

[d] **Piezometer SVI-518-303 was drilled out and replaced by well SVW-518-1915.**

[e] **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-in ID piezometers installed adjacent to the blank casing. Therefore, the casing depths with accompanying screened intervals refer to the piezometers.**

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	01-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	01-Dec-83	Slug	NA	110	34	Poor
W-002A	24-Jan-85	Drawdown	10.3	2,700	200	Good
W-004	01-Dec-83	Drawdown	3.3	63	13	Good
W-005	01-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	01-Dec-83	Slug	NA	43	14	Fair
W-008	01-Dec-83	Drawdown	2.9	29	4.9	Fair
W-011	01-Dec-83	Drawdown	4.1	130	15	Good
W-017	01-Dec-83	Slug	NA	38	2.5	Good
W-017	21-Feb-86	Slug	NA	85	5.7	Good
W-018	01-Dec-83	Drawdown	2.6	20	2.7	Poor
W-102	25-Mar-86	Drawdown	6.4	1,100	76	Good
W-102	05-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	03-Mar-88	Drawdown	5.4	1,200	170	Fair
W-104	25-Mar-88	Drawdown	3.3	450	45	Fair
W-105	06-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	05-Mar-86	Drawdown	8.1	3,200	530	Good
W-109	04-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	05-Nov-96	Longterm	13.7	3,300	260	Fair
W-113	17-Apr-86	Slug	NA	7.4	1.2	Excel
W-115	05-Mar-86	Drawdown	1.1	180	30	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-116	24-Dec-85	Slug	NA	37	7.5	Good
W-117	20-Feb-86	Slug	NA	2	0.4	Good
W-118	05-Mar-86	Drawdown	10.0	2,100	230	Good
W-119	08-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	03-Mar-88	Slug	NA	2,600	330	Excel
W-143	03-Mar-88	Slug	NA	1,200	240	Excel
W-149	09-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	02-Oct-85	Drawdown	3.1	640	210	Fair
W-150	03-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	05-Mar-86	Drawdown	10.0	740	86	Excel
W-203	02-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	02-Mar-88	Slug	NA	380	32	Excel
W-210	09-Jun-86	Slug	NA	0.6	0.1	Good
W-211	22-Oct-86	Drawdown	2.9	37	12	Fair
W-211	08-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	07-Oct-86	Longterm	27.6	2,300	350	Good
W-217	15-Jul-86	Slug	NA	750	120	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-218	17-Jun-86	Drawdown	11.7	6,400	1,100	Good
W-218	12-Nov-86	Longterm	7.7	4,000	670	Good
W-219	15-Jul-86	Drawdown	4.3	620	76	Good
W-219	23-Feb-87	Longterm	5.2	66	8.0	Fair
W-220	21-Aug-86	Slug	NA	28	5.5	Excel
W-221	05-Aug-86	Drawdown	2.1	120	16	Fair
W-222	12-Aug-86	Drawdown	16.0	1,700	160	Excel
W-222	08-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	04-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	06-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	05-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	01-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	04-Nov-86	Longterm	1.8	76	15	Excel
W-264	07-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	02-Jun-86	Drawdown	0.5	420	85	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-268	14-Nov-86	Drawdown	5.0	230	18	Good
W-269	14-Jul-86	Drawdown	5.0	570	95	Good
W-270	30-Dec-86	Slug	NA	14	2.0	Good
W-271	04-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	02-Feb-99	Slug	NA	10	2	Fair
W-275	30-Oct-86	Drawdown	7.0	730	150	Fair
W-275	02-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	03-Nov-86	Drawdown	0.9	74	25	Fair
W-290	05-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	04-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	03-Nov-87	Longterm	18.8	1,700	280	Good
W-313	25-Mar-87	Drawdown	7.9	3,000	600	Good
W-313	05-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

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-314	14-Oct-97	Longterm	12	1,400	100	Fair
W-315	09-Apr-87	Drawdown	15.4	150	11	Good
W-315	05-Jan-85	Longterm	24.5	571	41	Excel
W-316	04-May-87	Drawdown	7.8	1,400	280	Good
W-317	12-May-87	Drawdown	12.1	300	43	Fair
W-317	15-Dec-87	Longterm	8.2	120	17.1	Good
W-318	07-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	03-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	07-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	09-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

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-364	08-Apr-87	Drawdown	8.6	51	10	Fair
W-364	01-Jun-87	Longterm	4.8	110	22	Good
W-365	14-May-87	Drawdown	10.0	36	15	Fair
W-366	11-May-87	Drawdown	19.0	780	92	Fair
W-368	11-May-87	Drawdown	2.9	81	8.5	Fair
W-368	31-Jul-01	Step	6.0	2,600	350	Fair
W-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	03-Dec-87	Drawdown	9.7	370	26	Good
W-404	04-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	05-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	05-May-85	Drawdown	14.0	50	83	Good
W-412	06-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

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-441	30-Oct-87	Drawdown	6.0	500	56	Good
W-441	13-Apr-88	Drawdown	13.0	2,200	240	Poor
W-441	19-Apr-88	Longterm	14.0	470	52	Good
W-447	26-Feb-88	Drawdown	7.1	124	850	Poor
W-448	24-Mar-85	Drawdown	24.5	4,200	600	Good
W-449	21-Mar-85	Drawdown	6.2	170	11	Good
W-450	14-Apr-88	Drawdown	3.3	38	650	Fair
W-451	27-Apr-88	Drawdown	2.1	80	16	Good
W-452	02-May-88	Drawdown	5.2	310	21	Excel
W-453	03-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	02-Aug-85	Drawdown	0.8	24	150	Fair
W-460	01-Sep-85	Drawdown	17.0	1,900	380	Fair
W-461	07-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	08-Nov-88	Drawdown	9.0	370	53	Good
W-481	02-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	08-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	06-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	09-May-89	Drawdown	0.6	33	3.0	Fair
W-514	26-May-89	Drawdown	1.4	84	530	Fair
W-515	06-Jun-89	Drawdown	2.8	37	4.2	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-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	01-Feb-90	Drawdown	0.6	44	4.9	Fair
W-522	05-Feb-90	Drawdown	20.0	3,700	620	Fair
W-551	08-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	08-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	02-May-89	Drawdown	17.0	780	86	Good
W-566	31-Aug-93	Longterm	22.5	2,580	520	Fair
W-567	04-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	08-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	08-Feb-90	Drawdown	22.5	6,900	770	Excel
W-602	29-Jan-90	Drawdown	24.0	5,300	620	Good
W-603	07-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

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-607	22-Feb-90	Drawdown	1.4	800	100	Good
W-608	28-Feb-90	Drawdown	1.2	230	30	Fair
W-609	09-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	05-Apr-94	Longterm	14	230	40	Good
W-613	23-May-90	Drawdown	4.8	2,550	360	Good
W-614	07-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	01-Aug-90	Drawdown	1.9	24	4.8	Fair
W-619	30-Aug-90	Drawdown	11.8	190	11	Good
W-620	01-Oct-90	Drawdown	5.8	6,500	650	Good
W-621	04-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	1.9	Fair
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	03-Oct-92	Step	16.5	5,200	430	Good
W-701	01-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	04-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	06-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	02-Feb-96	Drawdown	1.4	53	2.1	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-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
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	09-Apr-97	Drawdown	6.7	3,500	250	Poor
W-1107	04-May-99	Drawdown	6.6	4,300	310	Fair
W-1108	03-Nov-95	Drawdown	12.3	950	68	Good
W-1108	25-Jun-96	Longterm	11.6	1,000	70	Poor
W-1109	26-Jun-95	Drawdown	8.7	460	33	Fair
W-1109	04-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	09-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	01-Nov-96	Drawdown	1	8.3	0.92	Poor
W-1203	02-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

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-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
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	08-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	08-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	02-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	07-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-1311	29-Oct-97	Drawdown	12.2	290	15	Good
W-1401	11-Nov-97	Drawdown	7.0	100	6.8	Excel

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

Well	Date	Type of test[b]	Flow rate (Q) (gpm)	Transmissivity (T) (gpd/ft)	Hydraulic conductivity (K)[c] (gpd/sq ft)	Data quality[d]
W-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	03-Apr-98	Drawdown	1.1	8.7	1.0	Excellent
W-1408	15-Apr-98	Drawdown	2.7	85	28	Fair
W-1410	29-Jun-98	Drawdown	11.5	3,000	500	Poor
W-1410	08-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	08-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	01-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	01-Oct-98	Drawdown	6	48	6.9	Excellent
W-1425	01-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

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-1508	28-Jun-01	Slug	NA	160	16	Good
W-1509	09-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	02-Feb-00	Longterm	1.1	75	4.1	Fair
W-1518	22-Mar-00	Step	6.0	440	19	Good
W-1520	21-Mar-00	Longterm	4.0	165	20	Poor
W-1522	20-Mar-00	Step	10.5	3,500	235	Good
W-1550	28-Dec-99	Drawdown	10.0	330	35	Fair
W-1601	25-Feb-00	Drawdown	3.0	35	3.6	Good
W-1602	03-Mar-00	Drawdown	8.3	3,100	310	Fair
W-1604	02-Apr-01	Drawdown	4.0	1,600	220	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-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	03-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
SIP-ETC-201	01-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

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-06	16-Jun-87	Longterm	20.0	5,500	350	Good
GSW-07	03-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	02-Jun-86	Drawdown	4.7	390	45	Excel
GSW-12	07-Jun-86	Drawdown	0.8	51	11	Fair
GSW-13	04-Aug-86	Slug	NA	110	13	Excel
GSW-13	08-Aug-86	Slug	NA	62	7	Good
GSW-15	23-Feb-88	Drawdown	25.8	1,500	190	Good
GSW-208	08-May-86	Drawdown	1.9	440	80	Good
GSW-209	08-May-86	Drawdown	6.1	1,200	120	Good
GSW-215	04-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	08-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	09-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.

[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)
SVW-543-001	04/22/03	2	6	19.3	3.7	296	3E-08
SVW-543-002A	04/30/03	2	6	10	5.1	138	8E-09
SVW-543-002B	05/01/03	2	6	14	5.1	145	2E-08
SVW-543-003	04/29/03	2	6	31	5.1	236	7E-08
SVW-543-004A	04/23/03	2	6	37	3.7	198	2E-08
SVW-543-004B	04/28/03	2	6	36.5	5.1	188	2E-08
SVW-HPA-001B	05/13/03	2	1.5	9.3	6.6	31	1E-08
SVW-HPA-002A	05/20/03	1B	2	0.8	6.6	4.3	1E-08
W-1552	10/06/03	3A/B	1.8	1	15	(NM)[b]	9E-11
W-1650	10/09/03	3A/B	2.8	0.8	12	(22.7)[b]	1E-10
W-1651	10/09/03	3A/B	3	0.9	12	(31)[b]	1E-10
W-1652	10/07/03	3A/B	6	1.1	12	(29)[b]	2E-10
W-1653	10/10/03	3A/B	2	0.8	12	(17.7)[b]	3E-10
W-1654	10/10/03	3A/B	2.5	0.8	12	(10)[b]	3E-11
W-1655	10/08/03	3A/B	1	1.5	12	(NM)[b]	4E-10
W-1656	10/13/03	3A/B	0.5	NM	12	(10)[b]	2E-10
W-1657	10/08/03	3A/B	2.8	1	12	(20)[b]	3E-10
SVW-518-201	01/26/04	2	6	4.5	13	102	7E-10
SVW-518-204	01/22/04	2	6	0.9	25	1,94.04	2E-11
SVW-518-1913	01/21/04	2	6	0.5	26	106	2E-11
SVW-518-1914	01/23/04	1B	6	5.5	16	44	1E-09
SVW-518-1915	01/28/04	2	6	0.03	25	193	2E-12
W-1615	01/29/04	2	6	1.4	24	478	4E-11
SVW-ETC-2001A	03/16/04	1B	6	8.3	5	52.5	2E-08
SVW-ETC-2001B	03/19/04	2	6	0.7	5	145.3	1E-09
SVW-ETC-2002A	03/11/04	1B/2	6	6	5	22.6	3E-09
SVW-ETC-2002B	03/15/04	2	6	4	5.5	26	NC
SVW-ETC-2003	03/22/04	1B	6	17	4.5	77.4	8E-09
SVW-ETC-2004A	03/05/04	1B/2	6	12	8	82.8	3E-09
SVW-ETC-2004B	03/09/04	2	6	18	3.8	188	3E-09
SIP-ETC-201	03/04/04	2	6	8	7	185.5	7E-09
W-1904	03/02/04	2	6	23	4	63.3	2E-08

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)
SVW-514-2007A	04/19/04	1B	96	14	7.5	17.6	NC
SVW-514-2007B	04/26/04	5	96	21	3.3	39.6	NC
W-217	05/03/04	5	96	20	3	63.2	NC
SVW-ETS-2008A	09/28/04	1B	6	50	7	23.7	NC
SVW-ETS-2008B	09/29/04	2	6	33	9.5	67.8	NC
SVW-ETS-2009	11/30/04	2	6	76	4.8	16.4	NC
SVW-ETS-2010A	10/07/04	1B	6	70	3	20.5	NC
SVW-ETS-2010B	10/11/04	2	6	63	4.5	39.8	NC
SIP-ETS-601	10/13/04	2	2.5	0.5	10	153.7	NC

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. Insufficient data to analyze unless otherwise noted.
[a] Sample collected in Tedlar bag for TO-14 analysis.
( )[b] Sample measured with organic vapor analyzer.

References

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Appendix D

2005 Ground Water Sampling Schedule

Table D-1. 2005 LLNL Livermore Site VOC ground water sampling schedule.

Well number	VOC sampling frequency	Next quarter sample date	Additional analytes (Q1-05)
W-001	O	2-05	
W-001A	A	1-05	
W-002	A	1-05	
W-002A	O	3-05	
W-004	A	1-05	
W-005	O	3-05	
W-005A	E	4-06	
W-007	Q	1-05	
W-008	Q	1-05	WGMG
W-011	E	4-06	
W-012	A	2-05	
W-017	E	1-06	WGMG
W-017A	Q	1-05	
W-019	O	1-05	
W-101	S	1-05	WGMG
W-102	A	1-05	
W-103	Q	1-05	
W-104	Q	1-05	
W-105	E	4-06	
W-106	Q	1-05	
W-107	Q	1-05	
W-108	O	3-05	
W-110	Q	1-05	
W-111	O	4-05	
W-113	Q	1-05	
W-114	A	1-05	
W-115	Q	1-05	
W-116	Q	1-05	
W-117	O	1-05	
W-118	E	4-06	
W-119	Q	1-05	WGMG
W-120	Q	1-05	
W-121	Q	1-05	WGMG
W-122	E	1-06	
W-123	E	1-06	
W-141	E	2-06	
W-142	Q	1-05	

Table D-1. 2005 LLNL Livermore Site VOC ground water sampling schedule.

Well number	VOC sampling frequency	Next quarter sample date	Additional analytes (Q1-05)
W-143	E	3-06	
W-146	E	2-06	
W-147	A	1-05	WGMG
W-148	O	4-05	WGMG
W-151	Q	1-05	WGMG
W-201	Q	1-05	
W-202	E	1-06	
W-203	E	2-06	
W-204	E	2-06	WGMG
W-205	Q	1-05	
W-206	Q	1-05	
W-207	Q	1-05	
W-210	Q	1-05	
W-212	Q	1-05	
W-213	O	4-05	
W-214	A	4-05	
W-217	Q	1-05	
W-218	A	4-05	
W-219	Q	1-05	
W-220	A	2-05	
W-221	E	2-06	WGMG
W-222	O	3-05	
W-223	A	2-05	
W-224	E	4-06	
W-225	E	2-06	
W-226	E	2-06	WGMG/NPDES
W-251	Q	1-05	
W-252	O	4-05	
W-253	O	1-05	
W-255	Q	1-05	
W-256	E	1-06	
W-257	Q	1-05	
W-258	Q	1-05	
W-259	Q	1-05	
W-260	E	4-06	
W-261	Q	1-05	
W-263	Q	1-05	

Table D-1. 2005 LLNL Livermore Site VOC ground water sampling schedule.

Well number	VOC sampling frequency	Next quarter sample date	Additional analytes (Q1-05)
W-264	A	2-05	
W-265	O	3-05	
W-267	E	4-06	
W-268	E	2-06	
W-269	S	1-05	
W-270	A	3-05	WGMG
W-271	Q	1-05	
W-272	Q	1-05	
W-273	O	4-05	
W-274	Q	1-05	
W-275	S	1-05	
W-276	S	1-05	
W-277	A	1-05	
W-290	Q	1-05	
W-291	O	1-05	
W-293	E	2-06	
W-294	A	3-05	
W-301	A	1-05	
W-302	E	2-06	
W-303	O	3-05	
W-304	S	1-05	
W-306	E	4-06	WGMG/NPDES
W-307	Q	1-05	WGMG/NPDES
W-308	E	4-06	
W-310	O	1-05	
W-311	A	1-05	
W-312	O	2-05	
W-313	Q	1-05	
W-315	Q	1-05	
W-316	A	4-05	
W-317	A	1-05	
Article I. W-318	Q	1-05	
W-319	E	3-06	
W-320	E	3-06	
W-321	O	4-05	
W-322	Q	1-05	
W-323	Q	1-05	

Table D-1. 2005 LLNL Livermore Site VOC ground water sampling schedule.

Well number	VOC sampling frequency	Next quarter sample date	Additional analytes (Q1-05)
W-324	E	2-06	
W-325	O	1-05	
W-353	Q	1-05	
W-354	S	1-05	
W-355	S	2-05	
W-356	Q	1-05	
W-359	Q	1-05	WGMG
W-361	Q	1-05	
Section 1.01W-362	Q	1-05	
W-363	Q	1-05	WGMG
W-364	S	1-05	
W-365	Q	2-05	
W-366	O	3-05	
W-369	S	1-05	
W-370	O	2-05	
W-371	A	2-05	
W-372	O	1-05	
W-373	O	3-05	WGMG
W-375	S	1-05	
W-376	S	2-05	
W-377	E	2-06	
W-378	A	2-05	
W-379	A	1-05	
W-380	O	1-05	
W-401	E	2-06	
W-402	O	1-05	
W-403	O	1-05	
W-404	Q	1-05	
W-405	Q	1-05	
W-406	E	4-06	
W-407	Q	1-05	
W-409	A	4-05	
W-410	Q	1-05	
W-411	Q	1-05	
W-412	S	2-05	
W-416	O	2-05	
W-417	O	4-05	

Table D-1. 2005 LLNL Livermore Site VOC ground water sampling schedule.

Well number	VOC sampling frequency	Next quarter sample date	Additional analytes (Q1-05)
W-418	E	4-06	
W-419	Q	1-05	
W-420	O	1-05	
W-421	Q	1-05	
W-422	Q	1-05	
W-423	A	4-05	
W-424	Q	1-05	
W-446	E	2-06	
W-447	A	1-05	
W-448	E	3-06	
W-449	Q	1-05	
W-450	A	1-05	
W-451	E	2-06	
W-452	E	4-06	
W-453	E	2-06	
W-454	A	1-05	
W-455	A	4-05	
W-458	E	4-06	
W-459	E	4-06	
W-461	Q	1-05	
W-462	E	4-06	
W-463	E	2-06	
W-464	A	1-05	
W-481	Q	1-05	
W-482	Q	1-05	
W-483	O	3-05	
W-484	Q	1-05	
W-485	E	2-06	
W-486	O	2-05	
W-487	O	1-05	
W-501	S	1-05	
W-502	A	3-05	
W-503	E	2-06	
W-504	O	4-05	
W-505	E	2-06	
W-506	S	1-05	
W-507	O	3-05	

Table D-1. 2005 LLNL Livermore Site VOC ground water sampling schedule.

Well number	VOC sampling frequency	Next quarter sample date	Additional analytes (Q1-05)
W-509	S	1-05	
W-510	O	1-05	
W-511	A	2-05	
W-512	E	2-06	
W-513	E	2-06	
W-514	O	4-05	
W-515	A	2-05	
W-516	O	2-05	
W-517	Q	1-05	
W-519	E	4-06	
W-521	Q	1-05	
W-551	A	1-05	
W-552	E	3-06	
W-553	E	4-06	
W-554	A	1-05	
W-555	E	2-06	
W-556	E	2-06	WGMG
W-557	E	4-06	
W-558	Q	1-05	
W-559	E	4-06	
W-560	E	1-06	
W-561	E	3-06	
W-562	E	2-06	
W-563	Q	1-05	
W-564	Q	1-05	
W-565	E	3-06	
W-567	A	2-05	
W-568	S	1-05	
W-569	A	3-05	
W-570	Q	1-05	
W-571	A	1-05	WGMG
W-591	E	4-06	
W-592	O	3-05	
W-593	O	1-05	
W-594	A	2-05	
W-604	A	3-05	
W-606	S	2-05	

Table D-1. 2005 LLNL Livermore Site VOC ground water sampling schedule.

Well number	VOC sampling frequency	Next quarter sample date	Additional analytes (Q1-05)
W-607	S	1-05	
W-608	O	3-05	
W-611	A	1-05	
W-612	A	4-05	
W-613	Q	1-05	
W-615	S	1-05	
W-616	E	1-06	
W-617	E	4-06	
W-618	Q	1-05	
W-619	O	3-05	
W-622	Q	1-05	
W-651	Q	1-05	
W-652	O	2-05	
W-653	Q	1-05	
W-654	S	1-05	
W-702	S	2-05	
W-705	E	4-06	
W-706	E	4-06	
W-750	E	4-06	
W-901	E	2-06	
W-902	E	2-06	
W-905	O	3-05	
W-906	Q	1-05	WGMG
W-908	O	1-05	
W-909	Q	1-05	
W-911	S	2-05	
W-912	Q	1-05	
W-913	Q	1-05	
W-1002	E	4-06	
W-1003	O	4-05	
W-1008	Q	1-05	
W-1010	O	4-05	
W-1011	E	3-06	
W-1012	Q	1-05	WGMG
W-1013	E	4-06	
W-1014	A	4-05	
W-1101	O	2-05	

Table D-1. 2005 LLNL Livermore Site VOC ground water sampling schedule.

Well number	VOC sampling frequency	Next quarter sample date	Additional analytes (Q1-05)
W-1105	E	3-06	
W-1106	E	3-06	
W-1107	Q	1-05	
W-1108	Q	1-05	
W-1110	A	1-05	
W-1112	A	1-05	
W-1113	E	4-06	
W-1115	A	3-05	
W-1117	Q	1-05	
W-1118	Q	1-05	
W-1201	Q	1-05	
W-1202	Q	1-05	
W-1203	Q	1-05	
W-1204	Q	1-05	
W-1205	S	1-05	
W-1207	A	2-05	
W-1209	A	1-05	
W-1210	S	1-05	
W-1212	Q	1-05	
W-1214	Q	1-05	
W-1217	S	1-05	
W-1219	S	1-05	
W-1222	Q	1-05	
W-1223	Q	1-05	
W-1224	E	4-06	
W-1225	Q	1-05	
W-1226	E	2-06	
W-1227	O	1-05	
W-1250	Q	1-05	
W-1251	S	2-05	
W-1252	Q	1-05	
W-1253	Q	1-05	
W-1255	Q	1-05	
W-1303	Q	1-05	WGMG
W-1304	Q	1-05	
W-1306	Q	1-05	WGMG
W-1308	Q	1-05	WGMG

Table D-1. 2005 LLNL Livermore Site VOC ground water sampling schedule.

Well number	VOC sampling frequency	Next quarter sample date	Additional analytes (Q1-05)
W-1309	A	1-05	
W-1311	Q	1-05	
W-1401	Q	1-05	
W-1402	S	1-05	
W-1403	Q	1-05	
W-1404	S	1-05	
Section 1.02W-1405	Q	1-05	
W-1406	Q	1-05	
W-1407	Q	1-05	
W-1408	Q	1-05	
W-1411	A	3-05	
W-1412	Q	1-05	
W-1413	E	1-06	
W-1414	Q	1-05	
W-1416	S	1-05	
W-1417	Q	1-05	
W-1418	Q	1-05	
W-1419	Q	1-05	
W-1420	S	1-05	
W-1421	Q	1-05	
W-1422	Q	1-05	
W-1424	A	1-05	
W-1425	S	1-05	
W-1426	S	2-05	
W-1427	A	2-05	
W-1428	E	4-06	
W-1501	E	3-06	
W-1502	A	2-05	
W-1505	Q	1-05	
W-1506	S	1-05	
W-1507	S	2-05	
W-1508	Q	1-05	
W-1509	A	1-05	
W-1511	Q	1-05	
W-1512	A	2-05	
W-1513	A	3-05	
W-1514	A	3-05	

Table D-1. 2005 LLNL Livermore Site VOC ground water sampling schedule.

Well number	VOC sampling frequency	Next quarter sample date	Additional analytes (Q1-05)
W-1515	A	3-05	
W-1516	S	1-05	
W-1517	S	1-05	
W-1519	A	1-05	
W-1553	Q	1-05	
W-1604	Q	1-05	
W-1613	A	1-05	
W-1614	A	2-05	
W-1701	A	3-05	
W-1703	A	1-05	
W-1704	(a) S	2-05	
W-1705	S	2-05	
W-1802	S	1-05	
W-1803-1[a]	Q	1-05	
W-1803-2[a]	Q	1-05	
W-1804-1[a]	A	4-05	
W-1804-2 [a]	Q	1-05	
Section 1.03W-1805	Q	1-05	
W-1901-1[a]	Q	1-05	
W-1901-2[a]	Q	1-05	
W-1904	Q	1-05	
W-1905-1[a]	Q	1-05	
W-1905-2[a]	Q	1-05	
W-1909	Q	1-05	
TW-11	A	1-05	
TW-11A	A	1-05	
TW-21	E	3-06	
11C1	E	2-06	
14A11	O	1-05	
14A3	Q	1-05	
14B1	O	2-05	WGMG
14B4	O	3-05	
14C1	Q	1-05	
14C2	A	2-05	
14C3	Q	1-05	
14H1	Q	1-05	
18D1	O	3-05	

Table D-1. 2005 LLNL Livermore Site VOC ground water sampling schedule.

Well number	VOC sampling frequency	Next quarter sample date	Additional analytes (Q1-05)
GEW-710	Q	1-05	WGMG
GSW-006	O	4-05	
GSW-007	E	1-06	
GSW-008	E	1-06	
GSW-009	Q	1-05	
GSW-011	Q	1-05	
GSW-013	A	1-05	
GSW-215	E	2-06	
GSW-216	A	2-05	
GSW-266	Q	1-05	
GSW-326	O	2-05	
GSW-367	E	3-06	
GSW-442	Q	1-05	
GSW-443	E	3-06	
GSW-444	Q	1-05	
GSW-445	S	1-05	

Notes:

All analyses are by EPA Method 601 for purgeable halocarbons.

E = Even years.

O = Odd years.

A = Annual.

S = Semiannual.

Q = Quarterly.

NPDES = National Pollutant Discharge Elimination System.

WGMG = LLNL Water Guidance and Monitoring Group. This work is related to 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

Drainage Retention Basin Annual Monitoring Program Summary

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Drainage Retention Basin Annual Monitoring Program Summary

This Appendix summarizes the 2004 LLNL Operations and Regulatory Affairs Division discharge data for the Drainage Retention Basin (DRB). The DRB is an artificial water body that was re-surveyed in 2000 and shown to have a capacity of about 37 acre-ft (12 million gallons). The DRB is located in the central portion of the Livermore Site (Fig. E-1) and receives storm water runoff and treated ground water discharges.

DRB release samples are collected at the first planned release of the rainy season and, at a minimum, in conjunction with one additional storm water monitoring event, as requested by the San Francisco Bay Regional Water Quality Control Board (RWQCB). Samples are also collected for each dry season release event or, if the release is continuous, samples are collected each month. Release samples are collected at location CDBX (Fig. E-1) and are compared with the LLNL Arroyo Las Positas outfall samples collected at location WPDC (Fig. E-1). Release samples are used to determine compliance with discharge limits established in the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Record of Decision (ROD) for the Lawrence Livermore National Laboratory, Livermore Site (DOE, 1992) and the Explanation of Significant Differences for Metals Discharge Limits at the Lawrence Livermore National Laboratory, Livermore Site (Berg et al., 1997). In 2003, the DRB monitoring strategy was modified according to a letter submitted to the RWQCB in December 2002 (Jackson, 2002) to eliminate monitoring within the basin.

The analytical results for release samples are reported in the LLNL Livermore Site Quarterly Self-Monitoring Reports for 2004 and will be reported in the LLNL Site Annual Environmental Report (Sanchez et al., 2004).

E-1. Drainage Retention Basin Discharge Monitoring

Releases from the DRB occurred continuously throughout the year except for brief periods when flow was stopped for maintenance, e.g., bullfrog mitigation in October (Coty, 2004).

Dry season release samples were collected June 9, July 7, August 4, and September 1, 2004. Samples for the last release of the 2003–2004 wet season were collected on February 2, 2004. Samples for the first two releases of the 2004–2005 wet season were collected on October 18 and October 26, 2004. The October 26 wet-season sampling event occurred in conjunction with storm water monitoring.

Samples from the DRB were within discharge limits for all parameters except pH. Samples collected at CDBX exceeded the pH limit of 8.5 in four of seven wet and dry season monitoring events, ranging from 8.1 to 9.5 in all seven events. The pH has averaged 8.8 since 1998 and is typically high during the summer due to increased photosynthesis. Corresponding samples collected at location WPDC exceeded the pH discharge limit in two of the seven monitoring events. The minimum pH at WPDC was 7.3 and the maximum was 9.0 for all seven events. Chromium, hexavalent chromium, copper, manganese and nickel were the only metals reported

above detection limits at both CDBX and WPDC. All detected metals were below discharge limits. All acute aquatic survival bioassay tests resulted in satisfactory survival of the test species.

DRB release samples were also analyzed for volatile organic compounds (VOCs), herbicides, and polychlorinated biphenyl compounds. All these analytical results were below detection limits.

E-2. References

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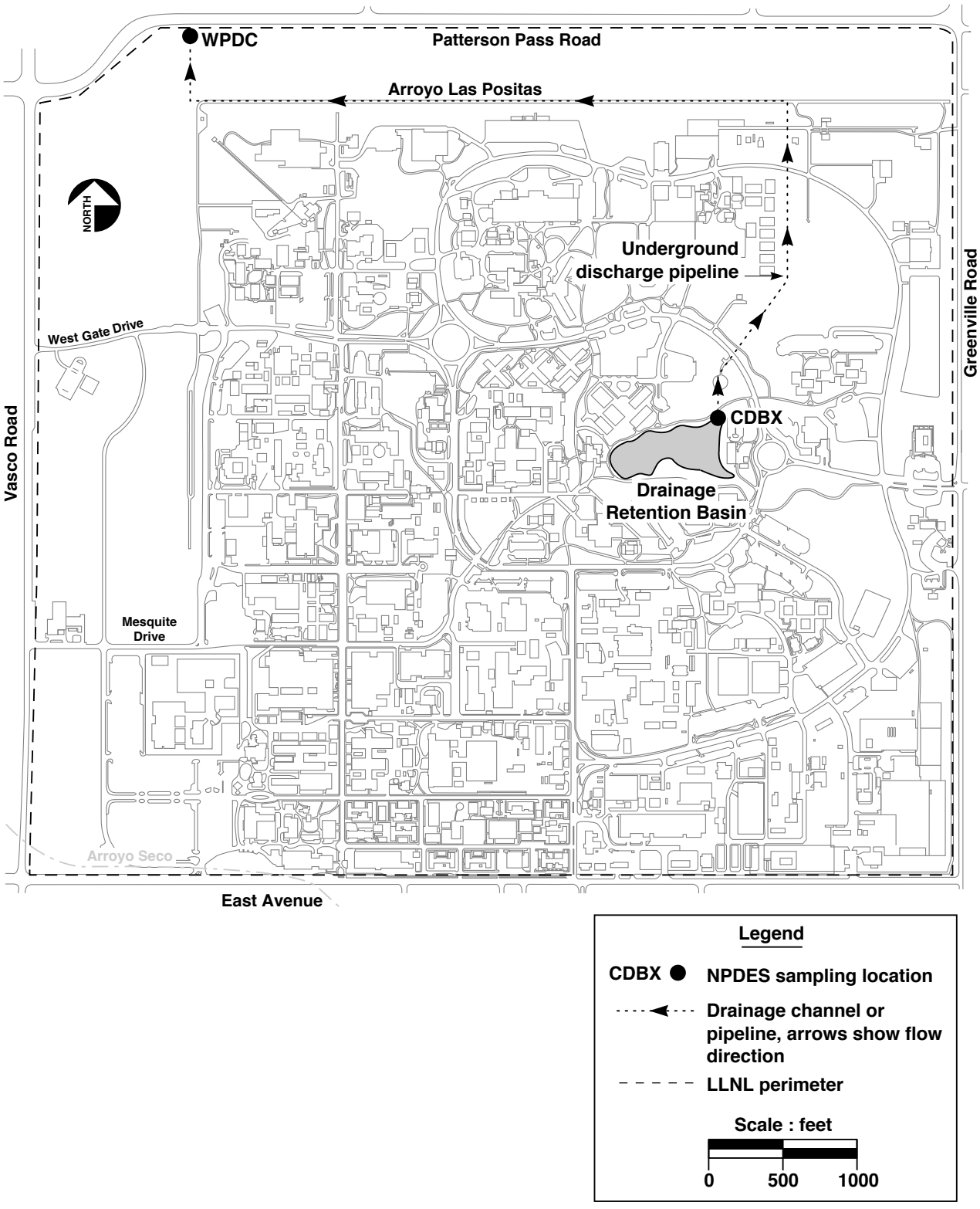

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Figure E-1. Location of the Drainage Retention Basin showing discharge sampling locations.