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Lawrence Livermore National Laboratory
University of California, Livermore, California 94550

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LLNL
Ground Water Project

2003 Annual Report

Technical Editors

J. Karachewski*
M. Dresen*
E. Folsom
L. Berg
J. Coty

Contributing Authors

L. Berg
N. Borglin
Z. Demir
K. Fox*
S. Gregory
K. Grote*
G. Howard
J. Karachewski*
P. Krauter
W. McConachie
C. Noyes
D. Rueppel
R. Ruiz

*Weiss Associates, Emeryville, California

Environmental Protection Department
Environmental Restoration Program and Division

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Summary

Significant 2003 Lawrence Livermore National Laboratory (LLNL) Livermore Site Ground Water Project (GWP) restoration activities included:

- Operating 26 ground water treatment facilities and two soil vapor treatment facilities.
- Operating 78 ground water extraction wells and three soil vapor extraction wells.
- Installing two ground water monitor wells, one dual (ground water and soil vapor) extraction well, 21 soil vapor wells, and abandoning one borehole.
- Installing four new anode wells and abandoning two anode wells for Plant Engineering.
- Conducting three hydraulic tests.
- Conducting 17 soil vapor extraction tests.
- Meeting all DOE milestones by starting:
  - TFC Northeast remediation,
  - Treatment Facility G North (TFG-N), and
  - Soil Vapor Treatment Facility E Eastern Landing Mat (VTFE ELM).
- Removing over 174 kilograms (kg) of mass from ground water and soil vapor (Table Summ-1).

In addition to the extraction wells, the Livermore Site currently has 514 monitor wells. Since remediation began in 1989, approximately 2.238 billion gallons of ground water and over 50 million cubic feet of vapor have been treated, removing more than 1,555 kg of VOCs (Table Summ-2).

Table Summ-1. Summary of 2003 VOC remediation.

Treatment facility area	Volume of ground water treated (Mgal)	Volume of soil vapor treated (kft^3)	Estimated total VOC mass removed (kg)
TFA	98.2	□	8.4
TFB	33.0	□	5.0
TFC	32.0	□	6.6
TFD	70.0	□	53.6
TFE	26.0	□	12.8
TFG	5.6	□	1.2
TF406	13.6	□	1.4
TF5475	0.1	□	0.5
VTF5475	□	8,532	33.9
TF518	1.4	□	0.5
VTF518	□	0	0
VTFE ELM	□	3,289	50.4
Total	280*	11,821	174*

Notes:

Mgal = Millions of gallons.

kft^3 = Thousands of cubic feet.

kg = Kilograms.

* = Rounded number.

□ = Not applicable.

Table Summ-2. Summary of cumulative VOC remediation.

Treatment facility area	Volume of ground water treated (Mgal)	Volume of soil vapor treated (kft^3)	Estimated total VOC mass removed (kg)
TFA	1,064.5	□	162.7
TFB	241.0	□	59.2
TFC	189.3	□	60.5
TFD	467.3	□	553.2
TFE	170.0	□	151.4
TFG	24.2	□	4.9
TF406	69.4	□	9.0
TF5475	0.7	□	5.4
VTF5475	□	31,757	340.0
TF518	11.2	□	4.8
VTF518	□	15,040	153.0
VTFE ELM	□	3,289	50.4
Total	2,238*	50,086	1,555*

Notes:

kg = Kilograms.

kft^3 = Thousands of cubic feet.

Mgal = Millions of gallons.

* = Rounded number.

□ = Not applicable.

1. Introduction

This report summarizes the Lawrence Livermore National Laboratory (LLNL) Livermore Site Ground Water Project (GWP) activities for the year 2003 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 during 2003; and Trends in Ground Water Analytical Results. The 2003 GWP quarterly self-monitoring reports (Bainer and Wong, 2003a; Bainer and Wong, 2003b; Berg and Wong, 2003; and Berg and Wong, 2004) were issued separately.

Figures 1 and 2 show the locations of treatment facilities, related areas, and wells at the Livermore Site. Twenty-eight wells, including four anode wells for cathodic protection for Plant Engineering, were installed in 2003 (Table 1). Hydraulic tests were conducted on three wells in 2003 (Table 2). Soil vapor extraction tests were conducted on 19 wells in 2003 (Table 3).

Appendices A through E present Well Construction and Closure Data, Hydraulic Test Results, Soil Vapor Extraction Test Results, the 2004 Ground Water Sampling Schedule, and the 2003 Drainage Retention Basin (DRB) Annual Monitoring Program Summary, respectively. Ground water volatile organic compound (VOC) analyses, water level elevations, and the Treatment Facility 406 (TF406) area ground water fuel hydrocarbon (FHC) analyses are available on request.

2. Regulatory Compliance

In 2003, the U.S. Department of Energy (DOE)/LLNL submitted the GWP 2002 Annual Report (Dibley et al., 2003) and Quarterly self-monitoring reports on schedule. In addition, DOE/LLNL completed all 2003 Remedial Action Implementation Plan (RAIP) milestones ahead of schedule (Dresen et al., 1993) (Table 4).

Livermore Site community relations activities in 2003 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 three times with members of Tri-Valley Communities Against a Radioactive Environment and their scientific advisor as part of the activities funded by an Environmental Protection Agency 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 Sampling

In 2003, the GWP collected 1,203 water samples during 854 events from 370 wells. Analytes included VOCs, FHCs, polychlorinated biphenyls (PCBs), metals, radionuclides, or

combinations thereof depending on well location. The following sampling methods were used in 2003:

- Specific-Depth Grab Sampling (SDGS) using an EasyPump or Geotech Specific Depth Sampler (SDS) pump: 525 events (61%).
- Three-volume purge: 155 events (18%).
- Low-volume purge: 74 events (9%).
- Other (bailer, electronic submersible pump, etc.): 100 events (12%).

The sampling frequency and method for collecting ground water samples from wells are determined by the Subproject Leaders by evaluating data quality objectives, historical analytical results, the cost-effective sampling algorithm, and hydraulic data.

Significant cost reduction is achieved each year through the use of SDGS and low-volume purge methods. The benefits of these methods include:

- Cost avoidance in excess of $100,000 again this year by preventing replacement of dedicated pumps and sampling equipment. This savings will eventually decline as dedicated equipment is replaced by SDGS devices.
- Increased technician efficiency and reduction in sampling time while increasing personnel safety.
- Elimination of 50,000 gallons of purge water requiring treatment and disposal.

Approximately 8,000 of the 50,000 gallons of purge water is mixed waste because it contains both VOCs and tritium. The SDGS and low-volume purge methods using the EasyPump and Geotech SDS pump has eliminated the need to collect, treat, and dispose mixed waste water and has resulted in further significant cost savings.

3.2. Source Investigations

During 2003, passive soil vapor investigations using Gore-Sorber® modules were conducted at two source areas to screen for VOCs in the vadose zone. Fifty Gore-Sorber® modules were deployed at the Treatment Facility D (TFD) – Southern East Traffic Circle (ETC-S) area and 64 Gore-Sorber® modules were deployed near Vapor Treatment Facility 518 (VTF518) (Fig. 2). The Gore-Sorber® modules were installed to a depth of approximately three feet below the surface and were left in the ground for a period of three weeks prior to retrieval and submission for VOC analysis.

The investigation at TFD ETC-S identified four VOC soil vapor anomalies in the vadose zone: (1) west of TFD Southeast (primarily tetrachloroethene [PCE] and trichloroethene [TCE]); (2) southeast of the Drainage Retention Basin (DRB) near well W-1301 (primarily PCE); (3) in the parking lot south of TFD Southeast (primarily PCE and TCE); and (4) southeast of the East Traffic Circle (primarily PCE). The Gore-Sorber® anomalies overlie the highest concentration hydrostratigraphic unit 2 (HSU 2) ground water VOC plume in the area. Results of this study and previous soil vapor investigations were used to site, drill, and install seven soil vapor extraction wells in the vadose zone for an upcoming TFD ETC-S milestone.

The investigation near VTF518 extended to the north and west of a previous Gore-Sorber® study (Fenstermacher, 2000). The current investigation identified three VOC soil vapor anomalies in the vadose zone: (1) north of VTF518 (primarily PCE); (2) west of VTF518

(primarily TCE); and (3) northwest of VTF518 near the decontamination pad (primarily TCE and PCE). The results of the Gore-Sorber® surveys will be used to plan the location of new wells in the area.

3.3. Soil Vapor Extraction Tests

Soil vapor extraction (SVE) tests were conducted in the vadose zone (HSUs 1B and 2) at TFD Helipad and Treatment Facility E (TFE) Eastern Landing Mat (ELM) (Fig. 2) to prepare for implementing RAIP milestones at both of these locations. The test wells are listed in Table 3 and the results are summarized in Table C-1 of Appendix C.

Six-hour SVE tests were conducted on six wells in the TFE ELM area. The vacuum applied to the wells ranged from 3.7 to 5.1 inches of mercury (Hg) and the vapor flow rates ranged from 10 to 37 standard cubic feet per minute (scfm). Soil vapor samples collected from the wellhead in Tedlar bags contained maximum total volatile organic compound (TVOC) concentrations ranging from 138 to 296 parts per million by volume (ppm_v).

Two-hour SVE tests were conducted on two wells in the TFD Helipad area. The shorter duration of these tests was due to the lower permeability of soils at the site. The vacuum applied to the wells ranged from 6.6 to 7.4 inches of Hg and the vapor flow rates ranged from 0.75 to 15.50 scfm. Soil vapor samples collected from the wellhead in Tedlar bags contained maximum TVOC concentrations ranging from 4.3 to 31 ppm_v.

As part of the TFD Helipad evaluation, nine HSU 3A/3B wells were also selected for high-vacuum, dual extraction tests. The ground water level was maintained at the base of the screened interval in nine former electro-osmosis (EO) wells for one month in an effort to de-water HSUs 3A/3B prior to conducting both short- and long-term high vacuum dual extraction tests. During the short-term tests, lasting six hours or less, the applied vacuum ranged from 12 to 15 inches Hg and the vapor flow rates ranged from 0.795 to 1.49 scfm. The maximum soil-vapor concentrations measured using an organic vapor analyzer (OVA) ranged from 10 to 31 ppm_v.

All nine wells were plumbed together for a two-week long-term test. The vacuum applied to the wells was 12 inches of Hg and the overall flow rate was 7 scfm. The OVA soil vapor concentrations ranged from 8.4 to 34.7 ppm_v. The flow and pressure data were analyzed to determine air permeability, radius of influence of each well, and communication between wells to provide design parameters for the proposed high-vacuum, dual extraction system.

4. Flow and Transport Modeling

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. In 2003, we continued development of the three-dimensional (3-D) basin-scale ground water flow and transport model initiated in 2002. The model was updated by incorporating remediation system improvements and hydrogeologic information from new wells. We are currently improving the calibration of the 3-D model flow field to simulate the extensive extraction well field and the resultant dewatering observed on the eastern portion of the site. In parallel with the basin-scale model, we developed several local-scale models to evaluate the

effectiveness of potential ground water injection wells to mitigate dewatering, as well as their long-term effect on the remediation system.

In addition to ground water flow and transport models, we also developed semi-analytical and numerical modeling tools to simulate dual extraction and SVE for remediation of source areas. We utilized these quantitative tools in the design, operation, and performance evaluation of the TFE ELM, Trailer 5475, and TFD Helipad source areas. The semi-analytical models were initially calibrated with the data obtained from SVE tests conducted at these source areas. The models were then used to select extraction well locations and treatment facility design parameters such as optimal vapor extraction flow rates. Currently we are refining our source area remedial modeling capabilities and developing approaches to integrate them with the regional-scale models for determining realistic estimates of cleanup time for the Livermore Site.

5. Summary of Remedial Action Program

This section summarizes 2003 activities 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 and abandoning wells, and performing hydraulic and SVE tests.

In 2003, DOE/LLNL operated ground water treatment facilities in the TFA, Treatment Facility B (TFB), Treatment Facility C (TFC), TFD, TFE, Treatment Facility G (TFG), TF406, Treatment Facility 518 (TF518), and Treatment Facility 5475 (TF5475) areas (Fig. 1). A total of 78 ground water extraction wells supplied water to 26 treatment facilities at a combined average flow rate of about 533 gallons per minute (gpm). In 2003, these facilities treated about 280 million gallons of ground water and removed about 90 kilograms (kg) of VOCs (Table Summ-1) compared to 108 kg in 2002. The lower quantity of mass removed in 2003 is partially due to decreasing concentrations in TFD and TFE area ground water extraction wells. Since remediation began in 1989, approximately 2.238 billion gallons of ground water have been treated, resulting in a mass removal of about 1,012 kg of VOCs (Fig. 3 and Table Summ-2).

In addition, DOE/LLNL operated two soil vapor treatment facilities (VTFs), VTF5475 and VTFE ELM (Fig. 1). In 2003, these facilities treated about 11 million standard cubic feet (scf) of vapor and removed an estimated 84 kg of VOCs (Table Summ-1) compared to about 38 kg in 2002. The higher quantity of mass removed in 2003 is due to increased flow rates at VTF5475 and activation of VTFE ELM. Since initial operation, the three VTFs (VTF5475, VTFE ELM, and VTF518) have treated over 50 million cubic feet of vapor and removed about 543 kg of VOCs (Fig. 3 and Table Summ-2).

The ground water and soil vapor treatment systems have removed about 1,555 kg of VOCs from the subsurface since remediation began in 1989 (Table Summ-2).

Wells installed in 2003 are shown on Figure 2 and Table 1. Well construction data are presented in Table A-1 of Appendix A. Wells sealed and abandoned in 2003 are presented in Table A-2 of Appendix A. Hydraulic tests performed in 2003 are presented in Table 2 and test results are presented in Appendix B. Soil vapor extraction tests performed in 2003 are presented in Table 3 and test results are presented in Appendix C. Mass removed by treatment facility area in 2003 is presented in Table Summ-1 and cumulative mass removed by treatment facility area is

presented in Table Summ-2. The treatment facilities, discharge locations, and extraction wells are presented in Table 5.

Treatment facility performance is evaluated using several different data sets. Figures 4 through 9 show the estimated hydraulic capture areas in HSUs 1B, 2, 3A, 3B, 4, and 5, respectively, based on 2003 ground water elevation data. Figures 10 through 15 show fourth quarter 2003 total VOC isoconcentrations in the same six HSUs. Contaminant concentration trends (Section 7) are also used to evaluate treatment facility performance and hydraulic capture. Figures 16 through 21 show new or modified treatment facilities, extraction wells, pipelines, discharge points, and self-monitoring program sampling locations for 2003.

Activities at and performance of each Livermore Site treatment facility in 2003 are briefly summarized below.

5.1. Treatment Facility A Area

Two treatment facilities, TFA and TFA East (TFA-E) (Figs. 1 and 2), operated in compliance with all permits throughout 2003.

Since December 2002, TFA has been discharging some treated ground water directly to Arroyo Seco. After June 2003, TFA ceased discharging treated effluent to the Recharge Basin due to severely decreased capacity of the percolation ponds (Dibley et al., 2002). In June 2003, TFA began also discharging to Arroyo Las Positas via the drainage ditch at TFB (Fig. 16).

With the exception of the offsite "detached" plume in HSU 2 (Fig. 11), the TFA 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. 4 and 5) and total VOC isoconcentration maps (Figs. 10 and 11). Capture zone analysis and stable concentrations at well W-404 suggest that the "detached" offsite plume remained immobilized within a stagnant zone west of the TFA West extraction wellfield during 2003 (Figs. 5 and 11). Pumping continues at offsite HSU 1B extraction well W-408 to ensure hydraulic control of the residual HSU 1B VOC plume at wells W-506 and W-1425, where the PCE concentrations were 5 parts per billion (ppb) and 9 ppb, respectively in October 2003.

5.2. Treatment Facility B Area

TFB (Figs. 1 and 2) operated in compliance with all permits during 2003. Extraction well W-655 did not operate in 2003 since all contaminants of concern continued to remain below Maximum Contaminant Levels (MCLs) at this location.

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. 4 and 5), the total VOC isoconcentration maps (Figs. 10 and 11), and stable or declining VOC concentrations in the area.

5.3. Treatment Facility C Area

Three treatment facilities, TFC, TFC Southeast (TFC-SE), and TFC East (TFC-E), (Figs. 1 and 2), operated in compliance with all permits throughout 2003.

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. 4 and 5), the total VOC isoconcentration maps (Figs. 10 and 11), and stable or declining VOC concentrations in the area.

5.4. Treatment Facility D Area

Seven treatment facilities operated in (Figs. 1 and 2). These facilities are TFD, TFD West (TFD-W), TFD East (TFD-E), TFD Southeast (TFD-SE), TFD South (TFD-S), TFD Southshore (TFD-SS), and TFD Helipad.

TFD facilities complied with all permits throughout 2003 except for two spills. Both spills were not required to be reported due to low contaminant mass; however, a courtesy notification was provided to the San Francisco Bay Regional Water Quality Control Board. Approximately 1,000 gallons of untreated ground water was released from TFD Helipad and spilled onto the ground on October 31, 2003. The water seeped into the nearby soil but did not enter a storm drain. The quantity of water was insufficient to reach ground water. The total VOC concentration in the spilled water was approximately 780 ppb and the VOC mass was about 3.2 grams, principally TCE. The cause of the spill was incorrect interlocking of a secondary pumping system. The interlock was corrected on November 5, 2003 prior to restarting the treatment facility.

Approximately 500 gallons of untreated ground water spilled onto the ground at TFD West on November 27, 2003. The water seeped into the nearby soil but did not enter a storm drain. The quantity of water was insufficient to reach ground water. The total VOC concentration in the spilled water was approximately 232 ppb and the VOC mass was about 0.4 grams of VOCs, principally Freon 11. The cause of the failure was a cracked pipe fitting at extraction well W-1902, which was repaired on December 1, 2003.

The TFD area extraction wells exert significant hydraulic control over VOCs in HSUs 2, 3B, and 4 based on the capture zone analysis shown on the ground water elevation contour maps (Figs. 5, 7, and 8) and the total VOC isoconcentration maps (Figs. 11, 13, and 14) for each HSU. Distal portions of VOC plumes in HSUs 1B and 2 (Figs. 4, 5, 10, and 11) in the western TFD area are being hydraulically contained by TFC-E. Distal portions of the VOC plume in HSU 3A in the northwestern TFD area are being hydraulically contained by new HSU 3A extraction well W-1902 at TFD-W (Figs. 2 and 6).

The TFD Helipad ground water treatment facility (Fig. 2) was originally installed to support electro-osmosis tests. Although no electro-osmosis tests were conducted in 2003, the facility continued to operate to expedite VOC mass removal and source area cleanup through conventional ground water extraction and above-ground treatment.

In lieu of constructing a new facility for remediation of the TFC-NE area (May 30, 2003 milestone), newly constructed ground water extraction well W-1902 was connected to TFD-W (Fig. 17). Well W-1902 is located and designed to hydraulically contain and treat VOCs in HSU 3A that had been migrating westward toward the TFC-NE area. The pipeline connecting well W-1902 to TFD-W was activated on May 23, 2003, seven days ahead of the TFC-NE milestone date.

Two new monitor wells and 11 soil vapor extraction wells were installed in the TFD area in 2003 (Fig. 2). Monitor well W-1904 was completed in HSU 2 north of the TFD-SE area and well W-1905 was completed in HSU 3A southeast of the TFD-SS area. Soil vapor extraction

wells SVB-HPA-001A, -001B, -002A, and -002B were completed in HSUs 1B and 2 in the TFD Helipad area. Soil vapor extraction wells SVB-ETC-2001A, -2001B, -2002A, -2002B, -2003, -2004A, and -2004B were completed in HSUs 1B and/or 2 in the TFD East Traffic Circle area. Well construction details are provided in Table A-1 of Appendix A.

A passive soil vapor survey (SVS) using Gore-Sorber® modules was conducted in the TFD East Traffic Circle area in 2003 (see Section 3.2).

5.5. Treatment Facility E Area

Six treatment facilities, TFE East (TFE-E), TFE Northwest (TFE-NW), TFE Southwest (TFE-SW), TFE Southeast (TFE-SE), TFE West (TFE-W), and VTFE ELM (Figs. 1 and 2), operated in compliance with all permits throughout 2003. PTU-4, a portable hydraulic test unit that normally operates in the northern TFE area when not being used elsewhere for testing, did not operate there in 2003 due to the lack of a permanent power hook up.

The TFE-E, TFE-NW, TFE-SW, TFE-SE, and TFE-W extraction wells hydraulically contain some portions of VOC plumes in HSUs 3A and 5 and most of the VOC plumes in HSUs 2, 3B, and 4 based on the capture zone analysis shown on the ground water elevation contour maps (Figs. 5, 6, 7, 8, and 9) and the total VOC isoconcentration maps (Figs. 11, 12, 13, 14, and 15) for each HSU. Hydraulic control of the leading edge of a mobile HSU 2 VOC plume emanating from the TFE area was achieved with activation of the TFG North (TFG-N) facility in July 2003.

One new air inlet well and seven SVE wells were installed in the TFE area in 2003 (Fig. 2). Well W-1909, completed in HSU 2 and designed as a hot air injection well to aid in remediating the newly de-watered vadose zone, was installed as part of the September 2003 TFE ELM milestone. SVE wells SVB-543-001, -002A, -002B, -003, -004A, -004B, and -1908 were installed at soil vapor anomalies identified during a Gore-Sorber® survey conducted in November 2002. The SVE wells were designed to remediate the vadose zone portion of the source area as part of the TFE ELM September 2003 milestone. Well construction details are provided in Table A-1 of Appendix A.

VTFE ELM was added to the TFE area in 2003 and treated soil vapor from one SVE well and one dual extraction well (Fig. 18). The ground water from dual extraction well W-1903 is being treated at TFE-E (Fig. 19). VTFE ELM was activated on September 12, 2003, four days ahead of the TFE ELM milestone date.

5.6. Treatment Facility G Area

Two treatment facilities, TFG-1 and TFG-N (Figs. 1 and 2), operated in compliance with all permits throughout 2003.

TFG-1 extraction well W-1111 hydraulically controls most of the VOCs in HSU 2 in the TFG area based on the capture zone analysis shown on the ground water elevation contour map (Fig. 5) and the total VOC isoconcentration map (Fig. 11).

One new treatment facility, TFG-N, was added in 2003. TFG-N extraction wells W-1806 and W-1807 hydraulically control VOCs in HSU-1B and 2, respectively. The TFG-N facility is a miniature treatment unit and was activated on July 28, 2003, three days ahead of the milestone date. It is equipped with an air stripper to treat VOCs in ground water. The effluent air is treated with granular activated carbon (GAC) to remove VOCs prior to venting to the atmosphere.

Treated ground water is discharged into an underground storm drain that empties into the TFC discharge location (Fig. 20).

5.7. Treatment Facility 406 Area

Two treatment facilities, TF406 and TF406 Northwest (TF406-NW) (Figs. 1 and 2), operated in compliance with all permits in 2003.

Passive bioremediation of fuel hydrocarbons in HSUs 3A and 3B continued during 2003.

The TF406, TF406-NW, and TF518-North (TF518-N) (see Section 5.9) extraction wells hydraulically control the VOC plumes in HSUs 3B, 4, and 5, and provide significant hydraulic control of VOC plumes in HSU 3A based on the capture zone analysis shown on the ground water elevation contour maps (Figs. 6, 7, 8, and 9), the total VOC isoconcentration maps (Figs. 12, 13, 14, and 15), and stable or declining VOC concentrations in the area.

5.8. Treatment Facility 518 Area

TF518-N (Figs. 1 and 2) was in compliance with all permits in 2003. HSU 5 remained de-watered throughout 2003 in the area where TF518 was formerly located.

HSU 4 extraction well W-1410 at TF518 North and HSU 5 extraction wells at TF406 and TFE-SE continue to provide hydraulic control of VOC plumes in HSUs 4 and 5 based on the capture zone analysis shown on the ground water elevation contour maps (Figs. 8 and 9) and the total VOC isoconcentration maps (Figs. 14 and 15). The sustained de-watering in HSU 5 impacts hydraulic control by widening the capture areas.

Vapor treatment facility 518 (VTF518) (Figs. 1 and 2) has not operated since 2001 (Dibley et al., 2002; 2003). Both perched ground water treatment and SVE are scheduled for implementation in this area as part of a July 30, 2004 milestone.

Water with high VOC concentrations (12 to 23 parts per million [ppm]) was extracted on a periodic basis from former SVE well SVB-518-303. This water was collected in a tank and transported to TFD for treatment. A total of 117 gallons of water was extracted during 2003, resulting in a mass removal of approximately 6.9 grams of VOCs. Three instrumented membrane systems (IMS) in boreholes IMS-518-1616, SEA-518-301 and SEA-518-304, are used to monitor and collect vapor pressure, soil temperature, soil moisture, and soil vapor concentration data from various discrete depths of the vadose zone. Vapor samples were collected for VOC analysis in September from all IMS wells and two SVE wells. Total VOC concentrations in the IMS wells ranged from 2 to 61 ppm_v. Total VOC concentrations in samples collected from the two SVE wells, SVB-518-204 and SVB-518-303 were 333 and 47 ppm_v, respectively. Moisture monitoring during 2003 indicated that fine-grained soils in the heterogeneous vadose zone have high relative saturation.

Three SVE wells were installed in the VTF518 area in 2003. SVB-518-1913, -1914, and -1915 (Fig. 2) will be used to remediate the perched water zone in this area. Well SVB-518-1915 replaced SVB-158-303, which was destroyed because of a long screened interval from 6 to 40 ft. The long screened interval may have acted as a vertical conduit for transporting near surface water deeper into the vadose zone. Electrical Resistance Tomography (ERT) sensors were installed in the boreholes of the three wells and at selected surface locations as a means of monitoring changes in soil moisture content in response to seasonal weather patterns

and remedial activities associated with the upcoming milestone. Well construction details are provided in Table A-1 of Appendix A. An additional shallow seismic survey was also conducted to aid delineation of the perched water zone.

A passive SVS using Gore-Sorber® modules was conducted in the TF518 area in 2003 (see Section 3.2).

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, 2, and 21), operated in compliance with all permits throughout 2003 except for one occasion noted below. TF5475-1 and TF5475-3 use catalytic reductive dehalogenation (CRD) to remediate the VOCs in ground water, and TF5475-3 also extracts soil vapor. TF5475-2 uses granular activated carbon to remediate VOCs.

A 90% VOC destruction efficiency is required for the CRD units. VOC destruction efficiency was greater than 98% in 2003 at TF5475-1 (CRD-1) based on comparison of influent and effluent concentrations. VOC destruction efficiency of TF5475-3 (CRD-2) was greater than 95% for all samples except for April 2003, which had a removal efficiency of 88%. The unusual April value was due to low hydrogen injection rates caused by difficulty in adjusting hydrogen flow at very low ground water extraction rates. This problem has been resolved by operating for a few hours per day at higher ground water flow rates and then shutting down the system over night to let water levels recover. Wells W-1606 and W-1608 are not currently extracting ground water at TF5475-3 due to the de-watered condition of HSU 3A in the T5475 area.

6. Ground Water Discharges During 2003

In 2003, approximately 11.5 millions of gallons (Mgal) of treated ground water was discharged to the Recharge Basin, about 205.7 Mgal of treated ground water was discharged to Arroyo Las Positas, and an estimated 62.6 Mgal of treated ground water was discharged to Arroyo Seco.

7. Trends in Ground Water Analytical Results

In 2003, concentrations continued to decrease in most Livermore Site VOC plumes. The decline in VOC concentrations is primarily attributed to active remediation and reflects the 90 kg of VOCs removed by the ground water extraction wells during 2003 (Table Summ-1). Notable trends and results of VOC analyses of ground water received from the fourth quarter 2002 to the third quarter 2003 are discussed below.

VOC concentrations on the western margin of the site either declined or remained unchanged during 2003, indicating continued effective hydraulic control of the boundary plumes in the TFA, TFB, and TFC areas. VOC concentrations in the TFA, TFB, and TFC source areas remained unchanged as well. The offsite HSU 1B VOC plumes were below MCLs for all VOCs of concern except at one well with only a slight exceedance. PCE was detected at 5.4 ppb at well W-506 in October 2003. The entire offsite and onsite TFA HSU 2 plume was below 50 ppb TVOCs for the first time in 2003. All offsite TFA HSU 3A wells remained below MCLs for all VOCs of concern.

VOC concentrations in a mobile HSU 2 plume located in the western TFE area continued to decline in 2003. The 100 ppb TVOC contour within the plume shrank 550 ft toward TFE-W extraction well W-305, and TVOCs in SIP-331-001 in the south central part of the site declined from 101 ppb in 2002 to 80 ppb in 2003. Concentrations further downgradient to the west increased slightly, probably in response to activation of TFG North extraction well W-1807, located at the leading edge of the plume. Total VOC concentrations in the Old Salvage Yard in the southeastern part of the site, also known as the TFE Hotspot source area, remained elevated in 2003 (e.g., 1,584 ppb TVOCs at SIP-ETS-601). Source area cleanup at the TFE Hotspot source area is scheduled to begin in 2005.

HSU 3A total VOC concentrations continued to decline in the TF5475 area in 2003 due to a combination of soil vapor extraction at VTF5475 and regional dewatering of HSU 3A. VOCs also declined in the east-central TFD area in response to pumping at TFD-SS. TCE concentrations in well W-361 declined from 1,000 ppb in 2002 to 140 ppb in 2003. Elsewhere in HSU 3A, concentrations remained largely unchanged during 2003.

In HSU 3B, a significant TCE concentration increase observed near TFD-S suggests that VOCs within HSU 3B may be migrating out of the TFD-SE area toward the TFD-S area. TCE in well W-1511 increased from 62 ppb in 2002 to 750 ppb in 2003. Hydraulic containment of the HSU 3B source area will be addressed as part of the upcoming TFD ETC-S milestone. Elsewhere in HSU 3B, VOC concentrations remained largely unchanged during 2003.

A significant TVOC concentration increase was also observed in HSU 4 at the TFD Helipad area, where concentrations in well W-1253 increased from 212 ppb in 2002 to 3,403 ppb in 2003. Hydraulic containment of the HSU 4 source area at the TFD Helipad area will be addressed as part of the upcoming 2004 TFD Helipad milestone. Elsewhere, concentrations in HSU 4 remained largely unchanged during 2003.

VOC concentrations in HSU 5 continue to slowly decline in the TFE-E area due to pumping at extraction well W-566. TVOC concentrations at downgradient well W-1210 decreased from 56 ppb in 2002 to 47 ppb in 2003. VOC concentrations on DOE property administered by Sandia National Laboratories south of East Avenue remained low during 2003, suggesting that the TF406 South facility proposed for 2006 may not be needed to achieve timely cleanup. The highest TCE concentrations were observed in well W-509, which declined from 20 ppb in 2002 to 15 ppb in 2003. HSU 5 VOC concentrations in other areas of the Livermore Site remained largely unchanged during 2003.

During 2003, tritium activities in ground water from all wells in the TF5475 area remained below the 20,000 picocuries per liter (pCi/L) MCL and continued to decrease by natural decay. Similarly, tritium activities in the Building 292 area declined below the MCL in 2003.

8. References

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Dibley, V., M.D. Dresen, L.L. Berg, R.W. Bainer, and E.N. Folsom (Eds.) (2002), *LLNL Ground Water Project 2001 Annual Report*, Lawrence Livermore National Laboratory, Livermore, Calif. (UCRL-AR-126020-01)

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Figures

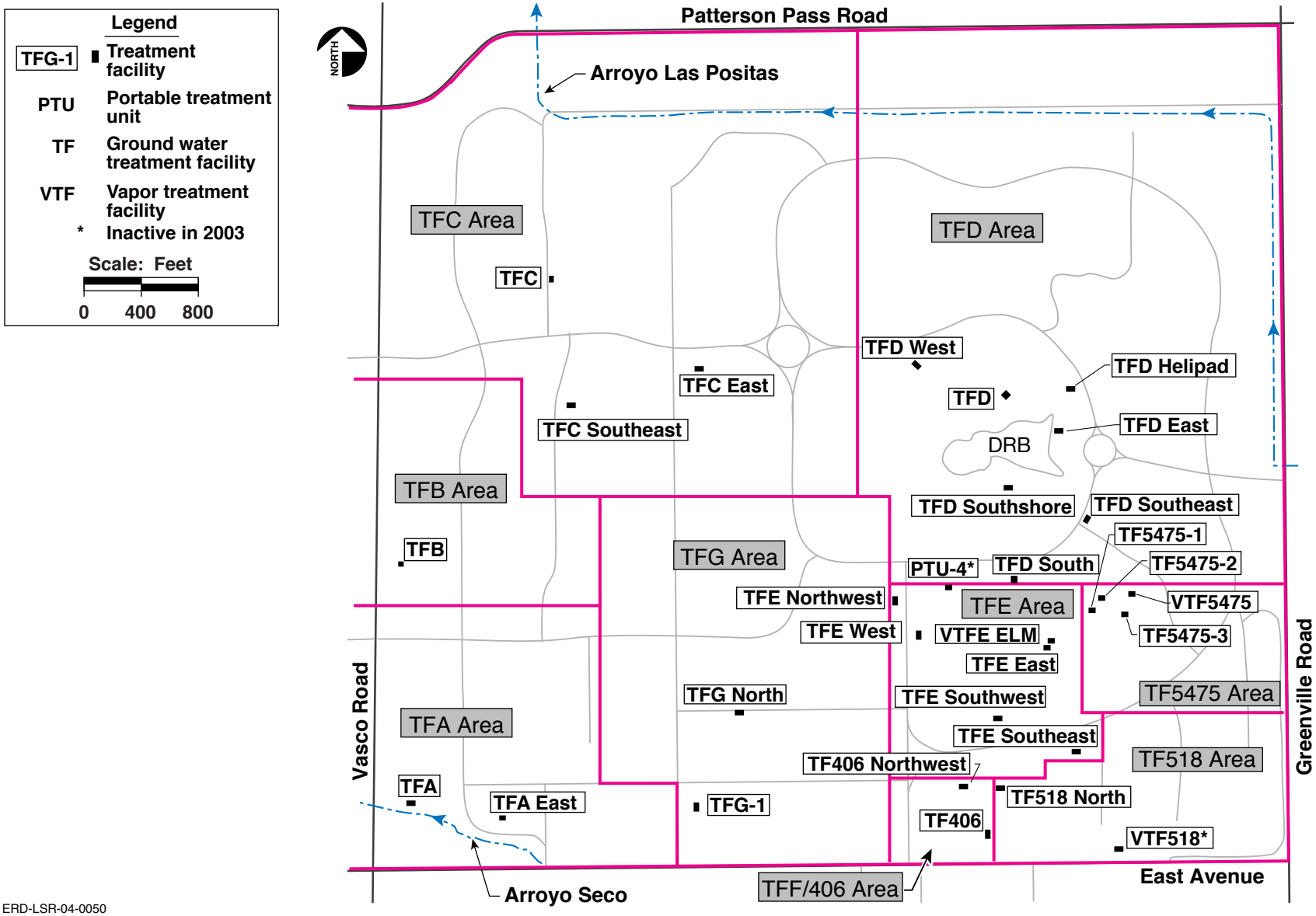

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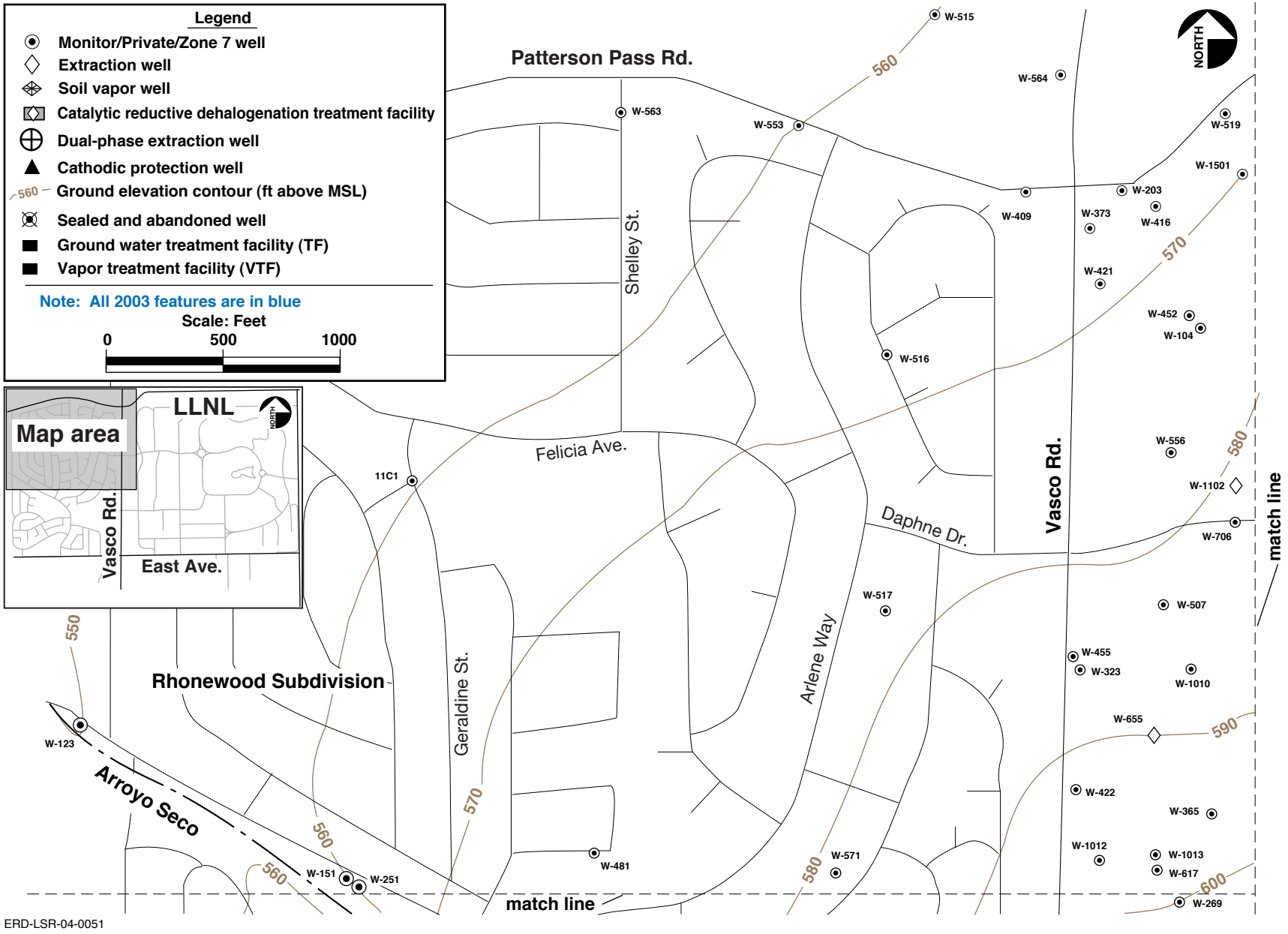
Figure 1. Livermore Site treatment facilities and related areas.



ERD-LSR-04-0051

Figure 2. Locations of Livermore Site wells and treatment facilities, December 2003.

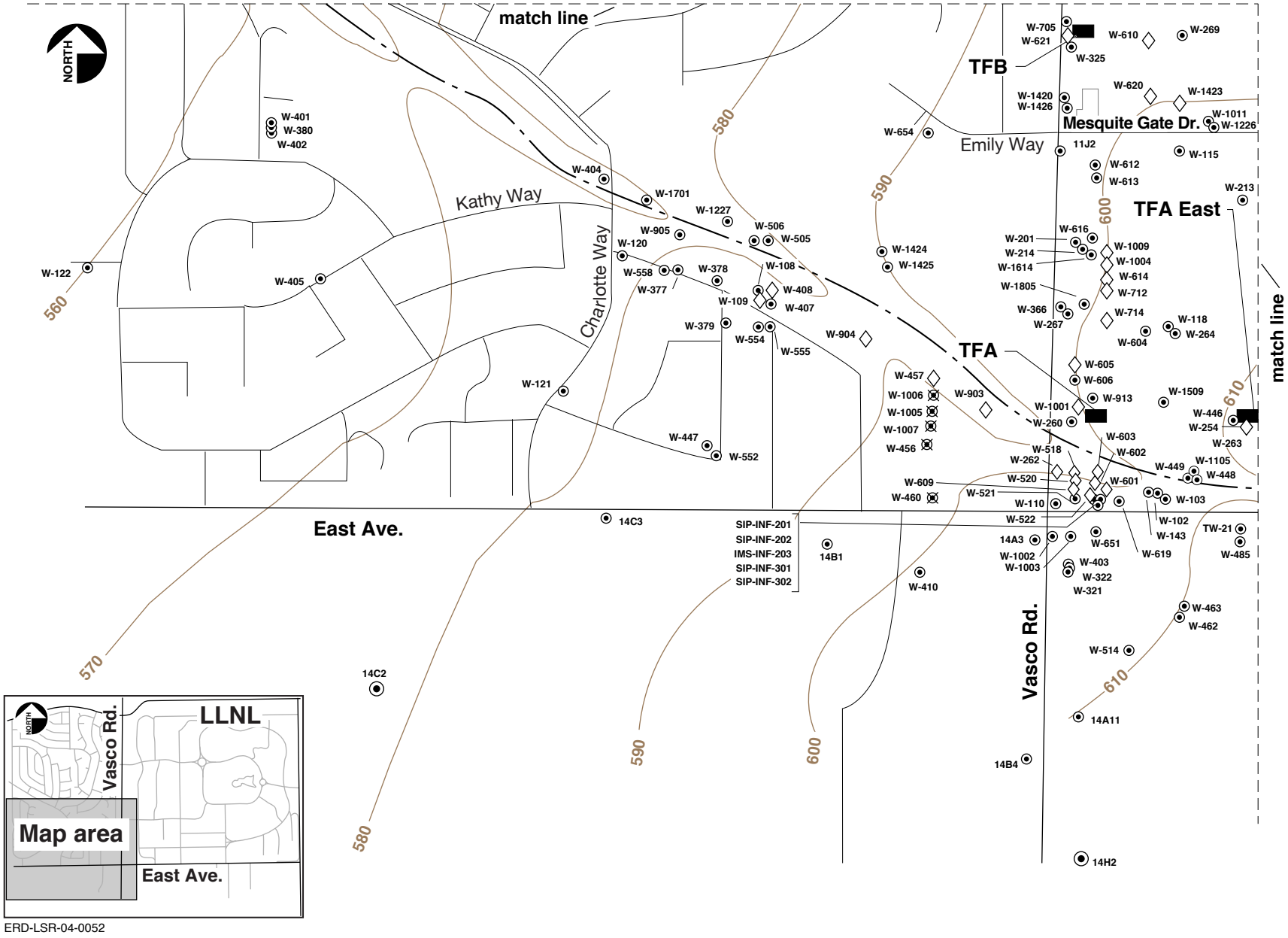


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Figure 2. Locations of Livermore Site wells and treatment facilities, December 2003 (continued).

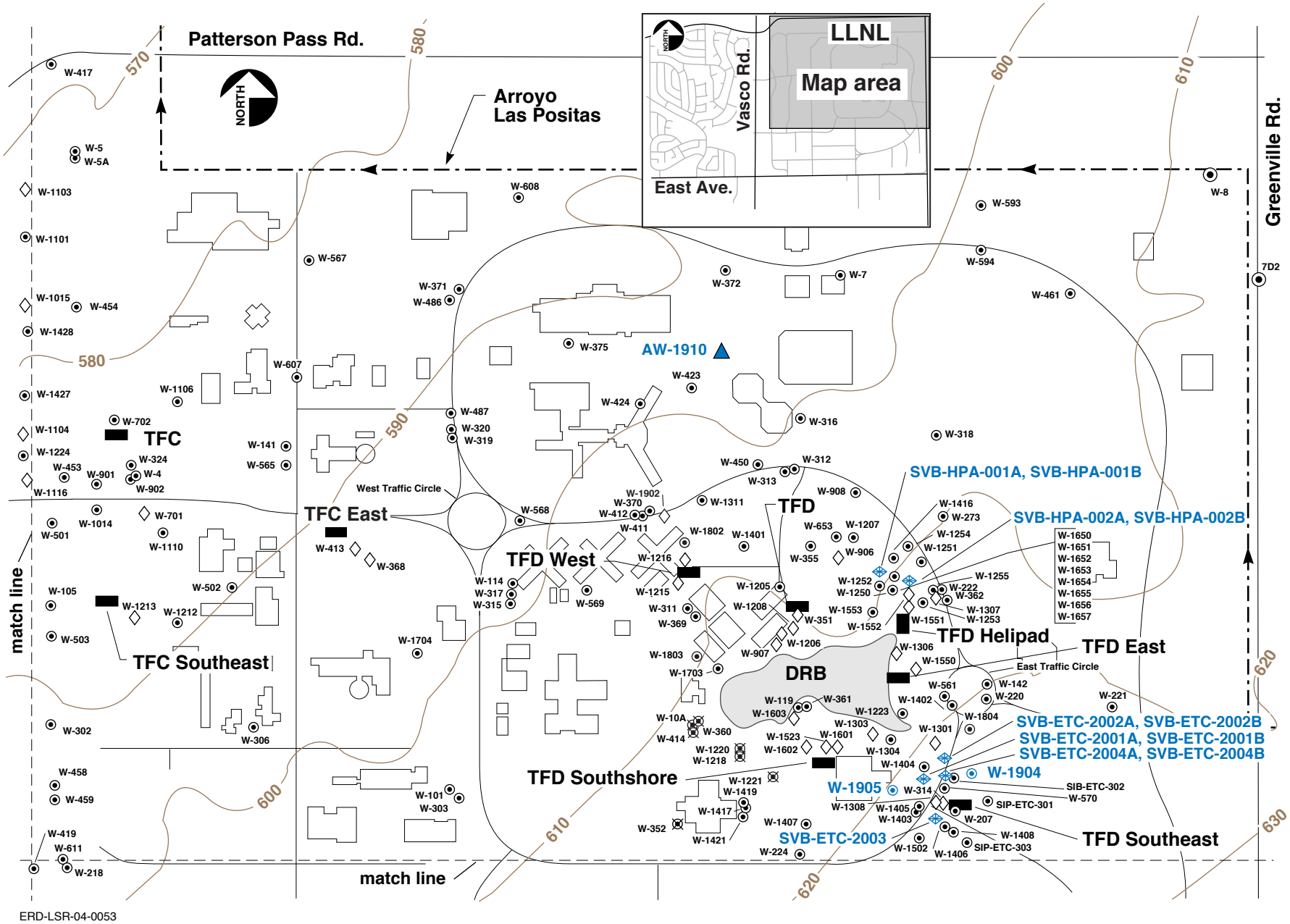

Figure 2. Locations of Livermore Site wells and treatment facilities, December 2003 (continued).

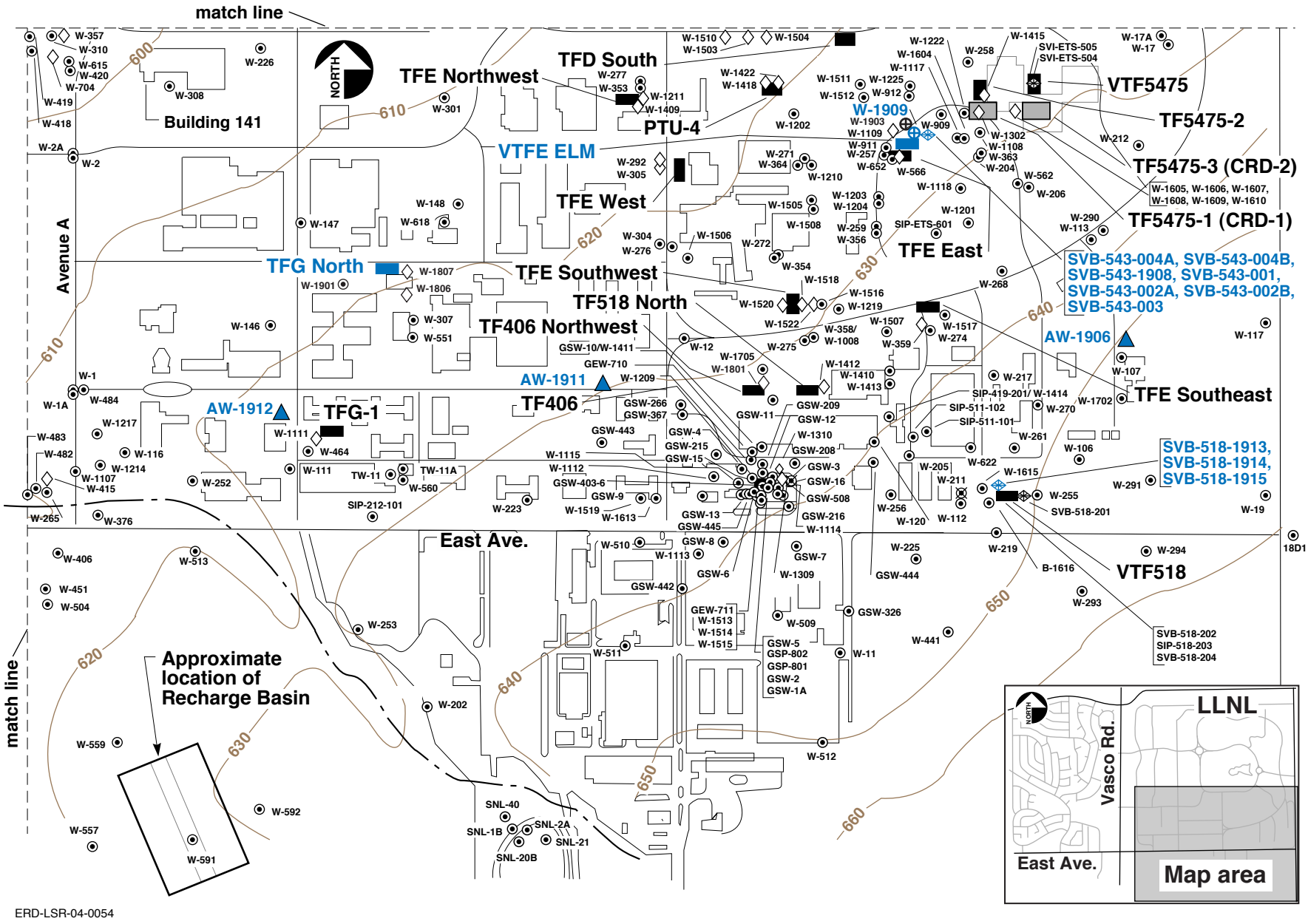

Figure 2. Locations of Livermore Site wells and treatment facilities, December 2003 (continued).

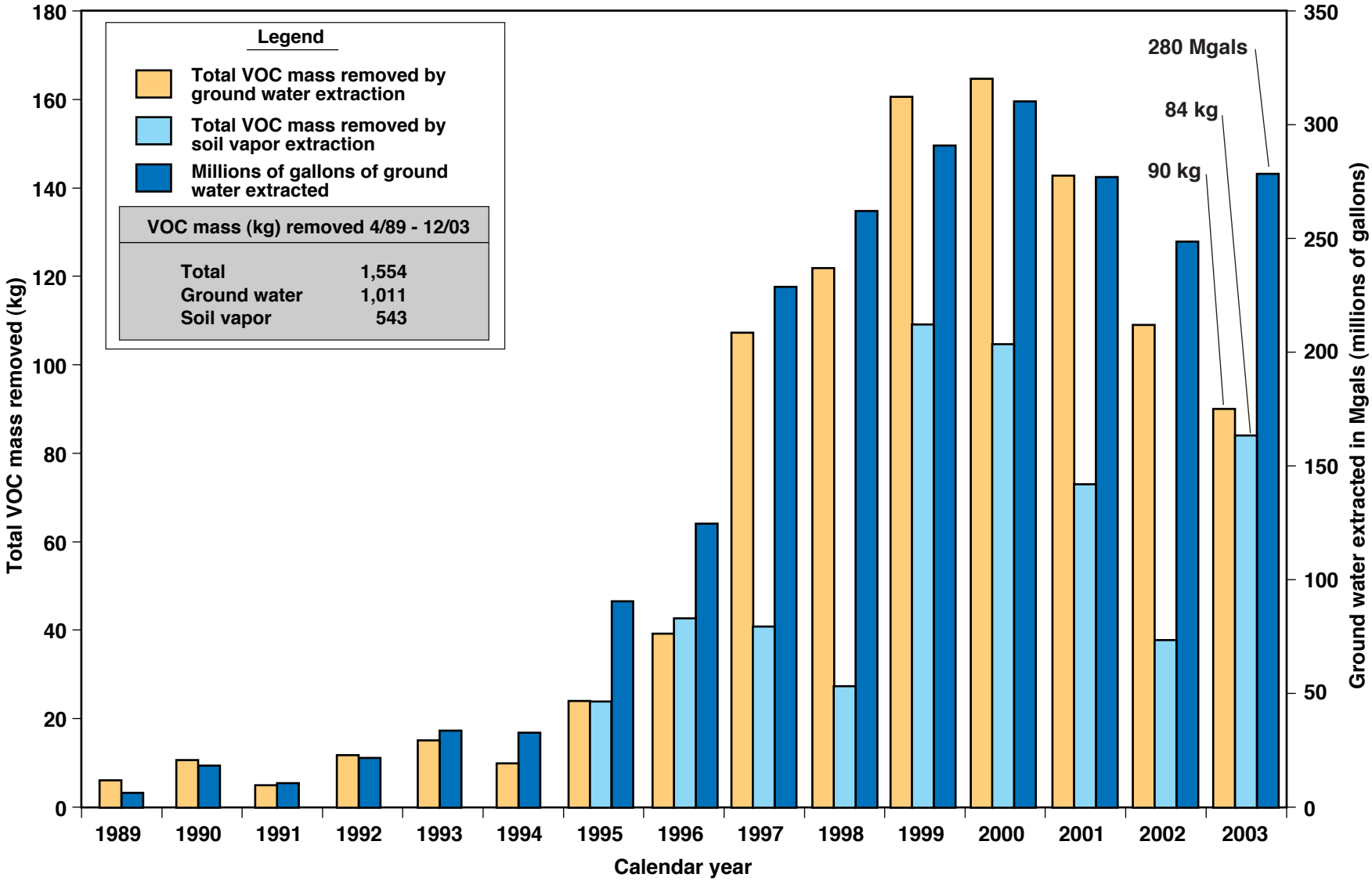

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Figure 3. Total VOC mass removed from the Livermore Site subsurface over time.

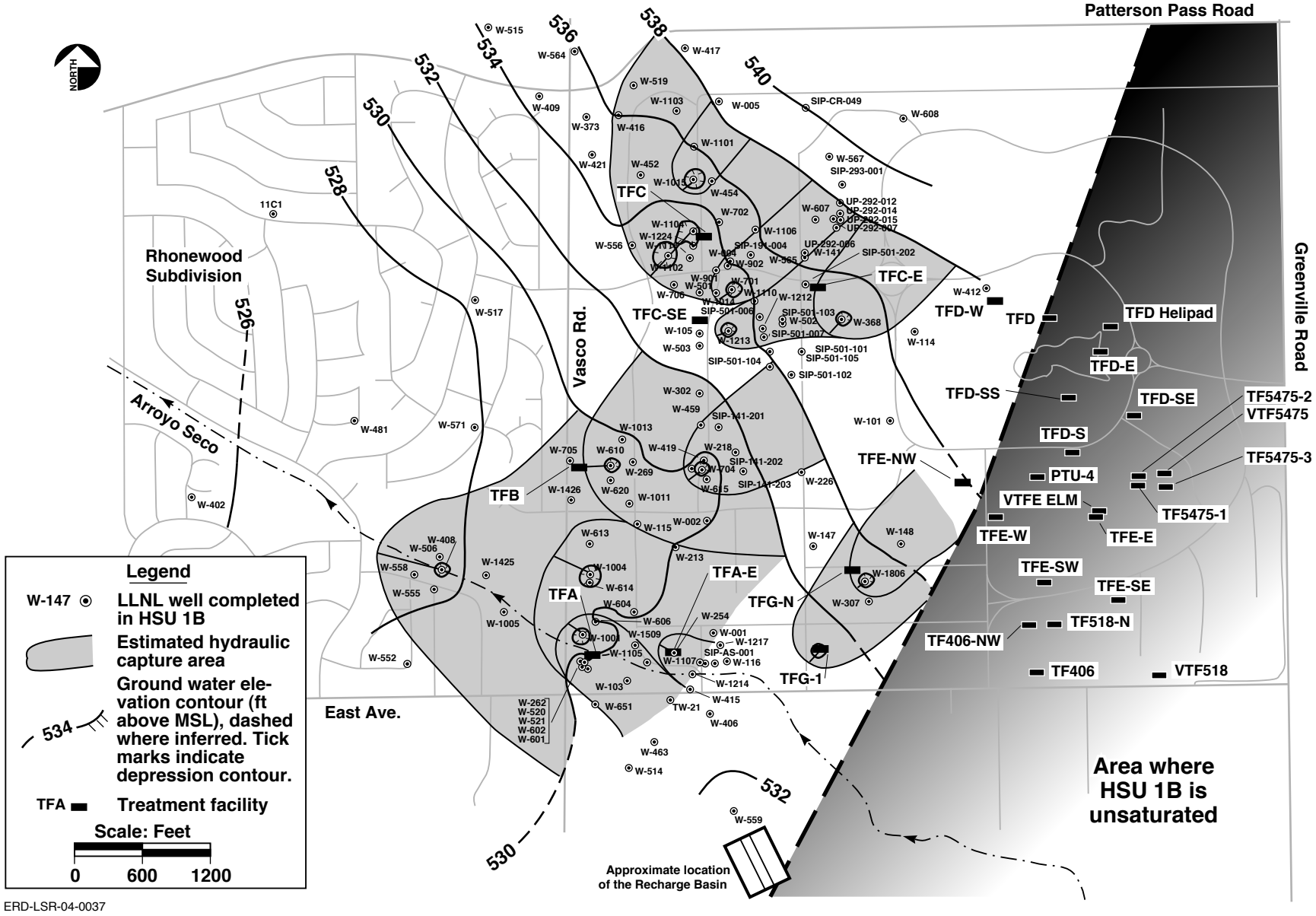

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Figure 4. Ground water elevation contour map based on water levels collected from 136 wells completed within HSU 1B showing estimated hydraulic capture areas, LLNL and vicinity, November 2003.

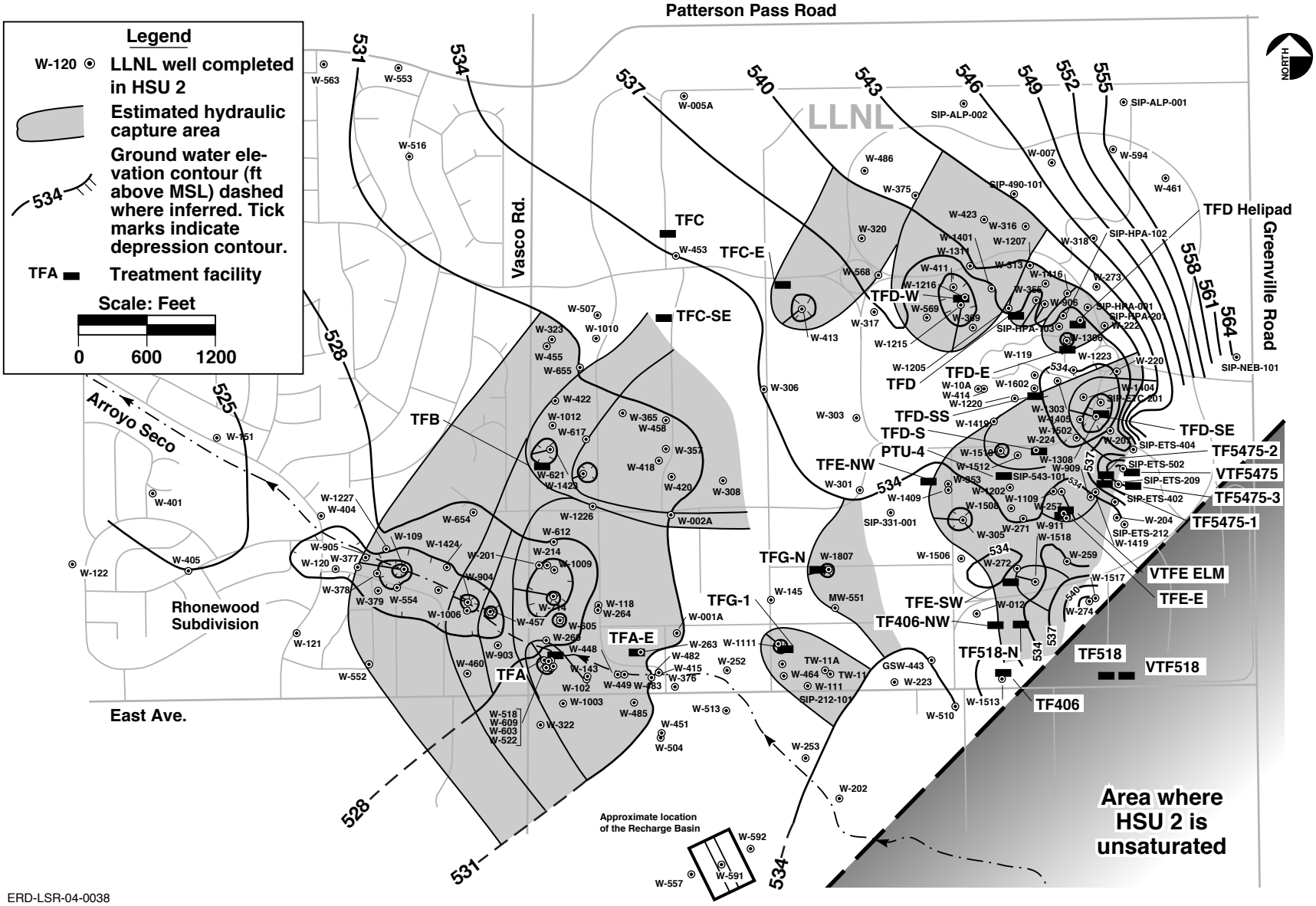

Figure 5. Ground water elevation contour map based on water levels collected from 166 wells completed within HSU 2 showing estimated hydraulic capture areas, LLNL and vicinity, November 2003.

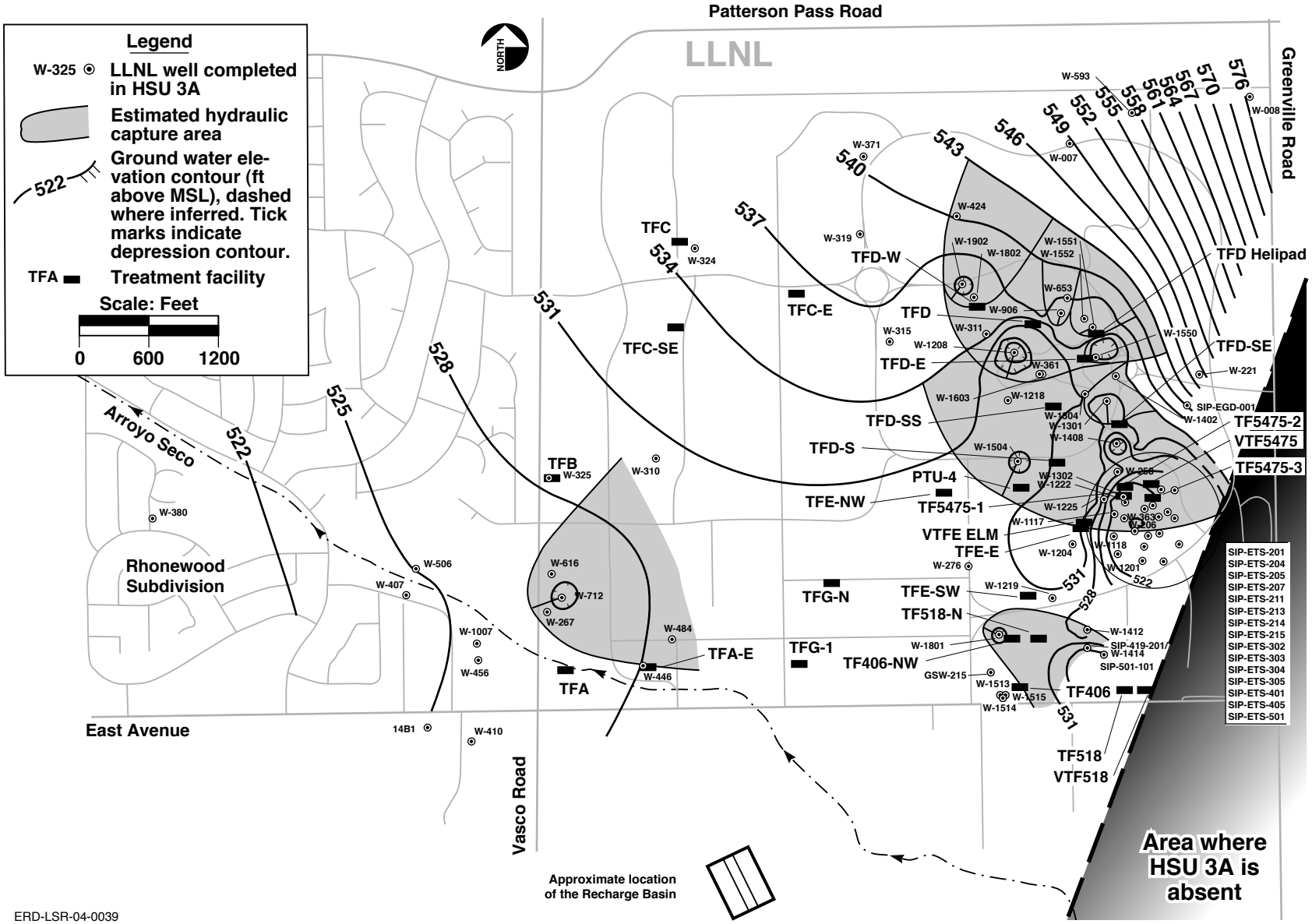

Figure 6. Ground water elevation contour map based on water levels collected from 72 wells completed within HSU 3A showing estimated hydraulic capture areas, LLNL and vicinity, October 2003.

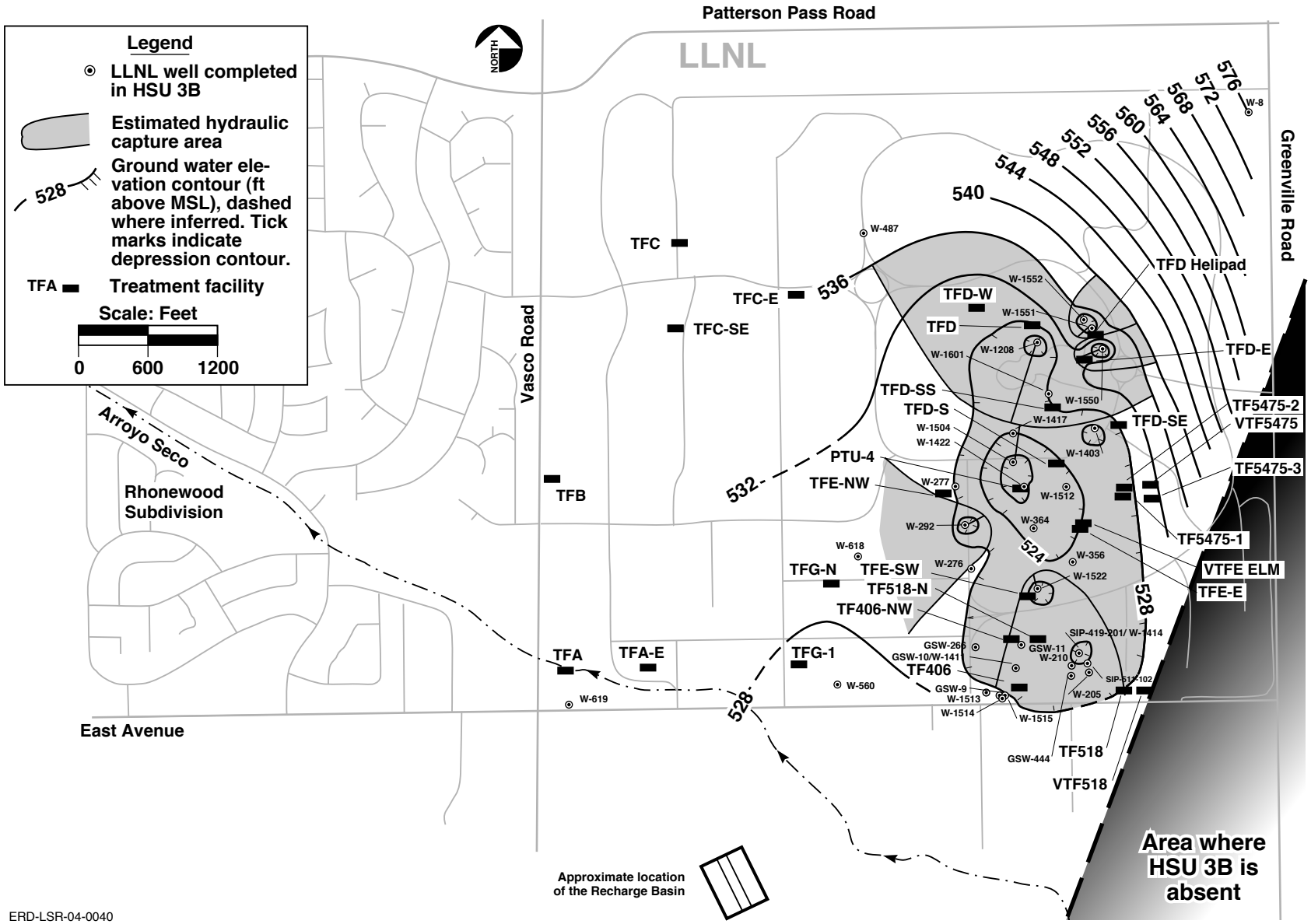

Figure 7. Ground water elevation contour map based on water levels collected from 29 wells completed within HSU 3B showing estimated hydraulic capture areas, LLNL and vicinity, November 2003.

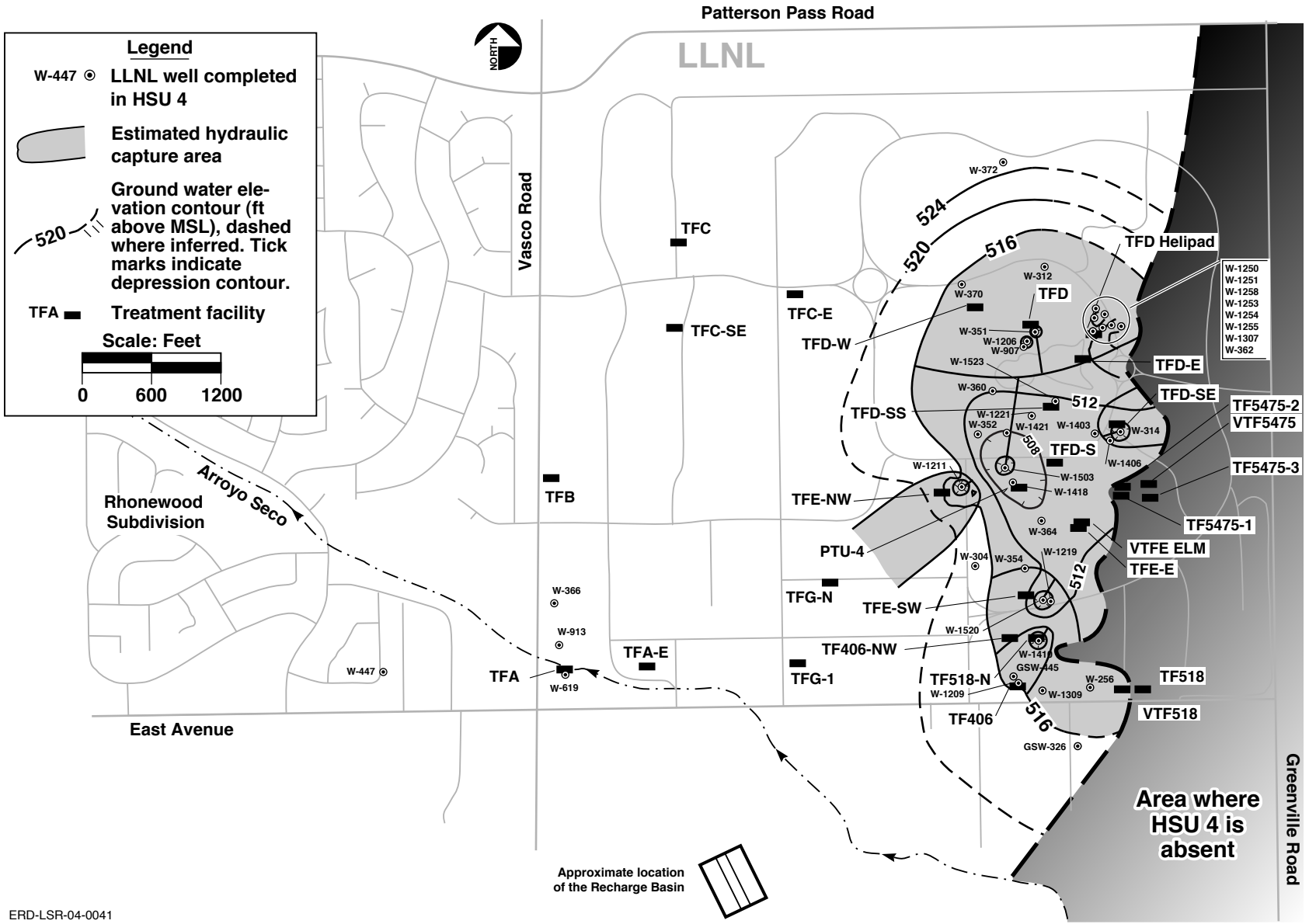

Figure 8. Ground water elevation contour map based on water levels collected from 32 wells completed within HSU 4 showing estimated hydraulic capture areas, LLNL and vicinity, October 2003.

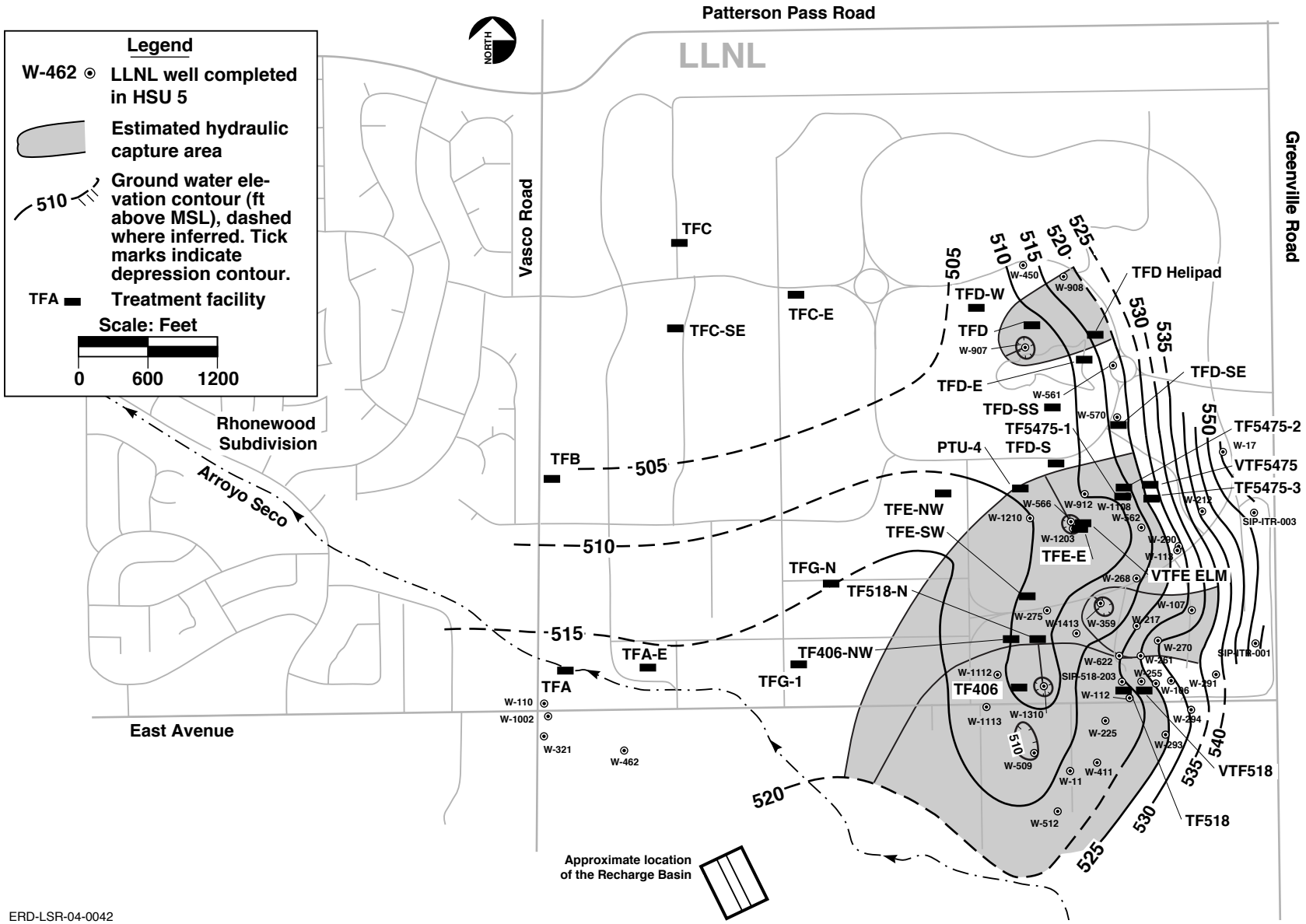

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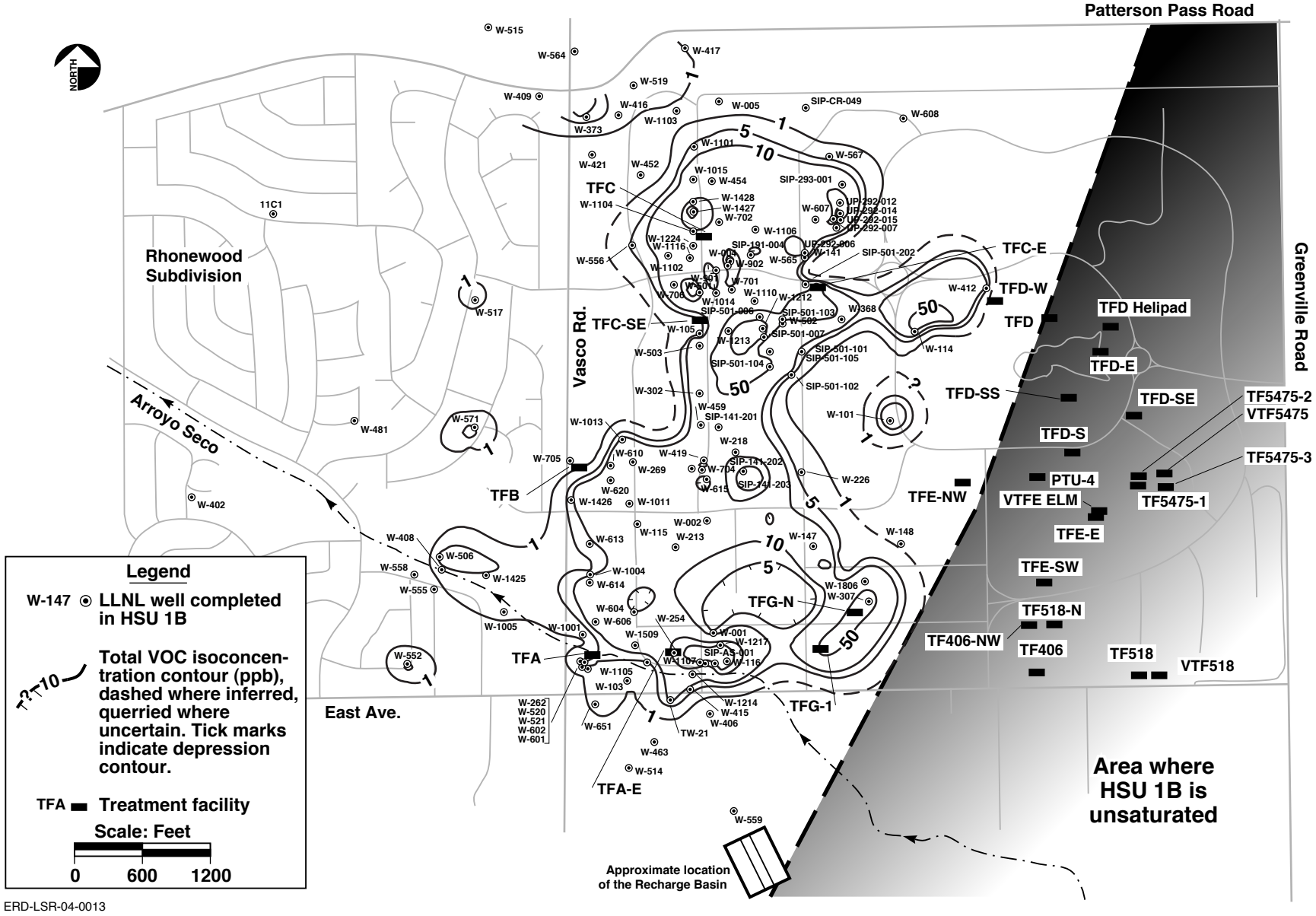
Figure 9. Ground water elevation contour map based on water levels collected from 49 wells completed within HSU 5 showing estimated hydraulic capture areas, LLNL and vicinity, November 2003.



ERD-LSR-04-0013

Figure 10. Isoconcentration contour map of total VOCs for 123 wells completed within HSU 1B based on samples collected in the fourth quarter of 2003 (or the next most recent data), and supplemented with soil chemistry data from 37 borehole locations.

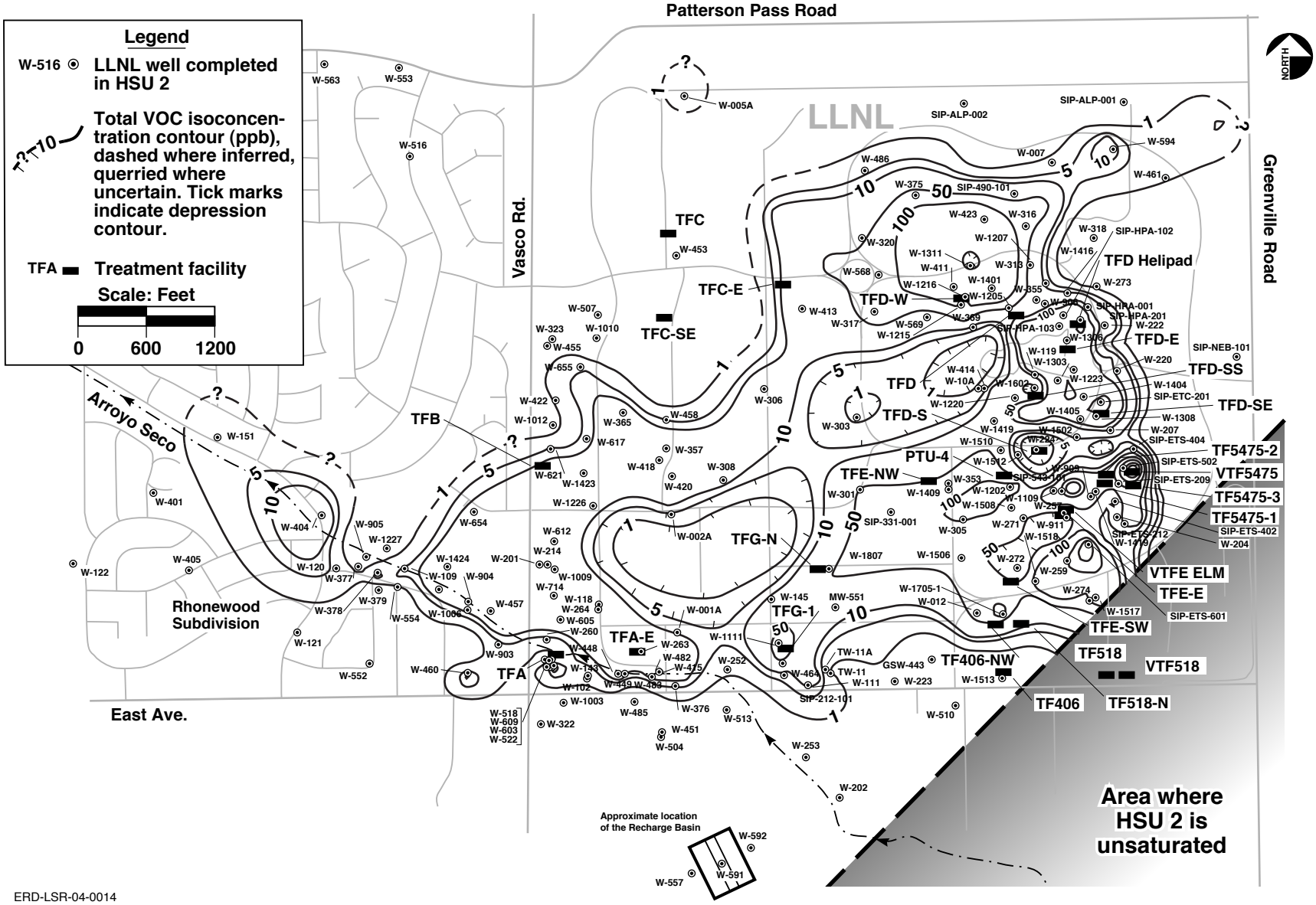


Figure 11. Isoconcentration contour map of total VOCs for 182 wells completed within HSU 2 based on samples collected in the fourth quarter of 2003 (or the next most recent data), and supplemented with soil chemistry data from 86 borehole locations.

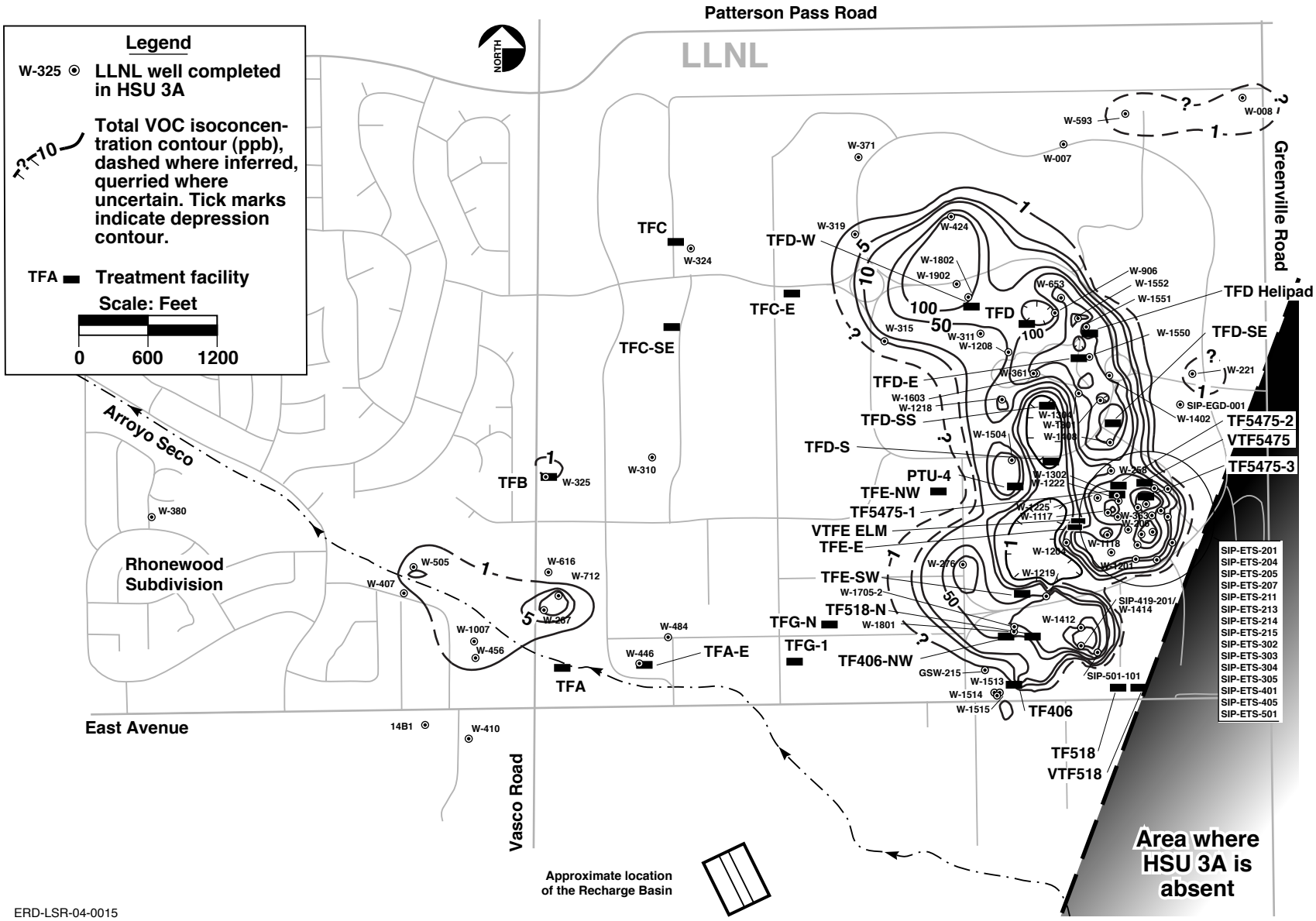


Figure 12. Isoconcentration contour map of total VOCs for 102 wells completed within HSU 3A based on samples collected in the fourth quarter of 2003 (or the next most recent data), and supplemented with soil chemistry data from 138 borehole locations.

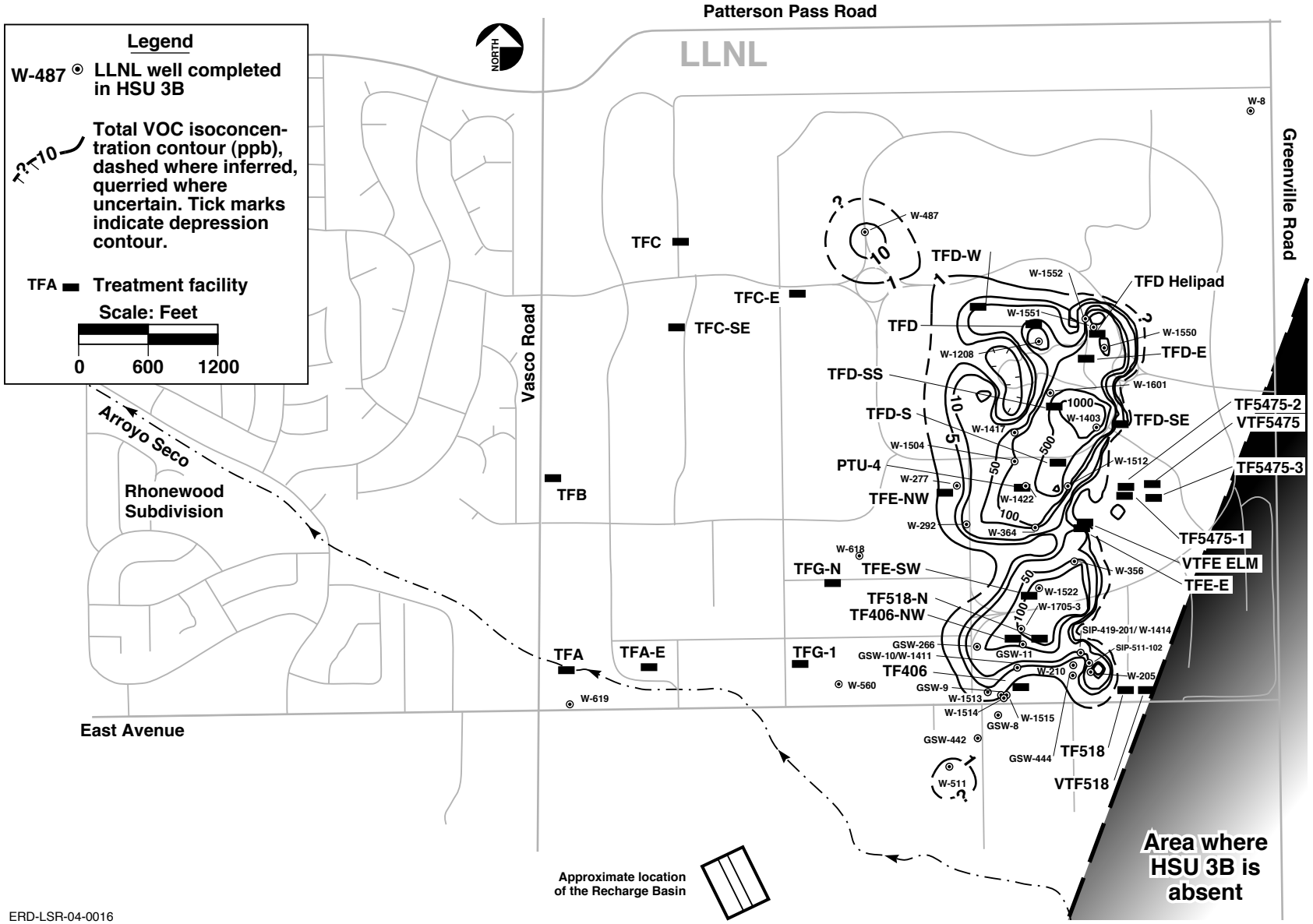


Figure 13. Isoconcentration contour map of total VOCs for 42 wells completed within HSU 3B based on samples collected in the fourth quarter of 2003 (or the next most recent data), and supplemented with soil chemistry data from 106 borehole locations.

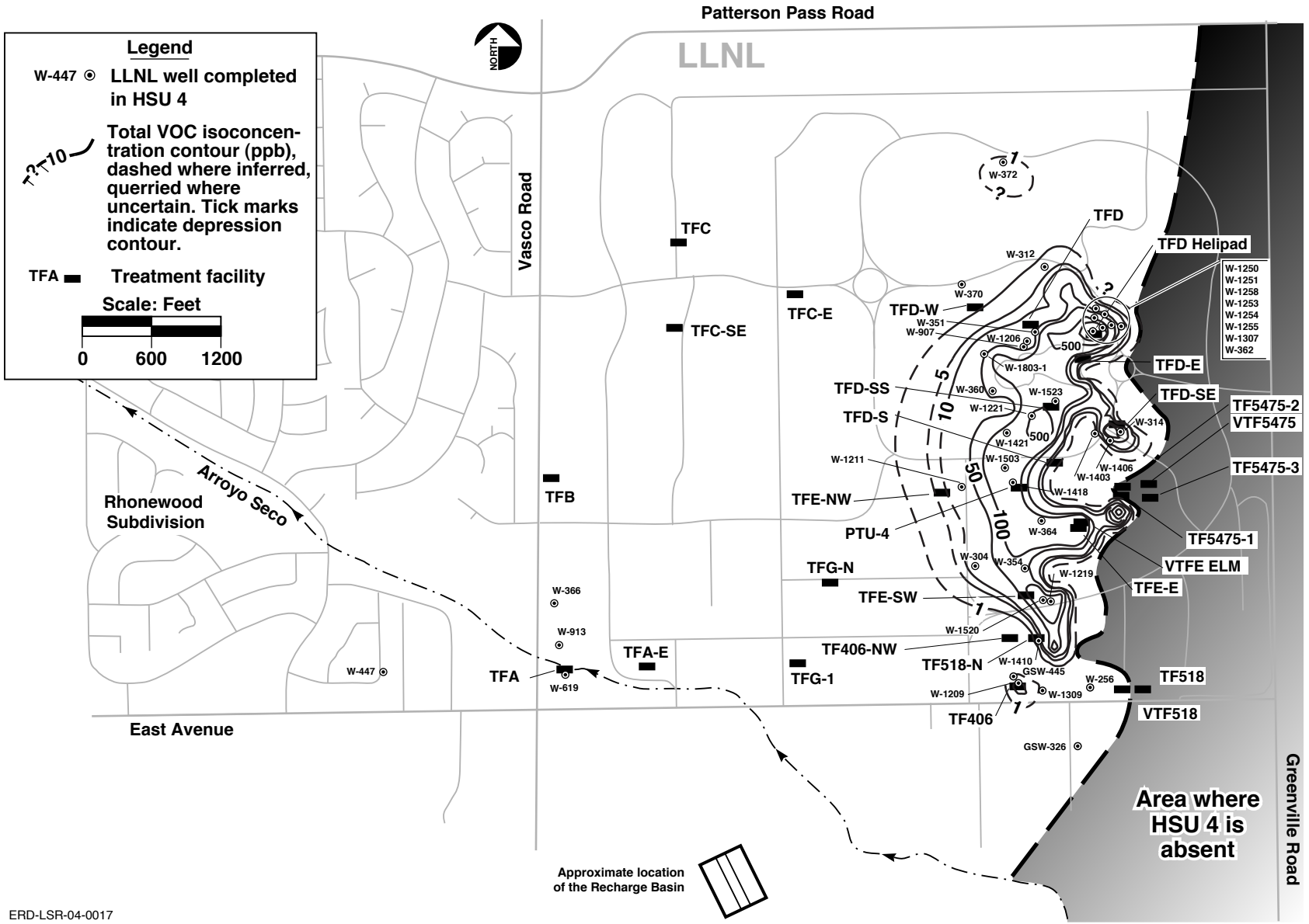


Figure 14. Isoconcentration contour map of total VOCs for 44 wells completed within HSU 4 based on samples collected in the fourth quarter of 2003 (or the next most recent data), and supplemented with soil chemistry data from 49 borehole locations.

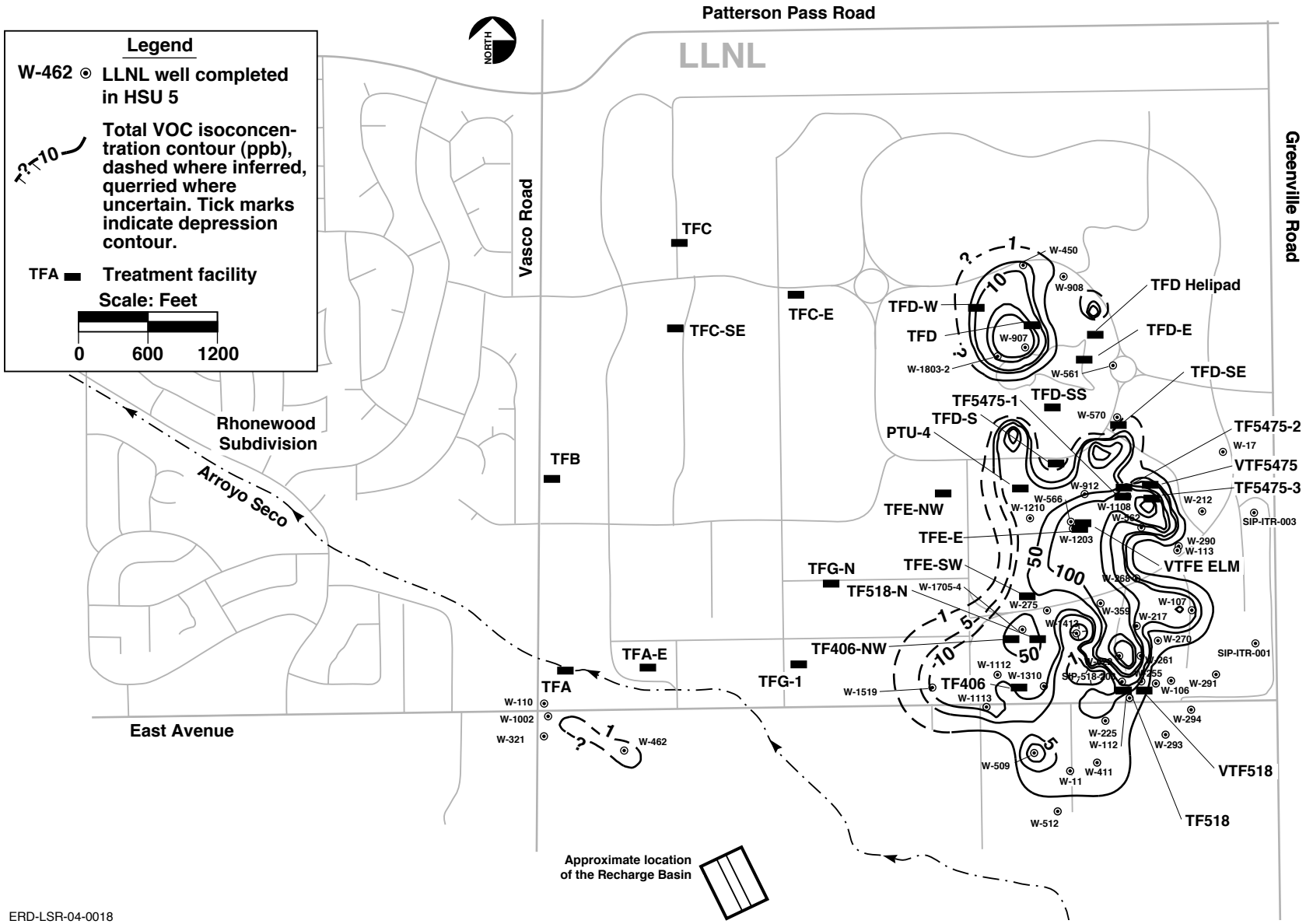


Figure 15. Isoconcentration contour map of total VOCs for 54 wells completed within HSU 5 based on samples collected in the fourth quarter of 2003 (or the next most recent data), and supplemented with soil chemistry data from 93 borehole locations.

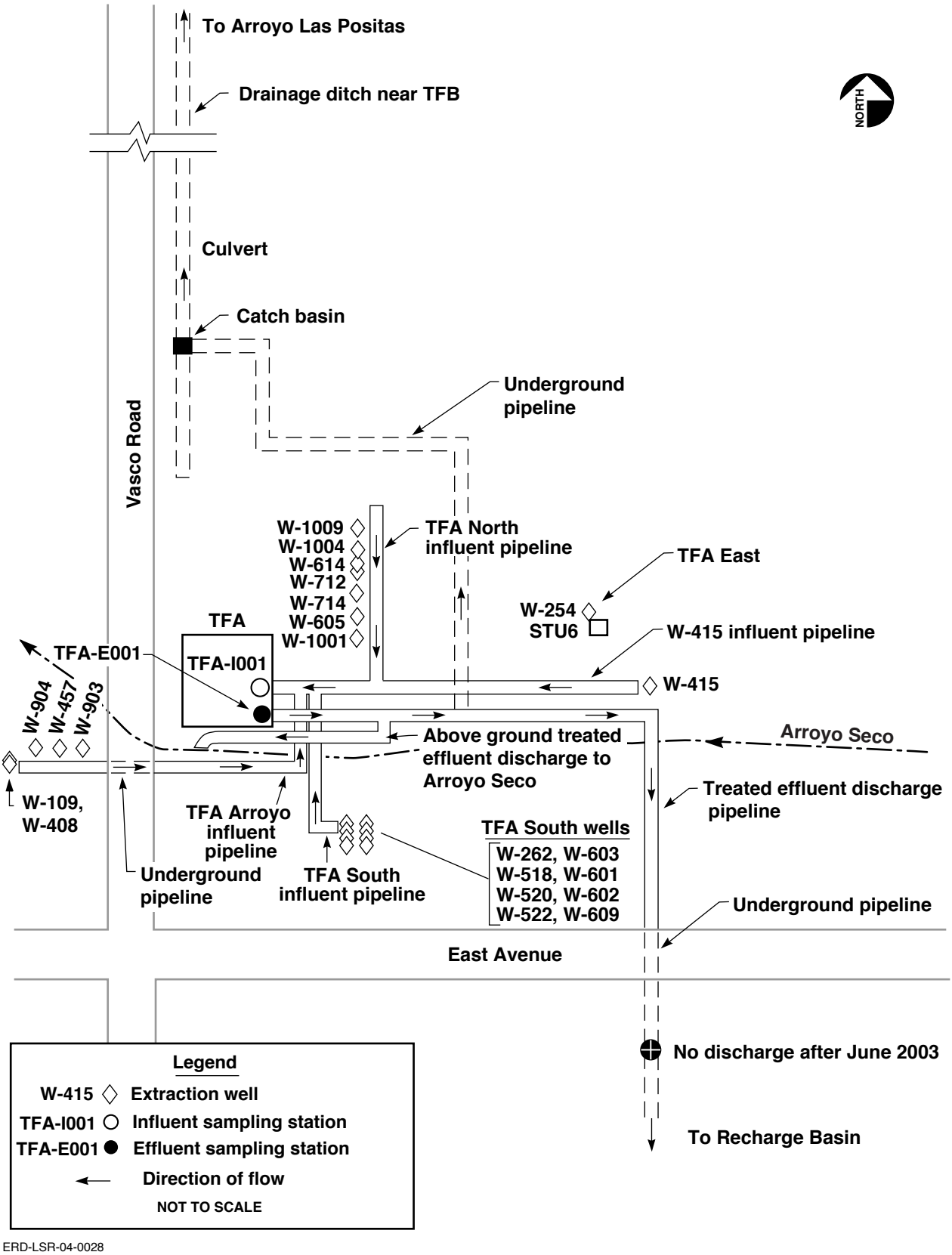


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Figure 16. TFA extraction well, pipeline and discharge locations.

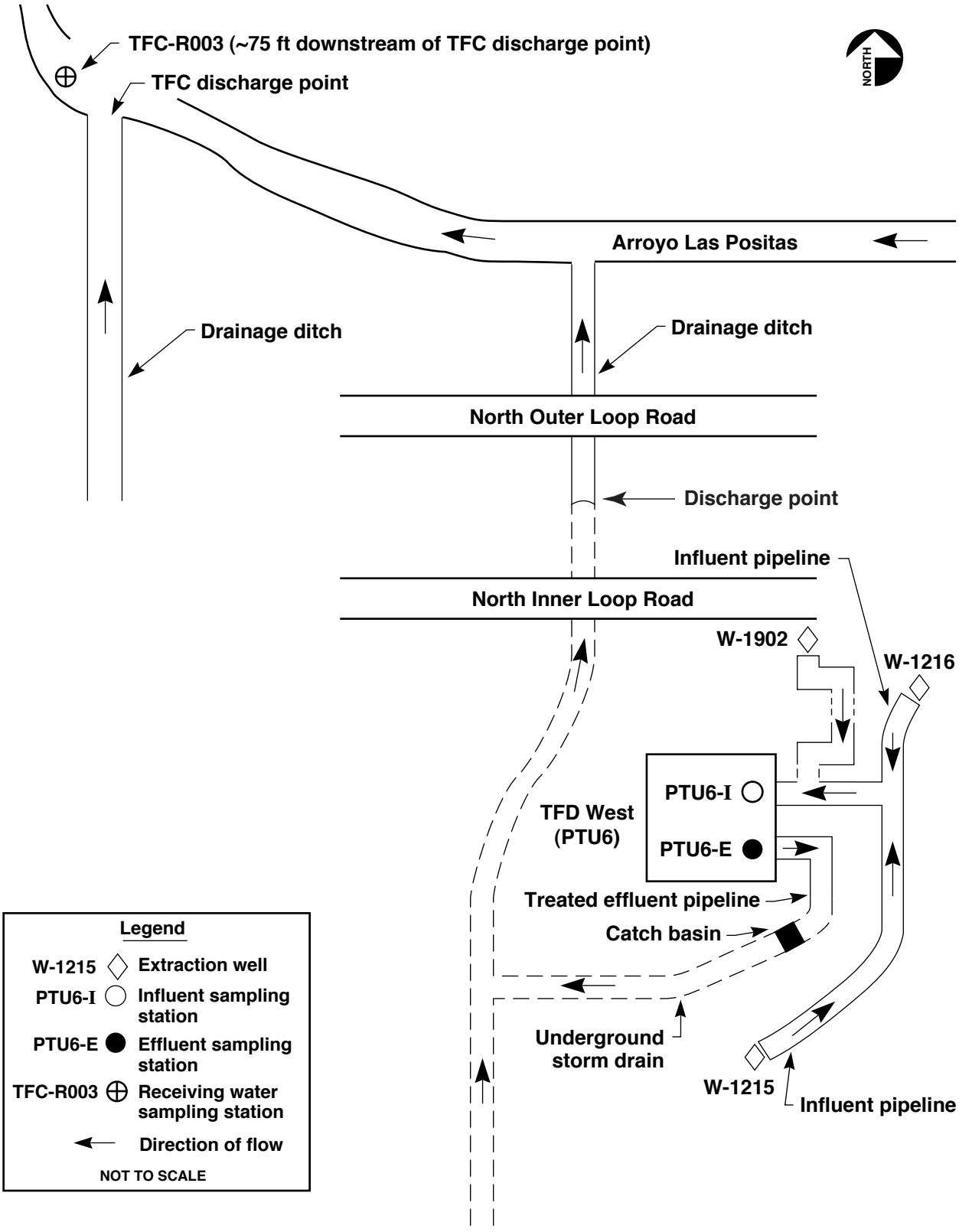

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Figure 17. TFD West extraction well, pipeline and discharge locations.

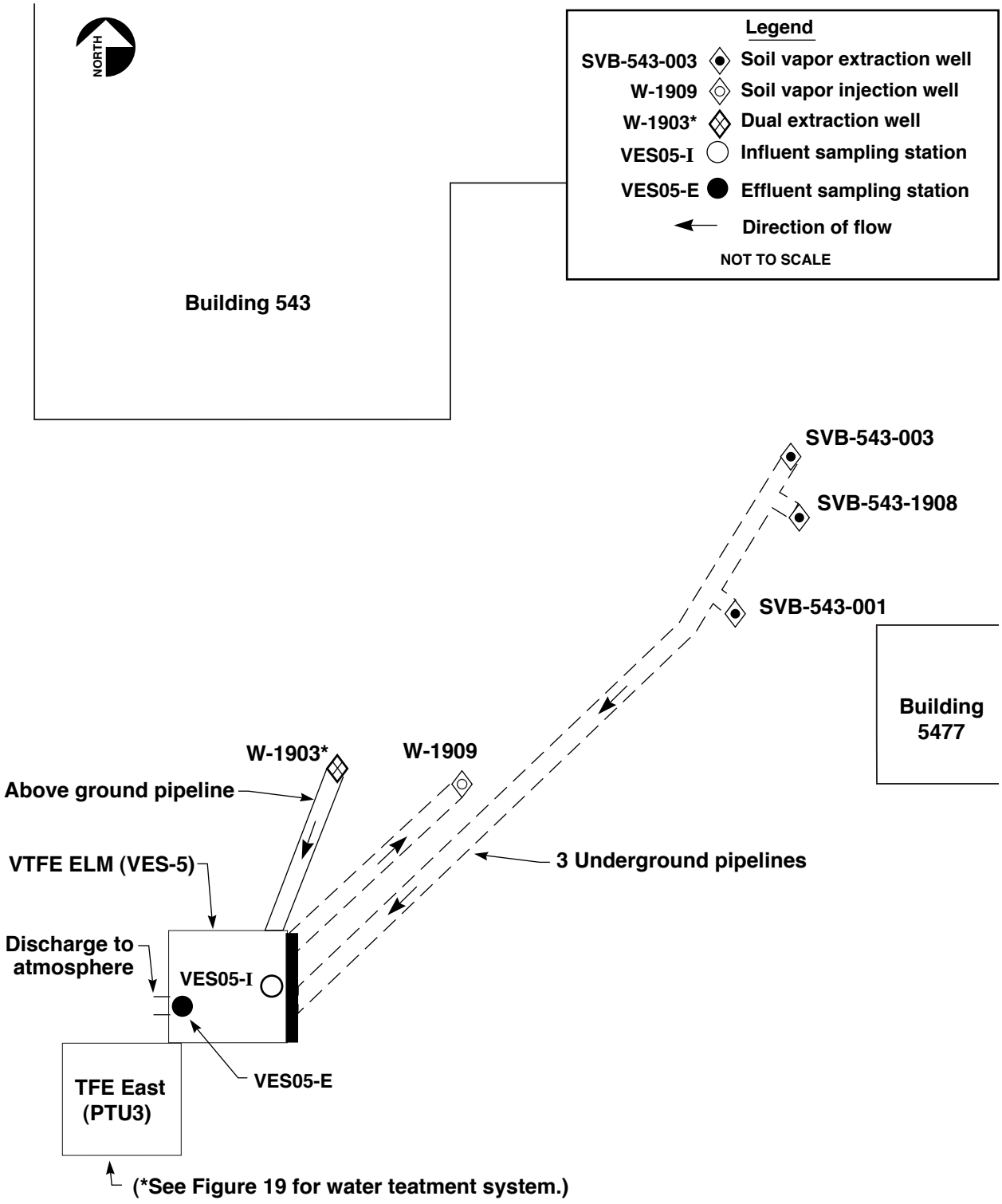

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Figure 18. VTFE Eastern Landing Mat soil vapor extraction well and pipeline locations.

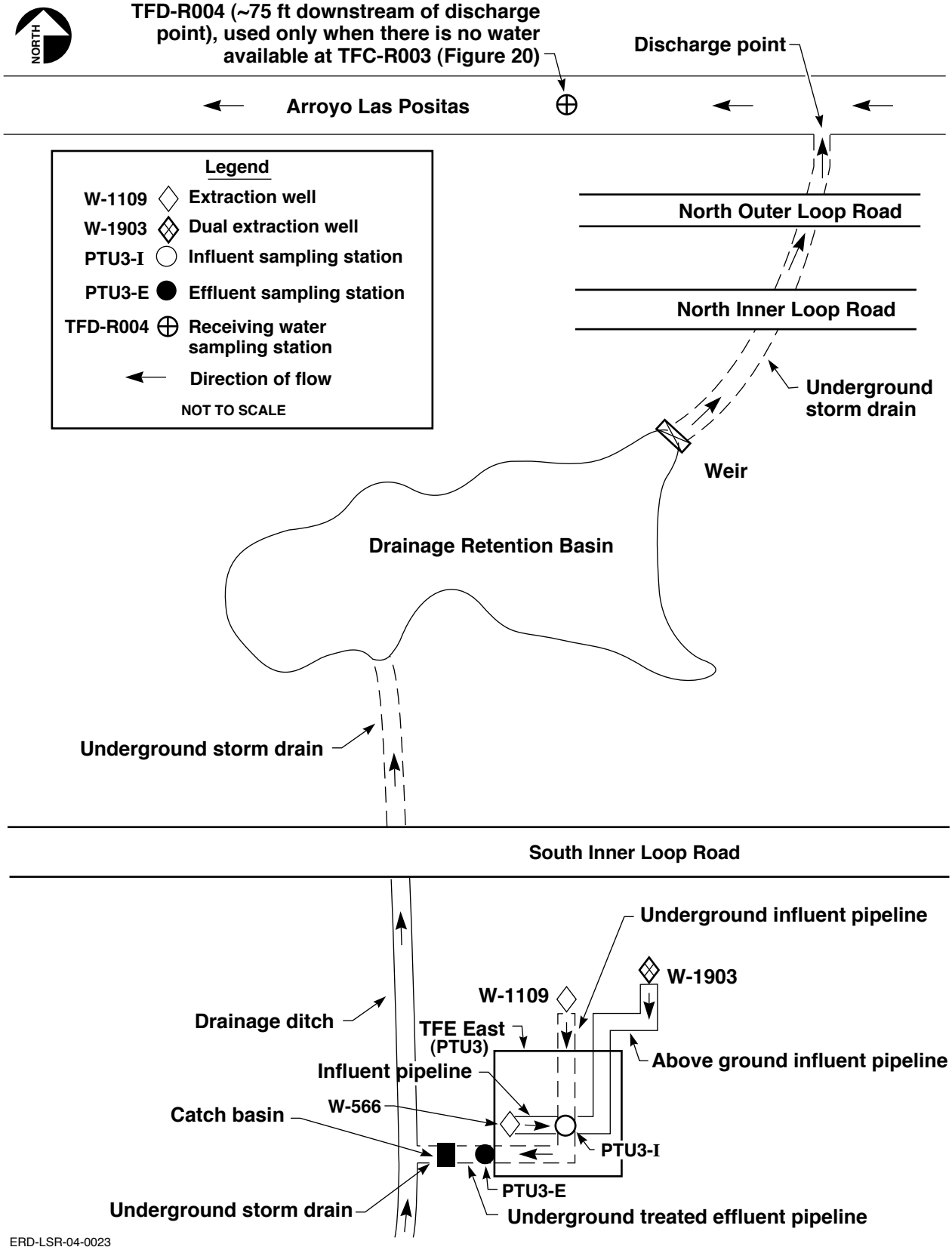

Figure 19. TFE East extraction well, pipeline and discharge locations.

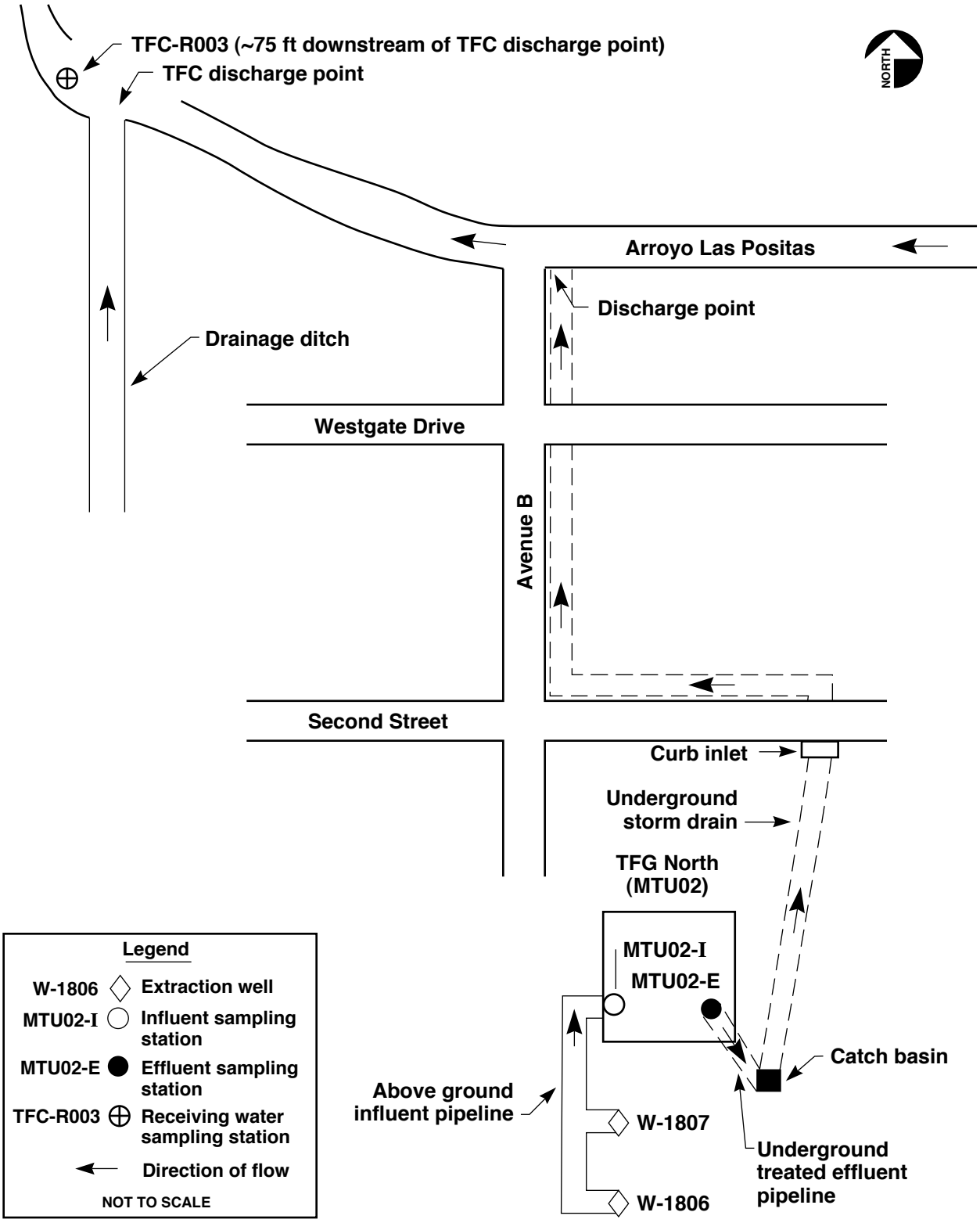

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Figure 20. TFG North extraction well, pipeline and discharge locations.

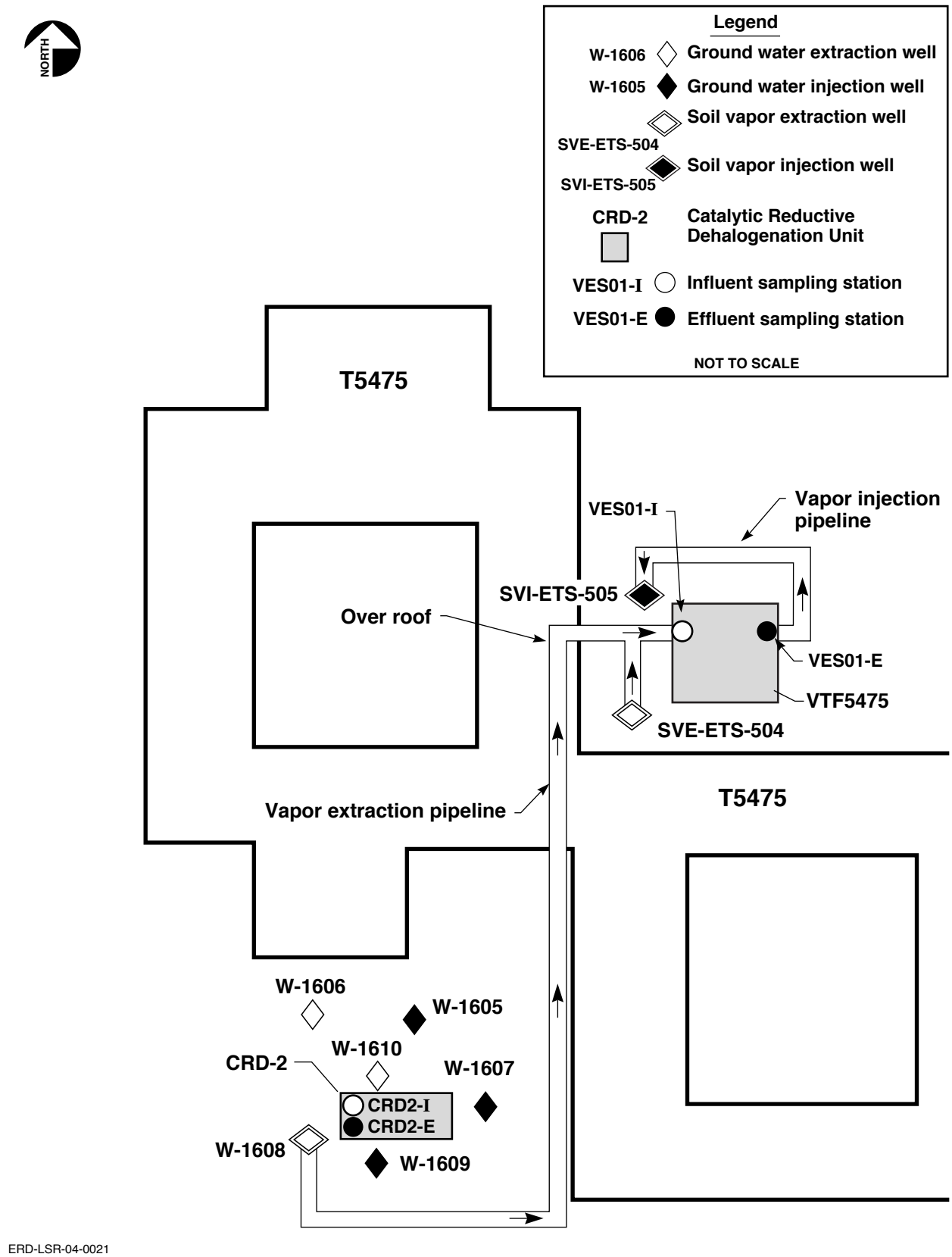

Figure 21. TF5475-3 (CRD-2) and VTF5475 extraction and injection well and pipeline locations.

Tables

Table 1. Livermore Site wells installed in 2003.

Treatment facility area	Well
TFA	None
TFB	None
TFC	None
TFD	AW-1910*, W- 1904, W-1905, SVB-ETC-2001A, SVB-ETC-2001B, SVB-ETC-2002A, SVB-ETC-2002B, SVB-ETC-2003, SVB-ETC-2004A, SVB-ETC-2004B, SVB-HPA-001A, SVB-HPA-001B, SVB-HPA-002A, SVB-HPA-002B
TFE	SVB-543-001, SVB-543-002A, SVB-543-002B, SVB-543-003, SVB-543-004A, SVB-543-004B, SVB-543-1908, W-1909
TF406	AW-1911*
TFG	AW-1912*
TF518	AW-1906*, SVB-518-1913, SVB-518-1914, SVB-518-1915
TF5475	None

Note:
See Figure 2 for well locations.
*** Plant Engineering anode well (AW) for cathodic protection.**

Table 2. Hydraulic tests conducted in 2003.

Treatment facility area	Well(s)
TFA	W-1805
TFB	None
TFC	None
TFD	W-1902
TFE	None
TF406	None
TFG	W-1806
TF518	None
TF5475	None

Note:
See Figure 2 for well locations.

Table 3. Soil vapor extraction tests conducted in 2003.

Treatment facility area	Well(s)
TFD	SVB-HPA-001B, SVB-HPA-002A, W-1552, W-1650, W-1651, W-1652, W-1653, W-1654, W-1655, W-1656, W-1657
TFE	SVB-543-001, SVB-543-002A, SVB-543-002B, SVB-543-003, SVB-543-004A, SVB-543-004B

Table 4. 2003 Livermore Site Remedial Action Implementation Plan milestones.

Milestone	Milestone date	Completion date
Begin TFC Northeast remediation	05/30/03	05/23/03
Begin operation of TFG North	07/31/03	07/28/03
Begin VTFE Eastern Landing Mat remediation	09/26/03	09/22/03

Table 5. Summary of treatment facilities, discharge locations, and extraction wells.

Treatment facilities	Discharge location	Hydrostratigraphic Unit	Operating extraction wells
TFA	Recharge Basin on Sandia National Laboratories property, Arroyo Seco, and Arroyo Las Positas	HSU-1B	W-262[a], W-408, W-520 W-601[b], W-602[b], W-1001, W-1004
		HSU-1B/2	W-415
		HSU-2	W-109[b], W-457, W-518[b], W-522, W-603[b], W-605, W-609[b], W-614, W-714, W-903, W-904, W-1009
		HSU-3A	W-712
TFA East	Arroyo Seco	HSU-1B	W-254
TFB	Arroyo Las Positas	HSU-1B	W-610, W-620, W-704
		HSU-2	W-357, W-621, W-655[a], W-1423
TFC	Arroyo Las Positas	HSU-1B	W-701, W-1015, W-1102, W-1103, W-1104, W-1116
TFC East	Arroyo Las Positas	HSU-1B	W-368
		HSU-2	W-413
TFC Southeast	Arroyo Las Positas	HSU-1B	W-1213
TFD	Arroyo Las Positas directly or via DRB	HSU-2/3A	W-906
		HSU-3A/3B	W-1208
		HSU-4	W-351, W-1206
		HSU-5	W-907
TFD West	Arroyo Las Positas	HSU-2	W-1215, W-1216
		HSU-3A	W-1902
TFD East	Arroyo Las Positas directly or via DRB	HSU-2	W-1303, W-1306
		HSU-3A	W-1301
		HSU-3A/3B	W-1550
		HSU-4	W-1307
TFD Southeast	Arroyo Las Positas via the DRB	HSU-2	W-1308
		HSU-4	W-314
TFD South	Arroyo Las Positas via the DRB	HSU-2	W-1510
		HSU-3A/3B	W-1504
		HSU-4	W-1503
TFD Southshore	Arroyo Las Positas via the DRB	HSU-2	W-1602
		HSU-3A	W-1603
		HSU-3B	W-1601
		HSU-4	W-1523
TFD Helipad	Arroyo Las Positas	HSU-3A/3B	W-1551, W-1552, W-1651, W-1654
TFE East	Arroyo Las Positas via the DRB	HSU-2	W-1109
		HSU-2	W-1903[c]
		HSU-5	W-566
VTFE ELM	Treated vapor to atmosphere	HSU-2	SVB-543-001
TFE Northwest	Arroyo Las Positas	HSU-2	W-1409
		HSU-4	W-1211
TFE Southwest	Arroyo Las Positas via the DRB	HSU-2	W-1518
		HSU-3B	W-1522
		HSU-4	W-1520
TFE Southeast	Arroyo Las Positas	HSU-5	W-359

Table 5. Summary of treatment facilities, discharge locations, and extraction wells.

Treatment facilities	Discharge location	Hydrostratigraphic Unit	Operating extraction wells
TFE West	Arroyo Las Positas	HSU-2 HSU-3B	W-305 W-292
Portable Treatment Unit No. 4	Arroyo Las Positas	HSU-3B HSU-4	W-1422[a] W-1418[a]
TFG-1	Arroyo Seco	HSU-1B/2	W-1111
TFG North	Arroyo Las Positas	HSU-1B HSU-2	W-1806 W-1807
TF406	Arroyo Las Positas	HSU-5	W-1310
TF406 Northwest	Arroyo Las Positas	HSU-3A	W-1801
TF5475-1	Reinjected in well W-1302 (upper section)	HSU-3A	W-1302
TF5475-2	Arroyo Las Positas via the DRB	HSU-2	W-1415
TF5475-3	Reinjected in well W-1603	HSU-3A HSU-5	W-1606 W-1610
VTF5475	Reinjected in SVI-ETS-505	N/A	SVI-ETS-504, W-1608
TF518 North	Arroyo Las Positas	HSU-4	W-1410

Note:

DRB = Drainage Retention Basin located in the central portion of the Livermore Site.

[a] Extraction well only operated for ground water sampling.

[b] Extraction well did not operate in 2003.

[c] Dual (ground water and soil vapor) extraction well.

Appendix A

Well Construction and Closure Data

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

Well number	Date completed	Borehole depth (ft)	Casing depth (ft)	Screen interval(s) (ft)	HSU[a] monitored	Initial well development flow rate (gpm)[b]
Monitor Wells						
W-1	21-Oct-80	122.5	116.0	95–100	1B/2	NA
W-1A	12-Apr-84	180.0	156.0	145–156	2	NA
W-2	29-Aug-80	102.5	101.0	86–101	1B	NA
W-2A	02-Apr-84	185.0	164.0	150–164	2	NA
W-4	28-Jul-80	92.0	90.0	75–90	1B	NA
W-5	24-Oct-80	93.5	90.0	56–71 81–86	1B	NA
W-5A	09-Apr-84	115.0	105.0	95–105	2	NA
W-7	03-Oct-80	110.5	100.5	76–81 88–98	2/3A	NA
W-8	14-May-81	110.0	105.0	72–77 92–102	3A/3B	NA
W-11	03-Jun-81	252.0	191.0	136–141 177–187	5	NA
W-12	14-Aug-80	115.75	115.0	99–114	2	NA
W-17	08-Oct-80	114.0	114.0	94–109	5	NA
W-17A	20-May-81	181.4	160.0	127–132 147–157	7	NA
W-19	19-Sep-80	164.75	161.0	147–157	7	NA
W-101	25-Jan-85	77.0	72.0	62–72	1B	1
W-102	12-Feb-85	396.5	171.5	151.5–171.5	2	40
W-103	14-Feb-85	96.0	89.5	79.5–89.5	1B	5
W-104	21-Feb-85	61.5	56.5	38.75–56.5	1B	2.5
W-105	26-Feb-85	69.0	62.0	42–62	1B	0.7
W-106	06-Mar-85	144.0	134.5	127.5–134.5	5	0.1–0.2
W-107	13-Mar-85	128.0	122.0	115–122	5	1–3
W-108	21-Mar-85	113.5	69.0	57–69	1A	10
W-110	26-Apr-85	371.0	365.0	340–365	5	6
W-111	02-May-85	122.0	117.0	97–117	2	1.5
W-113	16-May-85	124.0	115.0	100–115	5	0.9
W-114	23-May-85	70.5	63.0	51–63	1B	0.5
W-115	03-Jun-85	106.0	95.0	88–95	1B	1.1
W-116	14-Jun-85	181.0	91.0	86–91	1B	0.3
W-117	27-Jun-85	202.0	148.0	138–148	7	0.2

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

Well number	Date completed	Borehole depth (ft)	Casing depth (ft)	Screen interval(s) (ft)	HSU[a] monitored	Initial well development flow rate (gpm)[b]
Monitor Wells (cont.)						
W-118	19-Jul-85	206.5	110.0	99–110	2	8
W-119	02-Aug-85	139.0	102.5	87.5–102.5	2	3.3
W-120	19-Aug-85	195.0	153.0	147–153	2	1
W-121	23-Aug-85	194.0	171.0	159–171	2	3.75
W-122	17-Aug-85	189.0	132.0	125–132	2	15
W-123	01-Oct-85	174.0	47.7	37.3–47.7	1A	5
W-141	23-Mar-85	61.5	60.0	45–60	1B	0.8
W-142	29-Mar-85	74.2	72.0	62–72	2	0.8
W-143	12-Apr-85	130.0	126.0	121–126	2	0.8
W-146	16-Jul-85	225.0	125.0	115–125	2	5
W-147	26-Jul-85	137.0	87.0	77–87	1B	0.5
W-148	08-Aug-85	152.0	98.0	83–98	1B	0.5
W-151	30-Sep-85	237.0	157.5	148.5–157.5	2	1.5
W-201	17-Oct-85	211.0	161.0	151–161	2	14
W-202	07-Nov-85	191.0	109.0	99–109	2	0.5
W-203	15-Nov-85	87.0	41.0	31–41	1A	3
W-204	22-Nov-85	110.0	110.0	100–110	2	5+
W-205	09-Dec-85	180.0	117.0	107–117	3B	<0.1
W-206	19-Dec-85	188.0	118.0	106–118	3A	<0.5
W-207	24-Jan-86	150.0	85.0	69–85	2	<0.5
W-210	11-Mar-86	176.0	113.0	108–113	3B	<0.5
W-212	28-Mar-86	183.0	136.0	124–136	5	1
W-213	04-Apr-86	174.0	100.0	94–100	1B	2
W-214	11-Apr-86	146.0	141.5	134–141.5	2	20+
W-217	20-May-86	200.0	112.5	98.5–112.5	5	<0.5
W-218	30-May-86	201.0	71.0	64.5–71	1B	6
W-219	13-Jun-86	214.0	148.0	141–148	5	2
W-220	25-Jun-86	196.0	92.5	82.5–92.5	2	<0.5
W-221	07-Jul-86	178.0	95.0	82–95	3A	2
W-222	17-Jul-86	197.0	83.0	63–83	2	5
W-223	15-Aug-86	202.0	153.0	146–153	2	5.2
W-224	26-Aug-86	199.0	88.0	78–88	2	3
W-225	09-Sep-86	238.0	166.0	152–166	5	2.5
W-226	25-Sep-86	173.0	86.0	71–86	1B	<0.25

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

Well number	Date completed	Borehole depth (ft)	Casing depth (ft)	Screen interval(s) (ft)	HSU[a] monitored	Initial well development flow rate (gpm)[b]
Monitor Wells (cont.)						
W-251	03-Oct-85	50.0	47.5	35.5–47.5	1A	2
W-252	18-Oct-85	197.0	126.0	108–126	2	3
W-253	30-Oct-85	180.0	128.0	112.5–128	2	1
W-255	05-Dec-85	187.0	124.0	115–124	5	1
W-256	19-Dec-85	187.0	137.0	132–137	5	<0.5
W-257	15-Jan-86	197.0	96.5	82.5–96.5	2	<0.5
W-258	31-Jan-86	157.0	121.5	116.5–121.5	3A	0.5
W-259	07-Feb-86	200.0	99.0	93.5–99	2	<0.5
W-260	27-Feb-86	215.0	151.0	141–151	2	3.5
W-261	12-Mar-86	225.0	118.5	109–118.5	5	<0.5
W-263	07-Apr-86	146.0	130.0	123–130	2	2
W-264	14-Apr-86	170.0	151.0	141–151	2	20+
W-265	25-Apr-86	216.0	211.0	205–211	3A	3
W-267	27-May-86	196.0	179.0	172.5–179	3A	1
W-268	04-Jun-86	213.0	150.5	138–150.5	5	1
W-269	16-Jun-86	185.0	92.0	79–92	1B	2
W-270	26-Jun-86	185.0	127.0	113–127	5	<0.5
W-271	07-Jul-86	201.0	112.0	105–112	2	2.1
W-272	18-Jul-86	226.0	110.0	95–110	2	1
W-273	11-Aug-86	203.0	84.0	64–84	2	3
W-274	21-Aug-86	217.0	95.0	90–95	2	<0.5
W-275	05-Sep-86	262.0	184.0	179–184	5	4
W-276	17-Sep-86	267.0	170.0	153.5–169.5	3A	12
W-277	03-Oct-86	254.0	169.0	163–169	3B	1.1
W-290	08-Jul-86	181.0	126.0	119.5–126	5	<0.5
W-291	24-Jul-86	194.0	137.0	127–137	5	<0.5
W-292	14-Aug-86	250.0	184.5	176–184.5	3B	9
W-293	27-Aug-86	229.0	155.0	145–155	5	<1
W-294	15-Sep-86	251.0	139.0	122–139	5	1
W-301	07-Oct-86	203.0	141.0	136–141	2	5.5
W-302	22-Oct-86	191.0	83.5	78–83.5	1B	2
W-303	28-Oct-86	197.0	128.0	124–128	2	15
W-304	12-Nov-86	207.0	200.0	195–200	4	1
W-305	18-Nov-86	146.0	138.0	128–138	2	20

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

Well number	Date completed	Borehole depth (ft)	Casing depth (ft)	Screen interval(s) (ft)	HSU[a] monitored	Initial well development flow rate (gpm)[b]
Monitor Wells (cont.)						
W-306	04-Dec-86	207.0	110.0	98–110	2	8.5
W-307	15-Dec-86	214.0	102.0	93–102	1B	1
W-308	13-Jan-87	194.0	113.0	107–113	2	2
W-309	20-Jan-87	73.0	NA	NA	NA	NA
W-310	04-Feb-87	202.0	184.5	176.5–184.5	3A	10
W-311	20-Feb-87	226.5	147.5	134.5–147.5	3A	5
W-312	05-Mar-87	224.5	168.0	160–168	4	25
W-313	12-Mar-87	99.0	85.0	80–85	2	5.5
W-315	03-Apr-87	215.0	156.0	141–156	3A	15
W-316	15-Apr-87	196.0	71.0	66–72	2	3
W-317	20-Apr-87	100.0	95.0	88–95	2	7
W-318	28-Apr-87	200.0	81.0	74–81	2	0.5
W-319	05-May-87	198.0	125.0	119–125	3A	25
W-320	11-May-87	106.0	99.0	94–99	2	3
W-321	29-May-87	356.0	321.5	305–321.5	5	60
W-322	01-Jul-87	565.5	152.0	142–152	2	4
W-323	04-Aug-87	200.0	127.0	122–127	2	7
W-324	17-Aug-87	219.0	189.0	184–189	3A	15
W-325	28-Aug-87	312.0	170.0	158–170	3A	4
W-353	12-Nov-86	205.0	101.0	95.5–101	2	1
W-354	24-Nov-86	185.0	179.0	163–179	4/5	8
W-355	05-Dec-86	202.0	107.0	102–107	2	2
W-356	18-Dec-86	237.0	137.0	133–137	3B	6
W-362	13-Mar-87	151.0	145.0	131–145	4	12
W-363	24-Mar-87	195.0	129.0	117–129	3A	<0.5
W-364	31-Mar-87	195.0	165.0	155–165	3B/4	5
W-365	09-Apr-87	187.0	125.0	120–125	2	8.5
W-366	20-Apr-87	273.0	251.0	240–251	4	13
W-368	06-May-87	206.0	78.0	70–78	1B	3
W-369	14-May-87	204.0	113.0	107–113	2	2
W-370	29-May-87	286.0	208.0	196.5–208	4	5
W-371	12-Jun-87	233.0	162.0	155–162	3A	1.5
W-372	25-Jun-87	218.0	152.5	147.5–152.5	4	1
W-373	06-Jul-87	178.0	99.0	89–99	1B	7
W-375	29-Jul-87	223.0	71.0	65–71	2	0.75

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

Well number	Date completed	Borehole depth (ft)	Casing depth (ft)	Screen interval(s) (ft)	HSU[a] monitored	Initial well development flow rate (gpm)[b]
Monitor Wells (cont.)						
W-376	27-Aug-87	249.0	172.0	162–172	2	2
W-377	04-Sep-87	159.0	144.0	141.5–144	2	2.5
W-378	09-Sep-87	155.0	150.0	146–150	2	5
W-379	14-Sep-87	155.0	150.0	146–150	2	5
W-380	01-Oct-87	195.0	182.0	170–182	3A	10
W-401	05-Nov-87	159.0	153.0	109–153	2	25
W-402	13-Oct-87	104.0	102.0	92–102	1B	40
W-403	16-Nov-87	585.0	495.0	485–495	7	3
W-404	04-Dec-87	245.0	158.0	150–158	2	33
W-405	04-Jan-88	244.0	162.0	132–162	2	50
W-406	20-Jan-88	213.0	94.0	79–84	1B	2
W-407	04-Feb-88	215.0	205.0	192–205	3A	4
W-409	07-Mar-88	272.0	78.0	71–78	1B	30
W-410	30-Mar-88	369.0	205.0	193–205	3A	35
W-411	12-Apr-88	192.0	138.0	131–138	2	8
W-412	18-Apr-88	104.0	74.0	67–74	1B	2.5
W-413	28-Apr-88	163.0	115.0	100–115	2	25
W-416	10-Jun-88	152.0	80.5	72–80.5	1B	30
W-417	20-Jun-88	152.0	60.0	51–60	1B	5
W-418	24-Jun-88	124.0	118.0	108–118	2	2.5
W-419	29-Jun-88	82.0	75.5	62.5–75.5	1B	3
W-420	26-Jul-88	127.0	111.0	105–111	2	5
W-421	23-Aug-88	181.0	90.0	75–90	1B	4.5
W-422	02-Sep-88	203.0	139.5	133–139.5	2	5
W-423	09-Sep-88	308.0	118.0	106–118	2	14
W-424	04-Oct-88	208.0	144.0	137–144	3A	3
W-441	14-Oct-87	250.0	144.0	135–144	5	2.5
W-446	18-Dec-87	202.0	196.0	186–196	3A	3
W-447	05-Feb-88	353.0	274.0	256–274	4	5
W-448	17-Feb-88	235.0	127.5	120.5–127.5	2	15
W-449	07-Mar-88	172.0	165.0	152–165	2	3
W-450	21-Mar-88	300.0	200.0	193–200	5	2
W-451	06-Apr-88	202.0	112.0	106–112	2	1.5
W-452	15-Apr-88	210.0	79.5	64–79.5	1B	5

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

Well number	Date completed	Borehole depth (ft)	Casing depth (ft)	Screen interval(s) (ft)	HSU[a] monitored	Initial well development flow rate (gpm)[b]
Monitor Wells (cont.)						
W-453	27-Apr-88	185.0	130.3	121–130	2	4
W-454	09-May-88	196.0	83.5	73–83.5	1B	3
W-455	19-May-88	184.0	162.5	148–162.5	2	5
W-458	30-Jun-88	212.5	116.0	108–116	2	2
W-459	20-Jul-88	76.0	73.0	59.5–73	1B	1.5
W-461	16-Aug-88	133.0	51.5	41.5–51.5	2	<0.5
W-462	12-Sep-88	385.0	336.5	331–336.5	5	5
W-463	16-Sep-88	93.0	92.5	87–92.5	1B	5
W-464	30-Sep-88	253.0	104.5	96–104.5	2	3.5
W-481	04-Nov-88	224.5	105.0	100–105	1B	2
W-482	15-Jan-88	218.0	170.0	165–170	2	<0.5
W-483	26-Jan-88	140.0	130.0	115–130	2	2.5
W-484	11-Feb-88	255.0	188.0	185–188	3A	0.5
W-485	25-Feb-88	249.0	157.0	151–157	2	2
W-486	11-Mar-88	167.0	108.0	100–108	2	2
W-487	17-Mar-88	180.0	151.0	148–151	3B	1
W-501	13-Oct-88	174.0	92.0	84–92	1B	6.5
W-502	25-Oct-88	158.0	59.0	55–59	1B	<0.5
W-503	02-Nov-88	187.0	80.0	74–80	1B	1
W-504	21-Nov-88	358.0	167.0	157–167	2	3
W-505	15-Dec-88	278.0	180.0	167–180	3A	60
W-506	22-Dec-88	120.0	115.0	101–115	1B	30
W-507	18-Jan-89	158.0	139.0	129–139	2	50
W-508	17-Feb-89	316.0	305.0	287–305	7	60
W-509	03-Mar-89	305.0	184.0	179–184	5	1
W-510	15-Mar-89	300.0	119.0	111–119	2	<0.5
W-511	31-Mar-89	316.0	176.0	167–176	3B	1
W-512	13-Apr-89	261.0	176.0	166–176	5	2.5
W-513	26-Apr-89	259.0	115.0	102–115	2	1
W-514	17-May-89	386.0	115.5	92–115.5	1B	2
W-515	30-May-89	211.0	78.0	68–78	1B	3.5
W-516	09-Jun-89	203.0	119.0	114–119	2	15
W-517	20-Jun-89	215.0	88.0	80–88	1B	6.7
W-519	14-Aug-89	186.5	80.5	60–80.5	1B	25

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

Well number	Date completed	Borehole depth (ft)	Casing depth (ft)	Screen interval(s) (ft)	HSU[a] monitored	Initial well development flow rate (gpm)[b]
Monitor Wells (cont.)						
W-521	13-Sep-89	166.0	95.0	86–95	1B	1
W-551	18-Oct-88	308.0	155.5	151–155.5	2	20
W-552	25-Oct-88	70.5	64.0	48.5–64	1B	3
W-553	03-Nov-88	186.0	106.5	99–106.5	2	1
W-554	22-Nov-88	239.0	141.5	126.5–141.4	2	60
W-555	05-Dec-88	122.0	116.5	102.5–116.5	1B	20
W-556	15-Dec-88	192.0	81.5	76–81.5	1B	6
W-557	22-Dec-88	122.5	118.0	102–118	2	2
W-558	17-Jan-89	117.0	110.5	101–110.5	1B	20
W-559	24-Jan-89	105.0	100.0	93–100	1B	0.75
W-560	07-Feb-89	263.0	206.5	201-206.5	3B	10
W-561	23-Feb-89	180.0	152.0	143–152	5	4
W-562	08-Mar-89	263.0	158.0	145–158	5	2
W-563	17-Mar-89	192.0	105.0	95–105	2	2
W-564	30-Mar-89	184.0	85.0	79.5–85	1B	3
W-565	06-Apr-89	177.0	82.5	75–82.5	1B	15
W-567	27-Apr-89	194.0	61.5	51–61	1B	10
W-568	05-Jun-89	156.0	101.0	97–101	2	30
W-569	16-May-89	215.0	109.5	101–109.5	2	4
W-570	09-Jun-89	180.0	175.0	161–175	5	1
W-571	15-Jun-89	223.5	207.5	102–107	1B	22
W-591	29-Nov-88	112.0	107.5	97–107.5	2	<0.5
W-592	12-Dec-88	136.5	113.0	101–113	2	1.5
W-593	06-Feb-89	159.0	92.5	82–92.5	3A	1.5
W-594	27-Feb-89	156.0	61.0	55–61	2	0.5
W-604	27-Nov-89	111.0	83.0	76–82	1B	0.5
W-606	21-Dec-89	145.0	89.0	73–89	1B	2
W-607	24-Jan-90	186.0	55.0	49–55	1B	3
W-608	07-Feb-90	162.0	66.0	55–66	1B	3
W-611	04-Apr-90	161.0	98.0	87.5–98	1B	2
W-612	19-Apr-90	222.0	136.0	126–136	2	10
W-613	02-May-90	93.0	88.0	81.5–88	1B	7
W-615	01-Jun-90	121.0	99.0	91–99	1B	3
W-616	14-Jun-90	255.0	188.0	178–188	3A	8

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

Well number	Date completed	Borehole depth (ft)	Casing depth (ft)	Screen interval(s) (ft)	HSU[a] monitored	Initial well development flow rate (gpm)[b]
Monitor Wells (cont.)						
W-617	26-Jun-90	200.0	110.0	103–110	2	6
W-618	17-Jul-90	357.0	205.0	201–205	3B	10
W-619	07-Aug-90	330.0	252.0	232–252	3B/4	30
W-622	28-Sep-90	206.0	112.0	104–112	5	<0.5
W-651	22-Feb-90	155.0	89.0	82–89	1B	0.5
W-652	15-Mar-90	318.0	256.0	245–256	7	2
W-653	29-Mar-90	225.0	128.0	122–128	3A	0.5
W-654	11-Apr-90	240.0	158.0	140–158	2	20
W-702	24-Oct-90	180.5	95.0	77–95	1B	10
W-703	03-Dec-90	586.0	325.0	298–325	5	10
W-705	26-Dec-90	126.0	90.0	77–90	1B	2
W-706	16-Jan-91	178.0	84.0	71–84	1B	2
W-901	24-Feb-93	97.8	88.0	79–83	1B	1
W-902	22-Jan-93	95.5	88.0	80–83	1B	1
W-905	07-Apr-93	221.0	144.5	134–144	2	4
W-908	18-Aug-93	239.0	197.0	180–197	5/6	<0.5
W-909	04-Nov-93	252.0	113.5	80.5–108.5	2	2
W-911	20-Dec-93	180.0	113.5	73.5–108.5	2	3
W-912	07-Oct-93	239.0	174.0	168–174	5	3
W-913	08-Dec-93	454.0	255.0	235–255	4	25
W-1002	31-Jan-94	292.5	260.0	246–260	5	16
W-1003	08-Feb-94	184.0	147.0	140–147	2	1.5
W-1008	13-Apr-94	246.0	238.0	229.5–238	7	10
W-1010	24-May-94	463.0	142.0	128–142	2	20
W-1011	06-Jun-94	106.0	89.0	75–89	1B	3
W-1012	20-Jun-94	161.0	117.0	96–112	2	5
W-1013	29-Jun-94	147.0	73.0	65–73	1B	1.4
W-1014	12-Jul-94	99.0	89.0	65–89	1B	30
W-1101	10-Nov-94	200.0	79.0	76.0–79.0	1B	0.5
W-1105	17-Jan-95	110.0	93.0	78–93	1B	3.5–4
W-1106	08-Feb-95	245.0	86.0	76–85	1B	15

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

Well number	Date completed	Borehole depth (ft)	Casing depth (ft)	Screen interval(s) (ft)	HSU[a] monitored	Initial well development flow rate (gpm)[b]
Monitor Wells (cont.)						
W-1107	06-Mar-95	199.5	93.0	74–88	1B	<0.5
W-1108	27-Mar-95	250.0	156.0	142–156	5	12
W-1110	04-May-95	252.0	92.2	68–92	1B	7
W-1112	28-Jun-95	263.0	210.0	201–210	5	3
W-1113	18-Jul-95	260.0	214.0	204–214	5	2.5
W-1115	12-Oct-95	126.5	118.2	108–118	3A	1
W-1117	11-Sep-95	154.0	132.3	122–132	3A	1
W-1118	27-Sep-95	225.0	125.0	115–125	3A	3.5
W-1201	18-Oct-95	225.0	133.0	125–133	3A	1
W-1202	26-Oct-95	99.3	99.0	83–99	2	5+
W-1203	07-Nov-95	224.0	206.2	196–206	5	18+
W-1204	20 Nov-95	225.0	126.2	118–126	3A	2.5
W-1205	27-Nov-95	91.0	82.0	72–82	2	<0.5
W-1207	13-Dec-95	92.0	90.0	70–90	2	<0.5
W-1209	26-Jan-96	210.0	164.0	148–164	4	3
W-1210	12-Feb-96	250.0	223.0	213–223	5	3
W-1212	19-Mar-96	150.0	75.0	52–75	1B	3
W-1214	22-Apr--96	180.0	100.0	80–100	1B	2
W-1217	15-May-96	182.0	98.5	78–98	1B	<0.5
W-1219	04-Jun-96	201.0	142.0	138–142	4	<0.5
W-1222	26-Jun-96	175.0	125.5	115–125	3A	6
W-1223	23-Jul-96	175.0	102.0	87–97	2	4
W-1224	05-Sep-96	125.0	104.5	99–104	1B	4.3
W-1225	14-Aug-96	150.0	121.2	113–121	3A	2
W-1226	06-Aug-96	155.0	126.5	116–126	2	1
W-1227	09-Oct-96	200.0	134.0	126–134	2	11
W-1250	07-Jun-96	210.0	200.0	130–135	4	0.85
W-1251	03-Jul-96	210.0	200.0	134–139	4	1.3
W-1252	25-Jul-96	208.0	202.3	135–140	4	<0.5
W-1253	15-Aug-96	206.0	200.1	127–132	4	<0.5
W-1254	15-Aug-96	125.0	200.0	131–141	4	26
W-1255	27-Aug-96	208.0	200.7	124–129	4	<0.5
W-1304	20-Feb-97	149.5	125.0	120–125	3A	0.75
W-1311	25-Sep-97	153.0	120.5	100–120	2	14

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

Well number	Date completed	Borehole depth (ft)	Casing depth (ft)	Screen interval(s) (ft)	HSU[a] monitored	Initial well development flow rate (gpm)[b]
Monitor Wells (cont.)						
W-1401	15-Oct-97	250.0	120.0	105–120	2	7
W-1402	04-Nov-97	135.0	112.0	102–112	3A	4
W-1403	12-Nov-97	175.0	142.5	132–142	3B	3.5
W-1404	20-Nov-97	162.0	97.7	87–97	2	3.1
W-1405	24-Nov-97	100.0	97.8	87–97	2	4.5
W-1406	15-Dec-97	201.0	150.0	139.2–149.2	4	9.2
W-1407	12-Dec-97	224.0	118.7	105–118	2	1.5
W-1408	12-Jan-98	134.0	128.0	118–128	3A	3.8
W-1411	04-Feb-98	133.0	128.0	114–128	3A	10
W-1412	11-Feb-98	201.0	107.0	92–107	3A	0.75
W-1413	26-Mar-98	163.5	157.7	147–157	5	1
W-1414	31-Mar-98	128.0	107.5	97–107	3A	0.1
W-1416	02-Jun-98	194.5	105.0	85–100	2	10
W-1417	23-Apr-98	225.0	155.0	130–150	3A	20
W-1419	11-May-98	175.0	115.5	90–110	2	4.5
W-1420	17-June-98	177.5	112.0	102–112	2	10
W-1421	28-May-98	230.0	172.0	156–167	3B	3
W-1424	20-Aug-98	225.0	146.0	126–146	2	6.2
W-1425	31-Aug-98	115.0	100.5	88.5–100.5	1B	1
W-1426	09-Sep-98	89.0	85.0	70–85	1B	8
W-1427	22-Sep-98	104.0	80.2	70–80	1B	17
W-1428	29-Sep-98	104.0	78.4	63–78	1B	25
W-1501	13-Oct-98	126.0	86.0	72–86	1B	7.5
W-1502	28-Oct-98	204.0	98.7	88–98	2	1.7
W-1503	18-Nov-98	234.0	181.5	171–181	4	25
W-1504	14-Dec-98	168.0	162.5	140–160.4	3A/3B	21.7
W-1505	21-Jan-99	276.0	184.5	174–184	4	15
W-1506	8-Feb-99	160.0	120.0	110–120	2	3
W-1507	19-Feb-99	201.5	169.5	159–169	5	0.5
W-1508	3-Mar-99	135	128.5	118–128	2	0.75
W-1509	22-Mar-99	175	88.5	73–88	1B	8
W-1510	7-Apr-99	114.5	113.5	93–113	2	5
W-1511	22-Apr-99	229	146	138–146	3B	15
W-1512	29-Apr-99	100	98.5	88–98	2	0.5
W-1513	10-May-99	122	120	108–120	2/3A	0.1

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

Well number	Date completed	Borehole depth (ft)	Casing depth (ft)	Screen interval(s) (ft)	HSU[a] monitored	Initial well development flow rate (gpm)[b]
Monitor Wells (cont.)						
W-1514	19-May-99	127.5	126	103–121	2/3A	6.5
W-1515	3-Jun-99	130	121.5	102–120	2/3A	3
W-1516	22-Jun-99	204.5	200	188–200	5	10
W-1517	29-Jun-99	154	122.4	87–97	2	0.1
W-1519	28-Jul-99	245	238	222–237	5	30
W-1553	12-Aug-99	153	130	98–125	3A/3B	0.5
W-1604	30-Nov-99	194	148.7	138–148	4	8
W-1605	07-Mar-00	120.5	112	90–107	3A	<0.5
W-1607	10-Feb-00	155.4	112	90–107	3A	<0.5
W-1609	17-Apr-00	155	135	110–130	5	0.5
W-1610	04-May-00	155.3	135	110–130	5	0.5
W-1613	27-Apr-00	219	174.3	168.5–173.5	3B	7
W-1614	18-May-00	100	89.8	79–89	1B	3
W-1615	17-Aug-00	55	48	15–48	1B/2	NA
W-1616	16-Aug-00	55	NA	NA	1B/2	NA
W-1701	3-Jul-01	185	180.8	140–155 165–175	2 2	10.5 10.5
W-1702	15-Jun-01	15	14.25	4–13	1B	NA
W-1703	23-Aug-01	358	341.5	331–341	LL	36
W-1704	19-Sep-01	240	118.8	98–118	2	1
W-1705-1 W-1705-2 W-1705-3 W-1705-4	16-Oct-01	225	208.8	93–103 123–128 138–143 203–208	2 3A 3B 5	5 5 5 5
W-1802	02-Apr-02	175	162.2	147–157	3A	1.5
W-1803-1 W-1803-2	24-Apr-02	245	240.08	175–185 225–235	4 5	3 >8
W-1804-1 W-1804-2	22-May-02	155	110.8	80–95 100–105	2 3A	NA
W-1901-1 W-1901-2	31-Oct-02	175	127	92–97 107–122	1B 2	NA
W-1904	24-Jan-03	120	101	75–100	2	0.5–1
W-1905-1 W-1905-2	20-May-03	210	123.5	103–113 118–123	3A 3A	1.2–2.5 1.2–2.5
TW-11	09-Jun-81	112.5	107.0	97–107	2	NA
TW-11A	16-Mar-84	163.0	160.0	133–160	2	NA

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

Well number	Date completed	Borehole depth (ft)	Casing depth (ft)	Screen interval(s) (ft)	HSU[a] monitored	Initial well development flow rate (gpm)[b]
Monitor Wells (cont.)						
TW–21	12-Jun-81	111.5	95.0	85–95	1B	NA
GEW-710	02-Aug-91	159.0	158.0	94–137	3A/3B	25
GSW-1A	12-Jun-86	208.0	133.0	115–133	3A	12
GSW-2	14-Feb-85	113.0	107.0	87–107	2	NA
GSW-3	07-Feb-85	115.0	105.0	85–105	2	NA
GSW-4	22-Feb-85	112.0	106.0	86–106	2	NA
GSW-5	19-Mar-85	110.0	104.0	94–104	2	NA
GSW-6	28-Feb-86	212.0	137.0	121–137	3A	6
GSW-7	14-Mar-86	176.5	123.4	110.8–123.4	3A	2
GSW-8	01-Apr-86	176.0	133.0	127.5–133	3A	2
GSW-9	14-Apr-86	197.5	152.5	147–152.5	3B	1
GSW-11	07-May-86	182.5	126.0	116–126	3A	2
GSW-12	27-May-86	205.0	191.0	186.5–191	5	1
GSW-13	27-Jun-86	198.0	134.5	125–134.5	3A	1
GSW-15	14-Aug-87	148.0	145.0	20.5–28	1B	3.5
				38–44	1B	–
				50–56	2	–
				60–64	2	–
				68–73	2	–
				77–83	2	–
				95–105	2	–
				120–130	3A	–
GSW-16	19-Oct-87	146.0	145.0	23–28	1B	20.5–30
				38–43	1B	–
				50–55	2	–
				61–66	2	–
				78–83	2	–
				95–105	2	–
				120–130	3A	–
GSW-208	06-Feb-86	211.0	123.0	108–118	3A	<2
GSW-209	27-Feb-86	204.0	135.2	112.8–132.8	3A	2
GSW-215	22-Apr-86	213.5	133.5	127–133.5	3A	2
GSW-216	09-May-86	193.0	120.5	110.5–120.5	3A	3
GSW-266	08-May-86	220.0	166.0	159–166	3B	1

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

Well number	Date completed	Borehole depth (ft)	Casing depth (ft)	Screen interval(s) (ft)	HSU[a] monitored	Initial well development flow rate (gpm)[b]
Monitor Wells (cont.)						
GSW–326	02-Oct-87	230.0	134.0	129–134	4	0.5
GSW–367	29-Apr-87	159.0	124.0	114–124	2	2
GSW-403-6	11-May-84	138.0	113.6	90–110	3A	NA
GSW-442	27-Oct-87	270.0	145.0	138–145	3A	0.5
GSW-443	09-Nov-87	291.0	141.0	123–141	2	5
GSW-444	20-Nov-87	278.0	120.0	110–120	3B	0.3
Dynamic Stripping Wells[c]						
GSP-SNL-001	07-Jan-92	147.0	104.0	99–104	2	NA
			131.0	118–131	3A	NA
GEW-808	05-Jun-92	164.0	150.0	50–140	2/3A	25
GIW-813	25-Jun-92	140.7	87.0	67–87	2	NA
			104.0	89–99	2	
			127.0	107–127	2/3A	NA
GIW-814	19-Jun-92	149.6	106.5	86.5–106.5	2	NA
			117.0	110–120	3A	
			132.0	121–141	3A	NA
GIW-815	15-Jun-92	143.0	97.0	77–97	2	NA
			117.0	102–112	2/3A	
			132.0	112.8–132	3A	NA
GEW-816	03-Jun-92	161.7	150.0	50–140	2/3A	40
GIW-817	29-Jun-92	150.1	102.0	82–102	2/3A	NA
			122.0	107–117	3A	
			141.0	121–141	3B	NA
GIW-818	06-Jul-92	150.0	102	82–102	2/3A	NA
			125	110–120	3A	
			140	120–140	3A	NA
GIW-819	10-Jul-92	150.0	98.6	78.6–98.6	2	NA
			123	108–118	3A	
			141	121–141	3A	NA
GIW-820	16-Jul-92	143.3	105	85–105	2	NA
			132	112–132	3A	NA
HW-GP-001	17-Apr-92	120.0	77.0	67–77	2	NA
			113.0	103–113	3A	NA
HW-GP-002	13-May-92	120.0	78.0	68–78	2	NA
			117.0	107–117	3A	NA

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

Well number	Date completed	Borehole depth (ft)	Casing depth (ft)	Screen interval(s) (ft)	HSU[a] monitored	Initial well development flow rate (gpm)[b]
Dynamic Stripping Wells[c] (cont.)						
HW-GP-003	20-May-92	119.0	76.5 119.0	66.5–76.5 109–119	2 3A	NA NA
HW-GP-102	13-Aug-93	140.0	137.5	72.5–133.5	2/3A	NA
HW-GP-103	23-Aug-93	138.0	137.5	71.5–132.5	2/3A	NA
HW-GP-104	02-Sep-93	138.0	137.2	72.2–132.2	2/3A	NA
HW-GP-105	28-Sep-93	138.0	137.5	72.5–132.5	2/3A	NA
TEP-GP-106	21-Sep-93	137.5	135.5	NA	NA	NA
Extraction Wells						
GSW-445	09-Dec-87	319.0	161.0	155–161	4	3
W-109	02-Apr-85	289.0	147.0	137–147	2	12
W-112	10-May-85	129.0	123.5	111–123.5	5	4
W-254	21-Nov-85	277.0	91.5	84.5–91.5	1B	5
W-262	20-Mar-86	256.0	100.0	91–100	1B	7
W-314	20-Mar-87	228.0	142.0	129–142	4	9.5
W-351	17-Oct-86	191.0	151.0	146–152	4	2.9
W-357	12-Jan-87	197.0	123.0	107–123	2	8
W-359	10-Feb-87	195.0	150.5	138–150.5	5	10
W-361	05-Mar-87	257.0	135.0	125–135	3A	4
W-408	16-Feb-88	131.0	122.5	101–122.5	1B	35
W-415	12-Aug-88	205.0	183.7	79–179	1B/2	>50
W-457	22-Jun-88	289.0	149.5	130–149.5	2	20
W-518	08-Aug-89	251.0	139.0	131–139	2	2.5
W-520	30-Aug-89	160.0	101.5	94–101.5	1B	12
W-522	05-Oct-89	145.5	141.5	134–141.5	2	25
W-566	19-Apr-89	317.0	207.0	197–207	5	12
W-601	13-Oct-89	146.0	96.0	88–96	1B	15
W-602	06-Nov-89	168.0	100.0	90–100	1B	10
W-603	15-Nov-89	150.0	147.0	141–147	2	5
W-605	08-Dec-89	246.0	136.0	130–136	2	10
W-609	21-Feb-90	120.0	112.0	104–112	2	4
W-610	16-Mar-90	453.0	84.5	69–84.5	1B	4

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

Well number	Date completed	Borehole depth (ft)	Casing depth (ft)	Screen interval(s) (ft)	HSU[a] monitored	Initial well development flow rate (gpm)[b]
Extraction Wells (cont.)						
W-614	18-May-90	262.0	123.0	100–123	2	12
W-620	30-Aug-90	206.0	88.5	75–88.5	1B	5
W-621	09-Sep-90	149.0	120.0	113–120	2	4
W-655	25-Apr-90	193.0	130.0	121–129.5	2	2
W-701	10-Oct-90	159.0	86.0	74–86	1B	10
W-704	01-Feb-91	135.0	107.0	67–76 88–97	1B	20
W-712	29-Aug-91	200.0	185.5	170–185.5	3A	8
W-714	02-Jul-91	135.0	128.0	107–128	2	7.5
W-903	28-Apr-93	223.0	145	132–140	2	20
W-904	06-May-93	212.0	154.0	121–133 140–149	2	20
W-906	27-Jul-93	200.0	132.0	58–132	2/3A	10
W-907	02-Sep-93	239.0	220.0	172.7–188.8 204.5–215.0	4 5	25 NA
W-1001	20-Dec-93	105.0	92.0	85–92	1B	1.4
W-1004	23-Feb-94	99.0	97.0	71–91	1B	7
W-1009	02-May-94	191	140	134–140	2	20
W-1015	10-Aug-94	437	94	84–94	1B	20
W-1102	29-Nov-94	163.0	95.5	76.0–94.0	1B	8
W-1103	15-Dec-94	200.0	82.0	70.0–82.0	1B	3.5
W-1104	18-Jan-95	165.0	99.0	77–87 92–98	1B	35+
W-1109	11-Apr-95	121	113	94–108	2	3
W-1111	01-Jun-95	152	129	88–108 120–124	1B/2 2	10.5 NA
W-1116	17-Aug-95	214	101	72–98	1B	9
W-1206	06-Dec-95	220.0	191.0	174–186	4	40+
W-1208	09-Jan-96	166.0	163.0	135–163	3A/3B	40
W-1211	05-Mar-96	273.0	205.0	185–200	4	25+
W-1213	02-Apr-96	129.0	76.0	64–76	1B	5+
W-1215	17-Apr-96	175.0	120.0	103–120.5	2	8.5
W-1216	07-May-96	200.0	124.0	94–124	2	14

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

Well number	Date completed	Borehole depth (ft)	Casing depth (ft)	Screen interval(s) (ft)	HSU[a] monitored	Initial well development flow rate (gpm)[b]
Extraction Wells (cont.)						
W-1301	04-Dec-96	180.0	120.3	112–120	3A	15
W-1302	21-Jan-97	145.0	138.9	116.5–122.2 125.8–133.8	3A	7.5
W-1303	06-Feb-97	199.5	107	78–102	2	10
W-1306	06-May-97	200	106	81–101	2	3.3
W-1307	07-Feb-97	150	142	126–136	4	20
W-1308	22-Jul-97	150.0	116.0	81–111	2	7
W-1309	11-Aug-97	220.0	157.0	142–152	4	6.0
W-1310	08-Sep-97	220.0	198.0	173–193	5	28
W-1409	23-Jan-98	143	140	76–140	2	20
W-1410	20-Feb-98	205.0	133.0	126–131	4	8
W-1415	15-Apr-98	182.0	104.8	74.5–104.5	2	2
W-1418	05-May-98	252.5	190.0	176–190	4	9
W-1422	14-May-98	173.5	169.0	162–169	3A/3B	10
W-1423	08-Jul-98	175.0	134.5	99.5–109.5 119.5–129.5	2	22.4
W-1503	18-Nov-98	234.0	181.5	171–181	4	25
W-1504	14-Dec-98	168.0	162.5	140–160.4	3A/3B	21.7
W-1510	7-Apr-99	114.5	113.5	93–113	2	5
W-1513	10-May-99	122	120	108–120	2/3A	0.1
W-1514	19-May-99	127.5	126	103–121	2/3A	6.5
W-1515	3-Jun-99	130	121.5	102–120	2/3A	3
W-1518	6-Jul-99	184	112	84–107	2	3
W-1520	23-Jul-99	178.3	173	160–168	4	3.5
W-1522	9-Aug-99	169	161	141–156	3B	9
W-1523	1-Aug-99	216	172.3	164–172	4	15
W-1550	22-Jun-99	200	130	98–125	3A/3B	10
W-1551	8-Jul-99	153	129	93–124	3A/3B	10.5
W-1552	27-Jul-99	153.5	130	97–125	3A/3B	2
W-1601	18-Oct-99	169	160	150–155	3B	3.5
W-1602	27-Oct-99	115.5	110.7	80–90 100–110	2 2	8
W-1603	10-Nov-99	144	140	130–135	3A	17.2

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

Well number	Date completed	Borehole depth (ft)	Casing depth (ft)	Screen interval(s) (ft)	HSU[a] monitored	Initial well development flow rate (gpm)[b]
Extraction Wells (cont.)						
W-1606	27-Jan-00	175	112	90–107	3A	<0.5
W-1608	25-Feb-00	155	112	90–107	3A	<0.5
W-1650	03-Jan-00	145	126	96–121	3A/3B	2
W-1651	27-Jan-00	145	129	94–124	3A/3B	1
W-1652	09-Feb-00	145	127	92–122	3A/3B	0.33
W-1653	24-Feb-00	145	124.5	93.5–119.5	3A/3B	1.2
W-1654	25-Feb-00	146.5	128	93–123	3A/3B	0.8
W-1655	08-Mar-00	145	125	90–125	3A/3B	1.3
W-1656	14-Mar-00	145	125	95–120	3A/3B	5
W-1657	23-Mar-00	145	128	95–123	3A/3B	<1
W-1801	18-Mar-02	143	134.4	124–134	3A	>12
W-1805	20-Aug-02	110	100.8	70–80 85–95	1B 1B	>10
W-1806	12-Sept-02	260	106.2	80.7–101.2	1B	NA
W-1807	07-Oct-02	165	130	115–125	2	NA
W-1902	21-Nov-02	175	165	140–145 150–160	3A 3A	NA
W-1903*	16-Dec-02	120	109	84–104	2	NA
W-1909	24-Jun-03	110	106.35	86–106	2	1–1.5
Other Wells (non-LLNL)						
7D2	07-Jun-76	74	72.3	63.2–67.3	3A	NA
11C1	08-Jun-76	68	66.2	56.2–61.2	1B	NA
11H5	08-Nov-85	NA	255	NA	NA	NA
11J2	26-Apr-79	112	110	90–92 102–108	1B 2	NA
11Q4	NA	NA	NA	NA	NA	NA
11Q5	NA	NA	NA	NA	NA	NA
14A3	07-Dec-77	NA	110	100–105	1B	NA
14A11[d]	NA	NA	NA	NA	NA	NA
14B1	13-Aug-59	300	234	146–149	2	NA
				192–195	3A	–
				198	3A	–
				200	3A	–
				203	3A	–

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

Well number	Date completed	Borehole depth (ft)	Casing depth (ft)	Screen interval(s) (ft)	HSU[a] monitored	Initial well development flow rate (gpm)[b]
Other Wells (non-LLNL) (cont.)						
14B1 *(cont.)*	13-Aug-59	300	234	205	3A	–
				207	3A	–
				209–213	3A	–
				226	3A	–
				230	3B	–
				234	3B	–
14B4	Aug-60	NA	260	143–148	2	NA
				155–159	2	–
				186–189	3A	–
				205–215	3A	–
				245–250	4	–
14B7	NA	NA	NA	NA	NA	NA
14H1	NA	NA	288	NA	NA	NA
14H2[d]	NA	NA	NA	NA	NA	NA
18D1[d]	NA	NA	NA	NA	7	NA
Source Investigation Piezometers						
SIP-141-201	02-Feb-96	77	74.2	57–74	1B	NA
SIP-141-202	12-Feb-96	80	74	64–74	1B	NA
SIP-141-203	20-Feb-96	87	83	72–83	1B	NA
SIP-191-001	15-Apr-94	50	45	40–45	1A	NA
SIP-191-002	21-Apr-94	50	61	45–61	1B	NA
SIP-191-003	26-Apr-94	50.5	45	35–45	1B	NA
SIP-191-004	29-Apr-94	57.5	53.5	47.5–53.5	1B	NA
SIP-191-005	04-May-94	54	48	42–48	1A	NA
SIP-191-101	18-Nov-94	68.5	64	58–64	1B	NA
SIP-212-101	14-Mar-96	94	90.5	87–90.5	2	NA
SIP-293-001	05-Dec-90	56.5	50	45–50	1B	NA
SIP-331-001	21-Sep-91	122	116.5	106.5–116.5	2	NA
SIP-419-101	08-Sep-98	127	123	112–123	3B	NA
SIP-419-202	06-Mar-96	110	106.5	97–106.5	3A	NA
SIP-490-102	08-Nov-95	75	73.5	53.5–73.5	2	NA
SIP-501-004	20-0ct-94	60	56.9	48–56.9	1B	NA
SIP-501-006	11-Nov-92	59.5	56	50–56	1B	NA
SIP-501-007	16-Nov-92	64	59	53–59	1B	NA
SIP-501-101	10-May-94	77.5	73	69–73	1B	NA

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

Well number	Date completed	Borehole depth (ft)	Casing depth (ft)	Screen interval(s) (ft)	HSU[a] monitored	Initial well development flow rate (gpm)[b]
Source Investigation Piezometers (cont.)						
SIP-501-102	16-May-94	77	73	67–73	1B	NA
SIP-501-103	20-Mar-94	63	57.5	51–57.5	1B	NA
SIP-501-104	15-Jul-94	67	62	50–62	1B	NA
SIP-501-105	01-Sep-94	73	68	63–68	1B	NA
SIP-501-201	29-Nov-94	65	58.5	54–58.5	1B	NA
SIP-501-202	01-Jul-95	70	64.5	58–64.5	1B	NA
SIP-511-101	25-Jan-96	110	106.7	100–106.7	3A	NA
SIP-511-102	02-Apr-96	114	110.3	108–110	3B	NA
SIP-514-107	03-Jan-90	21.5	17	9–17	1B	NA
SIP-514-109	05-Jan-90	21.5	20	7–22	1B	NA
SIP-514-112	08-Jan-90	21.5	18	7–18	1B	NA
SIP-514-114	09-Jan-90	21.5	17	4–17	1B	NA
SIP-514-116	10-Jan-90	21.5	17	7–17	1B	NA
SIP-514-117	11-Jan-90	21.5	17.5	7–17.5	1B	NA
SIP-514-119	12-Jan-90	21.5	16	6–16	1B	NA
SIP-514-123	17-Jan-90	26.5	23	11.5–23	1B	NA
SIP-514-124	18-Jan-90	21.5	17	6–17	1B	NA
SIP-514-125	19-Jan-90	21.5	15	6–15	1B	NA
SIP-514-126	18-Jan-90	26.5	21.5	4–21.5	1B	NA
SIP-518-203	19-Sep-95	127	127	121–127	5	NA
SIP-543-101	31-Jan-95	111	104	43–103	2	NA
SIP-ALP-001	03-May-90	66	60	45–60	2	NA
SIP-ALP-002	07-May-90	62	57.5	47.5–57.5	1B/2	NA
SIP-AS-001	30-Apr-90	100	100.5	81–90.5	1B	NA
SIP-CR-049	26-Feb-90	42	40	36–40	1B	NA
SIP-EGD-001	16-Oct-90	101.5	85	75–85	2	NA
SIP-ETC-201	26-Mar-96	106	101	81–101	2	NA
SIP-ETC-301	12-Apr-99	102	83	76–82	2	NA
SIP-ETC-303	24-May-99	111	88.1	82–88	2	NA
SIP-ETS-201	05-Feb-91	95	90	85–90	3A	NA
SIP-ETS-204	07-May-91	93	97	87–97	3A	NA
SIP-ETS-205	20-Jun-91	103	95	89.5–95	3A	NA
SIP-ETS-209	25-Jul-91	96.6	90	79.75–90	2	NA
SIP-ETS-211	06-Aug-91	103	98.5	95–98.5	3A	NA
SIP-ETS-212	14-Aug-91	106.5	1023	97.5–1023	2	NA

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

Well number	Date completed	Borehole depth (ft)	Casing depth (ft)	Screen interval(s) (ft)	HSU[a] monitored	Initial well development flow rate (gpm)[b]
Source Investigation Piezometers (cont.)						
SIP-ETS-213	15-Nov-91	118.5	116.5	108.5–116.5	3A	NA
SIP-ETS-214	22-Nov-91	101	101	86–101	3A	NA
SIP-ETS-215	03-Dec-91	94.5	94.5	84.5–94.5	3A	NA
SIP-ETS-302	30-Mar-92	117.4	113	97–113	3A	NA
SIP-ETS-303	02-Apr-92	110.7	102	95–102	3A	NA
SIP-ETS-304	27-Aug-92	100	97	90–97	3A	NA
SIP-ETS-306	11-Sep-92	101	93	80.5-93	3A	NA
SIP-ETS-401	02-Aug-95	122	121	116–121	3A	NA
SIP-ETS-402	08-Aug-95	110	107	97–107	2	NA
SIP-ETS-404	22-Aug-95	99	95.5	83.5–95.5	2	NA
SIP-ETS-405	29-Aug-95	126	123	114.5–123	5	NA
SIP-ETS-501	16-Nov-95	110	106.5	100–1006.5	3A	NA
SIP-ETS-502	05-Dec-95	95	88	80–88	2	NA
SIP-ETS-601	07-Jun-99	115.5	104.9	98.3–104.8	2	NA
SIP-HPA-001	20-Apr-90	92.75	75	65–75	2	NA
SIP- HPA-003	19-Apr-90	91.5	66	61–66	2	NA
SIP- HPA-201	14-May-96	97.5	76	71–76	2	NA
SIP-IES-001	16-Sep-92	50.2	46.5	44–46.5	1B	NA
SIP-IES-002	05-Oct-92	41.5	39.2	33–39.2	1A	NA
SIP-INF-201	30-Jun-98	85.9	85.0	64.9–84.6	1B	NA
SIP-INF-202	02-Jul-98	86.3	85.2	64.9–84.8	1B	NA
SIP-INF-301	24-Mar-99	97	95.4	60–95	1B	NA
SIP-INF-302	29-Mar-99	97	88.4	53–88	1B	NA
SIP-ITR-001	19-Apr-91	121.6	115	105–115	5	NA
SIP-ITR-002	02-Apr-91	100	84	79–84	5	NA
SIP-ITR-003	25-Apr-91	121.5	106	98.5–106	5	NA
SIP-NEB-101	23-Sep-92	68.7	66	57–66	2	NA
UP-292-006	07-Nov-90	74	57.5	47.5–57.5	1B	NA
UP-292-007	26-Nov-90	71	56	46–56	1B	NA
UP-292-012	31-Oct-91	67.7	60	45–60	1B	NA
UP-292-014	07-Nov-91	66	66	50–66	1B	NA
UP-292-015	11-Nov-91	61.5	60.5	49.5–60.5	1B	NA
UP-292-020	30-Oct-92	68.5	64	56.5–64	1B	NA
SIP-PA-002	29-Jan-90	16.5	16.5	4–16.5	1B	NA
SIP-PA-003	26-Jan-90	18	14	4–14	1B	NA

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

Well number	Date completed	Borehole depth (ft)	Casing depth (ft)	Screen interval(s) (ft)	HSU[a] monitored	Initial well development flow rate (gpm)[b]
Source Investigation Piezometers (cont.)						
SIP-PA-005	04-Jan-90	11.5	8	3–8	1B	NA
SIP-PA-006	04-Jan-90	13.5	12	5–12	1B	NA
SIP-PA-007	04-Jan-90	11.5	5	1–5	1B	NA
SIP-PA-010	25-Jan-90	11.5	9	3–9	1B	NA
SIP-PA-012	29-Jan-90	11.5	9	2–9	1B	NA
SIP-PA-013	24-Jan-90	16.5	13	8–13	1B	NA
SIP-PA-015	25-Jan-90	21.5	17.5	2–17.5	1B	NA
SIP-PA-016	24-Jan-90	11.5	11.5	7–11.5	1B	NA
SIP-PA-017	24-Jan-90	16.5	14	7–14	1B	NA
SIP-PA-018	25-Jan-90	11.5	8	6–8	1B	NA
SIP-PA-019	26-Jan-90	16.5	12	2–12	1B	NA
SIP-PA-021	23-Jan-90	11.5	10	2–10	1B	NA
SIP-PA-024	23-Jan-90	16.5	15	5–15	1B	NA
SIP-PA-025	23-Jan-90	11.5	7	4–7	1B	NA
SIP-PA-026	29-Jan-90	11.5	10	2–10	1B	NA
SIP-PA-027	29-Jan-90	8.5	7	2–7	1B	NA
SIP-PA-028	23-Jan-90	11	8	5–8	1B	NA
SIP-PA-030	24-Jan-90	11.5	8	4–8	1B	NA
SIP-PA-034	04-Jan-90	6.5	5	3–5	1B	NA
SIP-PA-035	04-Jan-90	11.5	11.5	6.5–11.5	1B	NA
Soil Vapor Installations						
IMS-INF-203	08-Jul-98	63	63	NA[e]	1A	NA
SEA-518-301	11-Sep-95	102.6	100	NA[e]	1B/2/5	NA
SEA-518-304	11-Sep-95	100	50	NA[e]	1B/2/5	NA
SEA-ETS-305	03-Sep-92	85	85	NA[e]	1B/2	NA
SEA-ETS-506	24-Jul-96	75	66	NA[e]	1B/2	NA
SEA-ETS-507	30-Jul-96	75	66	NA[e]	1B/2	NA
Soil Vapor Wells						
SVI-518-101	21-Sep-90	125	61	55–61	2	NA
SVI-518-201	03-Mar-93	59.8	50	34–50	1B/2	NA
SVI-518-202	03-Nov-93	120.6	73.8	19–73.8	1B/2	NA
SVI-518-204	05-Nov-93	121.5	46	24–46	1B/2	NA
SVI-518-302	22-Jun-95	104.5	39.3	11–39	1B	NA
SVI-518-303*	29-Jun-95	104.5	42	6–40	1B	NA
SVI-ETS-504	09-Jul-96	76.5	67	42–67	2	NA
SVI-ETS-505	18-Jul-96	80.5	77.5	45–75	2	NA

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

Well number	Date completed	Borehole depth (ft)	Casing depth (ft)	Screen interval(s) (ft)	HSU[a] monitored	Initial well development flow rate (gpm)[b]
Soil Vapor Wells (cont.)						
SVB-518-1913	07-Oct-03	63	61	50.5–60.5	2	N/A
SVB-518-1914	09-Oct-03	18	16	5.5–15.5	1B	N/A
SVB-518-1915*	15-Oct-03	44	41	30.5–40.5	2	N/A
SVB-543-001	25-Feb-03	100	67.5	52–67	2	N/A
SVB-543-002A	10-Mar-03	96	65.4	45–65	1B/2	N/A
SVB-543-002B			82.4	72–82	2	N/A
SVB-543-003	20-Mar-03	95	80	69–79	2	N/A
SVB-543-004A	02-Apr-03	95	64.5	49–64	1B/2	N/A
SVB-543-004B			80.5	70–80	2	N/A
SVB-543-1908	12-Jun-03	40.8	40.4	20–40	1B	N/A
SVB-ETC-2001A	17-Nov-03	95	23.5	18–23	1B	N/A
SVB-ETC-2001B			88.5	78–88	2	N/A
SVB-ETC-2002A	25-Nov-03	95	64.5	34–64	1B/2	N/A
SVB-ETC-2002B			85.5	75–85	2	N/A
SVB-ETC-2003	09-Dec-03	95	45.5	20–45	1B	N/A
SVB-ETC-2004A	17-Dec-03	95	53.5	28–53	1B/2	N/A
SVB-ETC-2004B			88.5	63–68	2	
SVB-ETC-2004B			88.5	78–88	2	
SVB-HPA-001A	15-Apr-03	80	45.5	30–45	1B/2	N/A
SVB-HPA-001B			73.5	63–73	2	N/A
SVB-HPA-002A	29-Apr-03	80	43	32.5–42.5	1B/2	N/A
SVB-HPA-002B			72.5	52–72	2	N/A
Anode Wells (Plant Engineering)						
AW-1906 (U622)	17-Jun-03	270	258	N/A	N/A	N/A
AW-1910 (B482)	23-Jul-03	270	258	N/A	N/A	N/A
AW-1911 (B323)	13-Aug-03	290	258	N/A	N/A	N/A
AW-1912 (B117)	10-Sep-03	280	258	N/A	N/A	N/A

Notes and footnotes appear on following page.

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

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.

NA = Not applicable or not available.

* **Piezometer SVI-518-303 drilled out and replaced by SVB-518-1915.**

[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 subject to change.**

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

[c] **Wells installed for the Dynamic Underground Stripping Demonstration Project include extraction wells (GEW series), injection wells (GIW series), temperature monitoring wells (TEP series), and heating wells (HW series). TEP wells consist of two nested 1-in. inside diameter (ID) piezometers surrounding a blank fiberglass 2-in. ID casing instrumented with geophysical sensors. Therefore, the screened intervals listed refer to the two individual piezometers.**

[d] **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

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

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

Well number	Date installed	Borehole depth (ft)	Casing depth (ft)	Screen interval(s) (ft)	HSU monitored	Closure date
Monitor Wells						
W-010-A	08-Sept-80	110.7	110.0	85–95 100–105	2	26-Feb-02
W-14A	26-Aug-80	111.0	109.0	80,95,105	2	11-Dec-87
W-15	17-Nov-80	285.0	267.0	239–265	7	13-May-88
W-18	22-Aug-80	161.0	152.5	80–90	2	11-Nov-85
				100–105	2	
				112–117	3A	
				128–133	5	
				143–153	5	
W-149	23-Aug-85	201.0	169.0	161–169	2	29-Aug-96
W-150	13-Sep-85	212.0	162.0	157–162	2	11-Apr-90
W-211	19-Mar-86	215.5	193.0	183-–193	7	13-June-02
W-352	29-Oct-86	235.0	201.0	181–201	4	18-Dec-97
W-358	04-Feb-87	248.0	239.0	230–239	7	15-Apr-94
W-360	24-Feb-87	260	204.5	181.5–204.5	4	26-Feb-02
W-414	20-May-88	179.0	74.0	69.5–74	2	26-Feb-02
W-456	09-Jun-88	343.0	180.5	172–180.5	3A	15-Nov-00
W-460	22-Jul-88	361.0	140.5	135–140.5	2	15-Nov-00
W-1005	14-Mar-94	192.0	110.0	98–110	1B	14-Nov-00
W-1006	10-Mar-94	154.0	149.0	141–149	2	14-Nov-00
W-1007	31-Mar-94	199.5	182.0	172–182	3A	14-Nov-00
W-1114	07-Aug-95	223	205	177–200	5	22-Apr-97
W-1218	29-May-96	240	145.5	127–145	3A	27-Feb-02
W-1220	12-Jun-96	120	172	90–112	2	27-Feb-02
W-1221	01-Jul-96	220	172	162–172	4	28-Feb-02
GSW-1	05-Feb-85	112.0	109.0	85–106	3A	06-Jun-86
GSW-10	29-Apr-86	205.5	127.5	114–127.5	3B	27-Jan-98
GSW-20	18-May-84	134.0	101.3	95–101.3	3A	03-Sep-87
Extraction Wells						
GEW-711	24-May-91	167.5	157.0	94–137	3A,3B	16-Jun-92
Other Wells						
1N1	15-Jan-48	600	600	427–442	7	21-Oct-88
				450–453	1B	
				465–469	NA	

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

Well number	Date installed	Borehole depth (ft)	Casing depth (ft)	Screen interval(s) (ft)	HSU monitored	Closure date
Other Wells (cont.)						
1N1 *(cont.)*	15-Jan-48	600	600	500–515	NA	21-Oct-88
				575–588	NA	
11A1	08-Jun-76	66	64.7	54.7–59.7	NA	18-Aug-88
2R9 (11A5)[a]	NA	NA	NA	NA	NA	19-Jul-88
11BA[b]	NA	NA	NA	NA	NA	10-Jun-87
11H1	04-Nov-41	NA	519	157–161	NA	31-Oct-88
				169–177	NA	
				224–228	NA	
				243–245	NA	
				254–256	NA	
				306–314	NA	
				319–327	NA	
				339–342	NA	
				414–419	NA	
				424–431	NA	
				477–479	NA	
11H4	05-Apr-60	272	272	166–170	NA	07-Oct-88
				174–176	NA	
				183–185	NA	
				200–202	NA	
				211–214	NA	
				224–230	NA	
				250–252	NA	
				260–265	NA	
11J1	1941	160	NA	NA	NA	03-Aug-88
11J4[c]	1965	NA	NA	NA	NA	11-Oct-88
11K1	06-Jan-42	NA	621	247–255	NA	26-Sep-88
				272–276	NA	
				297–304	NA	
				322–339	NA	
				554–557	NA	
				580–602	NA	

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

Well number	Date installed	Borehole depth (ft)	Casing depth (ft)	Screen interval(s) (ft)	HSU monitored	Closure date
Other Wells (cont.)						
11K2	NA	NA	232	NA	NA	03-Oct-88
11Q2	NA	NA	264	NA	NA	16-Aug-88
11Q3	NA	NA	120	NA	NA	10-Aug-88
11Q6[c]	NA	NA	280	NA	NA	11-Jan-89
11R3	08-May-61	140	117	NA	NA	03-Sep-85
11R4	NA	NA	NA	NA	NA	03-Sep-85
11R5[c]	NA	NA	NA	NA	NA	26-Jul-85
12M1	09-Dec-42	702	702	375–378	NA	15-Apr-84
				420–426	NA	
				452–473	NA	
				560–564	NA	
				609–621	NA	
				626–657	NA	
12N1	14-Apr-42	702	681	392–399	NA	24-Jan-89
				514–518	NA	
				527–536	NA	
				666–670	NA	
				678–681	NA	
13D1[c]	29-Oct-56	NA	400	200–400	NA	23-Aug-88
14A1[c]	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[c]	15-Nov-56	NA	229	122–130	NA	12-Sep-88
				140–150	NA	
				160–180	NA	
14A4[c]	15-Jun-59	NA	252	167–170	NA	29-Aug-88
				175–179	NA	
				192–202	NA	
				235–246	NA	

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

Well number	Date installed	Borehole depth (ft)	Casing depth (ft)	Screen interval(s) (ft)	HSU monitored	Closure date
Other Wells (cont.)						
14A8	NA	NA	86	NA	NA	22-Jul-88
14B2	22-Aug-56	NA	312	185–312	NA	11-Nov-88
14B8	NA	NA	385	NA	NA	23-Oct-89
TEP-GP-001	21-Jan-92	165.0	97.0 117.0 160.5	87–97 107–117	3A 3B	09-Feb-93
TEP-GP-003	28-Jan-92	161.0	129.5 161.0	124.5–129.5	3B	13-Feb-93
TEP-GP-004	05-Feb-92	161.0	106.0 134.0 161.0	96–106 124–134	3A 3B	13-Feb-93
TEP-GP-005	18-Feb-92	161.0	124.5 161.0	114.5–124.5	3B	13-Feb-93
TEP-GP-006	26-Feb-92	161.0	127.0 161.0	107–127	3B	13-Feb-93
TEP-GP-007	13-Mar-92	161.0	161.0			NA
TEP-GP-008	03-Mar-92	161.0	110.0 161.0	100–110	3A	13-Feb-93
TEP-GP-009	06-May-92	161.7	107.0 130.5 161.0	98–107 120.5–130.5	3A 3B	13-Feb-93
TEP-GP-010	24-Mar-92	161.0	124.5	114.5–124.5	3B	12-Feb-93
TEP-GP-011	07-Apr-92	161.0	108.0 161.0	98–108	3A	13-Feb-93
TEP-GP-002	24-Jun-92	161.4	133.0 161.0	102–112.5 122–133	3A 3B	NA
Source Investigation Piezometers						
SIP-ETC-302	22-Apr-99	104	89.4	79–89	2	26-Apr-99
SIP-ETS-105	11-Feb-90	110	103	87–103	3A	18-Nov-93
SIP-ETS-207	11-Jul-91	103.5	98.5	89.75–98.5	3A	05-Jan-00
SIP-HPA-102	08-Dec-94	76	72	67–72	2	09-Apr-02
SIP-HPA-103	01-Mar-95	77	72.5	67–72.7	2	09-Apr-02
SIP-PA-029	22 -Jan-90	11.5	7	5-7	1B	18-Nov-93
SIP-419-201	29-Feb-96	126	107	97–107	3A/3B	25-Mar-98

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

Well number	Date installed	Borehole depth (ft)	Casing depth (ft)	Screen interval(s) (ft)	HSU monitored	Closure date
Source Investigation Piezometers (cont.)						
SIP-490-101	01-Nov-95	59	56	53–56	2	21-Dec-95
SIP-514-101	28-Dec-89	26	22	7–22	1B	03-Sep-96
UP-292-001	03-Dec-90	54.6	49.5	44.5–49.5	1B	25-Sep-95
SVI-518-303*	29-Jun-95	104.5	42	6–40	1B/2	NA
Anode Wells						
CPRS-03 (B482)	N/A	180	N/A	N/A	N/A	26-Sep-03
CPS-1-325CT (B323)	N/A	260	N/A	N/A	N/A	30-Oct-03

Notes:

ft = Feet.

HSU = Hydrostratigraphic unit.

NA = Not applicable or not available.

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

[a] 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.

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

[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 identification changes made on this table are:

11J81 ------> 11J4

11R81 ------> 11R5

11Q81 ------> 11Q6

13D81 ------> 13D1

14A81 ------> 14A1

14A82 ------> 14A2

14A83 ------> 14A4

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

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-115	05-Mar-86	Drawdown	1.1	180	30	Good
W-116	24-Dec-85	Slug	NA	37	7.5	Good
W-117	20-Feb-86	Slug	NA	2	0.4	Good
W-118	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

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-217	15-Jul-86	Slug	NA	750	120	Good
W-218	17-Jun-86	Drawdown	11.7	6,400	1,100	Good
W-218	12-Nov-86	Longterm	7.7	4,000	670	Good
W-219	15-Jul-86	Drawdown	4.3	620	76	Good
W-219	23-Feb-87	Longterm	5.2	66	8.0	Fair
W-220	21-Aug-86	Slug	NA	28	5.5	Excel
W-221	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

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-267	02-Jun-86	Drawdown	0.5	420	85	Poor
W-268	14-Nov-86	Drawdown	5.0	230	18	Good
W-269	14-Jul-86	Drawdown	5.0	570	95	Good
W-270	30-Dec-86	Slug	NA	14	2.0	Good
W-271	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

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	13-Jul-87	Longterm	13.6	2,500	330	Fair
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

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-363	24-Jul-87	Slug	NA	20	3.0	Excel
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

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-424	17-Oct-85	Drawdown	4.5	130	19	Good
W-441	30-Oct-87	Drawdown	6.0	500	56	Good
W-441	13-Apr-88	Drawdown	13.0	2,200	240	Poor
W-441	19-Apr-88	Longterm	14.0	470	52	Good
W-447	26-Feb-88	Drawdown	7.1	124	850	Poor
W-448	24-Mar-85	Drawdown	24.5	4,200	600	Good
W-449	21-Mar-85	Drawdown	6.2	170	11	Good
W-450	14-Apr-88	Drawdown	3.3	38	650	Fair
W-451	27-Apr-88	Drawdown	2.1	80	16	Good
W-452	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

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-515	06-Jun-89	Drawdown	2.8	37	4.2	Fair
W-516	19-Jun-89	Drawdown	19.5	1,428	286	Good
W-517	27-Jun-89	Drawdown	7.3	370	53	Good
W-518	10-Aug-89	Drawdown	6.2	1,421	178	Good
W-519	31-Aug-89	Drawdown	31.5	5,700	475	Excel
W-520	24-Jan-90	Drawdown	22.8	3,300	560	Excel
W-521	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

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-606	21-Feb-90	Slug	NA	120	20	Fair
W-607	22-Feb-90	Drawdown	1.4	800	100	Good
W-608	28-Feb-90	Drawdown	1.2	230	30	Fair
W-609	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

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-911	02-Feb-96	Drawdown	1.4	53	2.1	Good
W-912	10-Nov-95	Drawdown	4.1	65	11	Poor
W-913	16-Aug-95	Drawdown	23.5	730	36	Good
W-1001	13-Aug-95	Drawdown	1.3	170	25	Fair
W-1002	19-Jun-97	Drawdown	16.8	680	49	Good
W-1003	26-Jun-97	Drawdown	1.2	5.1	0.7	Poor
W-1006	17-Jun-97	Drawdown	17.4	180	23	Fair
W-1007	23-Sep-95	Drawdown	1.6	13	1.3	Fair
W-1008	17-Jan-97	Drawdown	7.3	110	13	Good
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
125W-1204	22-Feb-96	Drawdown	1.3	17	2.2	Poor

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

Well	Date	Type of test[b]	Flow rate (Q) (gpm)	Transmissivity (T) (gpd/ft)	Hydraulic conductivity (K)[c] (gpd/sq ft)	Data quality[d]
W-1205	27-Nov-96	Slug	NA	330	33	Fair
W-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-977	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

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-1401	11-Nov-97	Drawdown	7.0	100	6.8	Excel
W-1402	12-Dec-97	Drawdown	2.6	100	10.2	Fair
W-1403	21-Jul-98	Drawdown	5.4	95	13	Good
W-1404	21-Apr-98	Drawdown	6.5	210	84	Good
W-1405	23-Apr-98	Drawdown	6.4	1,300	360	Fair
W-1406	17-Apr-98	Drawdown	11.1	3,600	360	Good
W-1407	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

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-1507	27-Apr-99	Drawdown	0.65	15	1.9	Fair
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
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 following page.

Table B-1. Results of hydraulic tests (cont.)

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.

References

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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)
SVB-543-001	04/22/03	2	6.0	19.25	3.7	296	3E-08
SVB-543-002A	04/30/03	2	6.0	10.00	5.1	138	8E-09
SVB-543-002B	05/01/03	2	6.0	14.00	5.1	145	2E-08
SVB-543-003	04/29/03	2	6.0	31.00	5.1	236	7E-08
SVB-543-004A	04/23/03	2	6.0	37.00	3.7	198	2E-08
SVB-543-004B	04/28/03	2	6.0	36.50	5.1	188	2E-08
SVB-HPA-001B	05/13/03	2	1.5	9.25	6.6	31.0	1E-08
SVB-HPA-002A	05/20/03	1B	2.0	0.75	6.6	4.30	1E-08
W-1552	10/06/03	3A/B	1.8	1.02	15.0	(NM)[b]	9E-11
W-1650	10/09/03	3A/B	2.8	0.84	12.0	(22.7)[b]	1E-10
W-1651	10/09/03	3A/B	3.0	0.88	12.0	(31.0)[b]	1E-10
W-1652	10/07/03	3A/B	6.0	1.08	12.0	(29.0)[b]	2E-10
W-1653	10/10/03	3A/B	2.0	0.80	12.0	(17.7)[b]	3E-10
W-1654	10/10/03	3A/B	2.5	0.82	12.0	(10.0)[b]	3E-11
W-1655	10/08/03	3A/B	1.0	1.49	12.0	(NM)[b]	4E-10
W-1656	10/13/03	3A/B	0.5	NM	12.0	(10.0)[b]	2E-10
W-1657	10/08/03	3A/B	2.8	1.01	12.0	(20.0)[b]	3E-10

Notes:

cm^2 = Square centimeters.
ft = Feet.
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.

[a] Sample collected in Tedlar bag for TO-14 analysis.
[b] Sample measured with organic vapor analyzer.

Appendix D

2004 Ground Water Sampling Schedule

Table D-1. 2004 LLNL Livermore Site VOC ground water sampling schedule.

Well number	VOC sampling frequency	Next quarter sample date	Additional analytes (Q1-04)
W-001	O	2-05	
W-001A	A	3-04	
W-002	A	1-04	
W-002A	O	3-05	
W-004	S	1-04	
W-005	O	3-05	
W-005A	O	4-05	
W-007	E	4-04	
W-008	E	4-04	WGMG
W-011	O	4-05	
W-012	S	2-04	
W-017	E	1-04	WGMG
W-017A	E	4-04	
W-019	O	1-05	
W-101	O	2-05	WGMG
W-102	O	3-05	
W-103	E	4-04	
W-104	Q	1-04	
W-105	O	4-05	
W-106	E	4-04	
W-107	E	4-04	
W-108	O	3-05	
W-110	Q	1-04	
W-111	E	3-04	
W-113	Q	1-04	
W-114	A	3-04	
W-115	O	4-05	
W-116	Q	1-04	
W-117	O	1-05	
W-118	O	4-05	
W-119	Q	1-04	WGMG
W-120	A	1-04	
W-121	Q	1-04	WGMG
W-122	E	1-04	
W-123	E	1-04	
W-141	E	2-04	
W-142	Q	1-04	

Table D-1. 2004 LLNL Livermore Site VOC ground water sampling schedule.

Well number	VOC sampling frequency	Next quarter sample date	Additional analytes (Q1-04)
W-143	A	3-05	
W-146	O	4-05	
W-147	O	4-05	WGMG
W-148	O	4-05	WGMG
W-151	Q	1-04	WGMG
W-201	O	3-05	
W-202	E	1-04	
W-203	E	2-04	
W-204	O	2-05	WGMG
W-205	Q	1-04	
W-206	Q	1-04	
W-207	Q	1-04	
W-210	Q	1-04	
W-212	E	4-04	
W-213	O	4-05	
W-214	S	2-04	
W-217	Q	1-04	
W-218	S	2-04	
W-219	E	4-04	
W-220	S	2-04	
W-221	E	2-04	WGMG
W-222	O	3-05	
W-223	O	4-05	
W-224	O	1-05	
W-225	A	2-04	
W-226	E	2-04	WGMG/NPDES
W-251	Q	1-04	
W-252	O	4-05	
W-253	O	1-05	
W-255	Q	1-04	
W-256	O	4-05	
W-257	Q	1-04	
W-258	Q	1-04	
W-259	Q	1-04	
W-260	O	2-05	
W-261	Q	1-04	
W-263	Q	1-04	

Table D-1. 2004 LLNL Livermore Site VOC ground water sampling schedule.

Well number	VOC sampling frequency	Next quarter sample date	Additional analytes (Q1-04)
W-264	A	2-04	
W-265	O	3-05	
W-267	O	4-05	
W-268	A	3-04	
W-269	E	1-04	
W-270	E	3-04	WGMG
W-271	Q	1-04	
W-272	Q	1-04	
W-273	O	4-05	
W-274	Q	1-04	
W-275	A	1-04	
W-276	S	2-04	
W-277	O	4-05	
W-290	E	4-04	
W-291	O	1-05	
W-293	E	2-04	
W-294	Q	1-04	
W-301	O	4-05	
W-302	O	2-05	
W-303	O	3-05	
W-304	Q	1-04	
W-306	O	3-05	WGMG/NPDES
W-307	S	1-04	WGMG/NPDES
W-308	A	4-04	
W-310	O	1-05	
W-311	A	2-04	
W-312	O	2-05	
W-313	Q	1-04	
W-315	Q	1-04	
W-316	Q	1-04	
W-317	S	1-04	
W-318	Q	1-04	
W-319	O	1-05	
W-320	O	1-05	
W-321	O	4-05	
W-322	Q	1-04	
W-323	Q	1-04	

Table D-1. 2004 LLNL Livermore Site VOC ground water sampling schedule.

Well number	VOC sampling frequency	Next quarter sample date	Additional analytes (Q1-04)
W-324	E	2-04	
W-325	O	1-05	
W-353	S	2-04	
W-354	Q	1-04	
W-355	Q	1-04	
W-356	Q	1-04	
W-359	Q	1-04	WGMG
W-361	Q	1-04	
W-362	A	3-04	
W-363	Q	1-04	WGMG
W-364	Q	1-04	
W-365	Q	1-04	
W-366	O	3-05	
W-369	S	1-04	
W-370	O	2-05	
W-371	Q	1-04	
W-372	O	1-05	
W-373	O	3-05	WGMG
W-375	S	2-04	
W-376	O	4-05	
W-377	E	2-04	
W-378	A	2-04	
W-379	A	1-04	
W-380	O	1-05	
W-401	E	2-04	
W-402	O	1-05	
W-403	O	1-05	
W-404	E	1-04	
W-405	Q	1-04	
W-406	E	4-04	
W-407	Q	1-04	
W-409	A	4-04	
W-410	Q	1-04	
W-411	Q	1-04	
W-412	O	3-05	
W-416	O	2-05	
W-417	O	4-05	

Table D-1. 2004 LLNL Livermore Site VOC ground water sampling schedule.

Well number	VOC sampling frequency	Next quarter sample date	Additional analytes (Q1-04)
W-418	O	4-05	
W-419	Q	1-04	
W-420	O	1-05	
W-421	Q	1-04	
W-422	E	4-04	
W-423	Q	1-04	
W-424	Q	1-04	
W-446	E	1-04	
W-447	O	4-05	
W-448	O	3-05	
W-449	O	4-05	
W-450	A	1-04	
W-451	E	1-04	
W-452	E	4-04	
W-453	E	2-04	
W-454	A	1-04	
W-455	E	3-04	
W-458	E	4-04	
W-459	O	2-05	
W-461	Q	1-04	
W-462	O	4-05	
W-463	O	4-05	
W-464	S	1-04	
W-481	Q	1-04	
W-482	Q	1-04	
W-483	O	3-05	
W-484	E	4-04	
W-485	E	2-04	
W-486	O	2-05	
W-487	O	1-05	
W-501	S	2-04	
W-502	E	2-04	
W-503	O	2-05	
W-504	O	4-05	
W-505	E	2-04	
W-506	E	1-04	
W-507	O	3-05	

Table D-1. 2004 LLNL Livermore Site VOC ground water sampling schedule.

Well number	VOC sampling frequency	Next quarter sample date	Additional analytes (Q1-04)
W-509	Q	1-04	
W-510	O	2-05	
W-511	A	1-04	
W-512	O	2-05	
W-513	E	2-04	
W-514	O	4-05	
W-515	S	1-04	
W-516	O	2-05	
W-517	Q	1-04	
W-519	O	4-05	
W-521	E	3-04	
W-551	A	1-04	
W-552	O	3-05	
W-553	E	4-04	
W-554	E	1-04	
W-555	O	2-05	
W-556	O	2-05	WGMG
W-557	E	4-04	
W-558	Q	1-04	
W-559	E	4-04	
W-560	E	1-04	
W-561	E	3-04	
W-562	E	2-04	
W-563	E	3-04	
W-564	S	1-04	
W-565	A	3-04	
W-567	A	2-04	
W-568	E	3-04	
W-569	A	4-04	
W-570	E	4-04	
W-571	E	2-04	WGMG
W-591	E	4-04	
W-592	O	3-05	
W-593	O	1-05	
W-594	S	2-04	
W-604	A	4-04	
W-606	S	2-04	

Table D-1. 2004 LLNL Livermore Site VOC ground water sampling schedule.

Well number	VOC sampling frequency	Next quarter sample date	Additional analytes (Q1-04)
W-607	O	4-05	
W-608	O	3-05	
W-611	S	1-04	
W-612	A	4-04	
W-613	E	4-04	
W-615	A	1-04	
W-616	E	1-04	
W-617	O	4-05	
W-618	Q	1-04	
W-619	O	3-05	
W-622	Q	1-04	
W-651	Q	1-04	
W-652	O	2-05	
W-653	Q	1-04	
W-654	S	1-04	
W-702	A	2-04	
W-705	O	4-05	
W-706	O	4-05	
W-750	O	4-05	
W-901	E	2-04	
W-902	O	1-05	
W-905	O	3-05	
W-906	Q	1-04	WGMG
W-908	O	1-05	
W-909	Q	1-04	
W-911	Q	1-04	
W-912	S	1-04	
W-913	Q	1-04	
W-1002	O	4-05	
W-1003	O	4-05	
W-1008	E	4-04	
W-1010	O	4-05	
W-1011	O	2-05	
W-1012	E	4-04	WGMG
W-1013	O	3-05	
W-1014	A	4-04	
W-1101	O	2-05	

Table D-1. 2004 LLNL Livermore Site VOC ground water sampling schedule.

Well number	VOC sampling frequency	Next quarter sample date	Additional analytes (Q1-04)
W-1105	O	3-05	
W-1106	A	3-04	
W-1107	Q	1-04	
W-1108	Q	1-04	
W-1110	A	1-04	
W-1112	Q	1-04	
W-1113	A	3-04	
W-1115	A	4-04	
W-1117	Q	1-04	
W-1118	Q	1-04	
W-1201	Q	1-04	
W-1202	Q	1-04	
W-1203	Q	1-04	
W-1204	Q	1-04	
W-1205	Q	1-04	
W-1207	A	2-04	
W-1209	A	4-04	
W-1210	Q	1-04	
W-1212	Q	1-04	
W-1214	Q	1-04	
W-1217	Q	1-04	
W-1219	A	3-04	
W-1222	Q	1-04	
W-1223	Q	1-04	
W-1224	O	2-05	
W-1225	Q	1-04	
W-1226	O	2-05	
W-1227	O	1-05	
W-1250	Q	1-04	
W-1251	S	2-04	
W-1252	Q	1-04	
W-1253	Q	1-04	
W-1254	Q	1-04	
W-1255	Q	1-04	
W-1303	Q	1-04	WGMG
W-1304	Q	1-04	
W-1306	Q	1-04	WGMG

Table D-1. 2004 LLNL Livermore Site VOC ground water sampling schedule.

Well number	VOC sampling frequency	Next quarter sample date	Additional analytes (Q1-04)
W-1308	Q	1-04	WGMG
W-1309	A	1-04	
W-1311	Q	1-04	
W-1401	Q	1-04	
W-1402	Q	1-04	
W-1403	Q	1-04	
W-1404	S	2-04	
W-1405	Q	1-04	
W-1406	A	1-04	
W-1407	Q	1-04	
W-1408	Q	1-04	
W-1411	A	1-04	
W-1412	Q	1-04	
W-1413	E	1-04	
W-1414	Q	1-04	
W-1416	S	1-04	
W-1417	Q	1-04	
W-1418	Q	1-04	
W-1419	A	1-04	
W-1420	O	2-05	
W-1421	Q	1-04	
W-1422	Q	1-04	
W-1424	E	1-04	
W-1425	S	1-04	
W-1426	O	2-05	
W-1427	A	4-04	
W-1428	O	4-05	
W-1501	E	3-04	
W-1502	A	2-04	
W-1505	Q	1-04	
W-1506	Q	1-04	
W-1507	S	2-04	
W-1508	Q	1-04	
W-1509	A	1-04	
W-1511	Q	1-04	
W-1512	A	2-04	
W-1513	A	3-04	

Table D-1. 2004 LLNL Livermore Site VOC ground water sampling schedule.

Well number	VOC sampling frequency	Next quarter sample date	Additional analytes (Q1-04)
W-1514	A	3-04	
W-1515	A	3-04	
W-1516	S	1-04	
W-1517	A	4-04	
W-1519	S	1-04	
W-1553	Q	1-04	
W-1604	S	2-04	
W-1613	E	1-04	
W-1614	A	2-04	
W-1701	A	3-04	
W-1703	A	1-04	
W-1704	A	3-04	
W-1705	S	2-04	
W-1802	Q	1-04	
W-1803-1[a]	Q	1-04	
W-1803-2[a]	Q	1-04	
W-1804-1[a]	Q	1-04	
W-1804-2[a]	Q	1-04	
W-1805	Q	1-04	
W-1901-1[a]	Q	1-04	
W-1901-2[a]	Q	1-04	
W-1904	Q	1-04	
W-1905-1[a]	Q	1-04	
W-1905-2[a]	Q	1-04	
TW-11	A	1-04	
TW-11A	A	4-04	
TW-21	O	4-05	
11C1	E	2-04	
14A11	O	1-05	
14A3	E	4-04	
14B1	O	2-05	WGMG
14B4	O	3-05	
14C1	Q	1-04	
14C2	E	1-04	
14C3	Q	1-04	
14H1	Q	1-04	
18D1	O	3-05	

Table D-1. 2004 LLNL Livermore Site VOC ground water sampling schedule.

Well number	VOC sampling frequency	Next quarter sample date	Additional analytes (Q1-04)
GEW-710	S	1-04	WGMG
GSW-006	O	4-05	
GSW-007	E	1-04	
GSW-008	O	3-05	
GSW-009	Q	1-04	
GSW-011	Q	1-04	
GSW-013	Q	1-04	
GSW-215	A	2-04	
GSW-216	A	2-04	
GSW-266	Q	1-04	
GSW-326	O	2-05	
GSW-367	O	3-05	
GSW-442	Q	1-04	
GSW-443	E	3-04	
GSW-444	Q	1-04	
GSW-445	A	1-04	

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

2003 Drainage Retention Basin Annual Monitoring Program Summary

Appendix E

2003 Drainage Retention Basin Annual Monitoring Program Summary

This Appendix summarizes the 2003 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 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. Samples of each dry season release event are collected or, if release is continuous, samples are collected monthly. Release water samples are collected at sample location CDBX (Figs. E-1 and E-2) and are compared with the LLNL Arroyo Las Positas outfall samples collected at sample location WPDC. 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.

Complete analytical results of samples collected from releases are reported in the LLNL Livermore Site Project Quarterly Self-Monitoring Reports for 2003 and in the LLNL Site Annual Environmental Report (Sanchez et al., 2003).

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., in October for downstream bullfrog mitigation).

Dry season release samples were collected June 1, July 9, August 6, and September 3, 2003. Samples for the first release of the 2003–2004 wet season were collected on November 7, 2003. The second and third wet-season sampling events occurred in conjunction with storm water monitoring on December 11 and December 29, 2003. Final analytical data are not yet available for the December release events.

Based on available data, discharges from the DRB were within discharge limits for all parameters except pH. Discharge samples collected at CDBX exceeded the pH limit of 8.5 in five of seven wet and dry season monitoring events reported. The minimum recorded pH was 8.0 and the maximum was 9.8. Corresponding samples collected at sampling location WPDC exceeded the pH discharge limit in three of the seven 2003 sampling events. The minimum pH at the WPDC was 7.1 and the maximum pH was 8.8. Chromium, hexavalent chromium, and nickel were the only metals reported above detection limits at both CDBX and WPDC. All

detected metals were below discharge limits. Verbally reported analytical results indicated that the acute aquatic survival bioassay test for location WPDC on November 7 failed. Follow-up samples were collected on November 10 and 12, both of which passed the bioassey test. Official results have not yet been received from the laboratory.

DRB discharge water was sampled for volatile organic compounds (VOCs), herbicides, and polychlorinated biphenyl compounds (PCBs). All analytical results were below detection limits.

E-2. References

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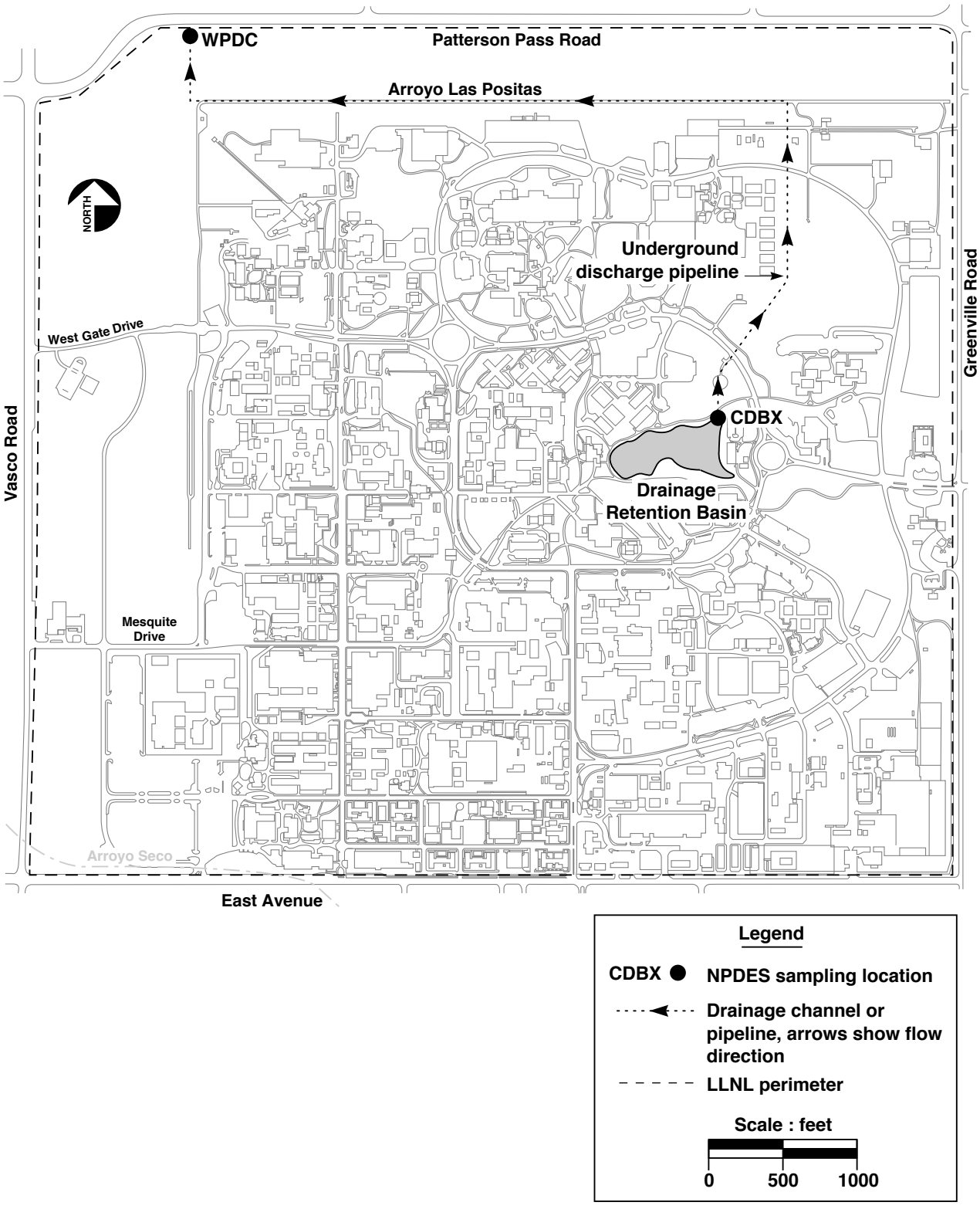

ERD-LSR-04-0026

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

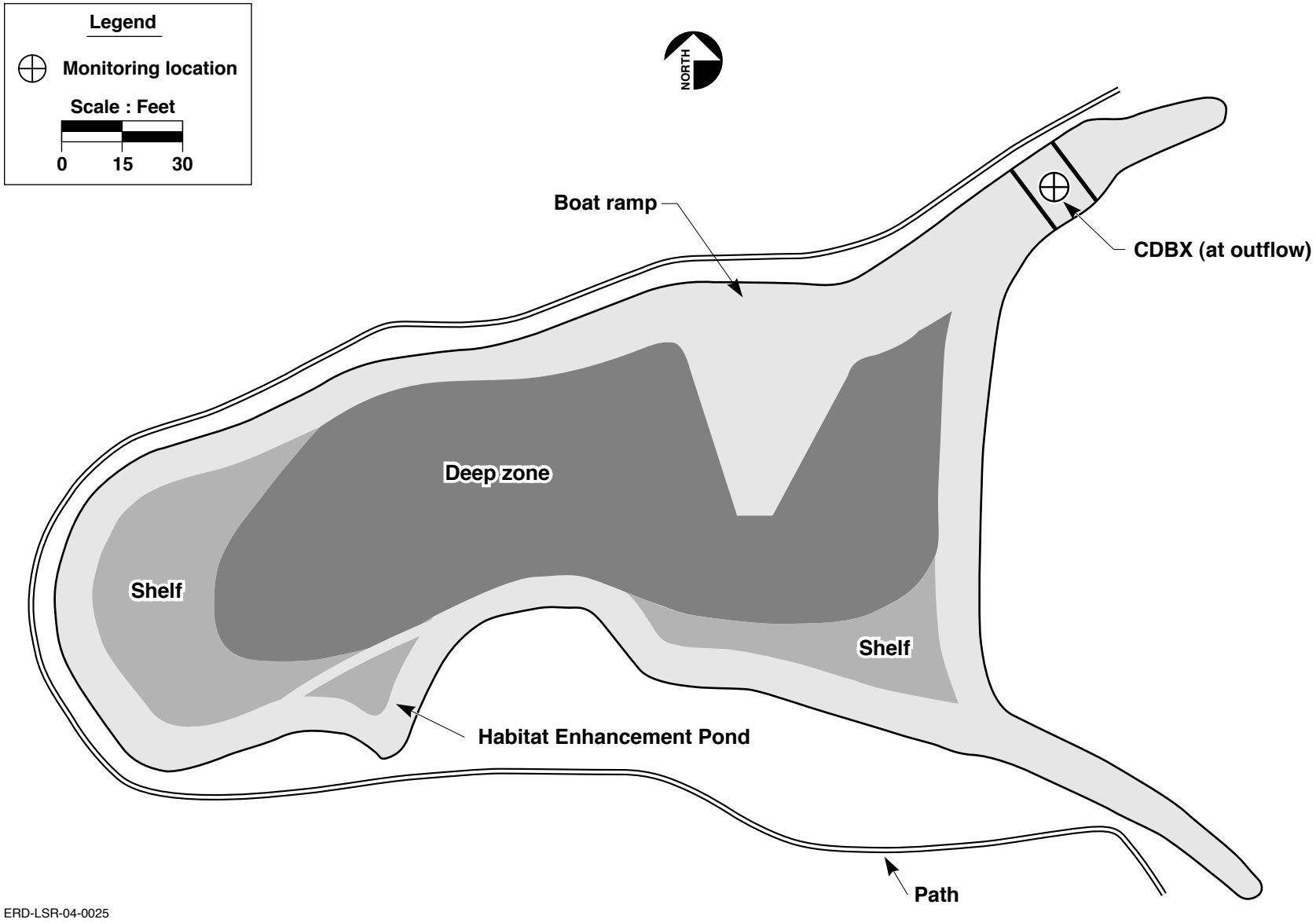

Figure E-2. Drainage Retention Basin monitoring location.