U.S. Department of Energy

Livermore Field Office, Livermore, California 94551

Lawrence Livermore National Laboratory

Lawrence Livermore National Security, LLC Livermore, California 94551

UCRL-AR-126020-15

LLNL
Ground Water Project

2015 Annual Report

Technical Editors

P. McKereghan
C. Noyes
Z. Demir
M. Dresen*

Contributors

A. Porubcan
S. Chamberlain
W. McConihe*
K. Mansoor

*Weiss Associates, Emeryville, California

Environmental Restoration Department

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

UCRL-AR-126020-15

LLNL Ground Water Project

2015 Annual Report

Technical Editors

P. McKereghan
C. Noyes
Z. Demir
M. Dresen*

Contributors

A. Porubcan*
W. McConihe*
S. Chamberlain
K. Mansoor

*Weiss Associates, Emeryville, California

Environmental Restoration Department

Table of Contents

List of Figures

List of Tables

Appendices

Attachments

Acknowledgements

Many people support the Lawrence Livermore National Laboratory Livermore Site Ground Water Project. The dedication and diverse skills of all these individuals contribute to the ongoing success of the Environmental Restoration Department activities. The editors wish to collectively thank all the contributing people and companies.

Summary

In 2015, environmental restoration activities for the Lawrence Livermore National Laboratory (LLNL) Livermore Site Ground Water Project (GWP) included:

- Removal of about 51 kilograms (kg) of volatile organic compounds (VOCs) from the Livermore Site subsurface, including 32 kg VOCs from ground water and 19 kg of VOCs from soil vapor (Table Summ-1).
- Operation and/or maintenance of 28 ground water treatment facilities and 9 soil vapor treatment facilities.
- Operation and/or maintenance of a network of 90 ground water extraction wells, 2 ground water injection wells, 17 dual extraction[1] wells and 34 soil vapor extraction wells.
- On-going hydraulic control and treatment of VOCs in ground water along the western and southern margins of the site where concentrations declined or remained stable during the year.
- Drilling and installation of three extraction wells and four monitor wells in the TFC, TFD and TFH areas, and redevelopment of an extraction well at TF406 Northwest (Figures 1 and 2).
- Proper abandonment of 19 obsolete wells in the TFC, TFD, and TFH areas.
- Implementing treatment facility upgrades and remedial wellfield expansions using the Remediation Evaluation (REVAL) process at TFC East and TFD (Figure 2).
- Continuing Enhanced Source Area Remediation (ESAR) treatability tests at TFD Helipad (*in situ* bioremediation), TFE Eastern Landing Mat (thermally-enhanced remediation), and at TFC Hotspot (emplaced zero valent iron (ZVI) for promoting *in situ* VOC destruction).
- Submittal of the following documents to the regulatory agencies: 2014 Annual Report (McKereghan et al., 2015), four quarterly reports (Yow and Wong, 2015[a-d]), and seven well construction work plans.

Livermore Site restoration activities in 2015, similar to those during the last several years, were focused on enhancing and optimizing ongoing operations at treatment facilities. Evaluation of technologies that may accelerate clean up of the Livermore Site source areas (Figure 2) and address areas of co-mingled VOC and low-level tritium plumes, also continued.

Ground water concentration and hydraulic data indicate consistent declines, subtle in some areas, in both the magnitude and areal extent of VOC plumes in 2015. VOCs in the offsite TFA area continued to decline rapidly in response to pumping along the Arroyo Seco Pipeline extension, which was activated in 2012 (Figure 1). Hydraulic containment along the western and southern boundaries of the site was fully maintained in 2015, and steady, incremental progress was made toward interior plume and source area clean up.

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

Limited recharge due to the ongoing California drought and continued ground water pumping from the Livermore Site subsurface resulted in declining ground water levels and yields at many extraction wells, and expansion of pumping-induced ground water depressions across the site.

New monitor wells revealed significant concentration declines in the T5475 and Building 511 source areas, where long-term remedial operations have been performed. Elsewhere, elevated VOC concentrations remain, indicating areas where additional remedial efforts will likely be needed, such as Hydrostratigraphic Unit 4 (HSU-4) in the TFD Helipad and Northern East Traffic Circle source areas east of Lake Haussmann (Figure 2). These and additional findings are discussed in Section 4.3.

An ESAR *in situ* bioremediation treatability test continued throughout the year at the TFD Helipad (Appendix G), as did the ESAR conductive heating treatability test at TFE Eastern Landing Mat (Appendix H). While the anaerobic subsurface conditions required for bioaugmentation were achieved in parts of the TFD Helipad area during 2015, elsewhere in the test area oxygen levels remained high. At TFE Eastern Landing Mat, soil vapor extraction mass removal rates remained higher than they would be without air injection and air and ground water heating. Both tests are expected to continue into 2016. Data analysis and interpretation of the ESAR pneumatic fracturing treatability test at TFE Hotspot were completed in 2014. The results of the test are summarized in Appendix I of the 2014 Annual Report (McKereghan et al., 2015). An ESAR treatability test to emplace ZVI for *in situ* VOC destruction was implemented at TFC Hotspot in September 2014 (Appendix I). Post-implementation performance monitoring data collection was initiated in November 2014 and continued throughout 2015. Thus far, due to low ground water velocities, there has been no discernible decrease in TFC Hotspot VOC concentrations.

Since remediation began in 1989, approximately 5.5 billion gallons of ground water and 709 million cubic feet (Mcf) of soil vapor have been treated, removing an estimated 3,222 kilograms (kg) (approximately 3.6 tons) of VOCs from the subsurface (Table Summ-2).

Table Summ-1. Summary of 2015 Livermore Site VOC remediation.

Treatment area[a]	Volume of ground water treated (Mgal)[b]	Estimated VOC mass removed from ground water (kg)[c]	Volume of soil vapor treated (Mcf)[b]	Estimated VOC mass removed from soil vapor (kg)[c]	Estimated total VOC mass removed (kg)[c, d]
TFA	**105**	**3.2**	**<0.01**	**<0.01**	**3.2**
TFB	**29**	**2.0**	**na**	**na**	**2.0**
TFC	**30**	**3.3**	**na**	**na**	**3.3**
TFD	**54**	**14.2**	**15**	**2.1**	**16.3**
TFE	**28**	**7.3**	**11**	**1.5**	**8.8**
TFG	**3**	**0.3**	**na**	**na**	**0.3**
TFH	**8**	**1.5**	**32**	**15.3**	**16.8**
Totals[d]	**257**	**31.8**	**58**	**18.9**	**50.7**

Notes:

Mgal = Millions of gallons.

kg = Kilograms.

Mcf = Millions of cubic feet.

na = Not applicable.

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

TFA area: TFA, TFA-E

TFB area: TFB

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

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

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

TFG area: TFG-1, TFG-N

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

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

*** Vapor Extraction System (VES) 13 and VES19**

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

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

[d] **Rounded numbers.**

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

Treatment area	Volume of ground water treated (Mgal)[a]	Estimated VOC mass removed from ground water (kg)[b]	Volume of soil vapor treated (Mcf)[a]	Estimated VOC mass removed from soil vapor (kg)[b]	Estimated VOC mass removed (kg)[b, c]
TFA	2,287	222	<0.01	<0.01	222
TFB	557	88	na	na	88
TFC	623	119	na	na	119
TFD	1,267	919	153	103	1,022
TFE	464	246	224	160	406
TFG	100	13	Na	na	13
TFH	194	44	332	1,308	1,352
Totals[c]	5,492	1,651	709	1,571	3,222

Notes:

Mgal = Millions of gallons.

kg = Kilograms.

Mcf = Millions of cubic feet.

na = Not applicable.

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

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

[c] Rounded numbers.

1. Introduction

This report summarizes the Lawrence Livermore National Laboratory (LLNL) Livermore Site Ground Water Project (GWP) field and regulatory compliance activities and remedial action program for calendar year 2015. The Field Activities section provides information on the GWP ground water monitoring and Enhanced Source Area Remediation (ESAR) activities (Section 3). The Remedial Action Program section includes details of treatment facility operations, treatment facility upgrades, ground water discharges, remediation performance, and decision support analysis (Section 4), The treatment areas, treatment facilities, newly installed and properly abandoned wells, and locations of principal projects conducted at the Livermore Site during 2015 are shown on Figures 1 and 2. Table 1 presents treatment facility abbreviations used in this report, Table 2 presents the types and number of wells at the site, and Table 3 presents treatment facility discharge sampling locations. Tables 4 and 5 summarize of extraction well performance and treatment facility operations for 2015, respectively. Except for the treatment facility abbreviations shown in Table 1, acronyms and abbreviations used in this report are defined in Section 6.

2. Regulatory Compliance

In 2015, the U.S. Department of Energy (DOE)/LLNL submitted all regulatory documents on schedule and all Federal Facility Agreement (FFA) milestones were completed early or on schedule. These included:

- *GWP 2014 Annual Report* (McKereghan et al., 2015); and
- *GWP Quarterly Self-Monitoring Reports* (Yow and Wong, 2015[a-d]).

In 2015, Livermore Site environmental community relations activities included:

- Maintaining the Environmental Community Relations website, consisting of project documents and reports, public notices, and other environment-related information https://www-envirinfo.llnl.gov/;
- Supporting the Environmental Information Repositories and the Administrative Record;
- Disseminating environment-related news releases and internal/external newsletter articles, and responding to journalists' inquiries regarding the Livermore Site environmental cleanup; and
- Conducting tours of site environmental activities upon request.

General community questions and requests for information were addressed via electronic mail, posted mail or telephone with the assistance of LLNL's Public Affairs Office. In addition, DOE/LLNL met with members of Tri-Valley CAREs and their scientific advisor on March 17 and October 15, 2015, as part of the activities funded by a U.S. Environmental Protection Agency (EPA) Technical Assistance Grant. DOE/LLNL also conducted a site tour of environmental restoration activities and facilities for Tri-Valley CAREs and other members of the community on November 19, 2015.

Six treatment facilities remained off-line in 2015. VTFD Helipad remained off-line while the *in situ* bioremediation ESAR treatability test continued at the TFD Helipad Source area

(Section 3.2 and Appendix G). TFA East remained off-line because the sole extraction well for this facility has dewatered due to over-drafting of the aquifer and limited recharge owing to the California drought. The four remaining facilities, TF5475-1, TF5475-3, VTF5475 and TF518 North, remain shutdown due to potential mixed waste issues (LLNL, 2009). Restart of these four facilities has been deferred pending the results of ESAR treatability tests described in this report. In the meantime, DOE/LLNL continue to monitor ground water in these areas for VOCs and tritium (see Section 4.4), and to maintain hydraulic control at downgradient ground water extraction wells and treatment facilities.

3. Field Activities

This section summarizes 2015 ground water monitoring, ESAR activities, and drilling activities.

3.1. Ground Water Monitoring

All ground water monitoring activities were conducted in compliance with applicable LLNL Standard Operating Procedures (Goodrich and Lorega, 2012).

3.1.1. Ground Water Level Measurements

All ground water levels were measured in monitor wells on a quarterly basis. Continuous ground water levels were recorded in pumping wells using real-time data acquisition, and additional ground water levels were measured during sampling events to augment these data. In 2015, a total of 2,627 ground water levels were manually measured in 675 wells. Of these measurements, 1,944 were collected during quarterly water level measurements and 683 were collected just prior to well sampling.

Quarterly water level measurements were collected to create ground water elevation maps that represent contemporaneous operating conditions for each extraction wellfield. These data were primarily used to generate quarterly ground water elevation contour maps showing estimated hydraulic capture areas for active extraction wells in Hydrostratigraphic Units (HSUs) 1B through 5 (Figures 5, 7, 9, 11, 13 and 15).

In addition to the routine quarterly measurements, ground water levels were measured to support Environmental Restoration Department (ERD) Remediation Evaluation (REVAL) activities (Appendix E). These included manual depth-to-water measurements as well as temporary installation of pressure transducers with data loggers in selected wells.

3.1.2. Ground Water Sampling

As in previous years, GWP personnel evaluated data quality objectives, analytical results, historical trends, the Cost Effective Sampling (CES) algorithm (Appendix C), and hydraulic data to determine the sampling frequency, chemical analyses and methods for collecting ground water samples. The samples were analyzed for VOCs, fuel hydrocarbons, metals, and/or radionuclides, depending upon the sampling location.

In 2015, 769 well sampling events were conducted (Appendix D). Samplers were unable to complete 181 scheduled sampling events due to various circumstances, including dry or insufficient ground water (170 events), inoperable pump or electrical safety issues (3 events), well inaccessibility (5 events), and abandoned wells (3). The methods and numbers of samples collected were:

- Specific-Depth Grab Sampling (SDGS): 327 events;
- Three-volume purge using a dedicated electric submersible pump: 92 events;
- Low-volume purge primarily using a dedicated electric submersible pump: 49 events;
- Other methods (bailer, portable electronic submersible pump, etc.): 120 events.

Ongoing and significant cost reduction was achieved again in 2015 through the use of SDGS and low-volume purge methods. SDGS is the preferred method for collecting ground water samples, especially at wells where purge water potentially contains both VOCs and tritium. The benefits of these methods include:

- No need to replace dedicated pumps and related sampling equipment;
- Increased technician efficiency and reduced sampling time;
- Increased personnel safety through the use of low voltage equipment; and
- Virtually eliminating collection, treatment and disposal of purge water from all wells sampled using these methods, particularly where ground water contains both VOCs and tritium.

In addition to the ground water sampling noted above, *in situ* measurements were collected for several field parameters to support the ESAR tests (Section 3.2) during 2015, including dissolved oxygen, pH, specific conductance and temperature. A total of 327 measurements were collected for multiple parameters in seven wells at TFC Hotspot and nine wells at TFD Helipad.

Samples were also collected from vadose zone monitor wells during 2015. A total of 111 soil vapor samples were collected; however six soil vapor sampling events could not be completed for a variety of reasons (ground water covering screened interval, inaccessible due to construction, submersible pump in the way, etc.).

3.2. Enhanced Source Area Remediation Activities

As a working conceptual model, the LLNL Livermore Site GWP delineated ground water plumes into distal and source area components. By definition, distal plumes reside in comparatively permeable portions of the subsurface where ambient ground water flow has resulted in down gradient migration and dilution. In contrast, source areas are characterized by relatively elevated concentrations of contaminants that are entrapped in low permeability materials or are otherwise hydraulically isolated. Back-diffusion from lower permeability zones, leaching of residual contaminants from the overlying vadose zone, and relatively slow advective transport in ground water all potentially contribute to a chronic “slow release” phenomenon of VOC mass transfer from source areas into more permeable, or hydraulically accessible, portions of the subsurface.

Historically, remediation of VOC plumes at the Livermore Site has emphasized control and gradual clean up of distal portions of plumes as a first priority, coupled with containment of VOC mass flux emanating from source areas through conventional treatment technologies such as pump-and-treat, soil vapor extraction, and dual extraction (i.e., LLNL’s “Engineered Plume Collapse” strategy) (Berg et al., 1997).

In this context, the time frame to achieve regulatory closure is closely tied to the persistence of the source areas that transfer mass to the VOC plumes. Therefore, source area remediation constitutes the primary rate-limiting step in the overall ground water cleanup effort, and thus targeted source area remediation warrants serious focus as a means for potentially reducing overall cleanup costs.

In 2007, the Source Area Cleanup Technology Evaluation (SACTE) approach was developed to identify the most appropriate targeted remediation strategies for the various VOC source areas across the site. DOE initiated this evaluation as a means to identify several technologies that would be evaluated via treatability studies under the ESAR effort. The SACTE approach is based on:

(1) Systematic characterization and cataloguing of representative macroscopic features of each source area (e.g., dimensions of the source area footprint, representative hydraulic conductivity, mean ambient hydraulic gradient) as permitted by the available data;

(2) Development of a compartmental screening model based on those data that capture the salient VOC mass and concentration-controlling parameters characteristic of the source areas; and

(3) Utilizing the compartmental model to simulate the potential response of source area VOC distribution to various remediation approaches that correspond to changes in key model parameters (e.g., mechanical fracturing to increase average hydraulic conductivity).

The SACTE approach allows comparison of the response of VOC concentrations and overall mass to a remediation technology that destroys mass *in situ* (e.g., chemical oxidation or bioremediation) in the more hydraulically accessible materials. This approach involves methods that enhance access to VOCs in low permeability materials, either by mechanical means (e.g., mechanical fracturing to improve hydraulic conductivity) or by means that directly enhance the mobility of the solute itself (e.g., thermal remediation, electro-osmosis).

Twenty-one separate source areas have been identified at the Livermore Site based on distributions of VOCs in soil, soil vapor, and ground water samples, analysis of hydrogeologic data in the context of the Livermore Site HSU framework, and information pertaining to historical chlorinated solvent use and disposal practices. The application of the SACTE compartmental model for modeling source area behavior at the Livermore Site entailed defining the physical and chemical characteristics of each source area, and the potential impact of different remediation technologies on the subsurface properties that control flow and transport processes in that particular source area.

As part of the modeling study, overall effects of alternative treatment technologies are compared numerically. The parameters include increase in mass removal rates, reduction in cleanup time, effect on low-permeability units, areal coverage and capture, capital investment and life-cycle costs. As a result of the SACTE effort, four ESAR technologies were selected for treatability testing (Figure 2):

- Dynamic Well-Field Operation (DWFO) at the TFE Eastern Landing Mat (TFE-ELM) and Trailer 5475 Source Areas;
- *In situ* Bioremediation at the TFD Helipad Source Area;
- Thermally Enhanced Remediation at the TFE-ELM Source Area; and
- Mechanical Fracturing at the TFE Hotspot and TFC Hotspot Source Areas.

In 2007, LLNL concluded a preliminary test of the DWFO concept, primarily at the TFE-ELM Source Area. Ongoing TFE-ELM soil vapor extraction (SVE) had effectively reduced VOC concentrations in shallow soil vapor extraction wells. Therefore, LLNL incorporated the DWFO approach with plans for Thermally Enhanced Remediation in the deeper zone at TFE-ELM.

As a result, the concept of combining complimentary remediation technologies was incorporated into the SACTE approach. Accordingly, the TFC Hotspot mechanical fracturing treatability test was modified to include an *in situ* chemical reduction approach using zero-valent iron (ZVI) (GeoSierra Environmental, 2014).

In 2010, LLNL constructed and activated a ground water circulation system for *in situ* bioremediation at the TFD Helipad Source Area. Also in 2010, LLNL conducted pneumatic fracturing at the TFE Hotspot Source Area, and began performance monitoring for this treatability test in 2011. In 2011, LLNL constructed and activated the TFE Eastern Landing Mat thermally enhanced remediation system.

In 2014, LLNL completed the TFC Hotspot ZVI emplacement project and began post-emplacement performance monitoring for the treatability test. In 2014, LLNL also completed analysis of the TFE Hotspot ESAR treatability test. A comprehensive analysis and review of the project is presented in Appendix I of the 2014 LLNL Ground Water Project Annual Report (McKereghan et al., 2015). In 2015, LLNL continued the ESAR treatability tests at TFD Helipad, TFE Eastern Landing Mat, and TFC Hotspot. The results of the treatability tests may identify alternative remedial approaches for other Livermore Site source areas. The active ESAR treatability tests are discussed in detail in Appendices G, H, and I.

3.3. Drilling Activities

In 2015, nineteen wells were properly abandoned and seven new wells were installed at the Livermore Site (Figure 2). A detailed map showing the location of all properly abandoned, new and existing wells, and treatment facilities is included as Attachment A.

The nineteen wells were abandoned according to Livermore-Amador Valley Zone 7 Water Agency guidelines and procedures detailed in ERD Standard Operating Procedure (SOP) 1.7 Well Closure – Revision 5 (Goodrich and Lorega, 2012). Nine of these wells were used to remove or monitor the removal of fuel hydrocarbons between the late 1980s and early 1990s using soil vapor extraction, ground water extraction, and subsurface heating during the Dynamic Stripping Underground Demonstration Project (Newmark, 1994) and no longer served a useful purpose. The other abandoned wells were either screened across multiple HSUs or were screened in HSU-1A, which is not impacted by contaminants at the Livermore Site. As such, none of the nineteen abandoned wells could be used to construct HSU-specific ground water elevation or isoconcentration contour maps. Because none of the wells were found to have a compromised completion, they were abandoned by pressure-grouting the well casings to surface. This well destruction method is fully compliant with Alameda County Zone 7 Water Agency guidelines and avoids the additional expense of over-drilling when it is unnecessary for proper abandonment.

New HSU-5 TFD extraction well W-3101, located south of TFD and north of Lake Haussmann, replaces properly abandoned extraction well W-907-2 (W-907-2 refers to the lower screened interval of well W-907 shown on Figure 2). W-907-2 was removed from operation due to the complexity and cost of replacing the in-well packer system that separates well screens in HSUs 4 and 5, and the increasing operation and maintenance costs associated with that system. Well W-3101 replaces the lower screened interval of W-907-2 and is designed to hydraulically contain HSU-5 VOCs in the area.

Similarly, new HSU-2 TFD extraction well W-3102, located adjacent to W-3101, replaces former TFD extraction well W-906. W-906 was properly abandoned because of its very low yield and its location in an area of HSU-2 that has been successfully remediated. In addition, since it had a single screen that spanned portions of both HSU-2 and -3A, data from the well could not be used for isoconcentration or ground water elevation contour maps for either HSU. Well W-3102 is designed to hydraulically contain the HSU-2 VOC ground water contaminant plume emanating from sources to the east.

Monitor well W-3103 is located in the TFC East area and will be used initially to monitor ground water concentrations at the leading edge of an HSU-3A VOC plume emanating from sources to the east. It may eventually serve as a TFC East HSU-3A extraction well.

Monitor well W-3104, located in the southeast corner of the site, has also been designed for multiple purposes. Initially, the well will be used to monitor HSU-5 VOC concentrations in the area. If needed, the well may eventually serve as a TF406 Northwest extraction well to hydraulically contain the western leading edge of the HSU-5 TCE plume.

HSU-5 well W-3105 will be used to monitor VOC concentrations and tritium activities in the Building 511/former Building 514 area. Analytical ground water data from W-3105 replaces old saturated soil data on the HSU-5 isoconcentration countour map, providing a more accurate representation of current aquifer conditions there.

HSU-5 well W-3106 will be used to monitor VOC concentrations and tritium activities in the T5475 area. Analytical ground water data from W-3106 replaces old T5475 area saturated soil data on this year’s isoconcentration contour map (Figure 16).

New TFC Southeast HSU-1B extraction well W-3107 will augment extraction well W-1213. De-watering of the HSU-1B aquifer because of over-drafting and limited recharge due to the California drought has resulted in a lowering of the water level and a consequent decrease in sustainable yield in W-1213. Well W-3107 was screened lower in HSU-1B thereby allowing for continued hydraulic containment of the TFC Hotspot source area as long as HSU-1B remains saturated.

4. Summary of Remedial Action Program

This section summarizes the 2015 Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) remedial action program activities at the Livermore Site. In 2015, DOE/LLNL operated and/or maintained 28 ground water treatment facilities (Figure 1 and Table 1). During the year, ground water extraction and dual extraction wells produced approximately 257 million gallons (Mgal) of ground water, and the treatment facilities removed an estimated 32 kg of VOCs (Table Summ-1 and Table 4). Since remediation began in 1989, approximately 5.5 billion gallons of ground water have been treated, resulting in the removal of an estimated 1,651 kg of VOCs (Table Summ-2).

In 2015, DOE/LLNL also operated and/or maintained nine soil vapor treatment facilities in the TFD, TFE and TFH areas (Figure 1 and Table 1). The soil vapor extraction and dual extraction wells produced approximately 58 million cubic feet (Mcf) of soil vapor, and the vapor treatment facilities removed approximately 19 kg of VOCs (Table Summ-1 and Table 4). Since startup in 1995, approximately 709 Mcf of soil vapor has been extracted and treated, removing an estimated 1,571 kg of VOCs (Table Summ-2).

In total, an estimated 3,222 kg (approximately 3.6 tons) of VOCs have been removed from the subsurface beneath the Livermore Site and surrounding area since 1989 (Table Summ-2). However as remediation continues, less VOC mass is being removed from the unsaturated zone (i.e., soil vapor) and ground water. Approximately 34 kg of VOCs were removed from ground water in 2014 compared to approximately 32 kg in 2015. Approximately 21 kg of VOCs were removed from soil vapor in 2014 compared to approximately 19 kg in 2015 (McKereghan et al., 2015). The declining VOC mass removal rates are considered to be the result of decreasing VOC concentrations in the subsurface and an overall decrease in the amount of mass remaining in both ground water and the unsaturated zone beneath the Livermore Site due to active remediation since 1989 (Figures 3 and 4).

Effectiveness of ground water remediation at the Livermore Site is evaluated using multiple data sets. Depth to ground water measurements recorded during the third quarter 2015 were used to construct HSU-specific ground water elevation contour maps and estimate hydraulic capture areas due to ground water pumping (Figures 5, 7, 9, 11, 13 and 15). HSU-specific isoconcentration contour maps showing total VOC concentrations above the maximum contaminant levels (MCLs) during the third quarter 2015 are shown on Figures 6, 8, 10, 12, 14 and 16. The estimated hydraulic capture areas for each HSU have been superimposed on the isoconcentration contour maps to highlight where hydraulic containment of contaminant plumes was achieved during this period. Contaminant concentration trends (Section 4.3) were also used to evaluate hydraulic capture and treatment facility performance.

4.1. Summary of Treatment Facility Operations

In 2015, 24 ground water and seven soil vapor treatment facilities were operated in compliance with applicable permits. These facilities were shut down occasionally for routine maintenance during the year. In addition, ERD's REVAL process (Appendix E) was completed at TFC East and initiated at TFD (Figure 2). Soil vapor extraction tests were conducted in the TFA East (TFA-E) and VTF518 Perched Zone (VTF518-PZ) areas (Figure 1). Vapor flow matrix and nitrogen dissipation tests were also conducted to further evaluate the (VTF518-PZ) remedial wellfield. Four treatment facilities, TF5475-1, TF5475-3, VTF5475 and TF518 North, remain shut down due to potential mixed waste issues (LLNL, 2009). VTFD Helipad was not operated during the year due to an ongoing ESAR treatability test in the area (Section 3.2). TFA East was not operated during 2015, as the sole extraction well for this facility is currently dewatered due to over-drafting of the aquifer and limited recharge due to the California drought. Table 5 summarizes the treatment facility operations and facility highlights for 2015.

4.2. Ground Water Discharges

In 2015, LLNL discharged approximately 257 Mgal of treated ground water to the ground surface. Approximately 121 Mgal were discharged to Arroyo Las Positas, 74 Mgal to the West Perimeter Drainage Channel, and 54 Mgal to Arroyo Seco (Figure 1). To reduce potable water usage at the site, LLNL utilized more than 8 Mgal of TFB-treated ground water at the Building 133 cooling tower. Lastly, approximately 14,600 gallons of ground water were recirculated through the *in situ* bioremediation facility (ISB01) at the TFD Helipad as part of the *in situ* bioremediation treatability test.

4.3. Remediation Performance Evaluation

In 2015, VOC concentrations declined or remained unchanged in most Livermore Site ground water plumes. The decreases in VOC concentrations discussed below are primarily attributable to active remediation at Livermore Site treatment facilities (Section 4.1). They are consistent with longer-term trends that show steady onsite and offsite mass removal and cleanup as described in the 2012 Fourth Five-Year Review for the LLNL Livermore Site (McKereghan et al., 2012) and the 2014 Annual Report (McKereghan et al., 2015).

As discussed in Appendix F, saturated soil analytical data are used to augment the data collected from ground water wells to provide better resolution in the isoconcentration contour maps where ground water data are not available. Additional saturated soil data were obtained during 2015 well construction activities (Section 3.3) to ensure that historical time-static, saturated soil data used to construct the Livermore Site VOC isoconcentration maps were still representative of subsurface conditions. In many instances, the time-static soil data were collected 20 or more years ago. Details of how the new data compared to historical data, and how the corresponding VOC isoconcentration contour maps were revised, are discussed in the HSU-specific sections below.

The VOC concentration data derived from saturated soil analytical data for purposes of refining the VOC plume maps are referred to as "ground water equivalent" concentrations, to distinguish them from actual ground water analyses. The ground water equivalent concentration was established by comparing saturated soil analytical results from core retained from the screened interval of a given well with the first three ground water analytical results from the same completed well, for numerous well locations across the site. This analysis yielded a nominal 1 to 10 saturated soil to ground water relationship that helped provide better resolution and constraint for the contours. For example, a saturated soil concentration of 0.005 milligrams per kilogram (mg/kg) represents a 0.05 milligram per liter (mg/L) ground water equivalent concentration (0.05 mg/L is equal to 50 micrograms per liter (μg/L), or 50 parts per billion (ppb). Similarly, 0.050 mg/kg saturated soil concentration represents a 500 ppb ground water equivalent concentration, and so forth. A more detailed explanation of the algorithm-based methodology used for generating the isoconcentration maps, known as Optimized Environmental Restoration Analysis (OPERA), and the rules governing how these analytical results are used, is described in Appendix F.

Ground water elevation contour maps for each HSU for third quarter 2015 are presented on Figures 5, 7, 9, 11, 13 and 15. HSU-specific isoconcentration contour maps of total VOC concentrations above MCLs for third quarter 2015 are presented on Figures 6, 8, 10, 12, 14 and 16. Estimated hydraulic capture areas due to ground water pumping are also shown on these figures. These capture areas are depicted very conservatively, and the capture areas of individual extraction wells are very likely larger than shown. Treatment facility locations are shown on Figure 1. Notable VOC concentration trends and results observed during the past reporting year (third quarter 2014 through the third quarter 2015) are discussed below. Where available and relevant, VOC concentration data more recent than third quarter 2015 are also discussed below.

The ground water data discussed in Section 4.3 are presented in Attachment B. However, it is important to note that the concentrations plotted on the isoconcentration maps are an average of the three most recent sampling results and do not represent a single analytical result at each well.

4.3.1. Hydrostratigraphic Unit 1B

In 2015, offsite TFA area VOC concentrations were once again below MCLs in all wells, including monitor well W-1425 which had risen above 5 ppb perchloroethylene (PCE) in 2014. During all four quarters, PCE remained below the 5 ppb MCL in W-1425, and is currently at below 0.6 ppb (October 2015). The drop in concentration is due to the increased flow rate at TFA Arroyo Seco Pipeline extraction well W-408, (from 11 to 28 gpm) which was implemented in January 2015 specifically to accelerate clean up at W-1425.

While concentrations in most of onsite TFA HSU-1B wells remained essentially unchanged, a notable concentration increase was observed at one location. At idle TFA East extraction well W-254 (Figure 6), PCE concentrations increased from 20 ppb (April 2013) to 85 ppb (November 2014). This increase may be in response to the cessation of pumping there because of falling water levels caused by overdrafting and exacerbated by diminishing recharge owing to the California drought. As shown in Figure 6, the well is within a large pumping-induced ground water depression as well as the capture area of extraction well W-415. Accordingly, VOCs in the vicinity of the well are hydraulically contained and unlikely to migrate farther to the west.

PCE concentrations in the TFA source area were essentially unchanged during 2015. PCE in monitor well W-1217 remained at 190 ppb throughout the year (October 2014 and July 2015), but increased from 140 ppb (July 2014) to 210 ppb (April 2015) at W-116. However, because concentrations there have shown considerable fluctuations over the years, this is not considered to be part of an upward concentration trend.

VOC concentrations at TFB continued to decline in response to ongoing ground water extraction and treatment. For example, 1,1-dichloroethene (1,1-DCE) at monitor well W-269 fell from 10 ppb (May 2014) to 3.8 ppb (April 2015), while trichloroethylene (TCE) at TFB source area piezometer SIP-141-202 fell from 48 ppb (January 2014) to 38 ppb (January 2015).

At TFC Southeast, TCE concentrations at extraction well W-1213 declined slightly from 25 ppb (November 2014) to 16 ppb (October 2015). At newly installed well W-3107, the TCE concentration was 28 ppb in September 2015, and this well will likely be converted to an extraction well. With falling water levels and a decreasing sustainable yield in W-1213, W-3107 will help hydraulically contain contaminants emanating from the TFC Hotspot source area (the well is screened in the deepest permeable sediments in HSU-1B). Once extraction begins, concentrations there are expected to begin to decline.

TFC extraction wells W-1015, W-1102 and W-1103 were turned off in April 2014 to perform a VOC concentration rebound test in the area near these wells. VOC concentrations in this area of TFC have been consistently below MCLs since 2011. No significant increase or evidence of rebound has been observed since these extraction wells were turned off. All wells in the area remain below MCLs, although well W-1015 rose to 5.4 ppb TCE in February and then fell to 4.5 ppb in November 2015. ERD will continue to monitor the area closely in 2016 for any signs of a concentration rebound.

Further to the south, TCE concentrations at piezometer SIP-191-002 declined from 73 ppb (July 2014) to 58 ppb (August 2015). The former concentration was not accurately represented on the 2014 Annual Report isoconcentration contour map as it was masked by low concentrations at adjacent monitor well W-1106 (2.6 ppb, January 2014, less than 0.5 ppb, January 2015). Regardless, the area is being hydraulically contained and treated by TFC extraction well W-1104.

VOC concentrations elsewhere at TFC, TFC-E, TFC-SE, and in the TFG area were essentially unchanged, and no evidence of westward migration of the contaminant plumes was observed. At the TFC Hotspot source area, TCE remained elevated in monitor well W-1212, but decreased over the year (210 ppb November 2014 and 160 ppb October 2015). The decrease may reflect natural fluctuations in source area concentrations rather than an actual decline due to remedial activities in the area. An ESAR treatability test that included the emplacement of ZVI to destroy VOCs *in situ* was implemented at the TFC Hotspot source area in September 2014. The status of this test is summarized in Appendix G of this report.

As shown on Figures 5 and 6, the HSU-1B contaminant plumes along the western LLNL margin were under full hydraulic containment in the TFA, TFB, TFC and TFC Southeast areas during third quarter 2015. The large ground water depression that was first observed in the TFA and TFB area in 2014 was also present during 2015. It is interpreted to be the result of over-drafting due to ground water extraction and exacerbated by less recharge amid current drought conditions. To the east, contaminant plumes were also hydraulically contained at TFC East, TFG-1, and TFG North.

4.3.2. Hydrostratigraphic Unit 2

In the offsite TFA area, consistent declines in PCE concentrations were observed again during 2015. Wellfield optimization implemented in late 2012 (including the shut-in of extraction well W-109, activation of the TFA West Pipeline extension, and pumping of extraction well W-404), continues to effectively clean up the offsite plume (Figure 8). Only one well, W-1424 had concentrations above the PCE MCL by third quarter 2015 (6.0 ppb, October 2015). The PCE concentration at well W-1701 was 5.0 ppb in October 2015. PCE in W-1701 began rising in late 2012 as extraction well W-404 was activated, suggesting that concentrations that were previously in the stagnation zone between W-109 and W-404 are now being captured at W-404 (Bourne et al., 2011). PCE at W-404 was below 4 ppb throughout the year, and at downgradient monitor well W-151, where PCE was first observed in July 2012, concentrations remained at or below the 0.5 ppb detection level. The concentration trend at W-151 indicates that ground water extraction at W-404 is effectively hydraulically containing PCE at the leading edge of the HSU-2 offsite plume.

In the onsite TFA area, VOC concentrations were essentially unchanged during the year. Elevated concentrations of 1,1-dichloroethane (1,1-DCA) are present at monitor well W-260 (28 ppb, October 2015). While the origin of this plume is not known, 1,1-DCA has been present since the well was installed in 1986. W-260 will be monitored to determine if concentrations continue to increase in 2016. VOC concentrations there are being captured by TFA extraction well W-1009 (Figure 8).

At TFB, concentrations of TCE along the western boundary of the site continued to decline due to ground water extraction at W-2501 and W-2502. TCE concentrations at monitor wells W-422 and W-1420 remain very close to the 5 ppb MCL (5.6 ppb, July 2015 and 4.4 ppb, July 2015 respectively). Elsewhere in the TFB and TFC areas, TCE remained essentially unchanged during the year.

In the northern TFD area, TCE at monitor well W-355 rose from 7.6 ppb (August 2014) to 36 ppb (January 2015). However, concentrations have been known to fluctuate at this location since 2007, and this is not considered to be the start of an upward trend. At TFD Main, a significant concentration change was observed during the year as a result of the installation of a new HSU-2 extraction well, W-3102. Ground water data acquired from the well replace old saturated soil data from the borehole of nearby HSU-3A/3B extraction well W-1208 (Figure 10). TCE concentrations that were previously estimated to be 295 ppb ground water equivalent were measured at 3 ppb in September 2015 at W-3102. The decline is interpreted to be the result of extensive ground water extraction and treatment that has occurred in the TFD area since W-1208 was drilled and installed in 1996.

In the TFD South area, TCE at extraction well W-1510 declined from 49 ppb (October 2014) to 19 ppb (October 2015). To the west at TFE Northwest extraction well W-1409, TCE fell from 40 ppb (October 2014) to 21 ppb (October 2015). Both declines are due to the ongoing ground water extraction and treatment occurring at these two locations. Elsewhere in the TFD area, concentrations remained relatively unchanged in 2015.

Notable concentration changes were observed in the TF406 Northwest area. In 2004, 75 ppb cis-1,2-DCE was detected in well W-1705-1. This well has not been sampled since 2004 due to a lack of water. However, cis-1,2-DCE was not detected in any saturated soil samples collected during the 2015 installation of nearby well W-3104 (Figure 16). A hydrogeochemical analysis of the area suggests that the historical cis-1,2-DCE concentrations may have been associated with an instrumented membrane ground water monitoring system that was previously installed in this well, and were not representative of actual aquifer conditions at this location. The instrumented membrane was removed from the well and replaced by a Solinst® continuous multichannel tubing (CMT) installation in 2010. Conversely, TCE in W-1705-1 was observed to be 17 ppb in 2004. The August 2015 ground water equivalent concentration from the W-3104 borehole saturated soil data is estimated at 36 ppb.

Elsewhere in the TFE, TFG and TFH areas, VOC concentrations remained largely unchanged during the year.

As shown on Figures 7 and 8, the HSU-2 contaminant plumes in the TFA and TFB areas were entirely within the estimated capture areas, including the plume immediately south of TFB monitor well W-1420 that was previously outside the capture area in 2014. Ground water elevations continue to decline due to over-drafting of the aquifer exacerbated by limited recharge owing to the ongoing California drought.

4.3.3. Hydrostratigraphic Unit 3A

The overall size, geometry, and location of the HSU-3A VOC ground water plumes were unchanged in 2015. However, several relatively minor concentration changes were noted during the year. TCE concentrations in the TFD area fluctuated somewhat, but remained essentially unchanged:

- At W-1804-2, TCE fell from 300 ppb (November 2014) to 240 ppb (December 2015);
- TCE at W-1301 rose from 240 ppb (November 2014) to 270 ppb (October 2015); and
- TCE at W-1905-1 fell from 490 ppb (August 2014) to 290 ppb (May 2015).

These fluctuations are common in Livermore Site source areas and are not necessarily indicative of an overall declining or increasing concentration trend.

The highest TCE concentrations in the TFD area remain the ground water equivalent concentrations from the 2014 borehole B-3010 (3500 ppb, July 2014), located north of

Lake Haussmann near the Central Cafeteria (Figure 10). A monitor well is planned for this location in 2016 to determine whether ground water concentrations are as elevated as the saturated soil data suggests.

At monitor well W-1705-2 in the TFH area, TCE fell from 100 ppb (December 2014) to 16 ppb (August 2015), while cis-1,2-DCE rose from 3.6 ppb (December 2014) to 48 ppb (August 2015). As discussed in Section 4.3.2, the cis-1,2-DCE is most likely an artifact of an instrumented membrane that was installed in W-1705 until 2010 and is probably not representative of actual aquifer conditions.

Elsewhere in the TFE and TFH areas, concentrations were essentially unchanged in 2015.

Figures 9 and 10 show the estimated hydraulic capture areas in HSU-3A during the third quarter of 2015. In the western TFE and eastern TFG areas, the plume monitored by monitor well W-276 remains outside of the hydraulic capture area. However TCE at W-2603, located at the downgradient edge of the plume, has remained consistently below the 5 ppb TCE MCL (1.3 ppb, March 2015), demonstrating that additional hydraulic containment is currently not needed in this area. VOC concentrations at W-315 were also outside of the capture area in 2015. This is largely due to TFD extraction well W-1208 not operating during the TFD Main REVAL. The area is expected to be back within the capture zone of W-1208 once it is re-activated in 2016.[2] In the meantime, concentrations will be closely monitored in newly-installed monitor well W-3103, located downgradient from W-315.

4.3.4. Hydrostratigraphic Unit 3B

Similar to HSU-3A, while the overall size, geometry, and location of the HSU-3B plumes did not change appreciably in 2015, several minor changes in concentration were noted within these plumes (Figure 12).

In the TFD area, old saturated soil data from the borehole of properly abandoned well W-360 was replaced by recent ground water data from well W-3002. VOC concentrations declined from 75 ppb ground water equivalent (February 1987) to 32 ppb (August 2015). The decrease in concentrations is interpreted to be due to ground water extraction and treatment in the area, including from TFD Southshore HSU-3B extraction well W-1601.

At W-2006 in the TFD Southeast area, TCE rose from 540 ppb (November 2014) to 580 ppb (October 2015). After a long-term decline, from 2004 to 2012, concentrations have been rising steadily at this location (from 190 ppb in March 2012). This trend may represent a long-term fluctuation in source area concentrations, as it appears to be unrelated to pumping from nearby HSU-3B extraction wells W-1403, W-1208, or W-1601.

In the TFD South area, minor but consistent declines in TCE concentrations were observed in several wells:

- From 210 ppb (November 2014) to 180 ppb (December 2015) in W-1511;
- From 50 ppb (August 2014) to 30 ppb (September 2015) in W-1422; and
- From 61 ppb (October 2014) to 55 ppb (October 2015) in W-1504.

These decreases result from ongoing ground water extraction from TFD-S extraction well W-1504.

[2] TFD Main was restarted in February 2016.

In the TFH area, TCE in monitor well W-2617 fell from 970 ppb (October 2014) to 650 ppb (August 2015) and TCE in well W-2205 declined from 990 (October 2014) to 760 (November 2015). These decreases are likely the result of ongoing ground water extraction at downgradient TFE Southwest extraction well W-1522.

Elsewhere in the TFD, TFE and TFH areas, concentrations remained essentially unchanged during the year.

In the third quarter of 2015, with the exception of an area northeast of TFD, all HSU-3B ground water contaminant plumes were either under hydraulic control of extraction wells associated with TFD, TFE and TFH treatment facilities or hydraulically contained within the pumping-induced ground water depression shown on Figures 11 and 12. The area is expected to be within a capture area or the pumping-induced ground water depression once pumping resumes at extraction well W-1208 following reactivation of TFD.

4.3.5. Hydrostratigraphic Unit 4

Several noteworthy changes or trends were observed within the HSU-4 VOC plumes during 2015. TCE concentrations at the Northern Eastern Taxi Strip Landfill and TFD Helipad source areas remain very high, up to 3000 ppb in W-1250 in October 2015.

Downgradient of TFD, TCE at monitor well W-1803-1 remained essentially unchanged (130 ppb August 2014 and 120 ppb August 2015). These concentrations suggest that no significant westward migration of the TCE plume has occurred during the TFD REVAL upgrade, and that the plume remains contained within the pumping-induced ground water depression that encompasses this area (Figure 14). Samples will be obtained from TFD extraction wells W-1206 and W-351 prior to the TFD Main restart to determine whether or not any significant increases in concentration have occurred during the hiatus in pumping.[3]

TCE increased at TFD Southshore extraction well W-1523, where concentrations rose from 97 ppb (October 2014) to 180 ppb (October 2015). The likely source of the increase is to the east, where the VOC ground water equivalent concentration at borehole B-3018 is 3010 ppb. A monitor well is proposed for this location in 2016 to determine whether ground water concentrations are as high as the saturated soil data suggest.

At TFD Southeast (TFD-SE), TCE continues to decline in response to ground water extraction from well W-314. TCE at W-314 declined from 17 ppb (October 2014) to 5 ppb (October 2015). At nearby HSU-4 monitor well W-1406, TCE remained below the MCL (1.5 ppb December 2013 and 1.4 ppb December 2014). W-1406 is scheduled to be sampled in Q1 2016.

In the TFE Southwest (TFE-SW) area, TCE declined at monitor well W-354 from 130 ppb (October 2014) to 44 ppb (September 2015). Concentrations also decreased at TFE-SW extraction well W-1520 where TCE was 130 ppb in October 2014 and 82 ppb in October 2015. Both declines are the result of ongoing ground water extraction and treatment at W-1520 and TFE-SW.

Figures 13 and 14 show the estimated hydraulic capture areas in HSU-4 during third quarter 2015. The pumping-induced ground water depression associated with extraction at TFD, TFD

[3] TFD Main was restarted in February 2016.

South, TFD Southshore and TFE Northwest continued to provide additional hydraulic containment in large portions of the TFD, TFE and TFH areas during 2015.

4.3.6. Hydrostratigraphic Unit 5

Several significant changes in the HSU-5 isoconcentration contour map are evident this year, primarily due to the installation of two new monitor wells in the Trailer 5475 (T5475) and Building 511 (B511) areas.

Elevated saturated soil data from the borehole for W-1415 (2,500 ppb TCE ground water equivalent, April 1998) were replaced by ground water concentration data from newly-installed monitor well W-3106, where TCE was 96 ppb in November 2015. The dramatic decline is in response to extensive soil vapor extraction from overlying HSUs between 1999 and 2006 (over 424 Kg of VOCs were removed from the T5475 area subsurface), and ground water extraction and treatment from HSU-5 T5475-2 extraction well W-1108 (16.5 Kg of VOCs removed between 2006 and the present).

In the B511 area, old bailed ground water data from borehole SIB-514-004 (570 ppb TCE, June 1989) were replaced by recent ground water concentration data from newly installed monitor well W-3105 (3.7 ppb TCE, December 2015). The decline in concentration is the result of ground water extraction and treatment performed since 1996 using HSU-5 extraction wells W-112, W-359, W-1114, and W-1310.

TCE at TFD-S extraction well W-2601 remained constant during the year (47 ppb, October 2014 versus 48 ppb, October 2015). TCE at downgradient well W-3001 remained constant as well (16 ppb, May 2014 and 14 ppb, October 2015), indicating that W-2601 is effectively hydraulically containing the HSU-5 VOC plume in this part of the site.

Finally, old VOC concentrations at W-1705-4 (screened interval number 4 within well W-1705 was properly abandoned in 2010) were replaced by VOC ground water concentrations at newly installed monitor well W-3104. Cis-1,2-DCE concentrations declined from 70 ppb (August 2004) to below the detection level (August 2015). As previously discussed in Section 4.3.2, we believe that the cis-1,2-DCE at this location is not representative of conditions within the HSU-5 aquifer but may have been an artifact of an instrumented membrane system that was installed in the well for sampling purposes until 2010. TCE in W-3104 was 5.3 ppb in August 2015, up from the 1.8 ppb previously observed in W-1705-4 (August 2004).

Figures 15 and 16 show the estimated hydraulic capture areas in HSU-5 during the third quarter 2015. All HSU-5 VOC plumes fall within extraction well capture areas or the pumping-induced ground water depression in HSU-5 shown on Figure 16. Recent ground water elevation data from new monitor well W-3003 was key to defining the western extent of the ground water depression.

4.4. Tritium

Due to ongoing radioactive decay, tritium activities in ground water were once again below the 20,000 picocuries per liter (pCi/L) MCL at all Livermore Site wells, including those in the Building 292, former Building 419, and the Trailer 5475 areas (Figure 1).

In the T5475 area, tritium activities remained relatively high in two wells, W-2211 and W-2302. Tritium in W-2211 (Figure 10) was measured at 13,200 pCi/L in March 2015, down from a high of 21,400 pCi/L (March 2012), while tritium in W-2302 was 5,720 pCi/L in

September 2015, down from a high of 21,600 pCi/L in March 2012. Elsewhere in the T5475 area, all wells were below 4,000 pCi/L, including newly-installed monitor well W-3106 (Figure 16), which was 319 pCi/L in November 2015.

Tritium activities in the Building 292 area continue to decline. Tritium at HSU-1B monitor well UP-292-007, where the highest activities onsite had previously been observed (24,000 pCi/L, October 2000), was 5,760 pCi/L in February 2013 (Figure 6). The well has been dry since that time. The highest tritium activity in the Building 292 area is currently less than 100 pCi/L (W-607, February, 2014).

As part of the Building 419 RCRA Closure agreement (California Department of Substances Control, 2013), DOE/LLNL installed a well to monitor tritium activities beneath the former Building 419 area. Tritium had been detected in 2011 at approximately 60,000 pCi/L in bailed ground water samples from pre-closure characterization boreholes B-419-040 and B-419-041 (Figure 10). In the fall of 2014, monitor well W-3004 was installed between these two boreholes. The initial tritium activity in W-3004 was 12,400 pCi/L (September 2014), and is currently 15,600 pCi/L (August 2015), which is consistent with other activities in the Building 419 area, including piezometer SIP-419-202, where tritium was 15,400 pCi/L in June 2015.

A new monitor well, W-3105 (Figure 16), was installed in the Building 511 area during September 2015. Tritium activities in ground water from this well were much lower than anticipated, at less than 100 pCi/L (November 2015).

4.5. Decision Support Analysis

A variety of decision support tools are utilized to analyze data and evaluate the performance of the Livermore Site remediation systems. These tools improve the quality, efficiency and consistency of routine tasks and result in significant cost savings for ERD. Decision support tools were also used extensively during REVAL (Appendix E) for each treatment facility and for ESAR activities. These decision support activities and associated tools are grouped into five categories:

- Taurus Environmental Information Management System (TEIMS);
- Automated Data Review and Mapping Tools;
- Predictive Analysis Tools;
- Treatment Facility Real-Time (TFRT) data acquisition system; and
- Mobile data collection systems.

The TEIMS database and associated data entry and review tools are routinely used for work tasks ranging from data management to report preparation. For example, the treatment facility self-monitoring reporting tool allows facility operators to enter data using a web-based interface, and to automatically generate reports that are included in the quarterly self-monitoring reports (Yow and Wong, 2015[a-d]).

The next level of decision-support tools consists of sophisticated graphical, statistical and numerical data analysis tools used for remedial performance evaluations. This suite of tools includes the CES algorithm (Appendix C) that enables ERD personnel to quickly review concentration trends in wells and set sampling frequencies on a quarterly basis. Another frequently used tool is the OPERA tool (Appendix F). This web tool enables ERD personnel to quickly view HSU-specific plume maps for each contaminant and compare current conditions with historical distributions. Plume and ground water elevation maps and animations that span the entire Livermore Site GWP history are updated each quarter within a matter of hours using the OPERA tool. The plume map library was updated quarterly during 2015 with the most recent sampling information available. The HSU conceptual model constitutes the basic framework for all decision support tools, and is continually updated using information from recently installed wells and hydraulic tests.

ERD's environmental database and the data analysis tools significantly reduce the effort required to develop analytical or numerical models for predictive analyses. Regional-scale flow and transport models are used to evaluate the effectiveness and startup order of wells in extraction wellfields. The results of these analyses allow ERD personnel to prioritize the maintenance and operation of critical facilities to ensure hydraulic containment.

In 2015, the TFRT data acquisition system continued to provide significant value to the Livermore Site cleanup project. TFRT data are used to optimize and maintain treatment facilities, and to quickly provide important information for diagnosing facility-related issues. Improvements were also implemented for controlling operation of ground water extraction wells. The operational mode of multiple wells in the eastern portion of the site, where well yields are typically lower, was converted from constant flow rate to water-level-controlled pumping. In this operational mode, the water level in the well is maintained at a desired elevation while the treatment facility electronic control system automatically adjusts the flow rate of the pump. This capability resulted in two significant improvements: 1) extraction wells operate continuously and require fewer adjustments and less technician oversight, and 2) plume capture is maintained at all times without further exacerbating the ongoing over-drafting of the aquifer.

In 2015, ERD also deployed a mobile data collection tool for recording manual water level measurements. The Water Level Collection (WLCO) tool allows field personnel to plan their activities, record water level measurements, and update the database on a daily basis. The tool has built-in decision support capabilities to minimize data measurement and data entry errors. WLCO also provides significant cost-savings by reducing the time required to get high-quality measurements into the database.

5. References

Berg, L. L., M. D. Dresen, R. W. Bainer, E. N. Folsom, and A. L. Lamarre (Eds.) (1997), *Five-Year Review for the Lawrence Livermore National Laboratory Livermore Site,* Lawrence Livermore National Laboratory, Livermore, Calif. (UCRL-AR-126935).

Bourne, S., V. Dibley, and P. McKereghan (Eds.) (2011), *Addendum to Remedial Design Report No. 1 for Treatment Facility A: Arroyo Seco Pipeline Extension, Lawrence Livermore National Laboratory Livermore Site,* Lawrence Livermore National Laboratory, Livermore, Calif. (LLNL-AR-480717).

California Department of Substances Control (2013), *Conditional Acknowledgement of Closure Certification for the 419 Hazardous Water Treatment Facility*, letter dated November 18, 2013.

GeoSierra Environmental, Inc. (2014), *Final Completion Report, Vertical Inclusion Propagation ZVI Emplacement Project, TFC-HS Area, Lawrence Livermore National Laboratory, Livermore, California,* GeoSierra Environmental, Inc., Medford NJ, December 19, 2014.

Goodrich, R., and G. Lorega (Eds.) (2012), *LLNL Livermore Site and Site 300 Environmental Restoration Department Standard Operating Procedures (SOPs)*, Lawrence Livermore National Laboratory, Livermore, Calif. (UCRL-AM-109115 rev. 14).

Lawrence Livermore National Laboratory (2009), *Resolution of Mixed Waste Management Issues Associated with Operation of Soil Vapor and Ground Water Treatment Facilities at LLNL, Livermore Site*, Lawrence Livermore National Laboratory, Livermore, Calif. (LLNL-AR-412616).

McKereghan, P., C. Noyes, M. Buscheck, Z. Demir, and V. Dibley (2012), *Fourth Five-Year Review for the Lawrence Livermore National Laboratory, Livermore Site,* Lawrence Livermore National Laboratory, Livermore, Calif. (UCRL-AR-533772).

McKereghan, P., C. Noyes, Z. Demir, M. Buscheck, and M. Dresen (Eds.) (2015), *LLNL Ground Water Project, 2014 Annual Report*, Lawrence Livermore National Laboratory, Livermore, Calif. (UCRL-AR-126020-14).

Newmark, R.L. (Ed) (1994) *Dynamic Underground Stripping Project: LLNL Gasoline Spill Demonstration Report,* Lawrence Livermore National Laboratory, Livermore, Calif. (UCRL-ID-116964 vol. 1-4).

Yow, J.L., and P.W. Wong (2015a), *Letter Report: LLNL Livermore Site Fourth Quarter 2014 Self-Monitoring Report*, February 2015 (LLNL-AR-654714-4).

Yow, J.L., and P.W. Wong (2015b), *Letter Report: LLNL Livermore Site First Quarter 2015 Self-Monitoring Report*, May 2015 (LLNL-AR-671099-1).

Yow, J.L., and P.W. Wong (2015c), *Letter Report: LLNL Livermore Site Second Quarter 2015 Self-Monitoring Report*, August 2015 (LLNL-AR-671099-2).

Yow, J.L., and P.W. Wong (2015d), *Letter Report: LLNL Livermore Site Third Quarter 2015 Self-Monitoring Report*, November 2015 (LLNL-AR-671099-3).

6. Acronyms and Abbreviations

CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CES	Cost effective sampling
DOE	U.S. Department of Energy
DWFO	Dynamic Well-Field Operation
ELM	Eastern Landing Mat
EPA	U.S. Environmental Protection Agency
ERD	Environmental Restoration Department (LLNL)
ESAR	Enhanced Source Area Remediation
ESD	Explanation of Significant Difference
ETC	East Traffic Circle
ETCS	East Traffic Circle South
ETS	East Taxi Strip
FFA	Federal Facility Agreement
GPM	Gallons per minute
GWP	Ground Water Project
HSU	Hydrostratigraphic unit
ISB01	*In situ* bioremediation facility
kg	Kilogram
LLNL	Lawrence Livermore National Laboratory
MCL	Maximum contaminant level
Mcf	Millions of cubic feet
Mgal	Millions of gallons
mg/kg	Milligrams per kilogram
mg/L	Milligrams per liter
OPERA	Optimized environmental restoration analysis
PCE	Perchloroethene or tetrachloroethene
pCi/L	Picocuries per liter
ppb	Parts per billion
RCRA	Resource Conservation and Recovery Act
REVAL	Remediation evaluation (ERD)
RPM	Remedial Project Manager
RWQCB	California Regional Water Quality Control Board
SDGS	Specific depth grab sampling
TCE	Trichloroethylene
TF	Treatment facility
μg/L	Micrograms per liter

VES	Vapor extraction system
VIP	Vertical inclusion process
VOC	Volatile organic compound
VTF	(Soil) vapor treatment facility
ZVI	Zero valent iron

Figures

List of Figures

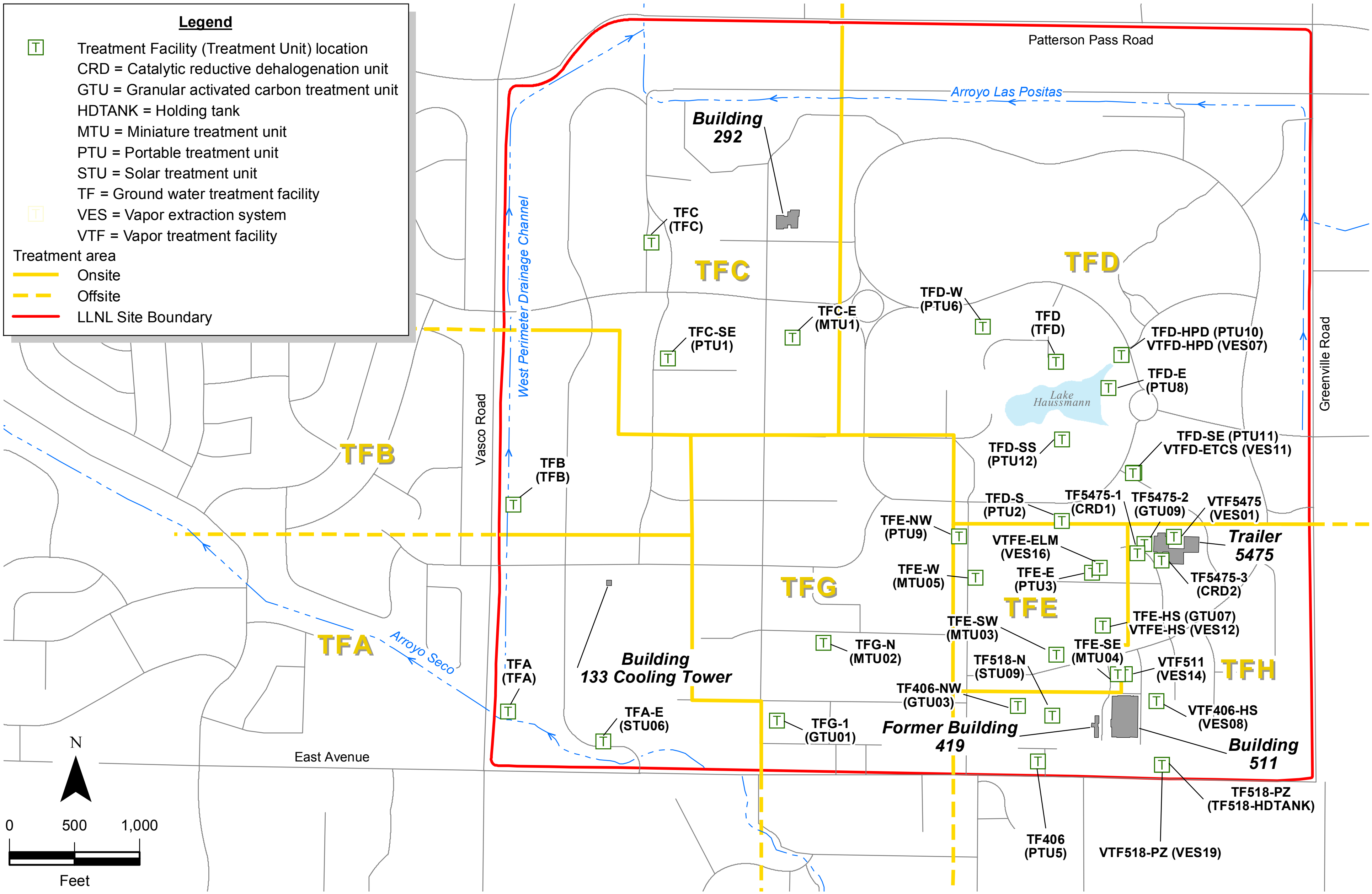


Figure 1. Livermore Site treatment areas and treatment facility locations.

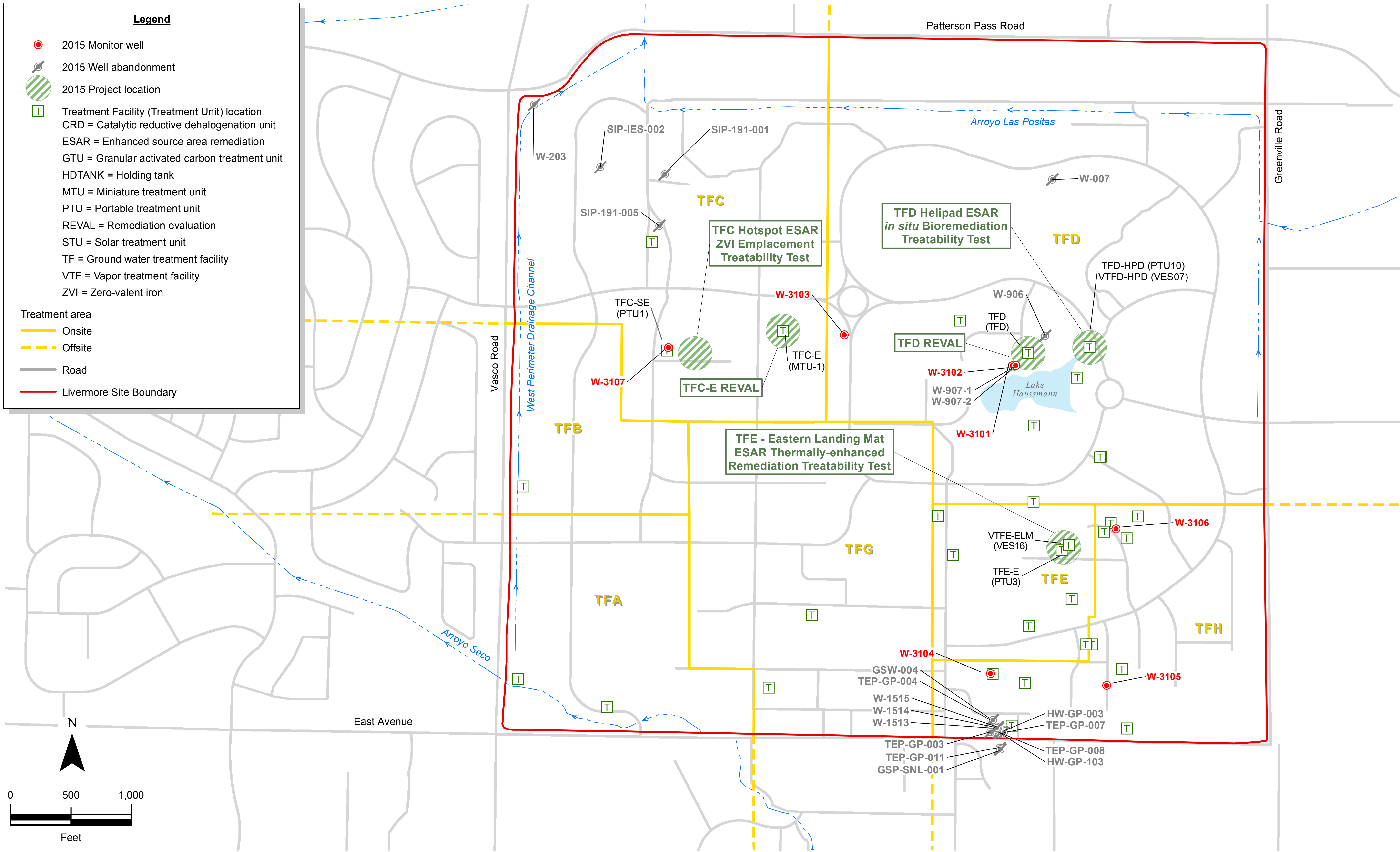
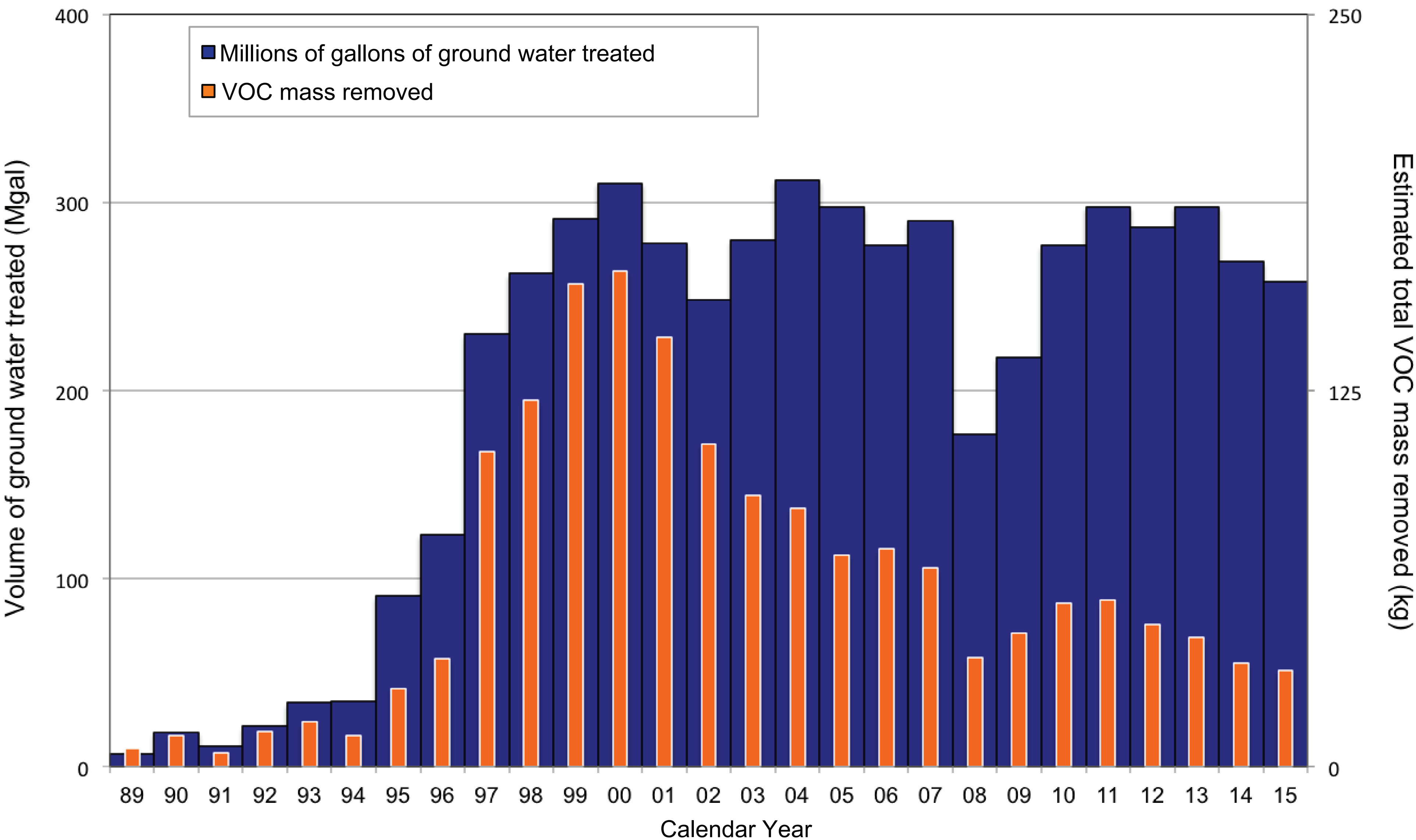
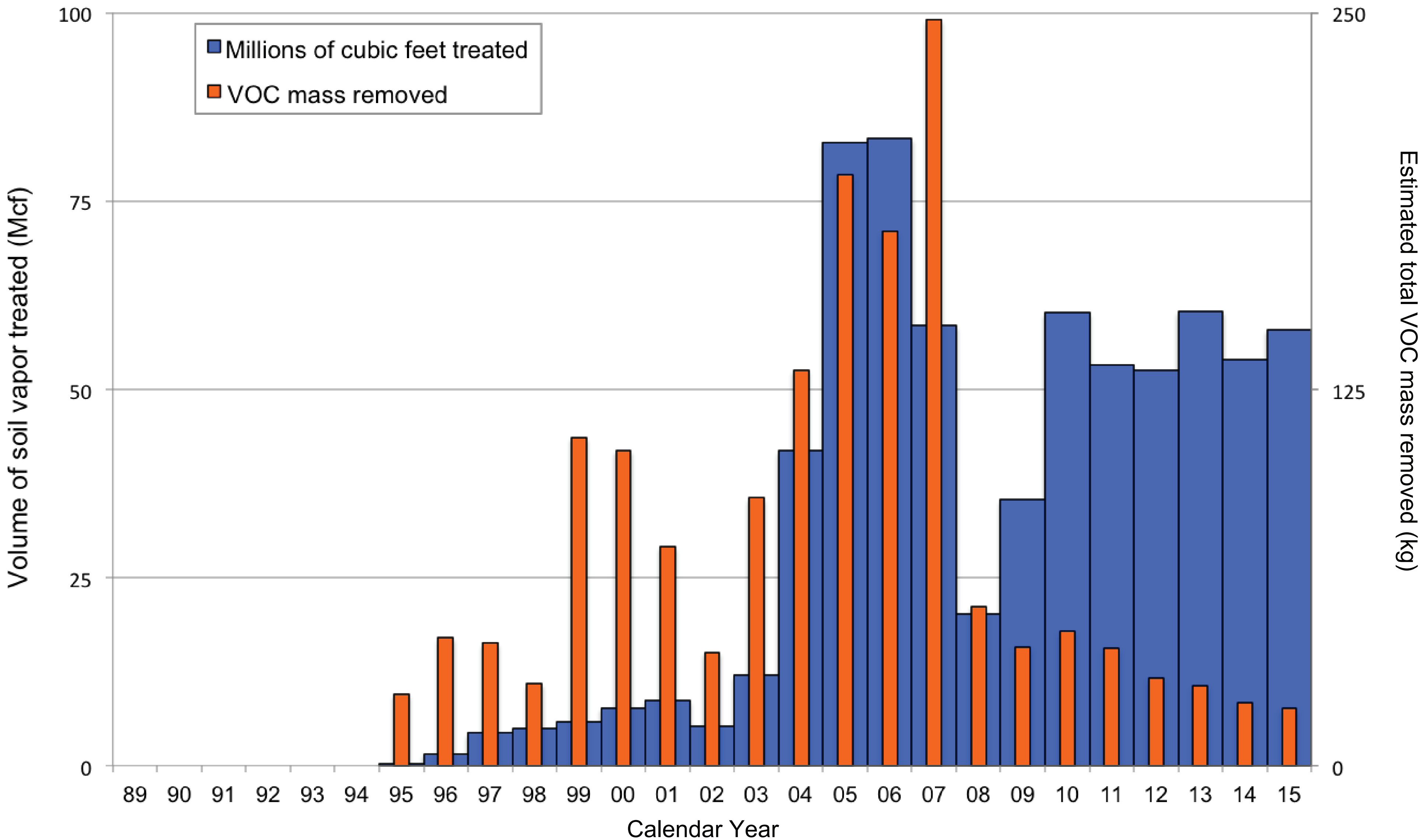


Figure 2. Locations of principal projects and drilling activities conducted at the Livermore Site in 2015.



ERD-S3R-16-0018

Figure 3. Estimated total VOC mass removed from Livermore Site ground water since 1989.



ERD-S3R-16-0019

Figure 4. Estimated total VOC mass removed from Livermore Site soil vapor since 1989.

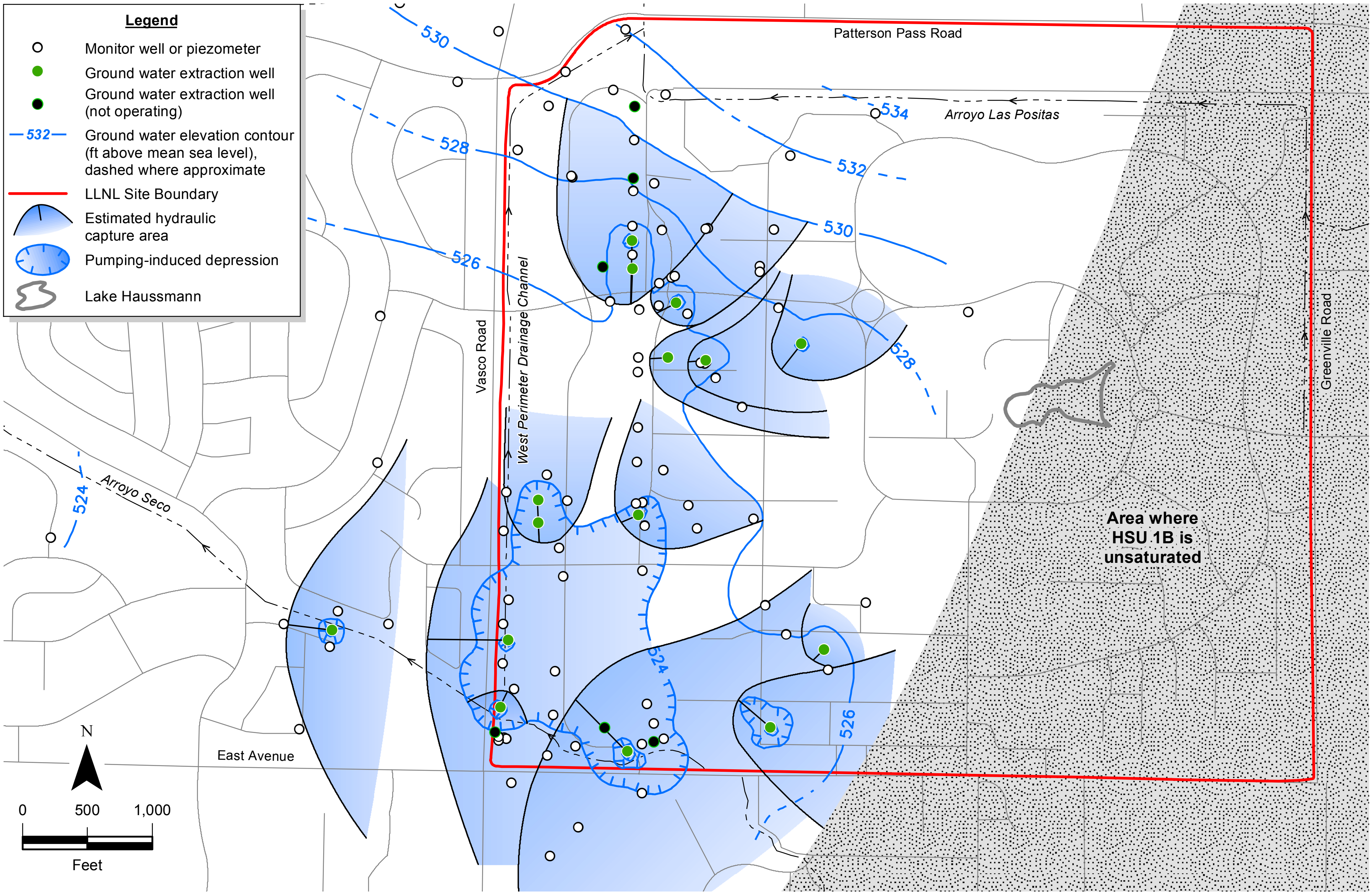


Figure 5. Ground water elevation contour map based on 110 wells completed within HSU-1B showing estimated hydraulic capture areas, LLNL and vicinity, third quarter 2015.

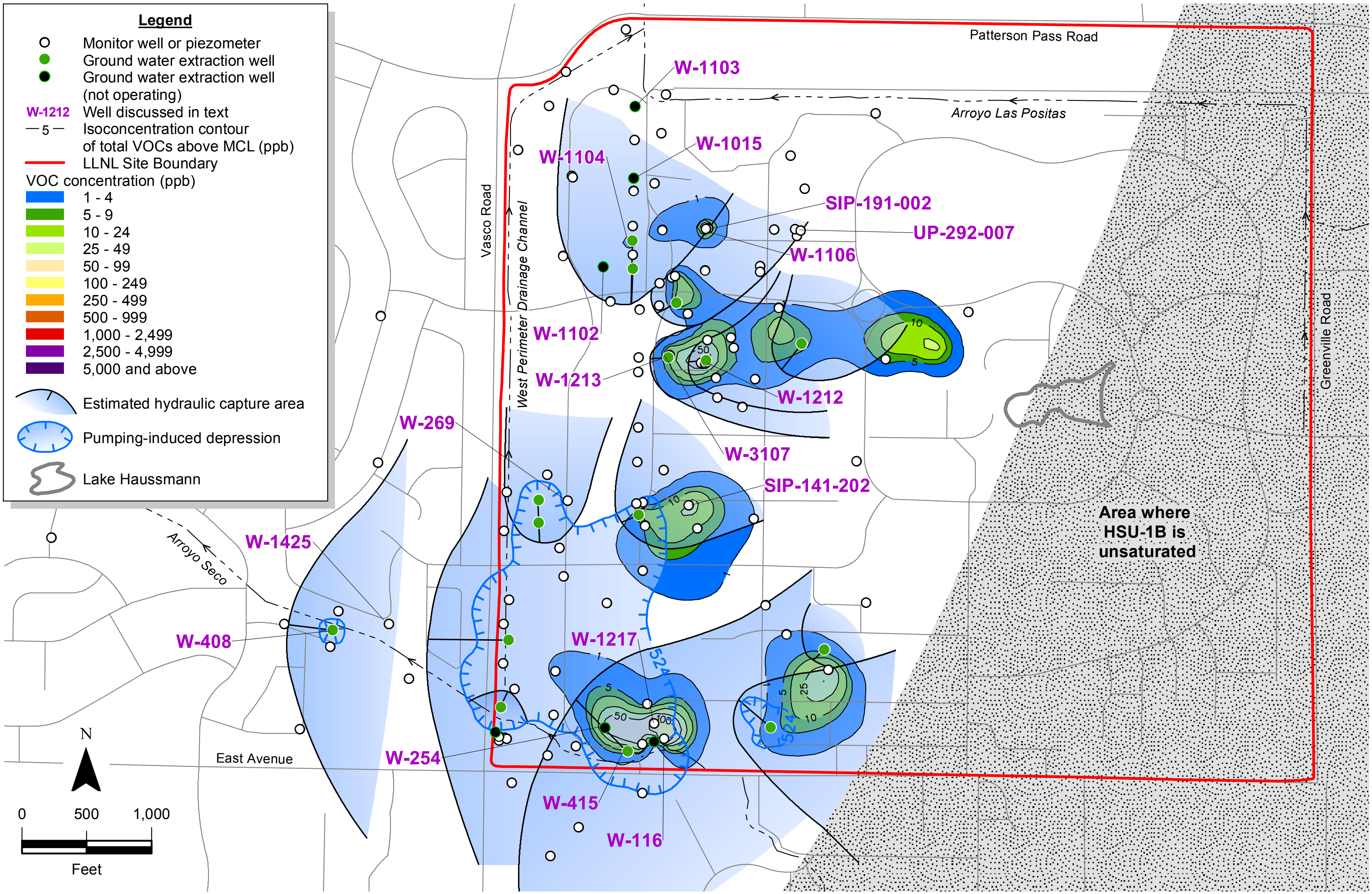


Figure 6. Isoconcentration contour map of total VOCs above MCLs from 130 wells completed within HSU-1B, third quarter 2015 (or the next most recent data), and supplemented with soil chemistry data from 43 borehole locations.

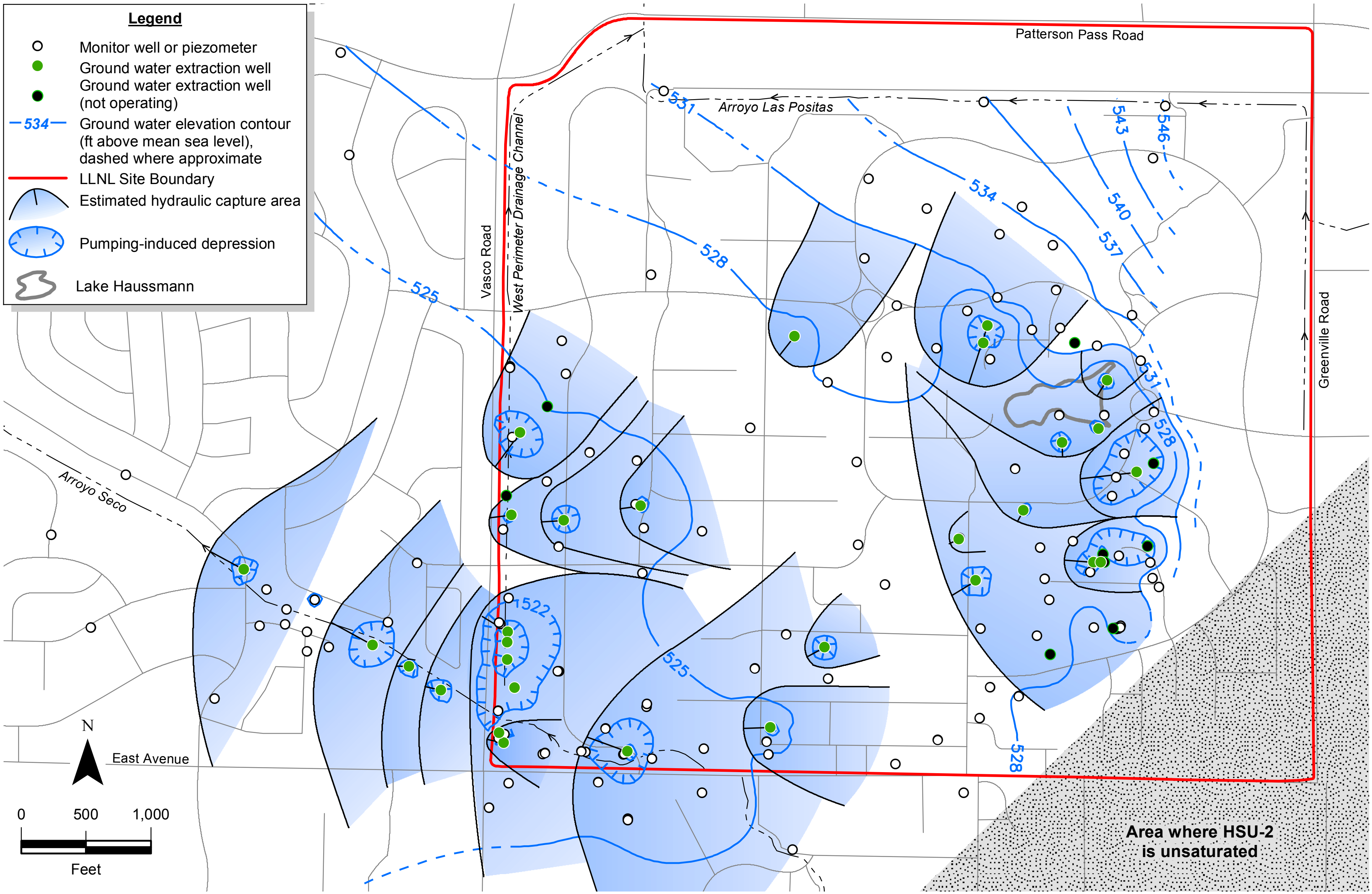


Figure 7. Ground water elevation contour map based on 164 wells completed within HSU-2 showing estimated hydraulic capture areas, LLNL and vicinity, third quarter 2015.

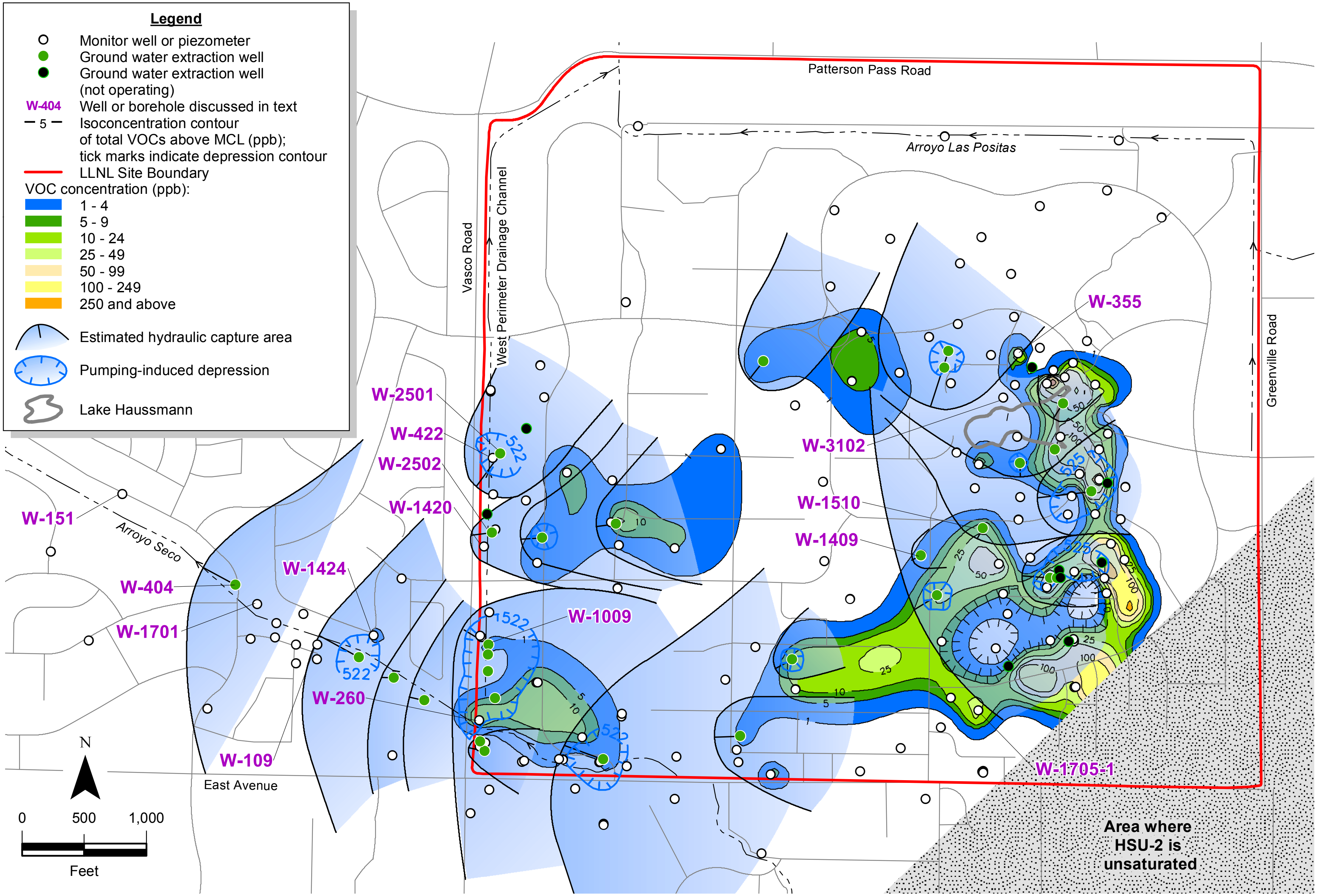


Figure 8. Isoconcentration contour map of total VOCs above MCLs from 194 wells completed within HSU-2, third quarter 2015 (or the next most recent data), and supplemented with soil chemistry data from 93 borehole locations.

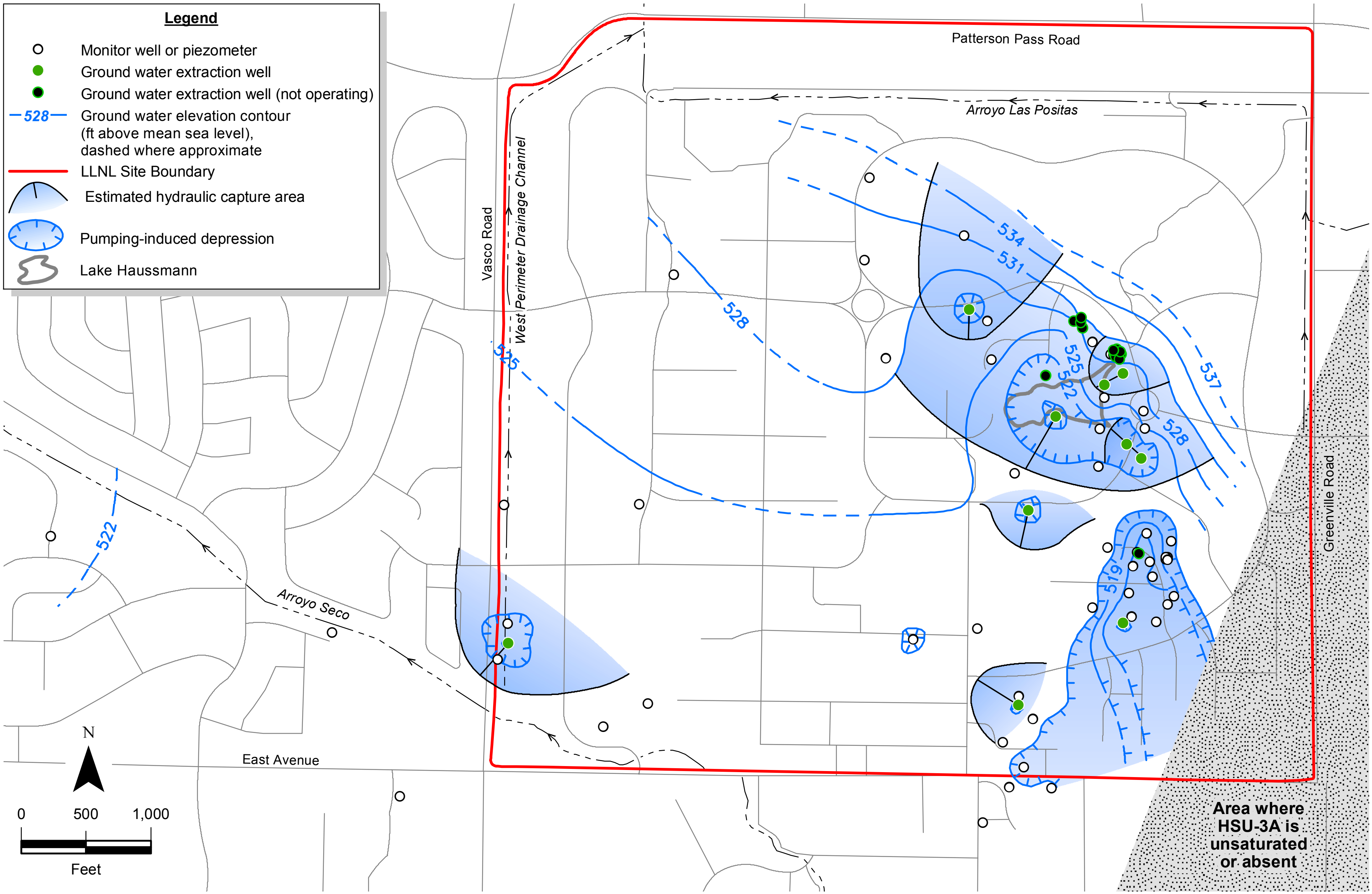


Figure 9. Ground water elevation contour map based on 75 wells completed within HSU-3A showing estimated hydraulic capture areas, LLNL and vicinity, third quarter 2015.

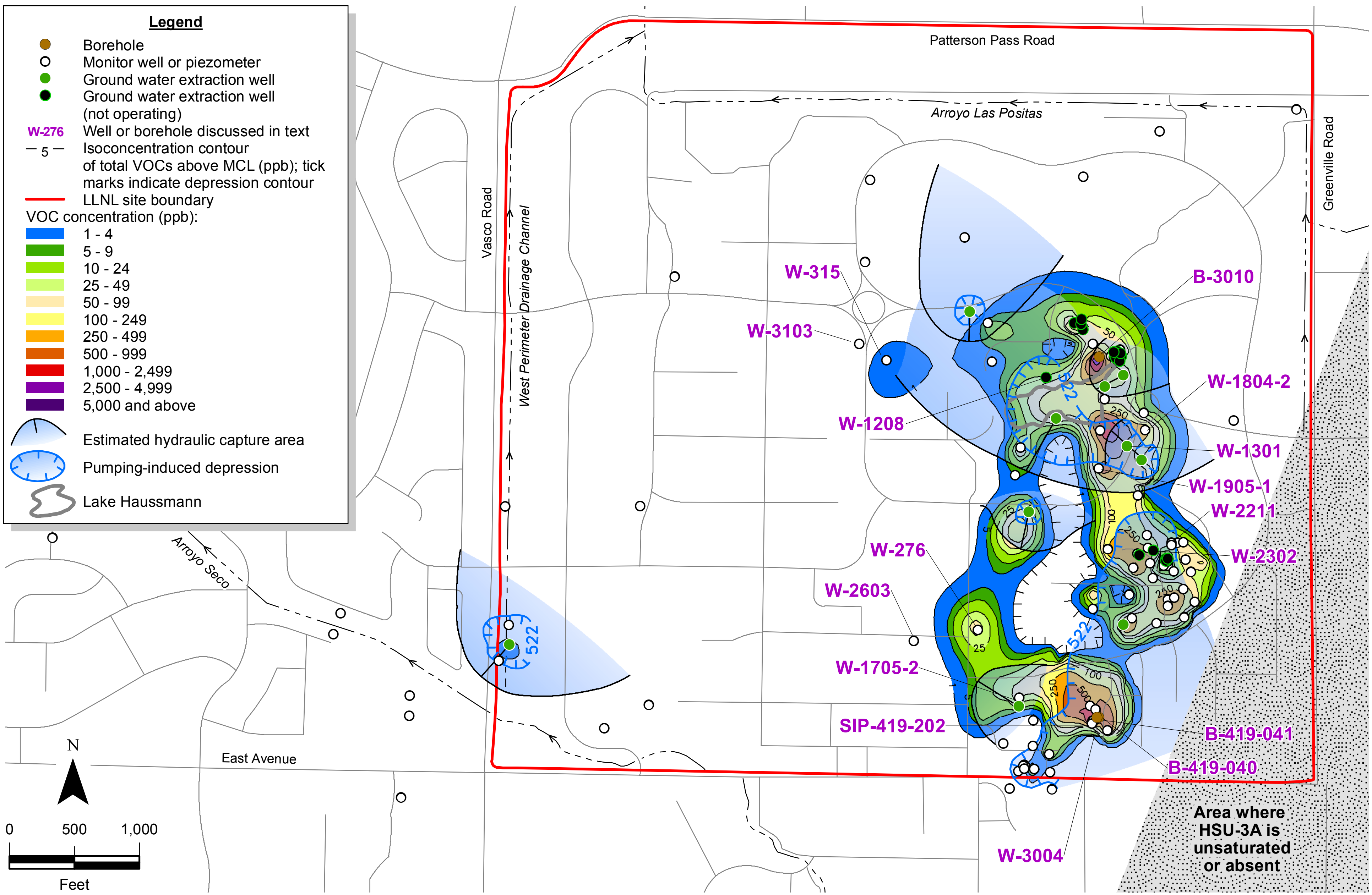


Figure 10. Isoconcentration contour map of total VOCs above MCLs from 121 wells completed within HSU-3A, third quarter 2015 (or the next most recent data), and supplemented with soil chemistry data from 143 borehole locations.

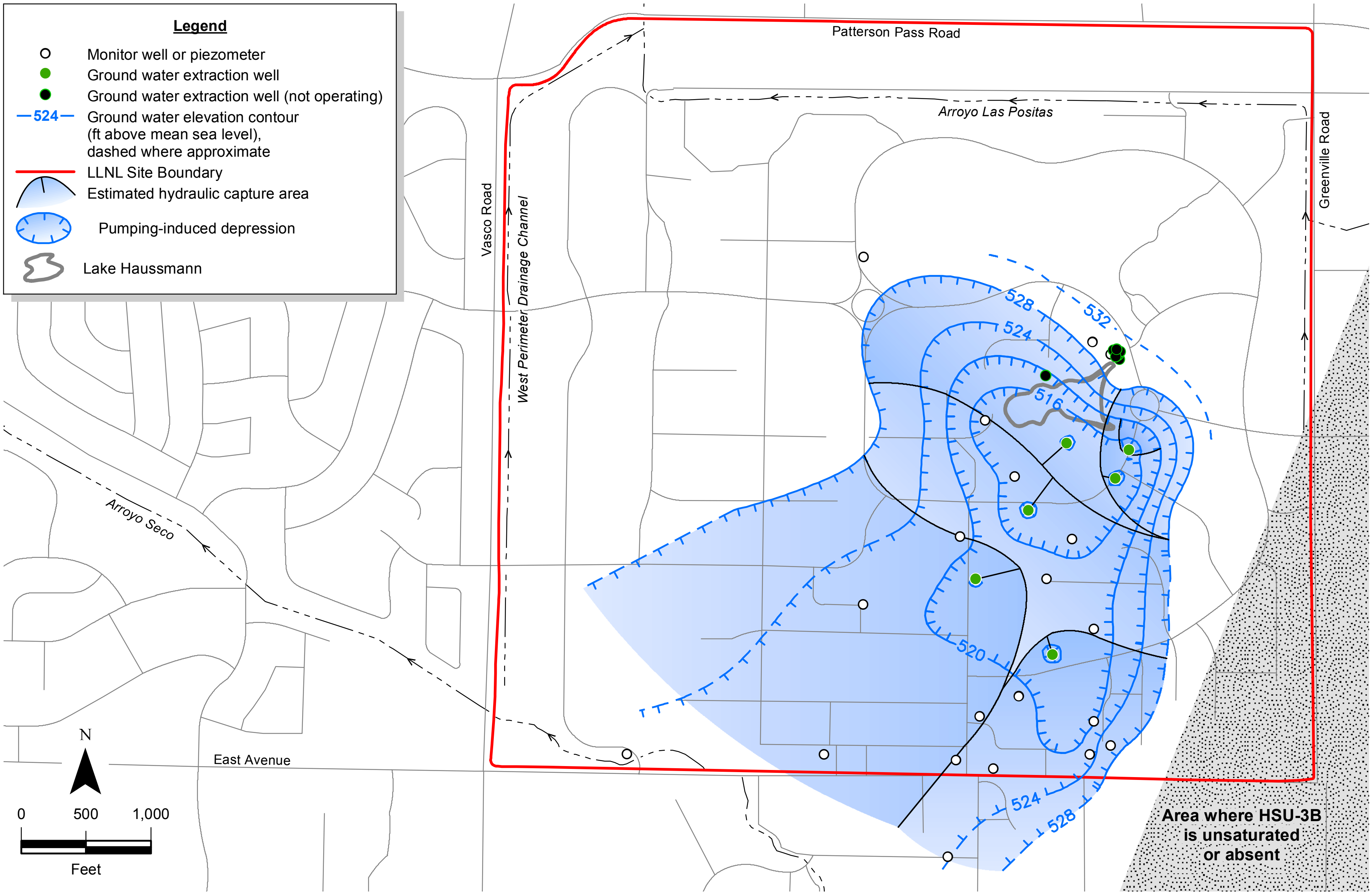


Figure 11. Ground water elevation contour map based on 33 wells completed within HSU-3B showing estimated hydraulic capture areas, LLNL and vicinity, third quarter 2015.

Figure 12. Isoconcentration contour map of total VOCs above MCLs from 43 wells completed within HSU-3B, third quarter 2015 (or the next most recent data), and supplemented with soil chemistry data from 110 borehole locations.

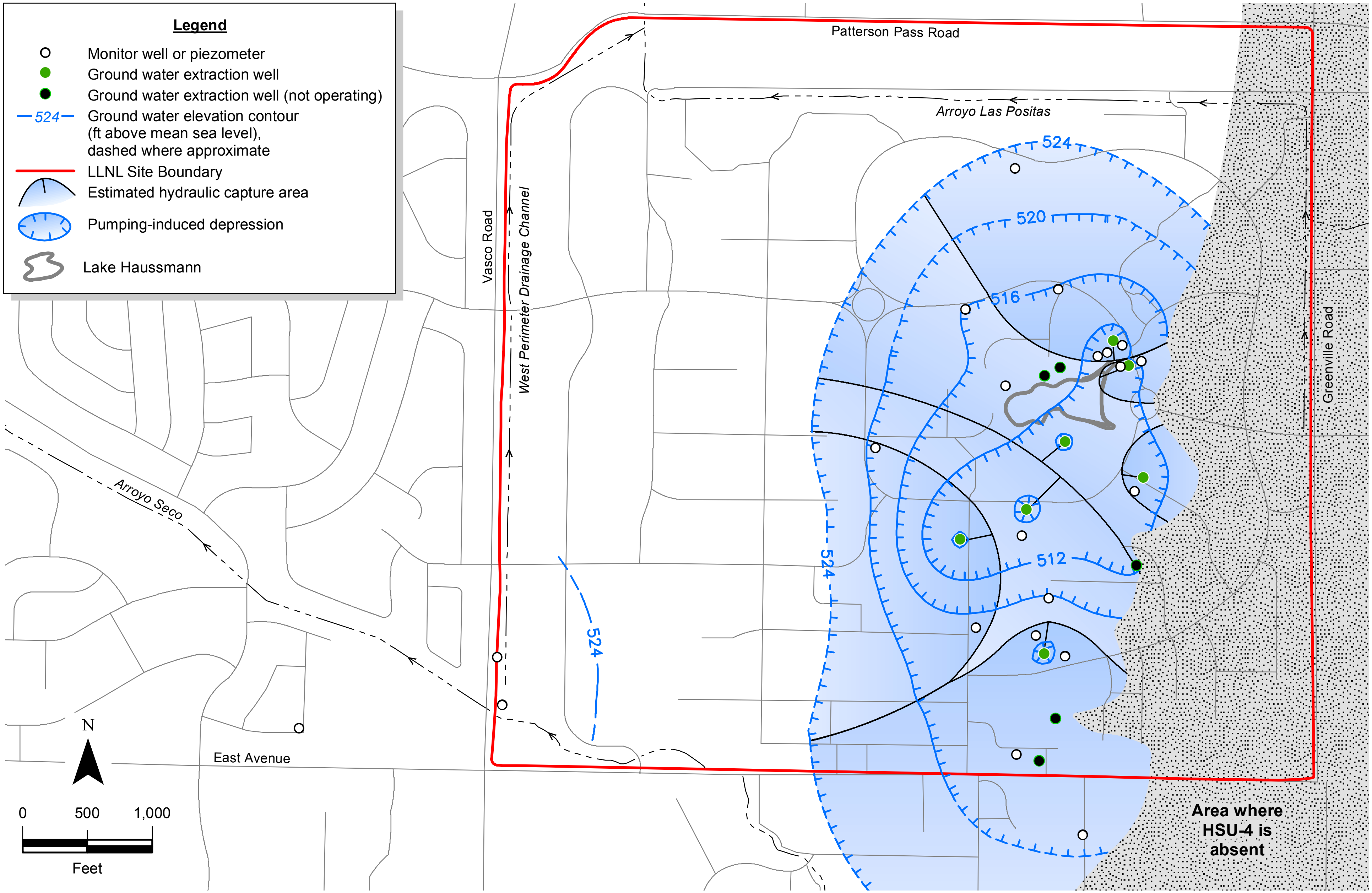


Figure 13. Ground water elevation contour map based on 33 wells completed within HSU-4 showing estimated hydraulic capture areas, LLNL and vicinity, third quarter 2015.

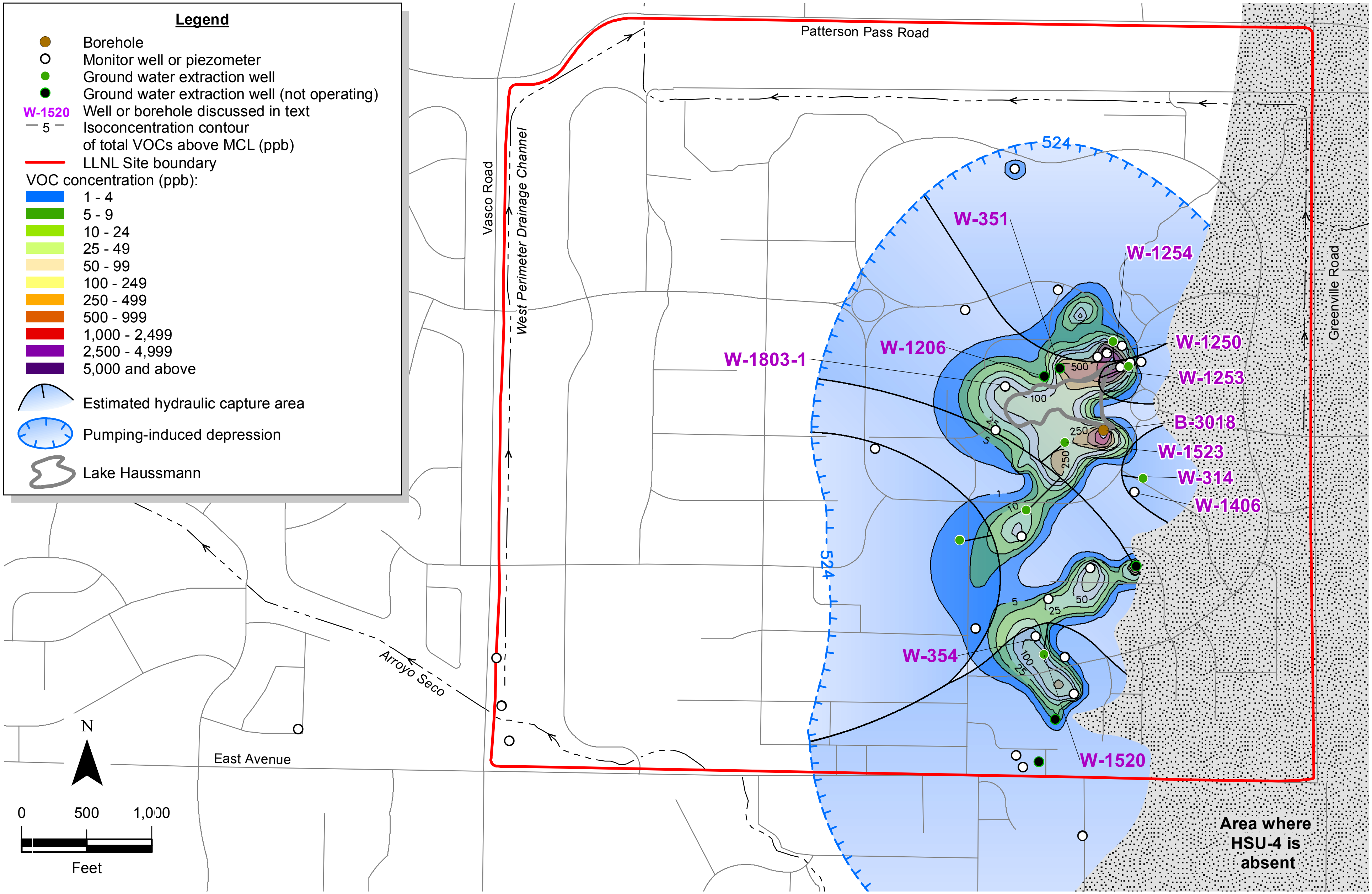


Figure 14. Isoconcentration contour map of total VOCs above MCLs from 39 wells completed within HSU-4, third quarter 2015 (or the next most recent data), and supplemented with soil chemistry data from 63 borehole locations.

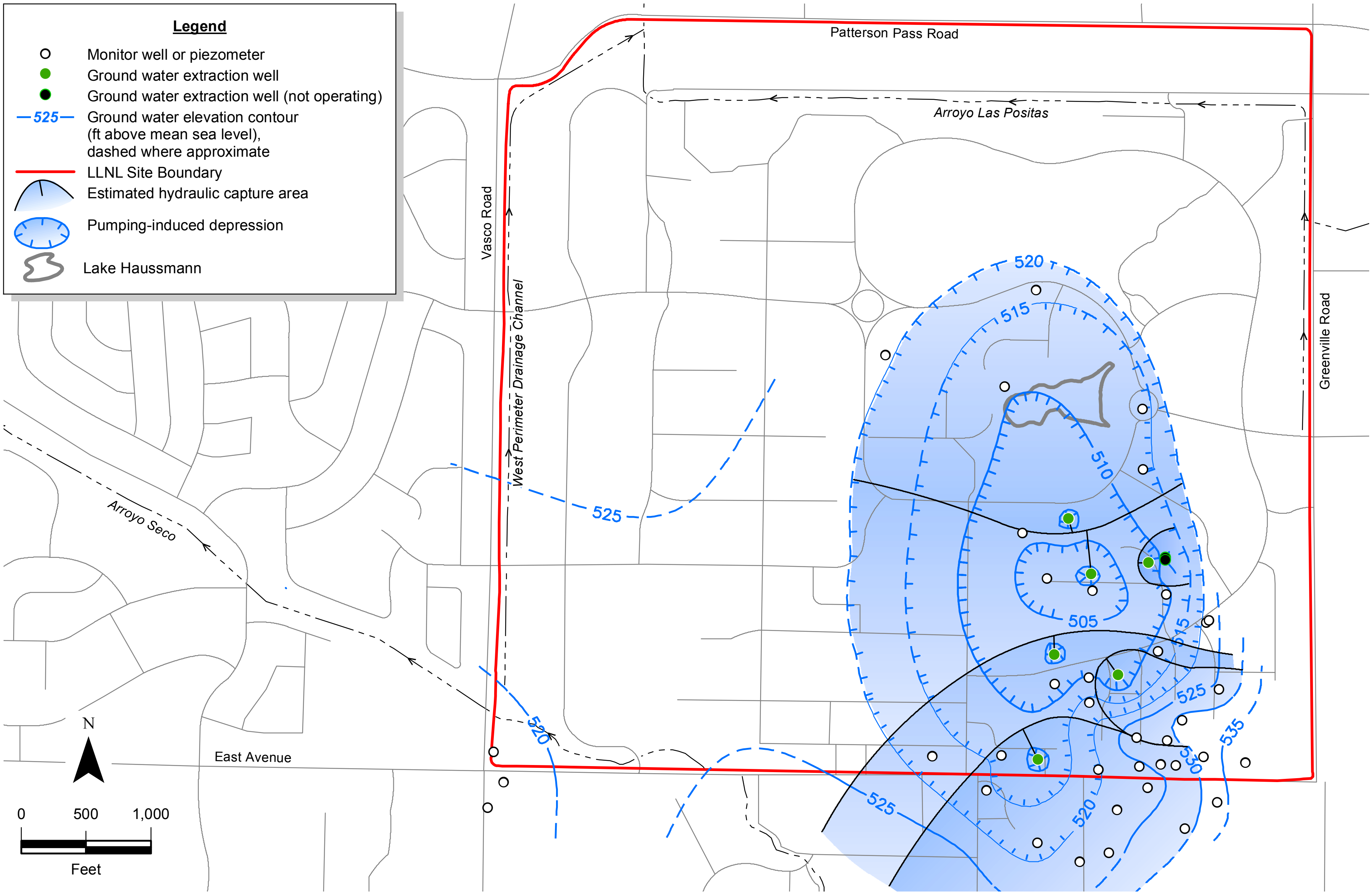


Figure 15. Ground water elevation contour map based on 48 wells completed within HSU-5 showing estimated hydraulic capture areas, LLNL and vicinity, third quarter 2015.

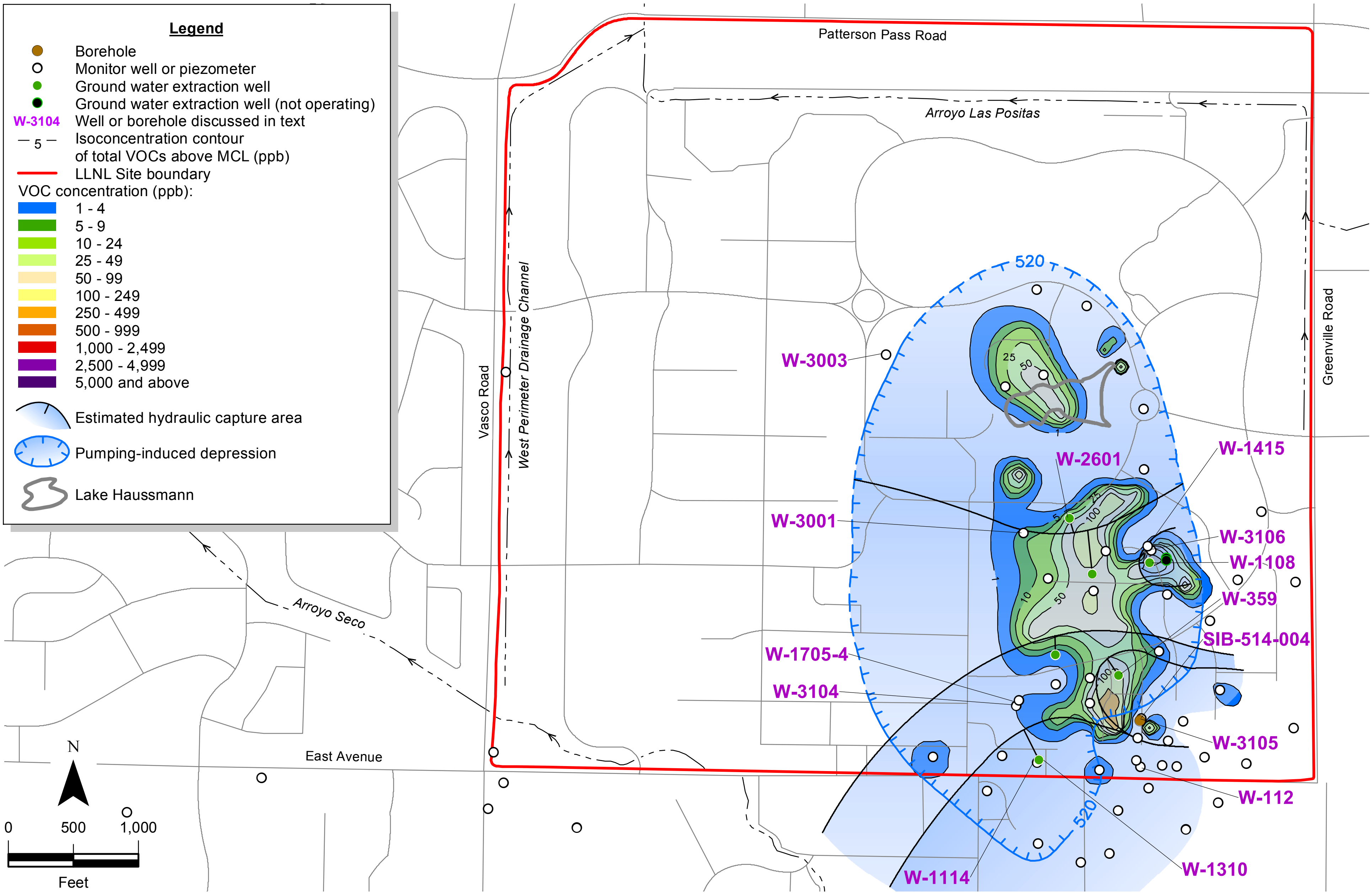


Figure 16. Isoconcentration contour map of total VOCs above MCLs from 62 wells completed within HSU-5, third quarter 2015 (or the next most recent data), and supplemented with soil chemistry data from 95 borehole locations.

Tables

List of Tables

Table 1. Livermore Site treatment facility abbreviations.

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

Notes:

TF = Ground water treatment facility.

VTF = Soil vapor treatment facility.

Table 2. Types and numbers of Livermore Site wells.

Well type	Number of wells
Anode wells (cathodic protection)[a]	**9**
Dual Extraction[b]	**17**
Ground Water Extraction	**90**
Ground Water Injection	**2**
Ground Water Monitor[c]	**412**
Ground Water Guard	**20**
Solinst CMT[d] Multiwell System®	**1**
Piezometer	**105**
Soil Vapor Extraction	**34**
Soil Vapor Injection	**1**
Soil Vapor Monitor	**39**
Total	**730**

Notes:

The number of Livermore Site wells is current through the end of December 2015.

Table A-1 of Appendix A summarizes construction information for all wells.

[a] **These wells protect metallic objects (e.g. pipelines) in contact with the ground from electrolytic corrosion.**

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

[c] **Does not include 33 offsite private or regulatory agency wells that are occasionally monitored by ERD.**

[d] **CMT = Continuous Multichannel Tubing.**

Table 3. Summary of treatment facility discharge sampling locations.

Treatment facility		Discharge sampling location[a]
TFA	TFA	Arroyo Seco (TFG-ASW) and West Perimeter Drainage Channel (TFB-R002)
	TFA East	Arroyo Seco (TFG-ASW)
TFB	TFB	West Perimeter Drainage Channel (TFB-R002) and Building 133 Cooling Tower (TFB-E-B133CT)
TFC	TFC	Arroyo Las Positas (TFC-R003)
	TFC East	Arroyo Las Positas (TFC-R003)
	TFC Southeast	Arroyo Las Positas (TFC-R003)
TFD	TFD	Arroyo Las Positas (TFC-R003) and TFD irrigation supply (TFD-IRR)
	TFD East	Arroyo Las Positas (TFC-R003)
	TFD Helipad	Arroyo Las Positas (TFC-R003)
	TFD South	Arroyo Las Positas (TFC-R003)
	TFD Southeast	Arroyo Las Positas (TFC-R003)
	TFD Southshore	Arroyo Las Positas (TFC-R003)
	TFD West	Arroyo Las Positas (TFC-R003)
	VTFD East Traffic Circle South	Treated vapor to atmosphere
	VTFD Helipad	Treated vapor to atmosphere
TFE	TFE East	Arroyo Las Positas (TFC-R003)
	TFE Hotspot	Arroyo Las Positas (TFC-R003)
	TFE Northwest	Arroyo Las Positas (TFC-R003)
	TFE Southeast	Arroyo Las Positas (TFC-R003)
	TFE Southwest	Arroyo Las Positas (TFC-R003)
	TFE West	Arroyo Las Positas (TFC-R003)
	VTFE Eastern Landing Mat	Treated vapor to atmosphere
	VTFE Hotspot	Treated vapor to atmosphere
TFG	TFG-1	Arroyo Seco (TFG-ASW)
	TFG North	Arroyo Las Positas (TFC-R003)
TFH	TF406	Arroyo Las Positas (TFC-R003)
	TF406 Northwest	Arroyo Las Positas (TFC-R003)
	VTF406 Hotspot	Treated vapor to atmosphere
	VTF511	Treated vapor to atmosphere
	TF518 North	Arroyo Las Positas (TFC-R003)
	TF518 Perched Zone	Tankered to TFB
	VTF518 Perched Zone	Treated vapor to atmosphere
	TF5475-1	CRD-1 injection (W-1302-1)
	TF5475-2	Arroyo Las Positas (TFC-R003)
	TF5475-3	CRD-2 injection (W-1610)
	VTF5475	Injection (SVI-ETS-505)

Note:

[a] **See Attachment A – LLNL Livermore Site Well Location Map, for water discharge locations to ground surface.**

Table 4. 2015 Livermore Site performance summary.

HSU	Extraction well	Volume of ground water treated (kgal)	Estimated VOC mass removed from ground water (kg)	Volume of soil vapor treated (kcf)	Estimated VOC mass removed from soil vapor (kg)
		Treatment Facility A (TFA)			
1B	W-262	<1	0	-	-
1B	W-408	13,947	0.01	-	-
1B	W-1001	650	0	-	-
1B	W-1004	4,306	0.03	-	-
1B/2	W-415	19,563	1.06	-	-
2	W-109	4	<0.01	-	-
2	W-404	15,901	0.30	-	-
2	W-457	3,908	0.07	-	-
2	W-518	1,946	0.08	-	-
2	W-522	6,303	0.11	-	-
2	W-605	4,443	0.21	-	-
2	W-614	5,446	0.09	-	-
2	W-714	2,800	0.05	-	-
2	W-903	6,113	0.12	-	-
2	W-904	7,199	0.13	-	-
2	W-1009	10,542	0.76	-	-
3A	W-712	2,456	0.14	-	-
		Treatment Facility A East (TFA-E)			
1B	W-116	-	-	<1	<0.01
1B	W-254	0	0	1	<0.01
1B	W-1217	-	-	<1	<0.01
		Treatment Facility B (TFB)			
1B	W-610	3,430	0.04	-	-
1B	W-620	1,680	0.03	-	-
1B	W-704	8,798	1.04	-	-
2	W-357	4,078	0.61	-	-
2	W-621	<1	<0.01	-	-
2	W-655	<1	<0.01	-	-
2	W-1423	1,471	0.12	-	-

Table 4. 2015 Livermore Site performance summary. (Continued)

HSU	Extraction well	Volume of ground water treated (kgal)	Estimated VOC mass removed from ground water (kg)	Volume of soil vapor treated (kcf)	Estimated VOC mass removed from soil vapor (kg)
		Treatment Facility B (TFB) (continued)			
2	W-2501	8,099	0.15		
2	W-2502	2,025	0.05		
		Treatment Facility C (TFC)			
1B	W-701	6,260	1.05	-	-
1B	W-1015	<1	<0.01	-	-
1B	W-1102	<1	<0.01	-	-
1B	W-1103	<1	<0.01	-	-
1B	W-1104	12,259	0.67	-	-
1B	W-1116	407	0.02	-	-
		Treatment Facility C East (TFC-E)			
1B	W-368	1,381	0.19	-	-
2	W-413	5,915	0.76	-	-
		Treatment Facility C Southeast (TFC-SE)			
1B	W-1213	962	0.13	-	-
1B	W-2201	3,203	0.52	-	-
		Treatment Facility D (TFD)			
2/3A	W-906	<1	<0.01	-	-
3A	W-653	11	0.02	-	-
3A	W-2011	23	<0.01	-	-
3A	W-2101	29	0.01	-	-
3A	W-2102	58	0.07	-	-
3A/3B	W-1208	1,975	0.47	-	-
4	W-351	193	0.30	-	-
4	W-1206	2,071	0.11	-	-
5	W-907-2	0	0	-	-

Table 4. 2015 Livermore Site performance summary. (Continued)

HSU	Extraction well	Volume of ground water treated (kgal)	Estimated VOC mass removed from ground water (kg)	Volume of soil vapor treated (kcf)	Estimated VOC mass removed from soil vapor (kg)
		Treatment Facility D East (TFD-E)			
2	W-1303	580	0.26	-	-
2	W-1306	49	<0.01	-	-
3A	W-1301	325	0.45	-	-
3A	W-1550	79	0.04	-	-
3A	W-2203	39	0.02	-	-
3B	W-2006	8	0.02	-	-
4	W-1307	2,900	0.58	-	-
		Treatment Facility D Helipad (TFD-HPD)[a]		**Vapor Treatment Facility D Helipad (VTFD-HPD)[b]**	
1B	W-HPA-002A	-	-	-	-
2	W-HPA-002B	-	-	-	-
2/3A	W-1655	<1	0	-	-
2/3A/3B	W-1651	-	-	-	-
3A	W-1551	-	-	-	-
3A	W-1552	0	0	-	-
3A	W-1650	8	0	-	-
3A	W-1653	6	0	-	-
3A	W-1654	-	-	-	-
3A	W-1656	-	-	-	-
3A/3B	W-1652	-	-	-	-
3A/3B	W-1657	0	0	-	-
4	W-1254	2,838	0.39	-	-
		Treatment Facility D South (TFD-S)			
2	W-1510	1,114	0.16	-	-
3A/3B	W-1504	3,333	0.98	-	-
4	W-1503	4,985	0.78	-	-
5	W-2601	2,192	0.53		

Table 4. 2015 Livermore Site performance summary. (Continued)

HSU	Extraction well	Volume of ground water treated (kgal)	Estimated VOC mass removed from ground water (kg)	Volume of soil vapor treated (kcf)	Estimated VOC mass removed from soil vapor (kg)
		Treatment Facility D Southeast (TFD-SE)		**Vapor Treatment Facility D East Traffic Circle South (VTFD-ETCS)**	
1B	W-ETC-2003	-	-	5,230	0.10
1B/2	W-ETC-2004A	-	-	1,774	0.09
2	W-ETC-2004B	-	-	7,475	1.95
2	W-1308	592	0.37	-	-
2	W-1904	0	0	<1	<0.01
2	SIP-ETC-201	0	0	<1	<0.01
3A	W-2005	389	0.16	-	-
3B	W-1403	490	0.80	-	-
4	W-314	2,306	0.09	-	-
		Treatment Facility D Southshore (TFD-SS)			
2	W-1602	1,158	0.06	-	-
3A	W-1603	6,752	3.04	-	-
3B	W-1601	423	0.51	-	-
4	W-1523	2,452	1.76	-	-
		Treatment Facility D West (TFD-W)			
2	W-1215	4,727	0.48	-	-
2	W-1216	4,687	0.49	-	-
3A	W-1902	6,809	1.29	-	-
		Treatment Facility E East (TFE-E)		**Vapor Treatment Facility E Eastern Landing Mat (VTFE-ELM)**	
1B	W-543-1908	-	-	<1	<0.01
2	W-543-001	-	-	<1	<0.01
2	W-543-003	-	-	1,121	0.14
2	W-1109	608	0.39	-	-
2	W-1903	80	0.02	1,462	0.47
2	W-1909	0	0	7	<0.01
2	W-2305	<1	<0.01	2	<0.01

Table 4. 2015 Livermore Site performance summary. (Continued)

HSU	Extraction well	Volume of ground water treated (kgal)	Estimated VOC mass removed from ground water (kg)	Volume of soil vapor treated (kcf)	Estimated VOC mass removed from soil vapor (kg)
		Treatment Facility E East (TFE-E) (continued)		**Vapor Treatment Facility E Eastern Landing Mat (VTFE-ELM)**	
5	W-566	4,014	1.50	-	-
		Treatment Facility E Hotspot (TFE-HS)		**Vapor Treatment Facility E Hotspot (VTFE-HS)**	
1B	W-ETS-2008A	-	-	<1	<0.01
1B/2	W-ETS-2008B	-	-	7,729	0.74
1B/2	W-ETS-2010A	-	-	<1	<0.01
2	W-ETS-2009	-	-	672	0.14
2	W-ETS-2010B	-	-	<1	<0.01
2	W-2105	7	<0.01	<1	<0.01
3A	W-2801	459	0.45		
		Treatment Facility E Northwest (TFE-NW)			
2	W-1409	854	0.09	-	-
4	W-1211	3,220	0.13	-	-
		Treatment Facility E Southeast (TFE-SE)			
5	W-359	3,913	2.62	-	-
		Treatment Facility E Southwest (TFE-SW)			
2	W-1518	2	<0.01	-	-
3B	W-1522	442	0.41	-	-
4	W-1520	364	0.15	-	-
5	W-1516	4,734	0.17		
		Treatment Facility E West (TFE-W)			
2	W-305	6,004	1.11	-	-
3B	W-292	3,044	0.27	-	-

Table 4. 2015 Livermore Site performance summary. (Continued)

HSU	Extraction well	Volume of ground water treated (kgal)	Estimated VOC mass removed from ground water (kg)	Volume of soil vapor treated (kcf)	Estimated VOC mass removed from soil vapor (kg)
		Treatment Facility G-1 (TFG-1)			
1B/2	W-1111	1,463	0.10	-	-
		Treatment Facility G North (TFG-N)			
1B	W-1806	207	<0.01	-	-
2	W-1807	1,789	0.18	-	-
		Treatment Facility 406 (TF406)			
4	W-1309	<1	<0.01	-	-
5	W-1310	4,193	0.06	-	-
		Treatment Facility 406 Northwest (TF406-NW)			
3A	W-1801	2,403	0.20	-	-
				Vapor Treatment Facility 406 Hotspot (VTF406-HS)	
1B/2	W-514-2007A	-	-	0	0
2/5	W-514-2007B	-	-	0.5877	4,603
5	W-217	-	-	2.083	6,295
				Vapor Treatment Facility 511 (VTF511)	
1B	W-2207A	-	-	<1	<0.01
2	W-2204	-	-	0	0
2	W-2205	-	-	0	0
2	W-2206	-	-	0	0
2	W-2208A	-	-	<1	<0.01
2/3A	W-2207B	-	-	8,909	0.91
2/3A	W-2208B	-	-	9,032	8.67

Table 4. 2015 Livermore Site performance summary. (Continued)

HSU	Extraction well	Volume of ground water treated (kgal)	Estimated VOC mass removed from ground water (kg)	Volume of soil vapor treated (kcf)	Estimated VOC mass removed from soil vapor (kg)
		Treatment Facility 518 North (TF518-N)[c]			
4	W-1410	0	0	-	-
		Treatment Facility 518 Perched Zone (TF518-PZ)		**Vapor Treatment Facility 518 Perched Zone (VTF518-PZ)**	
1B	W-518-1914	0	0	<1	<0.01
1B/2	W-1615	<1	<0.01	1,899	1.68
1B/2	W-2214A	-	-	2	<0.01
1B/2	W-2217A	-	-	3	<0.01
2	W-2214B	-	-	1	<0.01
2	W-2215A	-	-	491	1.07
2	W-2217B	-	-	3	<0.01
2	W-518-1913	0	0	<1	<0.01
2	W-518-1915	<1	<0.01	1,166	0.29
2	SVB-518-201	-	-	1	<0.01
2	SVB-518-204	-	-	1	<0.01
5	W-2215B	-	-	17	<0.01
		Treatment Facility 5475-1 (TF5475-1)[c]			
3A	W-1302-2	0	0	-	-
		Treatment Facility 5475-2 (TF5475-2)			
2/3A	W-1415	<1	<0.01	-	-
5	W-1108	1,063	1.22		
		Treatment Facility 5475-3 (TF5475-3)[c]			
3A	W-1605	0	0	-	-
3A	W-1608	0	0	-	-
4	W-1604	0	0	-	-
5	W-1609	0	0	-	-

Table 4. 2015 Livermore Site performance summary. (Continued)

HSU	Extraction well	Volume of ground water treated (kgal)	Estimated VOC mass removed from ground water (kg)	Volume of soil vapor treated (kcf)	Estimated VOC mass removed from soil vapor (kg)
				Vapor Treatment Facility 5475 (VTF5475)[c]	
1B/2	W-ETS-507	-	-	0	0
2	W-2211	-	-	0	0
2	W-2302	-	-	0	0
2	W-2303	-	-	0	0
2	SVI-ETS-504	-	-	0	0
3A	W-1605	-	-	0	0
3A	W-1608	-	-	0	0
3A	W-2212	-	-	0	0

Notes:

- = **Not applicable.**

HSU = **Hydrostratigraphic Unit.**

kg = **Kilogram.**

kgal = **Thousands at gallons.**

kcf = **Thousands of cubic feet.**

VOC = **Volatile Organic Compound.**

[a] **Wells W-1552, W-1650, W-1653, W-1655 and W-1657 are part of the *in situ* bioremediation treatability test being performed at the former Helipad area (see Section 3.2.2.).**

[b] **VTFD-HPD was secured in year 2010 to perform an ongoing *in situ* bioremediation treatability test at the TFD Helipad area.**

[c] **TF518-N, TF5475-1, TF5475-3 and VTF5475 are secured due to mixed waste issues (LLNL, 2009).**

Table 5. 2015 Summary of treatment facility operations.

Area	Treatment facility	Operated?	In compliance?	Facility highlights
TFA	TFA	Yes	Yes	• The TFA control system strategy was upgraded to utilize the facility flow meter for enhanced leak detection capability.
	TFA East	No	-	• TFA East was not operated in 2015 due to lack of available ground water in extraction well W-254, the sole source of water for this facility. • Soil vapor extraction tests were conducted at well W-254 and nearby monitor wells W-116 and W-1217 in mid-June.
TFB	TFB	Yes	Yes	• TFB extraction well W-620 was upgraded to water-level-based control in April to optimize hydraulic capture and extraction well performance.
TFC	TFC	Yes	Yes	• The TFC system strategy was upgraded to utilize the facility flow meter for enhanced leak detection capability. • TFC extraction wells W-1015, W-1102 and W-1103 remained off in 2015 to conduct a rebound test as the VOC concentrations in these wells and other area monitor wells have been below MCLs since 2011 (Section 4.3.1).
	TFC East	Yes	Yes	• As part of the REVAL process: ○ Testing and verification of the facility and extraction wellfield concluded in January; and ○ Hydraulic tests for extraction wells W-368 and W-413 were conducted in early March.
	TFC Southeast	Yes	Yes	• As part of the TFC Hotspot ESAR ZVI emplacement test, post-implementation hydraulic tests were performed in TFC Southeast extraction well W-2201 and several nearby monitor wells in January and February (Section 3.2). Resumed operation of TFC Southeast extraction well W-2201 in April. • TFC Southeast was temporarily shut down in September as a precautionary measure during drilling of proposed extraction well W-3107 (Section 3.3).
TFD	TFD	Yes	Yes	• As part of the REVAL process: ○ TFD was shut down in late April to perform system upgrades; ○ Obsolete extraction wells W-906 and W-907 were properly abandoned in early May and replacement extraction wells W-3101 and W-3102 were drilled from May to early June (Section 3.3); ○ Redevelopment of TFD Hotspot wells W-2011, W-2101, and W-2102 was completed in June; ○ Antennas for wireless data acquisition were installed in early December; ○ Power distribution modifications were completed in December; and ○ Testing and verification of the facility and extraction wellfield is scheduled to begin in January 2016.

Table 5. 2015 Summary of treatment facility operations. (Continued)

Area	Treatment facility	Operated?	In compliance?	Facility highlights
	TFD East	Yes	Yes	• None
	TFD Helipad	Yes	Yes	• None
	TFD South	Yes	Yes	• None
	TFD Southeast	Yes	Yes	• None
	TFD Southshore	Yes	Yes	• None
	TFD West	Yes	Yes	• None
	VTFD East Traffic Circle South	Yes	Yes	• None
	VTFD Helipad	No	-	• VTFD Helipad was not operated in 2015 to facilitate the TFD Helipad *in situ* bioremediation ESAR treatability test (Section 3.2). Restart of VTFD Helipad will depend upon residual VOC concentrations in the subsurface once the ESAR test is complete.
TFE	TFE East	Yes	Yes	• None
	TFE Hotspot	Yes	Yes	• None
	TFE Northwest	Yes	Yes	• None
	TFE Southeast	Yes	Yes	• None
	TFE Southwest	Yes	Yes	• None
	TFE West	Yes	Yes	• None
	VTFE Eastern Landing Mat	Yes	Yes	• None
	VTFE Hotspot	Yes	Yes	• None
TFG	TFG-1	Yes	Yes	• Installed a titanium water level transducer due to mineral scale issues.
	TFG North	Yes	Yes	• Well W-1806 shut-in due to declining water levels.
TFH	TF406	Yes	Yes	• None
	TF406 Northwest	Yes	Yes	• TF406 Northwest extraction well W-1801 was redeveloped using glycolic acid from February to mid-April to mitigate biofouling of the well screen and to restore the sustainable yield to approximately 6 gallons per minute (gpm). Following redevelopment, a new pump was installed in well W-1801.
	VTF406 Hotspot	Yes	Yes	• None
	VTF511	Yes	Yes	• None
	TF518 North	No	-	• TF518 North was not operated during 2015 due to the risk of producing mixed waste (LLNL, 2009).
	TF518 Perched Zone	Yes	Yes	• None

Table 5. 2015 Summary of treatment facility operations. (Continued)

Area	Treatment facility	Operated?	In compliance?	Facility highlights
	VTF518 Perched Zone	Yes	Yes	• As part of evaluating the VTF518 Perched Zone remedial wellfield: o Vapor flow matrix tests were conducted in January and February; o Nitrogen dissipation tests were conducted in April and September; and o A 6-month soil vapor extraction test commenced in December, initially extracting from well W-2215A.
	TF5475-1	No	-	• TF5475-1 was not operated during 2015 due to the risk of producing mixed waste (LLNL, 2009).
	TF5475-2	Yes	Yes	• TF5475-2 was temporarily shut down in September as a precautionary measure during drilling of nearby well W-3106 (Section 3.3).
	TF5475-3	No	-	• TF5475-3 was not operated during 2015 due to the risk of producing mixed waste (LLNL, 2009).
	VTF5475	No	-	• VTF5475 was not operated during 2015 due to the risk of producing mixed waste (LLNL, 2009).

Notes:

- = Not applicable.
ESAR = Enhanced Source Area Remediation.
MCL = Maximum contaminant level.
REVAL = Remediation Evaluation.
TF = Ground water treatment facility.
VOC = Volatile organic compound.
VTF = Soil vapor treatment facility.
ZVI = Zero valent iron.

Appendix A

Well Construction and Closure Data

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

Well	Well type	Date completed	Borehole depth (ft)	Casing depth (ft)	Screen position	Screen interval (ft)	HSU	Initial flow rate (gpm)
W-001	GW Monitor	21-Oct-80	122.5	116	1	95-100	1B	6
					2	104-114	2	6
W-001A	GW Monitor	12-Apr-84	180	156	1	145-156	2	5.3
W-002	GW Monitor	29-Aug-80	102.5	101	1	86-101	1B	2.8
W-002A	GW Monitor	2-Apr-84	185	164	1	150-164	2	9.3
W-004	GW Monitor	28-Jul-80	92	92	1	75-90	1B	7
W-005	GW Monitor	24-Oct-80	93.5	90	1	56-71	1B	7
					2	81-86	1B	7
W-005A	GW Monitor	9-Apr-84	115	105	1	95-105	2	11.5
W-008	GW Monitor	14-May-81	110	105	1	72-77	3A	7
					2	92-102	3B	7
W-011	GW Monitor	3-Jun-81	252	191	1	136-141	5	8.5
					2	177-187	5	8.5
W-012	GW Monitor	14-Aug-80	115.8	115	1	99-114	2	5
W-016	GW Monitor	30-Oct-80	122.7	119	1	NA	NA	NA
W-017	GW Monitor	8-Oct-80	114	109	1	94-109	5	0.4
W-017A	GW Monitor	20-May-81	181.4	160	1	127-132	7	5.5
					2	147-157	7	5.5
W-101	GW Monitor	25-Jan-85	77	72	1	62-72	1B	2
W-102	GW Monitor	14-Feb-85	396.5	171.5	1	151.5-171.5	2	6.6
W-103	GW Monitor	14-Feb-85	96	89.5	1	79.5-89.5	1B	6.2
W-104	GW Monitor	21-Feb-85	61.5	56.5	1	38.75-56.5	1B	3.1
W-105	GW Monitor	26-Feb-85	69	62	1	42-62	1B	1
W-106	GW Monitor	6-Mar-85	144	134.5	1	127.5-134.5	5	0.3
W-107	GW Monitor	13-Mar-85	128	122	1	115-122	5	2.5
W-108	GW Monitor	21-Mar-85	113.5	69	1	57-69	1A	13
W-109	GW Extraction	2-Apr-85	289	147	1	137-147	2	13
W-110	GW Monitor	26-Apr-85	371	365	1	340-365	5	16
W-111	GW Monitor	2-May-85	122	117	1	97-117	2	3.4
W-112	GW Monitor	10-May-85	129	123.5	1	111-123.5	5	3.5
W-113	GW Monitor	16-May-85	124	115	1	100-115	5	0.4
W-114	GW Monitor	23-May-85	70.5	66	1	51-63	1B	0.5
W-115	GW Monitor	3-Jun-85	106	95	1	88-95	1B	5.4
W-116	GW Monitor	14-Jun-85	181	92.6	1	86-91	1B	0.3
W-117	GW Monitor	27-Jun-85	202	150.1	1	138-148	7	6

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

Well	Well type	Date completed	Borehole depth (ft)	Casing depth (ft)	Screen position	Screen interval (ft)	HSU	Initial flow rate (gpm)
W-118	GW Monitor	19-Jul-85	206.5	110	1	99-110	2	10
W-119	GW Monitor	2-Aug-85	139	102.5	1	87.5-102.5	2	9
W-120	GW Monitor	19-Aug-85	195	153	1	147-153	2	3.5
W-121	GW Monitor	23-Aug-85	194	171	1	159-171	2	6
W-122	GW Monitor	17-Aug-85	189	132	1	125-132	2	13.4
W-123	GW Monitor	1-Oct-85	174	47.7	1	37.3-47.7	1A	6
W-141	GW Monitor	23-Mar-85	61.5	60	1	45-60	1B	0.5
W-142	GW Monitor	29-Mar-85	74.2	72	1	62-72	2	0.5
W-143	GW Monitor	12-Apr-85	130	126	1	121-126	2	6
W-146	GW Monitor	16-Jul-85	225	125	1	115-125	2	9.4
W-147	GW Monitor	26-Jul-85	137	87	1	77-87	1B	0.5
W-148	GW Monitor	8-Aug-85	152	98	1	83-98	1B	0.5
W-151	GW Monitor	30-Sep-85	247	158	1	148.5-157.5	2	8
W-201	GW Monitor	17-Oct-85	211	161	1	151-161	2	14
W-202	GW Monitor	7-Nov-85	191	109	1	99-109	2	0.4
W-204	GW Monitor	22-Nov-85	160	110	1	100-110	2	2.5
W-205	GW Monitor	9-Dec-85	180	117	1	107-117	3B	0.3
W-206	GW Monitor	19-Dec-85	188	118	1	106-118	3A	NA
W-207	GW Monitor	24-Jan-86	150	85	1	69-85	2	0.4
W-210	GW Monitor	11-Mar-86	176	113	1	108-113	3B	0.3
W-212	GW Monitor	28-Mar-86	183	136	1	124-136	5	1.3
W-213	GW Monitor	4-Apr-86	174	100	1	94-100	1B	4
W-214	GW Monitor	11-Apr-86	146	141.5	1	134-141.5	2	18
W-217	SV Extraction	20-May-86	200	112.5	1	98.5-112.5	5	0.3
W-218	GW Monitor	30-May-86	201	71	1	64.5-71	1B	10
W-219	GW Monitor	13-Jun-86	214	148	1	141-148	5	4.5
W-220	GW Monitor	25-Jun-86	196	92.5	1	82.5-92.5	2	0.4
W-221	GW Monitor	7-Jul-86	178	95	1	82-95	3A	2
W-222	GW Monitor	17-Jul-86	197	83	1	63-83	2	15
W-223	GW Monitor	15-Aug-86	202	153	1	146-153	2	4.2
W-224	GW Monitor	26-Aug-86	199	88	1	78-88	2	8.1
W-225	GW Monitor	9-Sep-86	238	166	1	152-166	5	4.2
W-226	GW Monitor	25-Sep-86	173	86	1	71-86	1B	0.5
W-251	GW Monitor	3-Oct-85	50	47.5	1	35.5-47.5	1A	7.9
W-252	GW Monitor	18-Oct-85	197	126	1	108-126	2	6

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

Well	Well type	Date completed	Borehole depth (ft)	Casing depth (ft)	Screen position	Screen interval (ft)	HSU	Initial flow rate (gpm)
W-253	GW Monitor	30-Oct-85	180	128	1	112.5-128	2	2.3
W-254	GW Extraction	21-Nov-85	277	89	1	82-89	1B	2
W-255	GW Monitor	5-Dec-85	187	124	1	115-124	5	10
W-256	GW Monitor	19-Dec-85	187	137	1	132-137	5	6
W-257	GW Monitor	15-Jan-86	197	96.5	1	82.5-96.5	2	0.5
W-258	GW Monitor	31-Jan-86	157	121.5	1	116.5-121.5	3A	NA
W-259	GW Monitor	7-Feb-86	200	99	1	93.5-99	2	0.3
W-260	GW Monitor	27-Feb-86	215	151	1	141-151	2	5.1
W-261	GW Monitor	12-Mar-86	225	118.5	1	109-118.5	5	0.5
W-262	GW Extraction	20-Mar-86	256	100	1	91-100	1B	12
W-263	GW Monitor	7-Apr-86	146	130	1	123-130	2	3
W-264	GW Monitor	14-Apr-86	170	151	1	141-151	2	15
W-265	GW Monitor	25-Apr-86	216	211	1	205-211	3B	2.5
W-267	GW Monitor	27-May-86	196	179	1	172.5-179	3A	3.3
W-268	GW Monitor	4-Jun-86	213	150.5	1	138-150.5	5	6
W-269	GW Monitor	16-Jun-86	185	92	1	79-92	1B	6.8
W-270	GW Monitor	26-Jun-86	185	127	1	113-127	5	0.3
W-271	GW Monitor	7-Jul-86	201	112	1	105-112	2	7.2
W-272	GW Monitor	18-Jul-86	226	110	1	95-110	2	1.3
W-273	GW Monitor	11-Aug-86	203	84	1	64-84	2	3.4
W-274	Dual Extraction	21-Aug-86	217	95	1	90-95	2	NA
W-275	GW Monitor	5-Sep-86	262	184	1	179-184	5	5.9
W-276	GW Monitor	17-Sep-86	267	170	1	153.5-169.5	3A	12
W-277	GW Monitor	3-Oct-86	254	169	1	163-169	3B	6
W-290	GW Monitor	8-Jul-86	181	126	1	119.5-126	5	0.3
W-291	GW Monitor	24-Jul-86	194	137	1	127-137	5	0.3
W-292	GW Extraction	10-Aug-86	250	184.5	1	176-184.5	3B	NA
W-293	GW Monitor	27-Aug-86	229	155	1	145-155	5	5
W-294	GW Monitor	15-Sep-86	251	139	1	122-139	5	6
W-301	GW Monitor	7-Oct-86	203	141	1	136-141	2	10
W-302	GW Monitor	22-Oct-86	191	83.5	1	78-83.5	1B	2
W-303	GW Monitor	28-Oct-86	197	128	1	124-128	2	24
W-304	GW Monitor	12-Nov-86	207	200	1	195-200	4	0.7
W-305	GW Extraction	18-Nov-86	146	138	1	128-138	2	16.2
W-306	GW Monitor	4-Dec-86	207	110	1	98-110	2	8.3

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

Well	Well type	Date completed	Borehole depth (ft)	Casing depth (ft)	Screen position	Screen interval (ft)	HSU	Initial flow rate (gpm)
W-307	GW Monitor	15-Dec-86	214	102	1	93-102	1B	1.4
W-308	GW Monitor	13-Jan-87	194	113	1	107-113	2	2.4
W-310	GW Monitor	4-Feb-87	202	184.5	1	176.5-184.5	3A	20
W-311	GW Monitor	20-Feb-87	226.5	147.5	1	134.5-147.5	3A	NA
W-312	GW Monitor	5-Mar-87	224.5	168	1	160-168	4	16.7
W-313	GW Monitor	12-Mar-87	99	85	1	80-85	2	7.8
W-314	GW Extraction	20-Mar-87	228	142	1	129-142	4	19
W-315	GW Monitor	3-Apr-87	215	156	1	141-156	3A	15
W-316	GW Monitor	15-Apr-87	196	72	1	68-71	2	7
W-317	GW Monitor	20-Apr-87	100	95	1	88-95	2	14
W-318	GW Monitor	28-Apr-87	200	81	1	74-81	2	6
W-319	GW Monitor	5-May-87	198	125	1	119-125	3A	15
W-320	GW Monitor	11-May-87	106	99	1	94-99	2	5
W-321	GW Monitor	29-May-87	356	321.5	1	305-321.5	5	17
W-322	GW Monitor	1-Jul-87	565.5	152	1	142-152	2	8
W-323	GW Monitor	4-Aug-87	200	127	1	122-127	2	5.6
W-324	GW Monitor	17-Aug-87	219	189	1	184-189	3A	15
W-325	GW Monitor	28-Aug-87	312	170	1	158-170	3A	10
W-351	GW Extraction	17-Oct-86	191	152	1	146-152	4	6.5
W-353	GW Monitor	12-Nov-86	205	101	1	95.5-101	2	2.4
W-354	GW Monitor	24-Nov-86	185	179	1	163-179	4/5	17.6
W-355	GW Monitor	5-Dec-86	202	107	1	102-107	2	1.7
W-356	GW Monitor	18-Dec-86	237	137	1	133-137	3B	5
W-357	GW Extraction	12-Jan-87	197	123	1	107-123	2	13.6
W-359	GW Extraction	10-Feb-87	195	150.5	1	138-150.5	5	5
W-361	GW Monitor	5-Mar-87	257	135	1	125-135	3A	6
W-362	GW Monitor	13-Mar-87	151	145	1	131-145	4	15
W-363	GW Monitor	24-Mar-87	195	129	1	117-129	3A	6
W-364	GW Monitor	31-Mar-87	195	165	1	155-165	3B	6.5
W-365	GW Monitor	9-Apr-87	187	125	1	120-125	2	10
W-366	GW Monitor	20-Apr-87	273	251	1	240-251	4	17.6
W-368	GW Extraction	6-May-87	206	78	1	70-78	1B	3.5
W-369	GW Monitor	14-May-87	204	113	1	107-113	2	7
W-370	GW Monitor	29-May-87	286	208	1	196.5-208	4	10
W-371	GW Monitor	12-Jun-87	233	162	1	155-162	3A	5

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

Well	Well type	Date completed	Borehole depth (ft)	Casing depth (ft)	Screen position	Screen interval (ft)	HSU	Initial flow rate (gpm)
W-372	GW Monitor	25-Jun-87	218	152.5	1	147.5-152.5	4	7.5
W-373	GW Monitor	6-Jul-87	178	99	1	89-99	1B	9
W-375	GW Monitor	29-Jul-87	223	71	1	65-71	2	0.4
W-376	GW Monitor	27-Aug-87	249	172	1	162-172	2	4
W-377	GW Monitor	4-Sep-87	159	144	1	141.5-144	2	0.5
W-378	GW Monitor	9-Sep-87	155	150	1	146-150	2	0.5
W-379	GW Monitor	14-Sep-87	155	150	1	146-150	2	0.5
W-380	GW Monitor	1-Oct-87	195	182	1	170-182	3A	9.1
W-401	GW Monitor	5-Nov-87	159	153	1	109-153	2	18
W-402	GW Monitor	13-Oct-87	104	102	1	92-102	1B	20
W-403	GW Monitor	16-Nov-87	585	495	1	485-495	7	15
W-404	GW Extraction	4-Dec-87	245	158	1	150-158	2	20
W-405	GW Monitor	4-Jan-88	244	162	1	132-162	2	20
W-406	GW Monitor	20-Jan-88	213	94	1	79-84	1B	5
W-407	GW Monitor	4-Feb-88	215	205	1	192-205	3A	10
W-408	GW Extraction	16-Feb-88	131	122.5	1	103-122.5	1B	20
W-409	GW Monitor	7-Mar-88	272	78	1	71-78	1B	20
W-410	GW Monitor	30-Mar-88	369	205	1	193-205	3A	16
W-411	GW Monitor	12-Apr-88	192	138	1	131-138	2	20
W-412	GW Monitor	18-Apr-88	104	74	1	67-74	1B	4
W-413	GW Extraction	28-Apr-88	163	115	1	100-115	2	12
W-415	GW Extraction	12-Aug-88	205	183.7	1	79-179	1B/2	50
W-416	GW Monitor	10-Jun-88	152	80.5	1	72-80.5	1B	20
W-417	GW Monitor	20-Jun-88	152	60	1	51-60	1B	5
W-418	GW Monitor	24-Jun-88	124	124	1	108-118	2	0.5
W-419	GW Monitor	29-Jun-88	82	82	1	62.5-75.5	1B	0.5
W-420	GW Monitor	26-Jul-88	127	111	1	105-111	2	4
W-421	GW Monitor	23-Aug-88	181	90	1	75-90	1B	5
W-422	GW Monitor	2-Sep-88	203	139.5	1	133-139.5	2	9
W-423	GW Monitor	9-Sep-88	308	118	1	106-118	2	19
W-424	GW Monitor	4-Oct-88	208	144	1	137-144	3A	6
W-441	GW Monitor	14-Oct-87	250	144	1	135-144	5	3
W-446	GW Monitor	18-Dec-87	202	196	1	186-196	3A	0.5
W-447	GW Monitor	05-Feb-88	353	274	1	256-274	4	8
W-448	GW Monitor	17-Feb-88	235	127.5	1	120.5-127.5	2	20

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

Well	Well type	Date completed	Borehole depth (ft)	Casing depth (ft)	Screen position	Screen interval (ft)	HSU	Initial flow rate (gpm)
W-449	GW Monitor	7-Mar-88	172	165	1	152-165	2	6
W-450	GW Monitor	21-Mar-88	300	200	1	193-200	5	6
W-451	GW Monitor	6-Apr-88	202	112	1	106-112	2	3
W-452	GW Monitor	15-Apr-88	210	79.5	1	64-79.5	1B	7
W-453	GW Monitor	27-Apr-88	185	130	1	121-130	2	8
W-454	GW Monitor	9-May-88	196	83	1	73-83	1B	3
W-455	GW Monitor	19-May-88	184	162.5	1	148-162.5	2	5
W-457	GW Extraction	22-Jun-88	289	149.5	1	130-149.5	2	20
W-458	GW Monitor	30-Jun-88	212.5	116	1	108-116	2	2
W-459	GW Monitor	20-Jul-88	76	73	1	59.5-73	1B	0.5
W-461	GW Monitor	16-Aug-88	133	50.5	1	41.5-50.5	2	0.5
W-462	GW Monitor	12-Sep-88	385	337	1	331-336.5	5	10
W-463	GW Monitor	16-Sep-88	93	92.8	1	87-92.5	1B	20
W-464	GW Monitor	30-Sep-88	253	104.5	1	96-104.5	2	7
W-481	GW Monitor	4-Nov-87	224.5	105	1	100-105	1B	2
W-482	GW Monitor	15-Jan-88	218	170	1	165-170	2	0.5
W-483	GW Monitor	26-Jan-88	140	130	1	115-130	2	0.5
W-484	GW Monitor	11-Feb-88	255	188	1	185-188	3A	0.5
W-485	GW Monitor	25-Feb-88	249	157	1	151-157	2	0.5
W-486	GW Monitor	11-Mar-88	167	110	1	100-108	2	6
W-487	GW Monitor	17-Mar-88	180	151	1	148-151	3B	5
W-501	GW Monitor	13-Oct-88	174	92	1	84-92	1B	6
W-502	GW Monitor	25-Oct-88	158	59	1	55-59	1B	0.5
W-503	GW Monitor	2-Nov-88	187	80	1	74-80	1B	2
W-504	GW Monitor	21-Nov-88	358	167	1	157-167	2	8
W-505	GW Monitor	15-Dec-88	278	180	1	167-180	2/3A	18
W-506	GW Monitor	22-Dec-88	120	115	1	101-115	1B	9
W-507	GW Monitor	18-Jan-89	158	139	1	129-139	2	15
W-508	GW Monitor	17-Feb-89	316	306	1	287-305	7	18
W-509	GW Monitor	3-Mar-89	305	184	1	179-184	5	2
W-510	GW Monitor	15-Mar-89	300	119.1	1	111-119	2	0.5
W-511	GW Monitor	31-Mar-89	316	176	1	167-176	3B	2
W-512	GW Monitor	13-Apr-89	261	176.5	1	166-176	5	2.5
W-513	GW Monitor	26-Apr-89	259	115	1	102-115	2	1
W-514	GW Monitor	17-May-89	386	115.5	1	92-115.5	1B	2

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

Well	Well type	Date completed	Borehole depth (ft)	Casing depth (ft)	Screen position	Screen interval (ft)	HSU	Initial flow rate (gpm)
W-515	GW Monitor	30-May-89	211	78	1	68-78	1B	3
W-516	GW Monitor	9-Jun-89	203	119	1	114-119	2	10
W-517	GW Monitor	20-Jun-89	215	88.2	1	80-88	1B	8
W-518	GW Extraction	8-Aug-89	251	139.3	1	131-139	2	6.7
W-519	GW Monitor	14-Aug-89	186.5	80.6	1	60-80.5	1B	20
W-520	GW Extraction	30-Aug-89	160	101.5	1	94-101.5	1B	10
W-521	GW Monitor	13-Sep-89	166	95.4	1	86-95	1B	1.5
W-522	GW Extraction	5-Oct-89	145.5	141.5	1	134-141.5	2	16
W-551	GW Monitor	18-Oct-88	308	155.5	1	151-155.5	2	9
W-552	GW Monitor	25-Oct-88	70.5	64.5	1	48.5-64	1B	15
W-553	GW Monitor	3-Nov-88	186	106.5	1	99-106.5	2	2
W-554	GW Monitor	22-Nov-88	239	141.5	1	126.5-141.4	2	15
W-555	GW Monitor	5-Dec-88	122	116.5	1	102.5-116.5	1B	14.5
W-556	GW Monitor	15-Dec-88	192	81.5	1	76-81.5	1B	15
W-557	GW Monitor	22-Dec-88	122.5	118	1	102-118	2	10
W-558	GW Monitor	17-Jan-89	117	110.5	1	101-110.5	1B	20.5
W-559	GW Monitor	24-Jan-89	105	100	1	93-100	1B	1.2
W-560	GW Monitor	7-Feb-89	263	206.5	1	201-206.5	3B	5
W-561	GW Monitor	23-Feb-89	180	152	1	143-152	5	1
W-562	GW Monitor	8-Mar-89	263	158.5	1	145-158	5	1.5
W-563	GW Monitor	17-Mar-89	192	105.5	1	95-105	2	8
W-564	GW Monitor	30-Mar-89	184	85	1	79.5-85	1B	3.5
W-565	GW Monitor	6-Apr-89	177	82.5	1	75-82.5	1B	15
W-566	GW Extraction	19-Apr-89	317	207.5	1	197-207	5	15
W-567	GW Monitor	27-Apr-89	194	61.5	1	51-61	1B	10.5
W-568	GW Monitor	5-Jun-89	156	101	1	97-101	2	10
W-569	GW Monitor	16-May-89	215	109.5	1	101-109.5	2	3
W-570	GW Monitor	9-Jun-89	180	175	1	161-175	5	2
W-571	GW Monitor	15-Jun-89	223.5	107.5	1	102-107	1B	20
W-592	GW Monitor	12-Dec-88	136.5	113	1	101-112	2	1.2
W-593	GW Monitor	6-Feb-89	159	92.5	1	82-92.5	3A	2.1
W-594	GW Monitor	27-Feb-89	156	61	1	55-61	2	0.5
W-601	GW Extraction	13-Oct-89	146	96	1	88-96	1B	12
W-602	GW Extraction	6-Nov-89	268	100.2	1	90-100	1B	11
W-603	GW Extraction	15-Nov-89	150	147	1	141-147	2	6

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

Well	Well type	Date completed	Borehole depth (ft)	Casing depth (ft)	Screen position	Screen interval (ft)	HSU	Initial flow rate (gpm)
W-604	GW Monitor	27-Nov-89	111	83	1	76-82	1B	0.4
W-605	GW Extraction	8-Dec-89	246	136	1	130-136	2	5
W-606	GW Monitor	21-Dec-89	145	89	1	73-89	1B	0.4
W-607	GW Monitor	24-Jan-90	186	55.1	1	49-55	1B	2
W-608	GW Monitor	7-Feb-90	162	66.3	1	55-66	1B	2
W-609	GW Extraction	21-Feb-90	120	112	1	104-112	2	3
W-610	GW Extraction	16-Mar-90	453	84.5	1	69-84.5	1B	5
W-611	GW Monitor	4-Apr-90	161	98	1	87.5-98	1B	3
W-612	GW Monitor	19-Apr-90	222	137	1	126-136	2	10
W-613	GW Monitor	2-May-90	93	88	1	81.5-88	1B	4.5
W-614	GW Extraction	18-May-90	262	123	1	100-123	2	6
W-615	GW Monitor	1-Jun-90	121	99.3	1	91-99	1B	5
W-616	GW Monitor	14-Jun-90	255	188	1	178-188	3A	4
W-617	GW Monitor	26-Jun-90	200	110	1	103-110	2	3
W-618	GW Monitor	17-Jul-90	357	205	1	201-205	3B	3
W-619	GW Monitor	7-Aug-90	330	252	1	232-252	3B/4	20
W-620	GW Extraction	30-Aug-90	206	88.5	1	75-88.5	1B	6
W-621	GW Extraction	9-Sep-90	149	120	1	113-120	2	3.5
W-622	GW Monitor	28-Sep-90	206	112.25	1	104-112	5	0.3
W-651	GW Monitor	22-Feb-90	155	89	1	82-89	1B	0.4
W-652	GW Monitor	15-Mar-90	318	256	1	245-256	7	2
W-653	GW Extraction	29-Mar-90	225	128	1	122-128	3A	1
W-654	GW Monitor	11-Apr-90	240	158	1	140-158	2	20
W-655	GW Extraction	25-Apr-90	193	130	1	121-129.5	2	15
W-701	GW Extraction	10-Oct-90	159	86	1	74-86	1B	14
W-702	GW Monitor	24-Oct-90	180.5	95	1	77-95	1B	4
W-703	GW Monitor	3-Dec-90	586	325	1	298-325	5	NA
W-704	GW Extraction	2-Feb-91	135	107	1	67-76	1B	20
					2	88-97	1B	20
W-705	GW Monitor	26-Dec-90	126	90	1	77-90	1B	1
W-706	GW Monitor	25-Jan-91	178	85	1	71-85	1B	NA
W-712	GW Extraction	28-Aug-91	200	185.5	1	170-185.5	3A	8
W-714	GW Extraction	5-Dec-91	128.5	128	1	107-128	2	NA
W-750	GW Monitor	10-Apr-91	152	150	1	130-150	5	NA
W-901	GW Monitor	24-Feb-93	97.8	88	1	80-83	1B	1

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

Well	Well type	Date completed	Borehole depth (ft)	Casing depth (ft)	Screen position	Screen interval (ft)	HSU	Initial flow rate (gpm)
W-902	GW Monitor	22-Jan-93	95.5	88	1	80-83	1B	1
W-903	GW Extraction	28-Apr-93	223	145	1	132-140	2	20
W-904	GW Extraction	6-May-93	212	154	1	121-133	2	30
					2	140-149	2	30
W-905	GW Monitor	7-Apr-93	221	144.5	1	134-144	2	3.5
W-908	GW Monitor	17-Aug-93	239	197	1	180-197	5/6	0.4
W-909	GW Monitor	11-Nov-93	252	113.5	1	80.5-113.5	2	2.5
W-911	GW Monitor	20-Sep-93	180	113.65	1	73.65-108.65	2	1.5
W-912	GW Monitor	7-Sep-93	239	174	1	168-174	5	3.5
W-913	GW Monitor	24-Nov-93	454	255	1	235-255	4	30
W-1001	GW Extraction	15-Dec-93	105	92	1	85-92	1B	1.5
W-1002	GW Monitor	12-Nov-93	293	260	1	246-260	5	20
W-1003	GW Monitor	2-Feb-94	184	147	1	140-147	2	1.5
W-1004	GW Extraction	23-Feb-94	100	97	1	71-91	1B	5
W-1008	GW Monitor	13-Apr-94	246	238	1	229.5-238	7	9.5
W-1009	GW Extraction	27-Apr-94	191	140	1	134-140	2	25
W-1010	GW Monitor	24-May-94	463	142	1	130-142	2	25
W-1011	GW Monitor	6-Jun-94	106	89	1	75-89	1B	2
W-1012	GW Monitor	20-Jun-94	161	117	1	96-112	2	2.5
W-1013	GW Monitor	29-Jun-94	147	73	1	65-73	1B	1.5
W-1014	GW Monitor	12-Jul-94	99	89	1	65-89	1B	30
W-1015	GW Extraction	10-Aug-94	437	94	1	84-94	1B	25
W-1101	GW Monitor	10-Nov-94	200	79	1	76-79	1B	1
W-1102	GW Extraction	29-Nov-94	163	95.6	1	76-94	1B	11
W-1103	GW Extraction	15-Dec-94	200	82	1	70-82	1B	4.5
W-1104	GW Extraction	18-Jan-95	165	99.3	1	77-87	1B	35
					2	92-98	1B	35
W-1105	GW Monitor	18-Jan-95	105	93	1	78-93	1B	3.75
W-1106	GW Monitor	17-Jan-95	245	86	1	76-85	1B	17.5
W-1107	GW Monitor	6-Mar-95	199.5	93	1	74-88	1B	1.5
W-1108	GW Extraction	17-Mar-95	250	156	1	142-156	5	22.5
W-1109	GW Extraction	11-Apr-95	121	113	1	94-113	2	6.5
W-1110	GW Monitor	4-Apr-95	252	92.9	1	68-92	1B	NA
W-1111	GW Extraction	1-June-95	152	129	1	88-108	1B/2	NA
					2	120-124	2	NA

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

Well	Well type	Date completed	Borehole depth (ft)	Casing depth (ft)	Screen position	Screen interval (ft)	HSU	Initial flow rate (gpm)
W-1112	GW Monitor	28-Jun-95	263	210	1	201-210	5	NA
W-1113	GW Monitor	12-Jul-95	260	214	1	204-214	5	NA
W-1115	GW Monitor	12-Oct-95	126.5	118	1	108-118	3A	0.5
W-1116	GW Extraction	17-Aug-95	214.8	101	1	72-98	1B	NA
W-1117	GW Monitor	21-Aug-96	154	132.2	1	122-132	3A	1
W-1118	GW Monitor	27-Sep-95	225	125	1	115-125	3A	NA
W-1201	GW Monitor	18-Oct-95	225	133	1	125-133	3A	1
W-1202	GW Monitor	25-Oct-95	99.3	99	1	83-99	2	5
W-1203	GW Monitor	7-Nov- 95	224	206.2	1	196-206	5	18
W-1204	GW Monitor	20-Nov-95	225	126.2	1	118-126	3A	2.5
W-1205	GW Monitor	27-Nov-95	91	82	1	72-82	2	1
W-1206	GW Extraction	6-Dec-95	220	191	1	174-186	4	40
W-1207	GW Monitor	13-Dec-95	92	90	1	70-90	2	1
W-1208	GW Extraction	9-Jan-96	166	163	1	135-163	3A/3B	40
W-1209	GW Monitor	26-Jan-96	210	164	1	148-164	4	3
W-1210	GW Monitor	12-Feb-96	250	223	1	213-223	5	3
W-1211	GW Extraction	5-Mar-96	273	205	1	185-200	4	25
W-1212	GW Monitor	19-Mar-96	150	75	1	52-75	1B	3
W-1213	GW Extraction	2-Apr-96	129	76	1	64-76	1B	5
W-1214	GW Monitor	22-Apr-96	180	100	1	80-100	1B	2
W-1215	GW Extraction	17-Apr-96	175	120	1	108-118	2	8.5
W-1216	GW Extraction	7-May-96	200	124	1	94-124	2	14
W-1217	GW Monitor	15-May-96	182	98.5	1	78-98	1B	0.25
W-1219	GW Monitor	4-Jun-96	201	142	1	138-142	4	0.18
W-1222	GW Monitor	26-Jun-96	175	125.2	1	115-125	3A	6
W-1223	GW Monitor	23-Jul-96	175	102	1	87-97	2	4
W-1224	GW Monitor	5-Sep-96	125	104.5	1	99-104	1B	4.3
W-1225	GW Monitor	14-Aug-96	150	121.2	1	113-121	3A	2
W-1226	GW Monitor	6-Aug-96	155	126.5	1	116-126	2	1
W-1227	GW Monitor	9-Oct-96	200	134	1	126-134	2	11
W-1250	GW Monitor	7-Jun-96	210	200.3	1	130-135	4	0.25
W-1251	GW Monitor	3-Jul-96	210	200.3	1	134-139	4	1.3
W-1252	GW Monitor	25-Jul-96	208	202.3	1	135-140	4	0.15
W-1253	GW Monitor	15-Aug-96	206	200.3	1	127-132	4	0.15
W-1254	GW Extraction	28-Aug-96	210	200	1	131-141	4	26

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

Well	Well type	Date completed	Borehole depth (ft)	Casing depth (ft)	Screen position	Screen interval (ft)	HSU	Initial flow rate (gpm)
W-1255	GW Monitor	27-Aug-96	208	200.7	1	124-129	4	0.2
W-1301	GW Extraction	4-Dec-96	180	120.3	1	112-120	3A	15
W-1302	GW Extraction	21-Jan-97	145	138.9	1	116.5-121.2	3A	7.5
					2	125.8-133.8	3A	7.5
W-1303	GW Extraction	6-Feb-97	199.5	107	1	78-102	2	10
W-1304	GW Monitor	20-Feb-97	149.5	125	1	120-125	3A	0.75
W-1306	GW Extraction	6-May-97	200	106	1	81-101	2	3.3
W-1307	GW Extraction	2-Jul-97	150	141	1	126-136	4	20
W-1308	GW Extraction	22-Jul-97	154	116	1	81-111	2	7
W-1309	GW Extraction	11-Aug-97	220	157	1	142-152	4	6
W-1310	GW Extraction	15-Sep-97	220	198	1	173-193	5	28
W-1311	GW Monitor	1-Oct-97	150	120.5	1	100-120	2	14
W-1401	GW Monitor	21-Oct-97	254	120	1	105-120	2	7.8
W-1402	GW Monitor	6-Nov-97	135	112	1	102-112	3A	4.1
W-1403	GW Extraction	13-Nov-97	175	142.5	1	132-142	3B	5
W-1404	GW Monitor	24-Nov-97	162	97.7	1	87-97	2	3.1
W-1405	GW Monitor	24-Nov-97	100	97.8	1	87-97	2	4.5
W-1406	GW Monitor	15-Dec-97	201	150	1	139.2-149.2	4	9.2
W-1407	GW Monitor	18-Dec-97	224	118	1	105-118	2	2
W-1408	GW Monitor	12-Jan-98	134	128	1	118-128	3A	3.8
W-1409	GW Extraction	23-Jan-98	143	140	1	80-135	2	13
W-1410	GW Extraction	19-Feb-98	208.5	131.1	1	126-131	4	9
W-1411	GW Monitor	4-Feb-98	133	128.1	1	114-128	3A	10.6
W-1412	GW Monitor	11-Mar-98	201	108	1	92-107	3A	1
W-1413	GW Monitor	26-Mar-98	163.5	163.5	1	147-157	5	1
W-1414	GW Monitor	31-Mar-98	128	107.5	1	97-107	3A	0.018
W-1415	GW Extraction	15-Apr-98	182	104.72	1	74.5-104.5	2	2
W-1416	GW Monitor	2-Jun-98	194.5	105	1	85-100	2	10.8
W-1417	GW Monitor	23-Apr-98	225	155	1	130-150	3A	8.9
W-1418	GW Monitor	5-May-98	252.5	190	1	176-190	4	9
W-1419	GW Monitor	13-May-98	175	115.5	1	90-110	2	4.45
W-1420	GW Monitor	17-Jun-98	175.5	112.5	1	102-112	2	20
W-1421	GW Monitor	28-May-98	230	172	1	157-167	3B	2.1
W-1422	GW Monitor	14-May-98	173.5	169.1	1	162-169	3B	11
W-1423	GW Extraction	2-Jul-98	175	134.5	1	99.5-109.5	2	22.4

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

Well	Well type	Date completed	Borehole depth (ft)	Casing depth (ft)	Screen position	Screen interval (ft)	HSU	Initial flow rate (gpm)
					2	119.5-129.5	2	22.4
W-1424	GW Monitor	13-Aug-98	225.3	146	1	126-146	2	6.2
W-1425	GW Monitor	26-Aug-98	115	100.5	1	88.5-100.5	1B	1
W-1426	GW Monitor	3-Sep-98	89	85	1	70-85	1B	10
W-1427	GW Monitor	7-Sep-98	104	80.2	1	70-80	1B	17.7
W-1428	GW Monitor	29-Sep-98	104	78.2	1	63-78	1B	30
W-1501	GW Monitor	12-Oct-98	126.1	88	1	72-88	1B	7.5
W-1502	GW Monitor	27-Oct-98	204	98.7	1	88-98	2	1.7
W-1503	GW Extraction	16-Nov-98	234	181.5	1	171-181	4	24
W-1504	GW Extraction	14-Dec-98	165.2	162.5	1	140-160.4	3A/3B	21.7
W-1505	GW Monitor	20-Jan-99	276	184.5	1	174-184	4	10
W-1506	GW Monitor	3-Feb-99	160	120.5	1	110-120	2	3
W-1507	GW Monitor	19-Feb-99	201.5	169.5	1	159-169	5	0.5
W-1508	GW Monitor	3-Mar-99	135	128.5	1	118-128	2	0.75
W-1509	GW Monitor	24-Mar-99	175	88.5	1	73-88	1B	8
W-1510	GW Extraction	9-Apr-99	114.5	113.5	1	93-113	2	5
W-1511	GW Monitor	27-Apr-99	229	146	1	138-146	3B	15
W-1512	GW Monitor	3-May-99	100	100	1	88-98	2	0.5
W-1516	GW Extraction	17-Jun-99	204.5	200.25	1	188-200	5	17
W-1517	Dual Extraction	6-Jun-99	154	122.4	1	87-97	2	0.1
W-1518	GW Extraction	8-Jul-99	184	115	1	84-107	2	3
W-1519	GW Monitor	3-Aug-99	245	238	1	222-237	5	30
W-1520	GW Extraction	27-Jul-99	178.3	173	1	160-168	4	3.5
W-1522	GW Extraction	11-Aug-99	169	161	1	141-156	3B	9
W-1523	GW Extraction	7-Sep-99	216	172.3	1	164-172	4	15
W-1550	GW Extraction	24-Jun-99	200	130	1	98-125	3A	10
W-1551	GW Extraction	15-Jul-99	153	129	1	93-124	3A	10.5
W-1552	Dual Extraction	24-Jun-99	153.5	130	1	97.2-124.5	3A	2
W-1553	GW Monitor	17-Aug-99	153	130	1	98-125	3A/3B	1
W-1601	GW Extraction	13-Oct-99	169	160	1	150-155	3B	2.7
W-1602	GW Extraction	2-Nov-99	115.5	110.7	1	80-90	2	8
W-1603	GW Extraction	16-Nov-99	144	140	1	130-135	3A	71.2
W-1604	GW Extraction	2-Dec-99	194	148.7	1	138-148	4	8
W-1605	Dual Extraction	7-Mar-00	120.5	112	1	90-107	3A	NA
W-1606	SV Monitor	27-Jan-00	175	112	1	90-107	3A	NA

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

Well	Well type	Date completed	Borehole depth (ft)	Casing depth (ft)	Screen position	Screen interval (ft)	HSU	Initial flow rate (gpm)
W-1607	SV Monitor	10-Feb-00	155.4	112	1	90-107	3A	0.1
W-1608	Dual Extraction	28-Feb-00	155	112	1	90-107	3A	NA
W-1609	GW Extraction	17-Apr-00	155	135	1	110-130	5	0.1
W-1610	GW Injection	4-May-00	155.3	135	1	110-130	5	0.5
W-1613	GW Monitor	27-Apr-00	219	173.4	1	168.4-173.4	3B	NA
W-1614	GW Monitor	18-May-00	100	89.8	1	79-89	1B	3
W-1615	Dual Extraction	15-Aug-00	55	48	1	15-48	1B/2	NA
W-1650	Dual Extraction	19-Jan-00	145	126	1	96-121	3A	2
W-1651	Dual Extraction	27-Jan-00	145	129	1	94-124	2/3A/3B	1
W-1652	Dual Extraction	9-Feb-00	145	127	1	92-122	3A/3B	0.5
W-1653	Dual Extraction	24-Feb-00	144	124	1	94-119	3A	1.2
W-1654	Dual Extraction	25-Feb-00	146.5	128	1	93-123	3A	1
W-1655	Dual Extraction	8-Mar-00	145	125	1	90-120	2/3A	0.5
W-1656	Dual Extraction	14-Mar-00	145	125.3	1	95.1-120.1	3A	5
W-1657	Dual Extraction	23-Mar-00	145	128	1	95-123	3A/3B	0.5
W-1701	GW Monitor	3-Jul-01	185	180.8	1	140-155	2	15
					2	165-175	2	15
W-1702	GW Monitor	15-Jun-01	15	14.25	1	4-13	2	NA
W-1703	GW Monitor	23-Aug-01	358	341.5	1	331-341	LL	22.6
W-1704	GW Monitor	19-Sep-01	240	118.8	1	98-118	2	2
W-1705	CMT Monitor	16-Oct-01	225	208.8	1	93-103	2	5
					2	123-128	3A	5
					3	138-143	3B	5
W-1801	GW Extraction	18-Mar-02	143	134.4	1	124-134	3A	5
W-1802	GW Monitor	2-Apr-02	175	162.2	1	147-157	3A	NA
W-1803	GW Monitor	24-Apr-02	245	240.8	1	175-185	4	15
					2	225-235	5	15
W-1804	GW Monitor	22-May-02	155	110.8	1	80-95	3A	0.5
					2	100-105	3B	0.5
W-1805	GW Monitor	20-Aug-02	110	100.8	1	70-80	1B	6
					2	85-95	1B	6
W-1806	GW Extraction	12-Sep-02	260	106.2	1	80.7-101.2	1B	3
W-1807	GW Extraction	7-Oct-02	165	130	1	115-125	2	10
W-1901	GW Monitor	31-Oct-02	175	127	1	92-97	1B	7
					2	107-122	2	7

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

Well	Well type	Date completed	Borehole depth (ft)	Casing depth (ft)	Screen position	Screen interval (ft)	HSU	Initial flow rate (gpm)
W-1902	GW Extraction	21-Nov-02	175	165	1	140-145	3A	20
					2	150-160	3A	20
W-1903	Dual Extraction	16-Dec-02	120	109	1	84-104	2	0.5
W-1904	Dual Extraction	23-Jan-03	120	101	1	75-100	2	0.5
W-1905	GW Monitor	20-May-03	210	123.5	1	103-113	3A	2.5
					2	118-123	3A	2.5
W-1909	Air Inlet	24-Jun-03	110	106.35	1	86-106	2	1.5
W-2005	GW Extraction	3-Feb-04	160	125	1	109-119	3A	2
W-2006	GW Extraction	24-Feb-04	160	132.5	1	122-132	3B	NA
W-2011	GW Extraction	29-Feb-04	155	116.3	1	106-116	3A	0.3
W-2101	GW Extraction	18-Nov-04	160	135.3	1	110-130	3A	0.25
W-2102	GW Extraction	14-Dec-04	160	138.35	1	118-133	3A	0.33
W-2103	GW Monitor	18-Jan-05	160	133.35	1	113-128	3A	0.5
W-2104A	SV Monitor	8-Feb-05	80	45.5	1	30-45	1B	NA
W-2104B	SV Monitor	8-Feb-05	80	72.55	1	52-72	2	NA
W-2105	Dual Extraction	9-Mar-05	126	115.33	1	90-110	2	0.25
W-2110A	SV Monitor	14-Jun-05	100	58.49	1	38-58	1B/2	NA
W-2110B	SV Monitor	14-Jun-05	100	85.49	1	65-85	2	NA
W-2111A	SV Monitor	22-Jun-05	90	40.3	1	25-40	1B	NA
W-2111B	SV Monitor	22-Jun-05	90	75.3	1	60-75	2	NA
W-2112A	SV Monitor	28-Jun-05	100	58.49	1	38-58	1B/2	NA
W-2112B	SV Monitor	28-Jun-05	100	78.49	1	68-78	2	NA
W-2113	GW Monitor	21-Jul-05	220	201.5	1	190.5-200.5	4	9
W-2201	GW Extraction	26-Jan-06	130	98.8	1	43.4-53.4	1B	12
					2	73.4-93.4	1B	12
W-2202	GW Monitor	15-Dec-05	140	122.25	1	102-107	3A	0.4
					2	112-117	3A	0.4
W-2203	GW Extraction	10-Jan-06	136.5	131.4	1	121-126	3A	1
W-2204	SV Extraction	26-Jan-06	120	111.38	1	41-66	2	0.1
					2	71-76	2	0.1
					3	91-106	2/3A	0.1
W-2205	SV Extraction	3-Apr-06	127	125.4	1	40-65	2	NA
					2	70-80	2	NA
					3	90-120	2/3A	NA
W-2206	SV Extraction	16-Feb-06	91.5	78.05	1	40-75	2	NA

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

Well	Well type	Date completed	Borehole depth (ft)	Casing depth (ft)	Screen position	Screen interval (ft)	HSU	Initial flow rate (gpm)
W-2207A	SV Extraction	9-Mar-06	103	60.41	1	25-35	1B	NA
					2	45-60	1B	NA
W-2207B	SV Extraction	9-Mar-06	103	100.4	1	65-95	2	NA
W-2208A	SV Extraction	30-Mar-06	104	71.38	1	36-66	2	0.1
W-2208B	SV Extraction	30-Mar-06	104	95.63	1	75.2-95.2	2	0.25
W-2211	SV Extraction	30-May-06	106.5	105.3	1	75-105	2	NA
W-2212	SV Extraction	6-Jun-06	115.4	115.4	1	90-115	3A	1
W-2214A	SV Monitor	24-Jul-06	135	39.3	1	6-39	1B/2	NA
W-2214B	SV Monitor	24-Jul-06	135	88.3	1	48-83	2	NA
W-2215A	SV Monitor	9-Aug-06	121.5	82.4	1	47-82	2	NA
W-2215B	SV Monitor	9-Aug-06	121.5	120.5	1	100-120	5	NA
W-2216A	SV Monitor	18-Sep-06	131.5	65.4	1	40-65	2	NA
W-2216B	GW Monitor	18-Sep-06	131.5	126.4	1	106-121	3A	0.2
W-2217A	SV Monitor	12-Oct-06	131.5	48.4	1	18-48	2	NA
W-2217B	SV Monitor	12-Oct-06	131.5	95.4	1	55-75	5	NA
					2	85-95	5	NA
W-2301A	SV Monitor	31-Oct-06	121	57.4	1	32-57	2	NA
W-2301B	SV Monitor	31-Oct-06	121	94.8	1	64.5-94.5	2/3A	NA
W-2302	SV Extraction	1-Feb-07	130	107.3	1	82-102	2	0.1
W-2303	SV Extraction	14-Feb-07	100	79.8	1	45-74.5	2	NA
W-2304	GW Monitor	19-Dec-06	130	124.3	1	114-119	3A	0.15
W-2305	Dual Extraction	23-Jan-07	115	108.3	1	83-103	2	0.5
W-2501	GW Extraction	9-Dec-09	175	144.2	1	128-133	2	15
W-2502	GW Extraction	28-Dec-09	177	164	1	101-106	2	15
					2	116-126	2	15
					3	143-153	2	15
W-2601	GW Extraction	2-Feb-10	225	220.1	1	179-189	5	20
					2	195-211	5	20
W-2602	GW Monitor	3-Mar-10	175	162.6	1	152-157	4	1
W-2603	GW Monitor	17-Mar-10	251	189.1	1	179-183.9	3A	3.4
W-2604A	GW Monitor	5-Apr-10	130	60.5	1	35-55	2	0.02
W-2604B	GW Monitor	5-Apr-10	130	100.9	1	65-95	2/5	0.03
W-2605A	GW Monitor	14-Apr-10	125	58.2	1	23-53	1B/2	NA
W-2605B	GW Monitor	14-Apr-10	125	110.3	2	70-105	2/5	0.16
W-2606 (a)	GW Monitor	28-Apr-10	113.1	112.6	1	59.9-110.3	2/5	NA

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

Well	Well type	Date completed	Borehole depth (ft)	Casing depth (ft)	Screen position	Screen interval (ft)	HSU	Initial flow rate (gpm)
W-2607 (a)	GW Monitor	11-May-10	120.2	104.1	1	50.9-101.8	2/5	NA
W-2608 (a)	GW Monitor	27-May-10	160.1	82.1	1	31.1-80.6	2/5	NA
W-2611	GW Monitor	13-Jul-10	90	75.2	1	50-75	1B	1.66
W-2612	GW Monitor	21-Jul-10	137	73.8	1	43.8-73.5	1B	0.22
W-2616	GW Monitor	12-Aug-10	187	145.4	1	130-140.5	4	0.09
W-2617	GW Monitor	24-Aug-10	177	127.2	1	117-121.9	3B	0.04
W-2618	GW Monitor	29-Oct-10	111	103.8	1	77.3-103.3	2	NA
W-2619	GW Monitor	1-Nov-10	110	105.5	1	75-105	2	NA
W-2620A	GW Monitor	11-Oct-10	110	105.3	1	75-105	2	NA
W-2621	GW Monitor	12-Oct-10	110	105.2	1	75-105	2	NA
W-2622	GW Monitor	20-Oct-10	111	105.2	1	75-105	2	NA
W-2623	GW Monitor	24-Oct-10	111	105.2	1	75-105	2	NA
W-2801	GW Extraction	18-Oct-11	140	135	1	114-119	3A	NA
					2	124.5-129.5	3A	NA
W-3001	GW Monitor	4-Apr-14	250	230	1	224-229	5	6
W-3002	GW Monitor	21-May-14	252	182.4	1	177-182	3B	0.9
W-3003	GW Monitor	7-May-14	252	204.5	1	199-204	5	0.9
W-3004	GW Monitor	12-Sep-14	107	105.5	1	94-104	3A	0.1
W-3101	GW Extraction	20-May-15	225	213	1	207.5-212.5	5	2
W-3102	GW Extraction	4-Jun-15	225	109.3	1	104-109	2	2
W-3103	GW Monitor	22-Jun-15	200.4	153.26	1	147.9-152.9	3A	5
W-3104	GW Monitor	14-Jul-15	225	208.5	1	203-208	5	1.83
W-3105	GW Monitor	23-Sep-15	140	130.52	1	120-130	5	NA
W-3106	GW Monitor	15-Sep-15	168	153.58	1	148.1-153.1	5	NA
W-3107	GW Monitor	17-Sep-15	125	89.38	1	84-89	1B	3
SIP-141-201	Piezometer	2-Feb-96	77	74.2	1	57-74	1B	0.5
SIP-141-202	Piezometer	12-Feb-96	80	74	1	64-74	1B	0.5
SIP-141-203	Piezometer	20-Feb-96	87	83	1	72-83	1B	NA
SIP-191-002	Piezometer	21-Apr-94	66	61	1	45-61	1B	NA
SIP-212-101	Piezometer	14-Mar-96	94	90.5	1	87-90.5	2	NA
SIP-293-001	Piezometer	5-Dec-90	56.5	50	1	45-50	1B	NA
SIP-331-001	Piezometer	21-Sep-95	122	116.5	1	106.5-116.5	2	NA
SIP-419-101	Piezometer	8-Sep-95	127	123	1	112-123	3B	NA
SIP-419-202	Piezometer	6-Mar-96	110	106.5	1	97-106.5	3A	NA
SIP-490-101	Piezometer	1-Nov-95	60	58	1	53-56	2	NA

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

Well	Well type	Date completed	Borehole depth (ft)	Casing depth (ft)	Screen position	Screen interval (ft)	HSU	Initial flow rate (gpm)
SIP-490-102	Piezometer	8-Nov-95	75	73.5	1	53.5-73.5	2	0.5
SIP-501-004	Piezometer	20-Oct-92	60	56.9	1	48.5-56.9	1B	NA
SIP-501-006	Piezometer	11-Nov-92	59.5	56	1	50-56	1B	NA
SIP-501-007	Piezometer	16-Nov-92	64	59	1	53-59	1B	NA
SIP-501-101	Piezometer	10-May-94	77.5	73	1	69-73	1B	NA
SIP-501-102	Piezometer	16-May-94	77	73	1	67-73	1B	NA
SIP-501-103	Piezometer	20-May-94	63	57.5	1	51-57.5	1B	NA
SIP-501-104	Piezometer	15-Jul-94	67	62	1	50-62	1B	NA
SIP-501-105	Piezometer	1-Sep-94	73	68	1	63-68	1B	NA
SIP-501-201	Piezometer	29-Nov-94	65	58.5	1	54-58.5	1B	NA
SIP-501-202	Piezometer	1-Jul-95	70	64.5	1	58-64.5	1B	NA
SIP-511-101	Piezometer	25-Jan-96	110	106.7	1	100-106.7	3A	0.5
SIP-511-102	Piezometer	2-Apr-96	114	110	1	108-110	3B	0.5
SIP-514-107	Piezometer	3-Jan-90	21.5	17	1	9-17	1B	NA
SIP-514-109	Piezometer	5-Jan-90	21.5	21.5	1	7-21.5	1B	NA
SIP-514-112	Piezometer	8-Jan-90	21.5	18	1	7-18	1B	NA
SIP-514-114	Piezometer	9-Jan-90	21.5	17	1	4-17	1B	NA
SIP-514-116	Piezometer	10-Jan-90	21.5	17	1	7-17	1B	NA
SIP-514-117	Piezometer	11-Jan-90	21.5	17.5	1	6-17.5	1B	NA
SIP-514-119	Piezometer	12-Jan-90	21.5	16	1	5-16	1B	NA
SIP-514-123	Piezometer	17-Jan-90	26.5	23	1	11.5-23	1B	NA
SIP-514-124	Piezometer	17-Jan-90	21.5	17	1	6-17	1B	NA
SIP-514-125	Piezometer	19-Jan-90	21.5	15	1	6-15	1B	NA
SIP-514-126	Piezometer	18-Jan-90	26.5	21.5	1	4-21.5	1B	NA
W-514-2007A	SV Extraction	18-Mar-04	110	45.5	1	15-45	1B/2	NA
W-514-2007B	SV Extraction	18-Mar-04	110	102.5	1	72-102	2/5	NA
SIP-518-101	Piezometer	20-Sep-90	125	61	1	55-61	2	NA
SVB-518-201	Dual Extraction	3-Mar-93	59.8	50	1	34-50	2	NA
SVB-518-202	SV Monitor	3-Nov-93	120.6	73.7	1	19-73.7	1B/2	NA
SIP-518-203	Piezometer	21-Oct-93	132.1	127	1	121-127	5	NA
SVB-518-204	Dual Extraction	5-Nov-93	121.5	50	1	24-46	2	NA
SVB-518-302	GW Monitor	22-Jun-95	104.5	39.5	1	11-39	NA	NA
W-518-1914	Dual Extraction	9-Oct-03	18	16	1	5.5-15.5	1B	NA
W-518-1915	Dual Extraction	15-Oct-93	104.5	41	1	30.5-40.5	2	NA
W-543-001	SV Extraction	25-Feb-03	71.5	67.5	1	52-67	2	NA

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

Well	Well type	Date completed	Borehole depth (ft)	Casing depth (ft)	Screen position	Screen interval (ft)	HSU	Initial flow rate (gpm)
W-543-002A	SV Monitor	10-Mar-03	96	65.4	1	45-65	2	NA
W-543-002B	SV Monitor	10-Mar-03	96	82.5	1	72-82	2	NA
W-543-003	SV Extraction	20-Mar-03	95	80	1	69-79	2	NA
W-543-004A	SV Monitor	27-Mar-03	95	64.5	1	49-64	2	NA
W-543-004B	SV Monitor	27-Mar-03	95	80.5	1	70-80	2	NA
SIP-543-101	Piezometer	1-Jul-95	111	104	1	93-103	2	NA
W-543-1908	SV Extraction	12-Jun-03	40.8	40.4	1	20-40	1B	9
SIP-ALP-001	Piezometer	3-May-90	66.5	60	1	45-60	2	NA
SIP-ALP-002	Piezometer	7-May-90	62	57.5	1	47.5-57.5	2	NA
SIP-AS-001	Piezometer	30-Apr-90	100.5	90.5	1	81-90.5	1B	NA
SIP-CR-049	Piezometer	26-Feb-90	41.5	40	1	36-40	1B	NA
SIP-EGD-001	Piezometer	16-Oct-90	101.5	85	1	75-85	2	NA
SIP-ETC-201	Dual Extraction	26-Mar-96	106	100	1	80-100	2	0.5
SIP-ETC-301	Piezometer	9-Apr-99	102	NA	1	NA	NA	NA
SIP-ETC-303	Piezometer	24-May-99	111	88	1	82-88	2	NA
W-ETC-2001A	SV Monitor	10-Nov-03	95	23.5	1	18-23	1B	NA
W-ETC-2001B	SV Monitor	10-Nov-03	95	88.5	1	78-88	2	NA
W-ETC-2002A	SV Monitor	25-Nov-03	95	64.5	1	34-64	1B/2	NA
W-ETC-2002B	SV Monitor	25-Nov-03	95	85.5	1	75-85	2	NA
W-ETC-2003	SV Extraction	9-Dec-03	95	45.5	1	20-45	1B	NA
W-ETC-2004A	SV Extraction	17-Dec-03	95	53.5	1	28-53	1B/2	NA
W-ETC-2004B	SV Extraction	17-Dec-03	95	88.5	1	63-68	2	NA
SIP-ETS-201	Piezometer	5-Feb-91	95	90	1	85-90	3A	NA
SIP-ETS-204	Piezometer	7-May-91	102.5	97	1	87-97	3A	NA
SIP-ETS-205	Piezometer	20-Jun-91	103	95	1	89.5-95	3A	NA
SIP-ETS-209	Piezometer	25-Jul-91	96.6	90.5	1	79.5-89.8	2	NA
SIP-ETS-211	Piezometer	6-Aug-91	103	98.5	1	95-98.5	3A	NA
SIP-ETS-212	Piezometer	14-Aug-91	106.5	102.5	1	97.5-102.25	2	NA
SIP-ETS-213	Piezometer	15-Nov-91	118.5	116.5	1	108.5-116.5	3A	NA
SIP-ETS-214	Piezometer	22-Nov-91	101	101	1	86-101	3A	NA
SIP-ETS-215	Piezometer	3-Dec-91	94.5	94.5	1	84.5-94.5	3A	NA
SIP-ETS-302	Piezometer	30-Mar-92	117.4	113	1	97-113	3A	NA
SIP-ETS-303	Piezometer	2-Apr-92	110.7	102	1	95-102	3A	NA
SIP-ETS-304	Piezometer	27-Aug-92	100	97	1	90-97	3A	NA
SIP-ETS-306	Piezometer	11-Sep-92	101	93	1	80.5-93	3A	NA

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

Well	Well type	Date completed	Borehole depth (ft)	Casing depth (ft)	Screen position	Screen interval (ft)	HSU	Initial flow rate (gpm)
SIP-ETS-401	Piezometer	2-Aug-95	122	122	1	116-121	3A	NA
SIP-ETS-402	Piezometer	8-Aug-95	110	110	1	97-107	2	NA
SIP-ETS-404	Piezometer	22-Aug-95	99	99	1	83.5-95.5	2	NA
SIP-ETS-405	Piezometer	29-Aug-95	126	126	1	114.5-123	3A	NA
SIP-ETS-501	Piezometer	16-Nov-95	110	106.5	1	100-106.5	3A	NA
SIP-ETS-502	Piezometer	5-Dec-95	95	88	1	80-88	2	NA
SVI-ETS-504	SV Extraction	9-Jul-96	76.5	67	1	42-67	2	NA
SVI-ETS-505	SV Injection	18-Jul-96	80	77.5	1	45-75	2	NA
W-ETS-305A	SV Monitor	30-May-07	80.5	50	1	14.7-49.7	1B/2	NA
W-ETS-305B	SV Monitor	30-May-07	85	79.7	1	59.3-79.3	2	NA
W-ETS-506A	SV Monitor	29-May-07	75	37.5	1	17.1-37.1	1B/2	NA
W-ETS-506B	SV Monitor	29-May-07	75	63.3	1	43-63	2	NA
W-ETS-507	SV Extraction	27-Apr-96	75	65.5	1	25.1-65.1	1B/2	NA
SIP-ETS-601	Piezometer	7-Jun-99	115.5	104.8	1	98.3-104.8	2	NA
W-ETS-2008A	SV Extraction	7-Apr-04	110	40.5	1	20-40	1B	NA
W-ETS-2008B	SV Extraction	7-Apr-04	110	85.5	1	50-85	2	NA
W-ETS-2009(a)	SV Extraction	3-May-04	103	79.5	1	54-79	2	NA
W-ETS-2010A	SV Extraction	19-May-04	110.3	70.5	1	35-70	1B/2	NA
W-ETS-2010B	SV Extraction	19-May-04	110.3	100.5	1	80-100	2	NA
SIP-HPA-001	Piezometer	20-Apr-90	92.75	75	1	65-75	2	NA
W-HPA-001A	SV Monitor	15-Apr-03	80	45.5	1	30-45	1B	NA
W-HPA-001B	SV Monitor	15-Apr-03	80	73.5	1	63-73	2	NA
W-HPA-002A	SV Extraction	29-Apr-03	80	43	1	32.5-42.5	1B	NA
W-HPA-002B	SV Extraction	29-Apr-03	80	72.5	1	52-72	2	NA
SIP-HPA-003	Piezometer	19-Apr-90	91.5	66	1	61-66	2	NA
SIP-HPA-201	Piezometer	14-May-96	97.5	76	1	71-76	2	NA
SIP-IES-001	Piezometer	16-Sep-92	50	46.5	1	44-46.5	1B	NA
SIP-ITR-001	Piezometer	19-Apr-91	121.5	115	1	105-115	5	NA
SIP-ITR-002	Piezometer	2-Apr-91	100	84	1	79-84	5	NA
SIP-ITR-003	Piezometer	25-Apr-91	121.5	106	1	98.66-106	5	NA
SIP-NEB-101	Piezometer	23-Sep-92	68.7	66	1	57-66	2	NA
SIP-PA-002	Piezometer	29-Jan-90	16.5	16.5	1	4-16.5	1B	NA
SIP-PA-003	Piezometer	26-Jan-90	18	14	1	4-14	1B	NA
SIP-PA-005	Piezometer	4-Jan-90	11.5	8	1	3-8	1B	NA
SIP-PA-006	Piezometer	4-Jan-90	13.5	12	1	5-12	1B	NA

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

Well	Well type	Date completed	Borehole depth (ft)	Casing depth (ft)	Screen position	Screen interval (ft)	HSU	Initial flow rate (gpm)
SIP-PA-007	Piezometer	4-Jan-90	11.5	5	1	1-5	1B	NA
SIP-PA-010	Piezometer	25-Jan-90	11.5	9	1	3-9	1B	NA
SIP-PA-012	Piezometer	29-Jan-90	11.5	9	1	2-9	1B	NA
SIP-PA-013	Piezometer	24-Jan-90	16.5	13	1	8-13	1B	NA
SIP-PA-015	Piezometer	25-Jan-90	21.5	17.5	1	2-17.5	1B	NA
SIP-PA-016	Piezometer	24-Jan-90	11.5	11.5	1	7-11.5	1B	NA
SIP-PA-017	Piezometer	24-Jan-90	16.5	14	1	7-14	1B	NA
SIP-PA-018	Piezometer	25-Jan-90	11.5	8	1	6-8	1B	NA
SIP-PA-019	Piezometer	26-Jan-90	16.5	12	1	2-12	1B	NA
SIP-PA-021	Piezometer	23-Jan-90	11.5	10	1	2-10	1B	NA
SIP-PA-024	Piezometer	23-Jan-90	16.5	15	1	5-15	1B	NA
SIP-PA-025	Piezometer	23-Jan-90	11.5	7	1	4-7	1B	NA
SIP-PA-026	Piezometer	29-Jan-90	11.5	10	1	2-10	1B	NA
SIP-PA-027	Piezometer	29-Jan-90	8.5	7	1	2-7	1B	NA
SIP-PA-028	Piezometer	23-Jan-90	11	8	1	5-8	1B	NA
SIP-PA-029	Piezometer	22-Jan-90	11.5	7	1	5-7	1B	NA
SIP-PA-030	Piezometer	24-Jan-90	11.5	8	1	4-8	1B	NA
SIP-PA-034	Piezometer	4-Jan-90	6.5	5	1	3-5	1B	NA
SIP-PA-035	Piezometer	4-Jan-90	11.5	11.5	1	6.5-11.5	1B	NA
TW-11	GW Monitor	9-Jun-81	112.5	107	1	97-107	2	NA
TW-11A	GW Monitor	16-Mar-84	163	160	1	133-160	2	6
TW-21	GW Monitor	12-Jun-81	111.5	95	1	85-95	1B	3
UP-292-006	Piezometer	7-Jan-91	74	57.5	1	47.5-57.5	1B	NA
UP-292-007	Piezometer	7-Jan-91	71	56	1	46-56	1B	NA
UP-292-012	Piezometer	29-Jan-92	67.7	60	1	45-60	1B	NA
UP-292-014	Piezometer	29-Jan-92	66	66	1	50-60	1B	NA
UP-292-015	Piezometer	29-Jan-92	61.5	61.5	1	49.5-60.5	1B	NA
UP-292-020	Piezometer	3-Feb-93	68.5	68.5	1	56.5-64	1B	NA
GSW-001A	GW Monitor	12-Jun-86	208	133	1	115-133	3A	14
GSW-006	GW Monitor	28-Feb-86	212	137	1	121-137	3A	11
GSW-007	GW Monitor	14-Mar-86	176.5	123.4	1	110.8-123.4	3A	5
GSW-008	GW Monitor	1-Apr-86	176	133	1	127.5-133	3A	2
GSW-009	GW Monitor	14-Apr-86	197.5	152.5	1	147-152.5	3B	5
GSW-011	GW Monitor	7-May-86	182.5	126	1	116-126	3A	5
GSW-013	GW Monitor	27-Jun-86	198	134.5	1	125-134.5	3A	NA

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

Well	Well type	Date completed	Borehole depth (ft)	Casing depth (ft)	Screen position	Screen interval (ft)	HSU	Initial flow rate (gpm)
GSW-215	GW Monitor	22-Apr-86	214	133.5	1	127-133.5	3A	6
GSW-216	GW Monitor	9-May-86	193	120.5	1	110.5-120.5	3A	7
GSW-266	GW Monitor	8-May-86	220	166	1	159-166	3B	3
GSW-326	GW Monitor	2-Oct-87	230	134	1	129-134	4	NA
GSW-367	GW Monitor	29-Apr-87	159	124	1	114-124	2	7
GSW-442	GW Monitor	27-Oct-87	270	145	1	138-145	3A	1
GSW-443	GW Monitor	9-Nov-87	291	141	1	123-141	2	5
GSW-444	GW Monitor	20-Nov-87	278	120	1	110-120	3B	NA
MW-NLF-1	GW Monitor	13-Mar-91	26	NA	1	NA	NA	NA
MW-NLF-2	GW Monitor	13-Mar-91	NA	NA	1	NA	NA	NA
MW-NLF-3	GW Monitor	13-Mar-91	20	NA	1	NA	NA	NA
MW-NLF-4	GW Monitor	13-Mar-91	26	NA	1	NA	NA	NA
MW-NLF-20	GW Monitor	NA	NA	NA	1	NA	NA	NA
MW-NLF-21	GW Monitor	NA	NA	NA	1	NA	NA	NA
MW-NLF-22	GW Monitor	NA	NA	NA	1	NA	NA	NA
					2	118-131	NA	NA
SNL-1B	Piezometer	NA	NA	NA	1	NA	NA	NA
SNL-2A	Piezometer	NA	NA	NA	1	NA	NA	NA
SNL-4D	Piezometer	NA	NA	NA	1	NA	NA	NA
MW-SNL-20B	GW Monitor	28-Jun-84	140	140	1	90-105	NA	NA
MW-SNL-20C	GW Monitor	16-Jul-84	165	156	1	140-155	NA	NA
11C1	GW Monitor	8-Jun-76	68	66	1	56.2-61.2	1B	1
11J2	GW Monitor	26-Apr-79	112	112	1	90-92	1B	5
					2	102-108	2	5
14A3	GW Monitor	7-Dec-77	110	110	1	100-105	1B	NA
14B1	Water-supply (pumping)	13-Aug-59	300	300	1	146-149	2	NA
					2	192-195	3A	NA
					3	209-213	3A	NA
14B4	Water-supply (pumping)	1-Aug-60	260	260	1	143-148	2	NA
					2	155-159	2	NA
					3	186-189	3A	NA
					4	205-215	3A	NA
					5	245-250	4	NA
14B7	GW Monitor	25-Aug-87	NA	NA	NA	NA	NA	NA

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

Well	Well type	Date completed	Borehole depth (ft)	Casing depth (ft)	Screen position	Screen interval (ft)	HSU	Initial flow rate (gpm)
14C2	Water-supply (pumping)	7-Jan-88	217	NA	1	135-150	2	NA
14C3	Water-supply (pumping)	19-Jan-88	405	NA	1	160-388	2/3A/3B/4/5	NA
14H1	GW Monitor	21-Dec-83	NA	288	1	0-288	NA	NA
14H2	GW Monitor	28-Aug-87	NA	NA	NA	NA	NA	NA
14JD1	GW Monitor	NA	NA	NA	NA	NA	NA	NA
14K1	GW Monitor	NA	372	361	1	153-157	NA	NA
					2	193-202	NA	NA
					3	217-251	NA	NA
					4	279-290	NA	NA
					5	300-336	NA	NA
					6	345-349	NA	NA
					7	354-361	NA	NA
15B1	GW Monitor	24-Jun-49	423	NA	NA	NA	NA	NA
18D1	Water-supply (pumping)	20-Apr-84	NA	NA	1	NA	7	12
2J2	GW Monitor	4-Jan-90	NA	NA	1	NA	NA	NA
2K3	GW Monitor	6-Mar-91	35	NA	1	NA	NA	NA
2K4	GW Monitor	6-Mar-91	35	NA	1	NA	1B	NA
2Q2	GW Monitor	6-Mar-91	40	NA	1	NA	1B	NA
2R3	GW Monitor	5-Mar-91	37	NA	1	NA	1B	NA
2R4	GW Monitor	5-Mar-91	37	NA	1	NA	NA	NA
2R8	GW Monitor	6-Mar-91	40	NA	1	NA	1B	NA
3S1E-1P2	Water-supply (pumping)	7-Oct-60	144	NA	NA	NA	NA	NA
3S2E-16B1	Water-supply (pumping)	1-Jul-44	410	410	1	140-235	NA	NA
					2	275-287	NA	NA
					3	304-320	NA	NA
					4	333-338	NA	NA
					5	347-352	NA	NA
					6	380-390	NA	NA
3S2E-16C1	Water-supply (pumping)	18-Feb-58	584	580	1	288-298	NA	950
					2	316-327	NA	950
					3	347-353	NA	950
					4	432-454	NA	950
					5	517-523	NA	950

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

Well	Well type	Date completed	Borehole depth (ft)	Casing depth (ft)	Screen position	Screen interval (ft)	HSU	Initial flow rate (gpm)
3S2E-7C2	Water-supply (pumping)	NA	NA	49	1	39-44	NA	NA
3S2E-8P1	Water-supply (pumping)	NA	NA	273	1	122-263	NA	NA
3S2E-9Q1	Water-supply (pumping)	13-Jan-60	576	516	1	180-492	NA	510
7D2	GW Monitor	7-Jun-76	74	72	1	63-68	3A	NA
AW-1906	Anode Well	17-Jun-03	270	258	NA	NA	NA	NA
AW-1910	Anode Well	23-Jul-03	270	258	NA	NA	NA	NA
AW-1911	Anode Well	NA	290	NA	NA	NA	NA	NA
AW-1912	Anode Well	28-Aug-03	280	258	NA	NA	NA	NA
AW-2106	Anode Well	11-Apr-05	290	257.5	NA	NA	NA	NA
AW-2107	Anode Well	4-May-05	290	NA	NA	NA	NA	NA
AW-2108	Anode Well	2-Jun-05	290	258	NA	NA	NA	NA
AW-2306	Anode Well	31-Aug-07	280	261	NA	NA	NA	NA

Notes and footnotes are on the following page.

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

Notes:

ft =	Feet (All depths reported are in feet below ground surface).
gpm =	Gallons per minute.
GW =	Ground Water.
HSU =	Hydrostratigraphic Unit.
NA =	Not Available.
SV =	Soil Vapor.
CMT =	Continuous Multichannel Tubing.

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

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

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

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

Wells installed for the Dynamic Underground Stripping Demonstration Project (1992-1993) include extraction wells (GEW series), injection wells (GIW series), gasoline spill piezometer (GSP series), and heating wells (HW series).

CMT was installed to monitor ground water chemistry in multiple HSUs. When the CMT was installed in well W-1705 in 2010, the fourth screen position (203-208 ft) monitoring HSU-5 was properly abandoned.

Piezometer SVB-518-303 was drilled out and replaced by well W-518-1915 in 2003.

(a) Wells W-2606, W-2607, and W-2608 were drilled at an angle 45 degrees from vertical; depths shown are calculated true vertical depth.

(b) Well W-ETS-2009 was drilled at an angle 20 degrees from vertical; depths shown are calculated true vertical depth.

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

Well number	Well type	Date installed	Borehole depth (ft)	Casing depth (ft)	Screen interval(s) (ft)	HSU monitored	Closure date
11A1	Other non-LLNL	8-Jun-76	66	64.7	54.7-59.7	NA	18-Aug-88
11BA[a]	Other non-LLNL	2-Mar-87	NA	NA	NA	NA	10-Jun-87
11H1	Other non-LLNL	4-Nov-41	NA	519	157-161	2/3A/4/5/6/7	31-Oct-88
					169-177		
					224-228		
					243-245		
					254-256		
					306-314		
					319-327		
					339-342		
					414-419		
					424-431		
					477-479		
11H4	Other non-LLNL	5-Apr-60	272	272	166-170	3/4/5	7-Oct-88
					174-176		
					183-185		
					200-202		
					211-214		
					224-230		
					250-252		
					260-265		
11J1	Other non-LLNL	1-Jan-41	160	160	NA	2	3-Aug-88
11J4	Other non-LLNL	1-Jan-65	NA	NA	NA	NA	11-Oct-88
11K1	Other non-LLNL	6-Jan-42	621	621	247-255	4/5/6	26-Sep-88
					272-276		
					297-304		
					322-339		
					554-557		
					580-602		
11K2	Other non-LLNL	NA	NA	232	NA	NA	3-Oct-88
11Q2	Other non-LLNL	20-Dec-83	NA	264	NA	NA	16-Aug-88
11Q3	Other non-LLNL	20-Dec-83	NA	120	NA	NA	10-Aug-88
11Q6	Other non-LLNL	20-Dec-83	NA	280	NA	NA	11-Jan-89
11R3	Other non-LLNL	8-May-61	140	117	NA	NA	3-Sep-85
11R4	Other non-LLNL	28-Oct-58	268	NA	165-177	NA	3-Sep-85
					252-258		
11R5	Other non-LLNL	19-Dec-83	NA	NA	NA	NA	26-Jul-85

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

Well number	Well type	Date installed	Borehole depth (ft)	Casing depth (ft)	Screen interval(s) (ft)	HSU monitored	Closure date
12M1	Other non-LLNL	12-Sep-42	702	702	375-378		15-Apr-84
					420-426		
					452-473		
					560-564		
					609-621		
					626-657		
12N1	Other non-LLNL	14-Apr-42	702	NA	392-399	7	24-Jan-89
					478-483		
					492-496		
					514-518		
					527-536		
					666-670		
					678-681		
13D1	Other non-LLNL	29-Oct-56	402	400	200-400	3B/4/5/6	23-Aug-88
14A1	Other non-LLNL	12-Jul-43	246	227	102-107		13-Sep-88
					113-119		
					144-148		
					176-179		
					188-190		
					192-194		
					219-222		
					223-227		
14A2	Other non-LLNL	15-Nov-56	229	229	122-130	2/3A	12-Sep-88
					140-150		
					160-180		
14A4	Other non-LLNL	15-Jun-59	252	248	167-170	3/4	29-Aug-88
					175-179		
					192-202		
					235-246		
14A8	Other non-LLNL	NA	NA	86	NA	NA	22-Jul-88
14B2	Other non-LLNL	22-Aug-56	312	312	185-312	3A/3B/4/5	11-Nov-88
14B8	Other non-LLNL	3-May-88	385	306	NA	NA	NA
14C1	Other non-LLNL	31-Jul-91	523	NA	NA	2/3A/4	NA
1N1	Other non-LLNL	15-Jan-88	600	600	427-442	7	21-Oct-88
					450-453		
					465-469		

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

Well number	Well type	Date installed	Borehole depth (ft)	Casing depth (ft)	Screen interval(s) (ft)	HSU monitored	Closure date
					500-515		
					575-588		
3S2E01P2	Other non-LLNL	7-Oct-60	144	144	124-144	NA	22-May-86
2R9 (11A5)	Other non-LLNL	NA	NA	NA	NA	NA	19-Jul-88
HW-GP-001	Monitor	16-Apr-92	120	113	NA	NA	25-Jan-10
HW-GP-002	Monitor	12-Jan-95	120	117	NA	NA	20-Jan-10
HW-GP-003	Monitor	18-May-92	119	119	NA	NA	29-Jul-15
HW-GP-102	Monitor	24-Jan-95	140	142.5	70-132.5	NA	25-Feb-10
HW-GP-103	Monitor	24-Jan-95	138	141.5	71.5-131.5	NA	29-Jul-15
HW-GP-104	Monitor	24-Jan-95	138	142.2	72.2-132.5	NA	21-Jan-10
HW-GP-105	Monitor	24-Jan-95	138	142.2	72.2-132.5	NA	20-Jan-10
GEW-710	Monitor	23-Sep-91	159	158	94-137	3A/3B	22-Feb-10
GEW-711	Extraction	24-May-91	167.5	157	94-137	3A/3B	16-Jun-92
GEW-808	Monitor	5-Jun-92	150	150	50-140	2/3A	18-Feb-10
GEW-816	Monitor	4-Aug-92	161.7	150	50-140	2/3A	22-Feb-10
GIW-813	Monitor	5-Aug-92	140.7	127	67-87	2	17-Feb-10
					89-99	2	
					120-127	2/3A	
GIW-814	Monitor	5-Aug-92	149.6	141	86.5-106.5	2	17-Feb-10
					110-120	2	
					121-141	2/3A	
GIW-815	Monitor	5-Aug-92	143	137.5	77-97	2	17-Feb-10
					102-112	2/3A	
					112.8-132.5	3A	
GIW-817	Monitor	NA	121	NA	NA	NA	NA
GIW-818	Monitor	5-Aug-92	150	140	82-102	2	20-Jan-10
					120-140	3A/3B	
GIW-819	Monitor	5-Aug-92	150	141	78.6-98.6	2	27-Jan-10
					108-118	2/3A	
GIW-820	Monitor	5-Aug-92	143.3	141	85-105	2	25-Jan-10
					112-132	3A	
GSB-804	NA	NA	145.5	NA	NA	NA	19-Jan-10
GSB-807	NA	NA	151.8	NA	NA	NA	21-Jan-10
GSB-811	NA	NA	140.1	NA	NA	NA	NA
GSP-SNL-001	Piezometer	10-Jan-92	147	131	99-104	NA	23-Sep-15
					118-131	NA	

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

Well number	Well type	Date installed	Borehole depth (ft)	Casing depth (ft)	Screen interval(s) (ft)	HSU monitored	Closure date
GSW-001	Monitor	5-Feb-85	112	109	85-106	2	6-Jun-86
GSW-002	Monitor	14-Feb-85	113	107	87-107	2	21-Jun-10
GSW-003	Monitor	7-Feb-85	115	105	85-105	2	22-Jun-10
GSW-004	Monitor	22-Feb-85	112	106	86-106	2	3-Aug-15
GSW-005	Monitor	19-Mar-85	110	104	94-104	2	9-Sep-10
GSW-010	Monitor	29-Apr-86	205.5	127.5	114-127.5	3A	28-Jan-98
GSW-012	Monitor	27-May-86	205	191	186.5-191	5	25-Jan-10
GSW-014	Monitor	17-Jul-86	141	NA	NA	NA	23-Feb-10
GSW-015	Monitor	14-Aug-87	148	145	20.5-28	1B/2/3A	18-Feb-10
					38-44		
					50-56		
					60-64		
					68-73		
					77-83		
					95-105		
					120-130		
GSW-016	Monitor	19-Oct-87	146	145	23-28	1B	18-Feb-10
					38-43	1B	
					50-55	2	
					61-66	2	
					78-83	2	
					95-105	2	
					120-130	3A	
GSW-020	Monitor	18-May-84	134	101.3	95-101.3	2	3-Sep-87
GSW-208	Monitor	6-Feb-86	211	123	108-118	3A	16-Feb-10
GSW-209	Monitor	27-Feb-86	204	135.2	112.8-132.8	3A	9-Sep-10
GSW-403-6	Monitor	11-May-84	138	100	90-110	2	21-Jan-10
GSW-445	Extraction	9-Dec-87	319	161	155-161	4	9-Sep-10
IMS-518-1616	IMS	16-Aug-00	55	NA	3-3.5	NA	31-May-07
					8-8.5		
					13-13.5		
					18-18.5		
					23-23.5		
					28-28.5		
					33.33.5		

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

Well number	Well type	Date installed	Borehole depth (ft)	Casing depth (ft)	Screen interval(s) (ft)	HSU monitored	Closure date
					38-38.5		
					48-48.5		
S-14-7	NA	NA	40	NA	NA	NA	24-Feb-10
SEA-518-301	SEAMIST	22-Jun-95	102.6	39.3	1	NA	4-Jun-07
SEA-518-304	SEAMIST	11-Sep-95	104.5	NA	1	NA	31-May-07
SEA-ETS-305	SEAMIST	2-Sep-92	85	NA	1	NA	30-May-07
SEA-ETS-506	SEAMIST	24-Jul-96	75	75	NA	1B/2	29-May-07
SEA-ETS-507	SEAMIST	30-Jul-96	75	75	7-8	1B/2	27-Apr-06
					20-21	1B/2	
					25-26	1B/2	
					32-33	1B/2	
					38-39	1B/2	
					47-48	1B/2	
					52-53	1B/2	
					59-60	1B/2	
SIB-INF-001	NA	NA	67	66.8	NA	NA	7-Jan-10
SIB-INF-002	NA	NA	67	66.4	NA	NA	7-Jan-10
SIB-INF-003	NA	NA	67	66	NA	NA	7-Jan-10
SIB-INF-008	NA	NA	92	91.9	NA	NA	6-Jan-10
SIB-INF-009	NA	NA	92	92	NA	NA	6-Jan-10
SIB-INF-010	NA	NA	95	81.8	NA	NA	6-Jan-10
SIB-INF-012	NA	NA	16	11.2	NA	NA	7-Jan-10
SIB-INF-103	NA	NA	103.5	91.5	NA	NA	6-Jan-10
SIB-INF-104	NA	NA	92	91.7	NA	NA	6-Jan-10
SIB-INF-201	NA	NA	87.4	85.7	NA	NA	6-Jan-10
SIB-INF-203	NA	NA	63	62.7	NA	NA	7-Jan-10
SIB-INF-301	Piezometer	NA	NA	95	NA	NA	21-Dec-09
SIP-INF-011	Monitor	Apr-97	93.4	92	NA	NA	23-Dec-09
SIP-INF-101	Piezometer	NA	NA	95	NA	NA	23-Dec-09
SIP-INF-102	Piezometer	NA	NA	90	NA	NA	23-Dec-09
SIP-INF-202	Piezometer	NA	NA	85	NA	NA	23-Dec-09
SIP-INF-302	Monitor	Mar-95	NA	89	NA	NA	23-Dec-09
SIB-INF-001	NA	NA	67	66.8	NA	NA	7-Jan-10

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

Well number	Well type	Date installed	Borehole depth (ft)	Casing depth (ft)	Screen interval(s) (ft)	HSU monitored	Closure date
SIP-191-001	Piezometer	1-Aug-94	50	NA	NA	1A	24-Sep-15
SIP-191-003	Piezometer	24-Apr-94	50.5	45	35-45	1B	21-Aug-13
SIP-191-004	Piezometer	15-Jul-94	57.5	55	47.5-53.5	1B	19-Aug-13
SIP-191-005	Piezometer	4-May-94	54	48	42-48	1A	24-Sep-15
SIP-191-101	Piezometer	18-Nov-94	68.5	64	58-64	1B	20-Aug-13
SIP-419-201	Piezometer	29-Feb-96	126	107	97-107	3A/3B	NA
SIP-490-101	Piezometer	1-Nov-95	59	56	53–56	2	21-Dec-95
SIP-514-101	Piezometer	28-Dec-89	26	22	7-22	1B	3-Sep-96
SVB-518-303	Monitor	29-Jun-95	104.5	40	6-40	1B/2	15-Oct-03
SIP-ETC-302	Piezometer	22-Apr-99	104	89.4	79–89	2	26-Apr-99
SIP-ETS-105	Piezometer	11-Dec-90	110	103	87-103	3A	6-Dec-93
SIP-ETS-207	Piezometer	11-Jul-91	103	98.5	89.75-98.5	3A	5-Jan-00
SIP-HPA-102	Piezometer	8-Dec-94	76	72	67-72	2	9-Apr-02
SIP-HPA-103	Piezometer	1-Mar-95	77	73.5	67-72.5	2	9-Apr-02
SIP-IES-002	Piezometer	5-Oct-92	41.5	39.2	33-39.2	1A	24-Sep-15
SIP-INF-011	NA	NA	NA	92	NA	NA	23-Dec-09
SIP-INF-202	NA	NA	NA	85	NA	NA	23-Dec-09
SIP-INF-301	NA	NA	NA	95	NA	NA	23-Dec-09
SIP-INF-302	NA	NA	NA	89	NA	NA	23-Dec-09
SVB-GP-001	NA	NA	20	NA	NA	NA	22-Feb-10
SVB-GP-002	NA	NA	20	NA	NA	NA	23-Feb-10
SVB-GP-006	NA	NA	30	NA	NA	NA	2-Sep-10
SVB-GP-008	NA	NA	20	NA	NA	NA	23-Feb-10
SVB-GP-008A	NA	NA	90.1	NA	NA	NA	24-Feb-10
SVB-GP-009	NA	NA	30	NA	NA	NA	2-Sep-10
SVB-GP-010	NA	NA	30	NA	NA	NA	2-Sep-10
SVB-GP-012	NA	NA	51	NA	NA	NA	2-Sep-10
SVB-GP-013	NA	NA	89	NA	NA	NA	24-Feb-10
TOM-001	Tomography	NA	NA	52	NA	NA	17-Dec-09
TOM-002	Tomography	NA	NA	55	NA	NA	17-Dec-09
TOM-003	Tomography	NA	NA	55	NA	NA	17-Dec-09
TOM-004	Tomography	NA	NA	54.6	NA	NA	17-Dec-09
TOM-005	Tomography	NA	NA	55	NA	NA	16-Dec-09
TOM-006	Tomography	NA	NA	55	NA	NA	16-Dec-09
TOM-007	Tomography	NA	NA	55	NA	NA	23-Dec-09
UP-292-001	Piezometer	7-Jan-91	54.5	49.5	44.5-49.5	1B	25-Sep-95
W-007	Monitor	3-Oct-80	110.5	100	76-81	2	29-Sep-15

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

Well number	Well type	Date installed	Borehole depth (ft)	Casing depth (ft)	Screen interval(s) (ft)	HSU monitored	Closure date
					88-98	3A	
W-010A	Monitor	8-Sep-80	110.7	110	85-95	2	26-Feb-02
					100-105		
W-014A	Monitor	26-Aug-80	112.8	109	NA	2	11-Dec-87
					NA	2	
					NA	2	
W-015	Monitor	17-Nov-80	285	267	239-265	7	13-May-88
W-018	Monitor	22-Aug-80	161	152	80-90	2	11-Nov-85
					100-105	2	
					112-117	3A	
					128-133	5	
					143-152	5	
W-019	Monitor	19-Sep-80	164.8	161	147-157	7	22-Jun-06
W-149	Monitor	23-Aug-85	201	169	161-169	2	3-Sep-96
W-150	Monitor	13-Sep-85	212	162	157-162	2	11-Apr-90
W-203	Monitor	15-Nov-85	87	41	31-41	1A	29-Sep-15
W-211	Monitor	19-Mar-86	215.5	193	183-193	7	13-Jun-02
W-352	Monitor	29-Oct-86	235	201	181-201	4	5-Jan-98
W-358	Monitor	4-Feb-87	248	239	230-239	7	13-Apr-94
W-360	Monitor	24-Feb-87	260	204.5	181.5-204.5	4	26-Feb-02
W-414	Monitor	20-May-88	179	74	69.5-74	2	26-Feb-02
W-456	Monitor	9-Jun-88	343	180.5	172-180.5	3A	15-Nov-00
W-460	Monitor	22-Jul-88	361	140.5	135-140.5	2	15-Nov-00
W-508	Monitor	17-Feb-89	316	306	287-305	7	NA
W-591	Monitor	29-Nov-88	112	107.5	97-107.5	2	18-Apr-06
W-906	GW Extraction	23-Jul-93	200	132	58-132	2/3A	30-Apr-15
W-907	GW Extraction	3-Aug-93	239	22	172.7-188.7	4	30-Apr-15
					204.5-215	5	
W-1005	Monitor	14-Mar-94	192	110	98-110	1B	13-Nov-00
W-1006	Monitor	10-Mar-94	154	149	141-149	2	14-Nov-00
W-1007	Monitor	31-Mar-94	199.5	182	172-182	3A	14-Nov-00
W-1114	Monitor	7-Aug-95	223	205	177-200	5	23-Apr-97
W-1218	Monitor	29-May-96	240	145.5	127-145	3A	27-Feb-02
W-1220	Monitor	12-Jun-96	120	117	90-112	2	27-Feb-02
W-1221	Monitor	1-Jul-96	220	172	162-172	4	28-Feb-02
W-1513	Monitor	11-May-99	122	120	108-120	2/3A	30-Jul-15
W-1514	Monitor	24-May-99	127.5	126	103-121	2/3A	30-Jul-15

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

Well number	Well type	Date installed	Borehole depth (ft)	Casing depth (ft)	Screen interval(s) (ft)	HSU monitored	Closure date
W-1515	Monitor	8-Jun-99	130	121.5	102-120	2/3A	30-Jul-15
W-2012	GW Extraction	21-Oct-04	155	136.6	111-116	3A	20-Oct-11
					126-131	3A	
TEP-GP-001	Dynamic Stripping	15-Jan-92	165	160.5	NA	NA	25-Jan-10
				117	107-117	2/3A	
				160.5	NA	NA	
TEP-GP-002	Dynamic Stripping	24-Jun-92	161.4	NA	102-112.5	2/3A	25-Feb-10
				133	122-133	3A	
				161	NA	NA	
TEP-GP-003	Dynamic Stripping	28-Jan-92	161	129.5	124.5-129.5	3A	3-Aug-15
				161	NA	NA	
TEP-GP-004	Dynamic Stripping	5-Feb-92	161	106	96-106	2	3-Aug-15
				134	124-134	3A	
				161	NA	NA	
TEP-GP-005	Dynamic Stripping	18-Feb-92	161	124.5	114.5-124.5	3A	25-Jan-10
				161	NA	NA	
TEP-GP-006	Dynamic Stripping	26-Feb-92	161	127	107-127	2/3A	9-Sep-10
				161	NA	NA	
TEP-GP-007	Dynamic Stripping	13-Mar-92	161	125.5	115.5-125.5	3A	29-Jul-15
				161	NA	NA	
TEP-GP-008	Dynamic Stripping	3-Mar-92	161	110	100-110	2	23-Sep-15
				129	119-129	3A	
				161	NA	NA	
TEP-GP-009	Dynamic Stripping	6-May-92	161.7	107	98-107	2	20-Jan-10
				130.5	120.5-130.5	3A	
				161	NA	NA	
TEP-GP-010	Dynamic Stripping	24-Mar-92	161	124.5	114.5-124.5	3A	21-Jan-10
				161	NA	NA	
TEP-GP-011	Dynamic Stripping	7-Apr-92	161	108	98-108	2	4-Aug-15
				161	NA	NA	
TEP-GP-106	Dynamic Stripping	21-Sep-93	137.5	135.5	NA	NA	19-Jan-10
CPRS-02	Anode Well	NA	290	NA	NA	NA	
CPRS-03 (B482)	Anode Well	NA	180	NA	NA	NA	26-Sep-03
CPRS-06 (B543)	Anode Well	NA	NA	NA	NA	NA	29-Aug-06
CPS-1-325CT (B323)	Anode Well	24-Feb-77	290	NA	NA	NA	30-Oct-03
CPS-622	Anode Well	14-Feb-77	290	NA	NA	NA	15-Jan-04

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

Well number	Well type	Date installed	Borehole depth (ft)	Casing depth (ft)	Screen interval(s) (ft)	HSU monitored	Closure date
CPS SC-5	Anode Well	NA	290	NA	NA	NA	21-Jul-05

Notes:

ft = Feet (All depths reported are in feet below ground surface).
HSU = Hydrostratigraphic Unit.
IMS = Instrumented Membrane System.
NA = Not Available.

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

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

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

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

IMSs were installed in the vadose zone to measure moisture content, pressure, temperature, and VOCs.

Piezometer SVB-518-303 was drilled out and replaced by well W-518-1915 in 2003.

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

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

Appendix B

Hydraulic Test Results

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

Well	Date	Type of test[b]	Flow rate (Q) (gpm)	Transmissivity (T) (gpd/ft)	Hydraulic conductivity (K)[c] (gpd/sq ft)	Data quality[d]
W-001	1-Dec-83	Drawdown	5.7	2,000	110	Fair
W-001	23-Jan-85	Drawdown	7.1	3,100	170	Good
W-001A	22-Jan-85	Drawdown	1.4	190	19	Good
W-002	1-Dec-83	Slug	NA	110	34	Poor
W-002A	24-Jan-85	Drawdown	10.3	2,700	200	Good
W-004	1-Dec-83	Drawdown	3.3	63	13	Good
W-005	1-Dec-83	Drawdown	4.3	110	20	Good
W-005	24-Jan-85	Drawdown	7.9	1,100	210	Fair
W-005A	23-Jan-85	Drawdown	13.0	1,300	130	Poor
W-007	1-Dec-83	Slug	NA	43	14	Fair
W-008	1-Dec-83	Drawdown	2.9	29	4.9	Fair
W-011	1-Dec-83	Drawdown	4.1	130	15	Good
W-017	1-Dec-83	Slug	NA	38	2.5	Good
W-017	21-Feb-86	Slug	NA	85	5.7	Good
W-018	1-Dec-83	Drawdown	2.6	20	2.7	Poor
W-102	25-Mar-86	Drawdown	6.4	1,100	76	Good
W-102	5-Sep-86	Drawdown	24.0	770	53	Good
W-102	15-Sep-86	Long-term	27.5	4,200	290	Good
W-103	25-Apr-86	Drawdown	6.7	15,000	1,500	Good
W-104	3-Mar-88	Drawdown	5.4	1,200	170	Fair
W-104	25-Mar-88	Drawdown	3.3	450	45	Fair
W-105	6-Apr-87	Drawdown	0.8	73	7.3	Fair
W-106	19-Feb-86	Slug	NA	7.4	1.3	Excel
W-107	17-Jun-85	Drawdown	1.0	94	9.4	Poor
W-108	29-Oct-85	Drawdown	7.9	750	63	Poor
W-109	5-Mar-86	Drawdown	8.1	3,200	530	Good
W-109	4-Sep-87	Drawdown	20.0	1,600	270	Good
W-109	29-Sep-87	Long-term	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	Long-term	13.2	3,100	260	Fair
W-112	5-Nov-96	Long-term	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	5-Mar-86	Drawdown	1.1	180	30	Good
W-116	24-Dec-85	Slug	NA	37	7.5	Good
W-117	20-Feb-86	Slug	NA	2	0.4	Good
W-118	18-Sep-85	Drawdown	16	1,200	120	Poor
W-118	27-Sep-85	Drawdown	13	1,900	190	Poor
W-118	5-Mar-86	Drawdown	10.0	2,100	230	Good
W-119	8-Aug-85	Drawdown	2.0	1,600	110	Good
W-120	22-Apr-86	Drawdown	1.1	23	5.6	Poor
W-121	10-Sep-85	Drawdown	2.0	120	7.5	Good
W-121	23-Sep-85	Drawdown	4.0	23	1.5	Excel
W-121	14-Oct-85	Drawdown	3.0	34	2.2	Excel
W-121	15-Oct-85	Drawdown	4.5	45	3.0	Excel
W-122	28-Oct-85	Drawdown	10.8	490	49	Good
W-123	28-Oct-85	Drawdown	5.8	40	4.4	Poor
W-142	3-Mar-88	Slug	NA	2,600	330	Excel
W-143	3-Mar-88	Slug	NA	1,200	240	Excel
W-149	9-Sep-85	Drawdown	4.0	120	19	Good
W-149	11-Sep-85	Drawdown	8.0	95	16	Excel
W-149	11-Oct-85	Drawdown	4.8	58	9.7	Excel
W-149	11-Oct-85	Drawdown	7.0	70	12	Good
W-150	2-Oct-85	Drawdown	3.1	640	210	Fair
W-150	3-Oct-85	Drawdown	6.0	720	240	Fair
W-150	10-Oct-85	Drawdown	8.8	630	210	Fair
W-150	10-Oct-85	Drawdown	12.0	620	210	Fair
W-151	28-Oct-85	Drawdown	5.8	550	61	Poor
W-201	5-Mar-86	Drawdown	10.0	740	86	Excel
W-203	2-Mar-88	Drawdown	6.6	1,100	110	Good
W-204	23-Jan-86	Drawdown	1.9	100	15	Fair
W-205	14-Feb-86	Slug	NA	5.9	1.9	Good
W-205	18-Feb-86	Slug	NA	5.9	1.9	Good
W-206	14-Apr-86	Slug	NA	120	11	Good
W-206	27-Sep-93	Drawdown	0.19	3.0	0.20	Fair
W-206	18-Oct-93	Drawdown	0.3	4.0	0.30	Fair
W-207	2-Mar-88	Slug	NA	380	32	Excel
W-210	9-Jun-86	Slug	NA	0.6	0.1	Good
W-211	22-Oct-86	Drawdown	2.9	37	12	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-211	8-Dec-86	Long-term	1.0	44	15	Fair
W-211	16-Sep-97	Long-term	1.1	14	1.4	Good
W-212	12-May-86	Drawdown	0.8	18	3.1	Poor
W-213	22-Apr-86	Drawdown	3.8	190	38	Good
W-214	7-Oct-86	Long-term	27.6	2,300	350	Good
W-217	15-Jul-86	Slug	NA	750	120	Good
W-218	17-Jun-86	Drawdown	11.7	6,400	1,100	Good
W-218	12-Nov-86	Long-term	7.7	4,000	670	Good
W-219	15-Jul-86	Drawdown	4.3	620	76	Good
W-219	23-Feb-87	Long-term	5.2	66	8.0	Fair
W-220	21-Aug-86	Slug	NA	28	5.5	Excel
W-221	5-Aug-86	Drawdown	2.1	120	16	Fair
W-222	12-Aug-86	Drawdown	16.0	1,700	160	Excel
W-222	8-Mar-85	Long-term	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	Long-term	2.0	62	8.5	Fair
W-226	31-Mar-87	Slug	NA	1,700	160	Fair
W-252	4-Nov-85	Drawdown	4.0	920	50	Fair
W-252	19-Nov-85	Drawdown	5.6	800	43	Fair
W-254	27-Jan-86	Drawdown	4.2	340	38	Fair
W-254	27-Feb-86	Drawdown	3.2	370	41	Good
W-255	21-Jan-86	Drawdown	5.0	2,800	250	Fair
W-255	21-Jan-86	Drawdown	6.0	2,000	180	Fair
W-255	6-Jan-87	Long-term	2.0	400	36	Fair
W-256	11-Apr-86	Slug	NA	11	5.5	Good
W-257	15-Apr-86	Slug	NA	120	24	Good
W-258	5-Jun-86	Slug	NA	35	9.0	Excel
W-258	29-Oct-86	Slug	NA	32	8.0	Good
W-259	26-Mar-88	Slug	NA	15	5.0	Good
W-260	25-Mar-86	Drawdown	3.0	140	22	Good
W-260	1-Oct-86	Long-term	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	Long-term	22.0	2,750	340	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-262	27-Apr-87	Long-term	23.1	6,800	810	Good
W-263	22-Apr-86	Drawdown	1.2	37	7.4	Poor
W-263	4-Nov-86	Long-term	1.8	76	15	Excel
W-264	7-May-86	Drawdown	8.1	930	100	Good
W-264	29-Oct-86	Long-term	23.0	480	50	Good
W-265	19-May-86	Drawdown	0.7	180	34	Fair
W-267	2-Jun-86	Drawdown	0.5	420	85	Poor
W-268	14-Nov-86	Drawdown	5.0	230	18	Good
W-269	14-Jul-86	Drawdown	5.0	570	95	Good
W-270	30-Dec-86	Slug	NA	14	2.0	Good
W-271	4-Aug-86	Drawdown	5.5	340	76	Fair
W-272	19-Aug-86	Drawdown	0.8	150	30	Fair
W-273	27-Aug-86	Drawdown	3.2	600	90	Good
W-274	25-Mar-85	Slug	NA	38	7.6	Fair
W-274	2-Feb-99	Slug	NA	10	2	Fair
W-275	30-Oct-86	Drawdown	7.0	730	150	Fair
W-275	2-Mar-87	Long-term	5.5	830	170	Fair
W-276	21-Nov-86	Drawdown	13.0	960	110	Good
W-276	04-May-87	Long-term	24.0	2,700	300	Fair
W-277	3-Nov-86	Drawdown	0.9	74	25	Fair
W-290	5-Jan-87	Slug	NA	14	4.0	Excel
W-291	27-Jan-87	Slug	NA	25	7.1	Fair
W-292	28-Aug-86	Drawdown	6.0	400	56	Excel
W-294	29-Dec-86	Drawdown	5.3	5,300	29	Fair
W-294	29-Dec-86	Drawdown	5.9	5,400	300	Good
W-301	30-Oct-86	Drawdown	6.0	460	100	Good
W-302	18-Nov-86	Drawdown	1.0	100	27	Good
W-302	18-Nov-86	Drawdown	2.0	76	21	Fair
W-303	12-Nov-86	Drawdown	11.1	210	70	Good
W-304	13-Mar-87	Drawdown	0.9	74	25	Fair
W-305	26-Nov-86	Drawdown	19.0	720	72	Excel
W-305	18-May-87	Long-term	20.1	640	64	Excel
W-306	31-Mar-87	Drawdown	9.5	270	68	Good
W-307	26-Mar-87	Drawdown	0.9	66	33	Fair
W-308	4-Dec-87	Drawdown	2.6	27	5.4	Good
W-310	17-Feb-87	Drawdown	6.7	58	850	Good

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-310	29-Jul-10	Drawdown	6.0	170	24	Fair
W-311	19-Mar-87	Drawdown	9.8	130	12	Good
W-311	17-Nov-87	Long-term	9.9	370	26	Good
W-312	27-Mar-87	Drawdown	20.5	1,800	300	Poor
W-312	3-Nov-87	Long-term	18.8	1,700	280	Good
W-313	25-Mar-87	Drawdown	7.9	3,000	600	Good
W-313	5-Oct-87	Long-term	9.6	3,400	680	Good
W-314	10-Apr-87	Drawdown	26.4	2,900	390	Good
W-314	13-Jul-87	Long-term	13.6	2,500	330	Fair
W-314	14-Oct-97	Long-term	12	1,400	100	Fair
W-315	9-Apr-87	Drawdown	15.4	150	11	Good
W-315	5-Jan-85	Long-term	24.5	571	41	Excel
W-316	4-May-87	Drawdown	7.8	1,400	280	Good
W-317	12-May-87	Drawdown	12.1	300	43	Fair
W-317	15-Dec-87	Long-term	8.2	120	17.1	Good
W-318	7-Aug-87	Slug	NA	120	16	Good
W-319	29-Jul-87	Drawdown	48.0	7,200	1,500	Good
W-320	15-May-87	Drawdown	1.8	58	17	Fair
W-320	15-May-87	Drawdown	3.0	22	3.7	Fair
W-320	26-Jun-87	Drawdown	2.1	49	14	Fair
W-321	28-Jul-87	Drawdown	40.0	6,600	450	Good
W-322	3-Aug-87	Drawdown	3.1	85	15	Good
W-323	11-Aug-87	Drawdown	3.4	205	59	Good
W-324	10-Sep-87	Drawdown	6.6	200	50	Good
W-325	10-Sep-87	Drawdown	6.0	160	13	Excel
W-351	12-Nov-86	Drawdown	5.7	27	14	Poor
W-351	20-Jun-09	Step	2.7	200	34	Good
W-352	30-Dec-86	Drawdown	20.0	280	14	Good
W-352	7-Jul-87	Long-term	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	Long-term	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	Long-term	4.9	230	57	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-357	18-Feb-87	Drawdown	15.0	1,300	110	Good
W-357	21-Jul-87	Long-term	9.2	210	18	Good
W-358	18-Mar-87	Drawdown	9.2	210	32	Excel
W-359	9-Mar-87	Long-term	19.0	2,800	290	Fair
W-359	20-Mar-87	Drawdown	18.6	1,100	110	Good
W-359	5-Jun-09	Drawdown	10.0	1,200	95	Fair
W-360	22-May-87	Drawdown	30.0	4,800	210	Excel
W-361	16-Mar-87	Drawdown	4.3	67	11	Good
W-361	12-Jan-85	Long-term	5.3	178	30	Good
W-362	23-Mar-87	Drawdown	16.4	470	49	Good
W-362	21-Sep-87	Long-term	13.6	370	39	Good
W-363	24-Jul-87	Slug	NA	20	3.0	Excel
W-364	8-Apr-87	Drawdown	8.6	51	10	Fair
W-364	1-Jun-87	Long-term	4.8	110	22	Good
W-365	14-May-87	Drawdown	10.0	36	15	Fair
W-366	11-May-87	Drawdown	19.0	780	92	Fair
W-368	11-May-87	Drawdown	2.9	81	8.5	Fair
W-368	31-Jul-01	Step	6.0	2,600	350	Fair
W-368	15-Apr-09	Step	3.8	410	51	Fair
W-369	25-Jun-87	Drawdown	7.0	580	96	Good
W-369	10-Nov-87	Long-term	5.5	89	18	Good
W-370	23-Jun-87	Drawdown	4.4	84	10	Fair
W-371	24-Jun-87	Drawdown	3.3	15	3.0	Good
W-372	23-Nov-87	Slug	NA	310	62	Excel
W-373	28-Jul-87	Drawdown	4.0	660	77	Fair
W-373	28-Jul-87	Drawdown	6.5	50	6.0	Poor
W-376	26-Jan-88	Drawdown	2.9	65	8.5	Fair
W-380	23-Oct-87	Drawdown	4.0	33	4.7	Excel
W-401	23-Oct-87	Drawdown	42.0	950	24	Excel
W-402	22-Oct-87	Drawdown	41.0	13,500	1,400	Good
W-403	3-Dec-87	Drawdown	9.7	370	26	Good
W-404	4-Feb-85	Drawdown	45.0	3,200	530	Good
W-405	16-Feb-85	Drawdown	47.2	546	14	Good
W-406	28-Jan-85	Drawdown	7.4	7,500	940	Fair
W-407	23-Feb-85	Drawdown	14.4	75	7.5	Fair
W-408	5-Apr-85	Drawdown	45.0	43,000	3,100	Good

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-409	22-Mar-85	Drawdown	20.0	230	38	Good
W-410	28-Apr-85	Drawdown	35.0	6,800	570	Fair
W-411	5-May-85	Drawdown	14.0	50	83	Good
W-412	6-May-88	Drawdown	4.1	700	64	Fair
W-413	30-Aug-01	Drawdown	20.0	9,400	790	Good
W-413	15-Apr-09	Step	10.0	5,500	370	Good
W-414	27-Jul-85	Slug	NA	150	38	Good
W-415	31-Aug-85	Drawdown	10.0	3,100	78	Fair
W-416	11-Jul-85	Drawdown	50.0	2,600	330	Good
W-417	27Jun-88	Drawdown	5.3	340	57	Fair
W-420	16-Aug-85	Drawdown	3.5	710	100	Excel
W-421	12-Sep-85	Drawdown	4.8	320	27	Excel
W-422	19-Sep-85	Drawdown	8.6	230	42	Good
W-423	12-Oct-85	Drawdown	22.0	1,500	130	Good
W-424	17-Oct-85	Drawdown	4.5	130	19	Good
W-441	30-Oct-87	Drawdown	6.0	500	56	Good
W-441	13-Apr-88	Drawdown	13.0	2,200	240	Poor
W-441	19-Apr-88	Long-term	14.0	470	52	Good
W-447	26-Feb-88	Drawdown	7.1	124	850	Poor
W-448	24-Mar-85	Drawdown	24.5	4,200	600	Good
W-449	21-Mar-85	Drawdown	6.2	170	11	Good
W-450	14-Apr-88	Drawdown	3.3	38	650	Fair
W-451	27-Apr-88	Drawdown	2.1	80	16	Good
W-452	2-May-88	Drawdown	5.2	310	21	Excel
W-453	3-May-88	Drawdown	5.8	67	7.4	Fair
W-455	22-Jun-88	Drawdown	5.8	160	13	Good
W-456	14-Jul-85	Drawdown	4.5	260	33	Fair
W-457	29-Jul-85	Drawdown	20.5	450	24	Excel
W-458	2-Aug-85	Drawdown	0.8	24	150	Fair
W-460	1-Sep-85	Drawdown	17.0	1,900	380	Fair
W-461	7-Sep-85	Slug	NA	690	140	Good
W-462	27-Sep-85	Drawdown	19.0	360	60	Good
W-463	11-Oct-85	Drawdown	24.0	1,600	200	Good
W-464	8-Nov-88	Drawdown	9.0	370	53	Good
W-481	2-Dec-87	Drawdown	1.1	8	1.7	Good
W-486	23-Mar-85	Drawdown	6.0	230	30	Good

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-487	14-Apr-88	Drawdown	2.2	45	15	Good
W-501	21-Oct-85	Drawdown	9.7	170	21	Good
W-502	14-Nov-85	Slug	NA	12	30	Good
W-503	11-Nov-88	Drawdown	1.3	15	3.0	Fair
W-504	8-Dec-85	Drawdown	10.0	590	84	Good
W-505	21-Mar-89	Drawdown	34.2	653	76	Good
W-506	10-Feb-89	Drawdown	31.0	7,423	460	Good
W-507	6-Feb-89	Drawdown	39.0	2,900	290	Good
W-508	29-Mar-89	Drawdown	30.0	47,000	2,600	Good
W-509	11-May-89	Drawdown	0.9	10	2.0	Fair
W-510	11-May-89	Slug	NA	220	110	Good
W-511	11-May-89	Drawdown	1.7	63	11	Fair
W-512	27-Apr-89	Drawdown	2.9	85	9.4	Good
W-513	9-May-89	Drawdown	0.6	33	3.0	Fair
W-514	26-May-89	Drawdown	1.4	84	530	Fair
W-515	6-Jun-89	Drawdown	2.8	37	4.2	Fair
W-516	19-Jun-89	Drawdown	19.5	1,428	286	Good
W-517	27-Jun-89	Drawdown	7.3	370	53	Good
W-518	10-Aug-89	Drawdown	6.2	1,421	178	Good
W-519	31-Aug-89	Drawdown	31.5	5,700	475	Excel
W-520	24-Jan-90	Drawdown	22.8	3,300	560	Excel
W-521	1-Feb-90	Drawdown	0.6	44	4.9	Fair
W-522	5-Feb-90	Drawdown	20.0	3,700	620	Fair
W-551	8-Nov-85	Drawdown	37.0	350	88	Good
W-552	12-Dec-88	Drawdown	38.0	4,700	390	Good
W-553	17-Nov-85	Drawdown	2.2	55	7.9	Fair
W-554	10-Jan-89	Drawdown	21.5	1,800	150	Good
W-555	28-Dec-88	Drawdown	14.0	460	23	Fair
W-556	25-Jan-89	Drawdown	17.0	850	170	Fair
W-557	23-Jan-89	Drawdown	1.2	570	36	Poor
W-558	23-Mar-89	Drawdown	24.7	5,200	650	Good
W-560	8-Mar-89	Drawdown	1.7	30	7.6	Fair
W-561	13-Mar-89	Drawdown	1.1	12	2.1	Fair
W-562	28-Mar-89	Drawdown	1.0	16	2.3	Fair
W-563	31-Mar-89	Drawdown	1.1	14	2.3	Fair
W-564	26-Apr-89	Drawdown	1.6	44	5.0	Poor

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-565	18-Apr-89	Drawdown	15.6	1,600	260	Good
W-566	2-May-89	Drawdown	17.0	780	86	Good
W-566	31-Aug-93	Long-term	22.5	2,580	520	Fair
W-566	11-Aug-09	Step	8.2	860	86	Good
W-567	4-May-89	Drawdown	10.4	2,600	320	Excel
W-568	20-Jun-89	Drawdown	18.3	620	160	Fair
W-569	24-May-89	Drawdown	2.8	100	15	Fair
W-570	8-Jun-89	Drawdown	1.1	7	1.1	Fair
W-571	17-Jul-89	Drawdown	17.7	1,000	200	Excel
W-592	23-Jan-89	Drawdown	2.2	2,200	280	Poor
W-593	22-Feb-89	Drawdown	2.2	57	11.4	Good
W-594	16-Mar-89	Slug	NA	380	54	Excel
W-601	8-Feb-90	Drawdown	22.5	6,900	770	Excel
W-602	29-Jan-90	Drawdown	24.0	5,300	620	Good
W-603	7-Feb-90	Drawdown	6.1	100	20	Fair
W-604	20-Feb-90	Slug	NA	380	63	Good
W-605	28-Feb-90	Drawdown	4.8	50	12	Good
W-606	21-Feb-90	Slug	NA	120	20	Fair
W-607	22-Feb-90	Drawdown	1.4	800	100	Good
W-608	28-Feb-90	Drawdown	1.2	230	30	Fair
W-609	9-Mar-90	Drawdown	6.7	470	70	Good
W-610	28-Mar-90	Drawdown	5.8	5,500	380	Good
W-611	16-Apr-90	Drawdown	3.5	1,000	110	Fair
W-612	24-May-90	Drawdown	13.5	550	55	Good
W-612	5-Apr-94	Long-term	14	230	40	Good
W-613	23-May-90	Drawdown	4.8	2,550	360	Good
W-614	7-Jun-90	Drawdown	6.7	1,650	130	Good
W-615	21-Jun-90	Drawdown	1.3	130	19	Fair
W-616	27-Jun-90	Drawdown	2.0	390	40	Fair
W-617	12-Jul-90	Drawdown	2.8	53	6.8	Good
W-618	1-Aug-90	Drawdown	1.9	24	4.8	Fair
W-619	30-Aug-90	Drawdown	11.8	190	11	Good
W-620	1-Oct-90	Drawdown	5.8	6,500	650	Good
W-621	4-Oct-90	Drawdown	3.8	310	39	Good
W-622	12-Oct-90	Slug	NA	130	16	Fair
W-651	16-Mar-90	Slug	NA	530	180	Fair

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-652	22-Mar-90	Drawdown	1.0	11	3.8	Good
W-653	11-Apr-90	Drawdown	0.3	2	2.0	Fair
W-653	16-Mar-05	Drawdown	0.45	1.0	1.0	Good
W-654	25-Apr-90	Drawdown	21.7	390	25	Fair
W-655	12-May-90	Drawdown	12.2	1,000	220	Good
W-701	23-Oct-90	Drawdown	14.5	6,800	650	Good
W-701	3-Oct-92	Step	16.5	5,200	430	Good
W-701	1-Apr-93	Drawdown	24.0	3,700	370	Good
W-702	29-Nov-90	Drawdown	2.5	150	30	Good
W-702	25-Feb-93	Step	4.6	36	7	Poor
W-703	19-Dec-90	Drawdown	7.0	230	9.1	Good
W-704	4-Mar-91	Drawdown	19.0	1,800	140	Fair
W-705	20-Feb-91	Drawdown	0.8	40	6.1	Fair
W-706	29-Jan-91	Drawdown	0.2	8	1	Fair
W-712	25-Feb-92	Drawdown	7.8	750	48	Good
W-712	18-Mar-93	Long-term	15.1	1,440	93	Good
W-714	6-Dec-91	Drawdown	2.9	140	6.7	Good
W-902	25-Mar-93	Drawdown	0.6	6	2	Fair
W-906	20-Jun-09	Step	8.6	290	4.0	Good
W-909	18-Oct-95	Drawdown	2.7	150	5.1	Good
W-911	2-Feb-96	Drawdown	1.4	53	2.1	Good
W-912	10-Nov-95	Drawdown	4.1	65	11	Poor
W-913	16-Aug-95	Drawdown	23.5	730	36	Good
W-1001	13-Aug-95	Drawdown	1.3	170	25	Fair
W-1002	19-Jun-97	Drawdown	16.8	680	49	Good
W-1003	26-Jun-97	Drawdown	1.2	5.1	0.7	Poor
W-1005	16-Jun-97	Drawdown	17	110,000	91,000	Poor
W-1006	17-Jun-97	Drawdown	17.4	180	23	Fair
W-1007	23-Sep-95	Drawdown	1.6	13	1.3	Fair
W-1007	4-May-99	Drawdown	6.6	4,300	540	Fair
W-1008	17-Jan-97	Drawdown	7.3	110	13	Good
W-1010	10-Jul-95	Drawdown	20.3	1,650	140	Fair
W-1011	11-Jul-95	Drawdown	3.8	240	17	Good
W-1012	13-Jul-95	Drawdown	3.3	35	2.2	Fair
W-1013	13-Jul-95	Drawdown	2.7	2,000	250	Poor
W-1014	28-Aug-96	Drawdown	31.1	7,700	320	Good

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-1101	22-Nov-95	Drawdown	0.8	9.9	3.3	Good
W-1102	29-Jan-96	Drawdown	14.7	81	4.5	Fair
W-1103	29-Nov-95	Drawdown	3	19	1.6	Fair
W-1105	17-Jul-95	Drawdown	2.4	320	26	Fair
W-1106	24-Jul-96	Drawdown	7.1	5,200	580	Good
W-1107	9-Apr-97	Drawdown	6.7	3,500	250	Poor
W-1107	4-May-99	Drawdown	6.6	4,300	310	Fair
W-1108	3-Nov-95	Drawdown	12.3	950	68	Good
W-1108	25-Jun-96	Long-term	11.6	1,000	70	Poor
W-1108	1-Nov-05	Drawdown	7.1	800	57	Fair
W-1108	26-Jun-09	Step	2.9	1,300	89	Fair
W-1109	26-Jun-95	Drawdown	8.7	460	33	Fair
W-1109	4-Jun-96	Long-term	6.8	760	40	Poor
W-1109	11-Aug-09	Step	1.5	650	72	Good
W-1110	22-Jan-96	Drawdown	6.3	690	29	Fair
W-1111	20-Oct-95	Drawdown	15.8	2,100	95	Good
W-1111	9-Dec-96	Long-term	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	Long-term	15.1	270	12	Fair
W-1116	23-Feb-96	Drawdown	6.6	290	11	Fair
W-1117	23-Aug-96	Drawdown	0.7	3.4	0.34	Fair
W-1118	18-Jan-96	Drawdown	5.6	350	35	Good
W-1201	1-Nov-96	Drawdown	1	8.3	0.92	Poor
W-1203	2-May-96	Drawdown	18.8	900	90	Good
W-1204	22-Feb-96	Drawdown	1.3	17	2.2	Poor
W-1205	27-Nov-96	Slug	NA	330	33	Fair
W-1206	20-Jun-09	Step	18	1,900	160	Fair
W-1207	27-Nov-96	Slug	NA	900	45	Poor
W-1208	20-Jun-09	Step	23	784	28	Fair
W-1209	17-May-96	Drawdown	0.98	11	0.69	Good
W-1210	30-May-96	Drawdown	3.8	7.3	0.73	Fair
W-1211	26-Jul-96	Drawdown	28.6	5,000	330	Good
W-1212	14-May-96	Drawdown	1.9	35	2.5	Good
W-1212	10-Sep-96	Long-term	1.3	85	3.6	Poor
W-1213	22-Jul-96	Drawdown	11.6	500	42	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-1213	30-Jul-96	Long-term	9.6	440	37	Poor
W-1213	9-Feb-09	Step	3.3	4,400	360	Fair
W-1214	28-Apr-97	Drawdown	2.2	110	5.4	Fair
W-1215	15-Aug-96	Drawdown	11.6	610	61	Fair
W-1215	8-Oct-96	Long-term	9.8	3,000	300	Poor
W-1216	14-Aug-96	Drawdown	11.4	210	6.9	Good
W-1216	15-Oct-96	Long-term	11.1	160	5.4	Poor
W-1218	11-Nov-96	Drawdown	5.8	83	4.6	Fair
W-1218	8-Jul-97	Long-term	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	Long-term	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	Long-term	18.9	1,130	110	Fair
W-1301	10-Mar-97	Long-term	4.7	120	15	Fair
W-1303	18-Mar-97	Long-term	7.8	490	21	Fair
W-1304	2-Jul-97	Drawdown	0.7	2.6	0.52	Poor
W-1306	30-Apr-97	Drawdown	2.8	24	1.2	Good
W-1306	18-Jun-97	Long-term	1.6	54	2.7	Poor
W-1307	31-Jul-97	Drawdown	11.6	1,100	110	Good
W-1308	14-Aug-97	Drawdown	6.5	150	5.1	Good
W-1308	7-Oct-97	Long-term	4.0	530	18	Fair
W-1309	15-Oct-97	Drawdown	9.1	90	8.9	Fair
W-1310	10-Mar-97	Drawdown	27.9	1,060	53	Good
W-1310	17-Nov-08	Drawdown	5.1	1,200	62	Poor
W-1311	29-Oct-97	Drawdown	12.2	290	15	Good
W-1401	11-Nov-97	Drawdown	7.0	100	6.8	Excel
W-1402	12-Dec-97	Drawdown	2.6	100	10.2	Fair
W-1403	21-Jul-98	Drawdown	5.4	95	13	Good
W-1404	21-Apr-98	Drawdown	6.5	210	84	Good
W-1405	23-Apr-98	Drawdown	6.4	1,300	360	Fair

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-1406	17-Apr-98	Drawdown	11.1	3,600	360	Good
W-1407	3-Apr-98	Drawdown	1.1	8.7	1.0	Excellent
W-1408	15-Apr-98	Drawdown	2.7	85	28	Fair
W-1410	29-Jun-98	Drawdown	11.5	3,000	500	Poor
W-1410	8-Sep-99	Step	6.5	3,800	650	Poor
W-1411	15-May-98	Drawdown	12.3	14,700	1,300	Poor
W-1412	29-May-98	Slug	NA	2	0.67	Fair
W-1413	8-Jun-98	Drawdown	0.63	8.7	3.5	Fair
W-1415	11-Jun-98	Drawdown	0.87	18	1.2	Fair
W-1416	28-Jul-98	Drawdown	12.3	1,300	180	Good
W-1417	1-Jul-98	Drawdown	15.1	130	11	Good
W-1417	16-Jul-98	Step	5.9	150	13	Fair
W-1418	25-Sep-98	Drawdown	10.7	78	6.5	Excellent
W-1418	16-Dec-98	Step	10.5	490	41	Fair
W-1419	15-Jul-98	Step	6.1	47	3	Poor
W-1420	12-Aug-98	Drawdown	13.1	3,000	220	Poor
W-1421	14-Jul-98	Step	1.82	14	1.8	Poor
W-1421	17-Jul-98	Step	3.8	22	2.8	Poor
W-1422	18-Sep-98	Drawdown	12.0	170	33	Excellent
W-1422	18-Dec-98	Step	11.7	160	32	Good
W-1423	12-Nov-98	Drawdown	24.6	540	39	Fair
W-1424	1-Oct-98	Drawdown	6	48	6.9	Excellent
W-1425	1-Oct-98	Drawdown	1.4	15	2.4	Fair
W-1426	13-Nov-98	Drawdown	6.5	840	56	Good
W-1427	11-Jan-99	Drawdown	7.9	2,100	300	Good
W-1428	13-Jan-99	Drawdown	8.1	8,200	550	Good
W-1501	20-Nov-98	Drawdown	7.2	68	11	Good
W-1502	17-May-99	Drawdown	1.5	360	60	Good
W-1503	12-Feb-99	Drawdown	17.6	1,700	180	Good
W-1503	21-Apr-09	Step	14	1,000	100	Fair
W-1504	18-Feb-99	Drawdown	15.4	600	60	Fair
W-1504	21-Apr-09	Step	3.2	370	18	Good
W-1505	29-Apr-99	Drawdown	11.2	280	35	Fair
W-1506	19-Apr-99	Drawdown	3.1	50	5.4	Good
W-1507	27-Apr-99	Drawdown	0.65	15	1.9	Fair
W-1508	28-Jun-01	Slug	NA	160	16	Good

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-1509	9-Apr-99	Drawdown	7.2	7,000	700	Good
W-1510	14-Apr-99	Drawdown	6.6	280	20	Fair
W-1510	21-Apr-09	Step	4.5	3,200	160	Fair
W-1512	21-Jun-01	Slug	NA	230	23	Good
W-1514	23-Jun-99	Long-term	5.8	440	90	Good
W-1515	18-Jan-00	Drawdown	1.5	26	1.5	Poor
W-1515	2-Feb-00	Long-term	1.1	75	4.1	Fair
W-1518	22-Mar-00	Step	6.0	440	19	Good
W-1520	21-Mar-00	Long-term	4.0	165	20	Poor
W-1522	20-Mar-00	Step	10.5	3,500	235	Good
W-1550	28-Dec-99	Drawdown	10.0	330	35	Fair
W-1601	25-Feb-00	Drawdown	3.0	35	3.6	Good
W-1602	3-Mar-00	Drawdown	8.3	3,100	310	Fair
W-1604	2-Apr-01	Drawdown	4.0	1,600	220	Fair
W-1609	14-Dec-05	Injection	0.30	1.90	0.10	Fair
W-1610	14-Jul-00	Injection	2.0	17	0.8	Good
W-1610	17-Jul-00	Injection	3.0	17	0.8	Excel
W-1610	7-Dec-05	Injection	1.5	17	0.80	Fair
W-1614	25-Aug-00	Drawdown	1.9	75	8.3	Good
W-1654	20-Apr-00	Drawdown	0.5	12	2.0	Good
W-1655	21-Apr-00	Drawdown	1.5	27	4.9	Good
W-1701	23-Jul-01	Drawdown	9.0	160	40	Good
W-1701	26-Sep-01	Long-term	15.0	60	15	Fair
W-1703	25-Oct-01	Drawdown	12.0	16,000	2,300	Fair
W-1801	3-May-02	Drawdown	10.0	6,600	660	Fair
W-1801	18-Jun-09	Step	7	1,100	110	Good
W-1802	30-Sep-02	Drawdown	1.3	11	1.1	Fair
W-1805	22-Jan-03	Drawdown	11.1	13,000	800	Fair
W-1806	15-Apr-03	Drawdown	3.1	450	77	Good
W-1807	24-Aug-09	Step	3	3,200	320	Good
W-1902	19-Mar-03	Step	11.0	1,100	29	Good
W-2012	8-Jul-10	Drawdown	NA	83.0	27.7	Fair
W-2201	9-Feb-09	Step	3.0	12,000	680	Fair
W-2202	2-Mar-06	Drawdown	0.95	65	6.5	Poor
W-2203	23-Feb-06	Drawdown	1.04	15	1.4	Fair
W-2501	5-May-10	Drawdown	35.00	240	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-2502	23-Apr-10	Drawdown	24	51	2.1	Good
W-2601	15-May-10	Drawdown	34	760	51	Fair
W-2602	2-Jun-10	Drawdown	5	38	7.6	Poor
W-2603	5-May-10	Drawdown	4.8	68.8	14.0	Good
W-2611	22-Oct-10	Drawdown	2.0	125	10.2	Good
W-2612	19-Oct-10	Slug	NA	3.9	0.13	Good
W-2801	18-Nov-11	Drawdown	3.1	339	33.9	Good
W-2801	22-Nov-11	Step	1.0	256	25.6	Good
W-3001	22-May-14	Drawdown	4.0	70	14	Good
W-3002	17-Jun-14	Drawdown	1.1	48	9.5	Excellent
W-3003	18-Jun-14	Drawdown	0.79	35	7	Excellent
W-3004	23-Sep-14	Slug	NA	28	2.8	Good
W-3101	17-Jun-15	Drawdown	5.9	38.5	7.7	Good
W-3102	18-Jun-15	Drawdown	2.1	44.5	8.9	Good
W-3104	23-Dec-15	Drawdown	2.0	24	4.8	Good
W-3107	15-Dec-15	Drawdown	1.7	65.3	13.1	Good
SIP-ETC-201	1-Apr-04	Drawdown	1.0	200	10	Fair
SIP-ETS-201	13-Mar-96	Drawdown	0.0	430	89	Fair
SIP-ETS-204	13-Mar-96	Drawdown	0.0	150	15	Poor
SIP-ETS-207	26-Oct-93	Drawdown	0.58	710	68	Fair
SIP-ETS-207	10-Nov-93	Drawdown	2.7	440	51	Fair
SIP-ETS-207	13-Mar-96	Slug	0.0	1,800	200	Poor
SIP-ETS-601	15-Jun-10	Slug	NA	5.3	0.82	Fair
SIP-ETS-601	16-Jun-10	Slug	NA	2.4	0.36	Fair
SIP-ETS-601	17-Jun-10	Slug	NA	3.0	0.46	Fair
TW-11	24-Jan-85	Drawdown	0.3	200	20	Good
TW-11A	24-Jan-85	Drawdown	10.0	3,100	110	Fair
GSW-01	11-Dec-85	Slug	NA	72	0.2	Fair
GSW-01A	14-Jul-86	Drawdown	13.4	12,000	790	Good
GSW-02	17-Dec-85	Slug	NA	240	10	Good
GSW-03	23-Dec-85	Slug	NA	510	41	Good
GSW-04	19-Dec-85	Slug	NA	17	0.9	Good
GSW-05	12-Feb-86	Slug	NA	99	9	Excel
GSW-06	23-Jun-86	Drawdown	25.0	4,800	310	Good
GSW-06	16-Jun-87	Long-term	20.0	5,500	350	Good
GSW-07	3-Apr-86	Drawdown	4.3	230	23	Excel

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

Well	Date	Type of test[b]	Flow rate (Q) (gpm)	Transmissivity (T) (gpd/ft)	Hydraulic conductivity (K)[c] (gpd/sq ft)	Data quality[d]
GSW-08	19-Nov-86	Drawdown	2.0	230	38	Good
GSW-09	28-May-86	Drawdown	1.9	500	63	Poor
GSW-10	22-May-86	Drawdown	14.3	21,000	2,000	Good
GSW-11	2-Jun-86	Drawdown	4.7	390	45	Excel
GSW-12	7-Jun-86	Drawdown	0.8	51	11	Fair
GSW-13	4-Aug-86	Slug	NA	110	13	Excel
GSW-13	8-Aug-86	Slug	NA	62	7	Good
GSW-15	23-Feb-88	Drawdown	25.8	1,500	190	Good
GSW-208	8-May-86	Drawdown	1.9	440	80	Good
GSW-209	8-May-86	Drawdown	6.1	1,200	120	Good
GSW-215	4-Jun-86	Drawdown	1.9	220	40	Poor
GSW-216	16-Jan-92	Drawdown	10.5	3,500	440	Fair
GSW-266	20-Jun-86	Drawdown	2.1	470	72	Good
GSW-266	18-Nov-86	Drawdown	3.0	450	64	Good
GSW-266	18-Nov-86	Drawdown	4.7	410	59	Good
GSW-367	11-May-87	Drawdown	6.9	200	29	Fair
GSW-403-6	8-Dec-85	Slug	NA	4	0.2	Good
GSW-442	23-Nov-87	Drawdown	1.2	32	4.6	Good
GSW-443	30-Nov-87	Drawdown	10.3	260	8.7	Good
GSW-444	28-Jan-88	Slug	NA	9	0.86	Good
GSW-445	26-Jan-85	Drawdown	4.7	43	4.30	Fair
GEW-710	23-Sept-91	Step	36.0	4,800	220	Excel
GEW-816	15-Aug-92	Drawdown	39.0	12,000	1,100	Good
11H4	15-Jan-85	Drawdown	24.6	2,000	77	Good
11H4	19-Jan-85	Long-term	29.5	1,780	18	Good
11J4	10-Jun-88	Drawdown	17.0	1,000	15	Excel
11J4	14-Jun-85	Long-term	16.0	1,100	16	Good
13D1	9-Feb-85	Long-term	50.0	4,800	48	Excel

Notes and footnotes appear on the following page.

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

Notes:

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

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

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

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

[d] **Hydraulic test quality criteria:**

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

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

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

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

References

Boulton, N. (1963), "Analysis of Data from Non-Equilibrium Pumping Tests Allowing for Delayed Yield from Storage," *Proc. Inst. Civ. Eng.* 26, 469-482.

Cooper, H., Jr., J.D. Bredehoeft, and I.S. Papadopulos (1967), "Response of a Finite-Diameter Well to an Instantaneous Charge of Water," *Water Resour. Res*. 3, 263-269.

Cooper, H., and C.E. Jacob (1946), "A Generalized Graphical Method of Evaluating Formation Constants and Summarizing Well Field History," *Am. Geophys. Union Trans.* 27, 526-534.

Hantush, M. (1960), "Modification of the Theory of Leaky Aquifers," *J. of Geophys. Res.* 65, 3173-3725.

Hantush, M., and C.E. Jacob (1955), "Non-Steady Radial Flow in an Infinite Leaky Aquifer," *Am. Geophys. Union Trans.* 36 (1), 95-100.

Papadopulos, I., and H.H. Cooper, Jr. (1967), "Drawdown in a Well of Large Diameter," *Water Resour. Res.* 3, 241-244.

Theis, C. (1935), "The Relation Between the Lowering of the Piezometric Surface and the Rate and Duration of Discharge of a Well Using Ground-Water Storage," *Am. Geophys. Union Trans*. 16, 519–524.

Appendix C

Ground Water Sampling Monitoring Algorithm

Appendix C

Ground Water Sampling Monitoring Algorithm

C-1. Introduction

LLNL uses a statistically based methodology, referred to as the cost-effective sampling (CES) frequency algorithm, to estimate the lowest-frequency sampling schedule for ground water monitoring locations that meets regulatory and cleanup monitoring needs.

The CES algorithm first generates an initial, or "raw", recommendation separately for each location using a computer program that evaluates patterns in the available data. The raw recommendation at each location may be for quarterly, semi-annual, annual, or biennial (every other year) sampling. Project personnel then review the raw recommendations and are permitted to increase, but not decrease, the sampling frequency based on other (non-statistical) considerations (McConachie, 1993). In some instances the computer program is unable to make a raw recommendation, in which case project personnel determine a sampling frequency.

The CES algorithm is applied every quarter to obtain recommendations that will take effect in the following quarter. Thus the sampling frequency determinations are updated regularly as new data are obtained.

The algorithm is a dynamic tool that can be modified as remediation continues and technical advances occur.

C-2. Use of the CES Algorithm

The CES algorithm is applied separately to each location. Concentration trend, variability, and magnitude statistics are calculated for each of thirteen key contaminants of concern (COCs): carbon tetrachloride, chloroform, 1,1-DCA, 1,2-DCA, 1,1-DCE, 1,2-DCE (total), Freon 113, PCE, 1,1,1-TCA, 1,1,2-TCA, TCE, Freon 11 (trichloroflouromethane), and vinyl chloride. The statistics are then evaluated to produce a raw recommended sampling frequency for each COC. The raw CES recommendation for each location is the greatest sampling frequency among the individual COC recommendations at that location.

Two time periods are defined: "recent" and "long-term". Recent data consist of the most recent 1.5 to 2.5 years and at least 2 data points. Long-term data consist of at least 4.5 to 6 years and at least 4 data points. The time periods are extended if necessary to obtain at least the required minimum number of data points.

C-2.1. Analyzing trend, variability, and magnitude

The basic CES principle is that the greater the rate of change, whether up or down, the greater the potential need for more frequent sampling. Where little change is observed, less frequent sampling is warranted. Similarly, the greater the variability in concentrations, the greater the potential need for more frequent sampling.

Trends are obtained by calculating a linear regression of concentration as a function of time. The slope of the regression line represents an average rate of concentration change per year. The magnitude of the concentration affects whether a given rate of change is environmentally significant. For example, a yearly change of 50 ppb is more significant for a well in which concentrations are around 100 ppb than for one in which concentrations are around 1,000 ppb. In a 100 ppb well, a 50 ppb/year rate of change would be considered large, whereas in a 1,000 ppb well it would be considered small. Therefore, trends are categorized as high, medium-high, medium-low, or low, depending on both the slope and their concentration range (as indicated by the median concentration), as shown in Table C-1.

Table C-1. Trend categories as a function of regression slope and median concentration.

	Annual Rate of Change Category (ppb)			
Concentration range	**Low**	**Medium-low**	**Medium-high**	**High**
<100	<5	5-10	10-30	>30
<300	<15	15-30	40-90	>90
>300	<50	50-100	100-300	>300

Variability is evaluated by an index of relative variability defined as the concentration range divided by the median concentration. For example, data with a range of 50 ppb at a median of 5,000 ppb are considerably less variable than data with a range of 50 ppb at a median of 100 ppb. “High” variability is defined as a variability index greater than 1, and “low” variability is defined as a variability index less than or equal to 1.

Finally, trend and variability are considered together to determine an initial sampling frequency recommendation, as shown in Table C-2.

Table C-2. Trend and variability determine a sampling frequency.

Trend category	Variability index	Sampling Frequency
High	Any	Quarterly
Medium-high	High (>1)	Quarterly
Medium-high	Low (<1)	Semi-annual
Medium-low	High (>1)	Semi-annual
Medium-low	Low (<1)	Annual
Low	Any	Annual

C-2.2. Determining a CES raw recommendation

The CES recommendation for an individual COC at a single location is determined in four steps:

Step 1 consists of applying the trend and variability evaluation of Section C-2.1 to recent data to obtain an initial sampling frequency of quarterly, semi-annual, or annual (this is the "Step 1 frequency").

Step 2 consists of applying the trend and variability evaluation of Section C-2.1 to long-term data and comparing with the results of Step 1.

- If the sampling frequency based on recent data (the Step 1 frequency) is semi-annual or annual, it is used for the CES raw recommendation.
- If the recent trend is greater than the overall trend (in absolute value), the Step 1 frequency is used for the CES raw recommendation.
- If recent and long-term trends are in the same category, the Step 1 frequency is used for the CES raw recommendation.

Otherwise, the recent and long-term trends are compared using the absolute value of the ratio of the recent slope to the long-term slope.

- If the ratio is ≥0.25 then the sampling frequency based on the long-term data is used for the CES raw recommendation.
- If the ratio is <0.25 and the median recent concentration is <10 ppb, the Step 1 sampling frequency is used.
- If the ratio is <0.25 but the median recent concentration is ≥ 10 ppb, then CES does not make a recommendation; project personnel review the data and make a determination.

Step 3 consists of reducing the sampling frequency for the low-risk compounds chloroform, Freon 11, and Freon 113.

Not all compounds in the analytical target list are equally harmful. For example, an average rate of change of 25 ppb per year for TCE (5 ppb MCL) is more significant than the same trend for chloroform, Freon 11 or Freon 113 (100 ppb, 150 ppb, and 1,200 ppb MCL, respectively). If the maximum concentration in the recent data is less than half of the MCL then quarterly and semiannual sampling frequencies are reduced to semi-annual and annual respectively.

Step 4 consists of reducing the sampling frequency to biennial if the following conditions are met.

- The result of Steps 1 through 3 must be an annual frequency recommendation.
- The average rates of change for both recent and long-term data sets must be in the annual category.

- There must be no indication of upward trend. The recent median concentration must be less than the long-term median concentration plus 2.5 ppb. Small fluctuations of slopes within the low annual category are expected, but there should be no indication of a larger upward trend.
- The median recent concentration must be low (less than 20 ppb).

After all four steps have been completed for every analyte at a location, the CES raw recommendation for the location is the greatest sampling frequency among the individual COC recommendations at that location. If the algorithm was unable to determine a sampling frequency for any of the COCs, the CES raw recommendation for the location as a whole is undetermined.

Finally, project personnel review the raw recommendations and are permitted to increase, but not decrease, the sampling frequency based on other (non-statistical) considerations.

C-3. Applicability

Some locations will have sampling frequencies driven by regulatory or remedial needs regardless of their concentration history. For example, wells located downgradient of the leading edge of a plume can be designated as “guard” wells and will remain on a quarterly sampling schedule regardless of the CES analyses. Sampling frequencies for ground water extraction wells associated with treatment facilities always remain quarterly for use in mass removal estimates, and are not included in the CES algorithm analysis. Each quarter, the list of wells evaluated by the CES algorithm is reviewed and adjusted based on such considerations.

C-4. Reference

McConachie, W.A. (1993), LLNL Environmental Restoration Division: letter to M. Gill of U.S. Environmental Protection Agency, B. Cook of the Department of Toxic Substances Control, and S. Ritchie of the Regional Water Quality Control Board, describing the sampling schedule for the LLNL Livermore Site monitor wells, dated February 10, 1993.

Appendix D

2015 and 2016 Ground Water Sampling Schedules

Table D-1. 2015 and 2016 LLNL Livermore Site VOC ground water sampling schedules.

Well number	2015		2016		Additional analytes (Q1-10)
	VOC sampling frequency	Next quarter sample date	VOC sampling frequency	Next quarter sample date	
W-001	E	4-16	A	1-16	
W-001A	A	1-15	A	1-16	
W-002	A	1-15	A	1-16	
W-002A	O	3-15	O	3-17	
W-004	E	2-16	O	2-17	
W-005	E	3-16	E	3-16	
W-005A	E	4-16	E	4-16	
W-008	E	3-16	E	3-16	EFA
W-011	O	3-15	O	3-17	
W-012	A	1-14	A	1-16	
W-017	E	1-16	E	1-16	EFA
W-017A	O	1-15	O	1-17	
W-101	O	1-15	E	1-16	
W-102	O	1-15	O	1-17	
W-103	O	1-15	O	1-17	
W-104	Q	1-15	Q	1-16	
W-105	Q	1-15	S	1-16	
W-106	O	1-15	O	1-17	
W-107	O	1-15	E	1-16	
W-108	O	3-15	O	3-17	
W-110	Q	1-15	Q	1-16	
W-111	E	1-16	A	2-16	
W-112	E	4-16	A	4-16	
W-113	O	1-15	E	1-16	
W-114	O	1-15	E	1-16	
W-115	O	2-15	O	2-17	
W-116	Q	1-15	Q	1-16	
W-117	O	3-15	O	3-17	
W-118	E	2-16	O	2-17	
W-119	A	1-15	A	1-16	EFA
W-120	Q	1-15	S	1-16	
W-121	Q	1-15	Q	1-16	EFA
W-122	E	1-16	E	1-16	
W-123	E	1-16	E	1-16	
W-141	A	3-15	O	3-17	
W-142	O	1-15	E	1-16	
W-143	A	1-15	A	1-16	
W-146	Q	1-15	Q	1-16	
W-147	O	2-15	S	1-16	
W-148	E	1-16	E	1-16	
W-151	Q	1-15	Q	1-16	EFA
W-201	E	3-16	O	2-17	

Table D-1. 2015 and 2016 LLNL Livermore Site VOC ground water sampling schedules.

Well number	2015		2016		Additional analytes (Q1-10)
	VOC sampling frequency	Next quarter sample date	VOC sampling frequency	Next quarter sample date	
W-202	O	1-15	E	1-16	
W-204	A	1-15	A	1-16	
W-205	S	2-15	Q	2-16	
W-206	Q	1-15	S	1-16	
W-207	O	1-15	E	1-16	
W-210	O	1-15	O	4-17	
W-212	O	1-15	O	1-17	
W-213	E	3-16	E	3-16	
W-214	A	1-15	A	1-16	
W-218	O	1-15	A	1-16	
W-219	O	3-15	O	3-17	
W-220	A	4-15	A	1-16	
W-221	E	1-16	E	1-16	EFA
W-222	A	4-15	A	1-16	
W-223	O	3-15	O	3-17	
W-224	E	4-16	E	1-16	
W-225	E	2-16	E	2-16	
W-226	O	1-15	O	1-17	
W-251	Q	1-15	Q	1-16	
W-252	O	1-15	A	3-16	
W-253	O	3-15	O	3-17	
W-255	O	1-15	O	1-17	
W-256	O	4-15	O	4-17	
W-257	O	1-15	A	1-16	
W-258	A	2-15	A	2-16	
W-259	Q	1-15	S	1-16	
W-260	A	4-15	A	4-16	
W-261	O	2-15	Q	1-16	
W-263	Q	1-15	Q	1-16	
W-264	Q	1-15	A	1-16	
W-265	O	3-15	O	3-17	
W-267	S	1-15	O	3-17	
W-268	A	3-15	S	1-16	
W-269	E	2-16	S	1-16	
W-270	O	1-15	O	1-17	
W-271	Q	1-15	A	1-16	
W-272	E	3-16	O	3-17	
W-273	E	1-16	E	1-16	
W-274	A	1-15	Q	1-16	
W-275	E	4-16	O	4-17	
W-276	S	1-15	S	1-16	
W-277	E	1-16	O	1-17	

Table D-1. 2015 and 2016 LLNL Livermore Site VOC ground water sampling schedules.

Well number	2015		2016		Additional analytes (Q1-10)
	VOC sampling frequency	Next quarter sample date	VOC sampling frequency	Next quarter sample date	
W-290	O	1-15	O	1-17	
W-291	O	1-15	O	1-17	
W-293	O	1-15	O	1-17	
W-294	O	1-15	O	1-17	
W-301	E	3-16	O	3-17	
W-302	E	4-16	O	4-17	
W-303	E	3-16	E	3-16	
W-304	E	2-16	O	2-17	
W-306	E	2-16	E	2-16	
W-307	S	1-15	A	1-16	
W-308	E	3-16	O	3-17	
W-310	Q	1-15	S	1-16	
W-311	A	1-15	A	1-16	
W-312	O	2-15	O	2-17	
W-313	O	1-15	O	1-17	
W-315	Q	1-15	Q	1-16	
W-316	E	3-16	A	1-16	
W-317	A	4-15	A	1-16	
W-319	E	3-16	E	3-16	
W-320	A	4-15	A	1-16	
W-321	E	1-16	E	1-16	
W-322	Q	1-15	Q	1-16	
W-323	Q	1-15	Q	1-16	
W-324	E	4-16	E	4-16	
W-325	E	1-16	O	2-17	
W-353	A	1-16	A	3-16	
W-354	Q	1-15	Q	1-16	
W-355	Q	1-15	A	1-16	
W-356	S	2-15	A	4-16	
W-361	O	1-15	O	4-17	
W-362	E	2-16	E	2-16	
W-363	S	2-15	Q	2-16	EFA
W-364	A	3-15	A	3-16	
W-365	E	3-16	O	3-17	
W-366	E	2-16	E	2-16	
W-369	A	1-15	O	1-17	
W-370	O	2-15	O	2-17	
W-371	E	1-16	E	1-16	
W-372	O	1-15	O	1-17	
W-373	A	1-15	A	1-16	EFA
W-375	E	1-16	E	1-16	
W-376	O	2-15	O	2-17	
W-377	O	4-15	O	4-17	

Table D-1. 2015 and 2016 LLNL Livermore Site VOC ground water sampling schedules.

Well number	2015		2016		Additional analytes (Q1-10)
	VOC sampling frequency	Next quarter sample date	VOC sampling frequency	Next quarter sample date	
W-378	A	1-15	A	1-16	
W-379	Q	1-15	A	2-16	
W-380	O	2-15	O	2-17	
W-401	E	4-16	E	4-16	
W-402	O	2-15	O	2-17	
W-403	O	2-15	O	2-17	
W-405	Q	1-15	Q	1-16	
W-406	E	1-16	E	1-16	
W-407	Q	1-15	Q	1-16	
W-409	E	4-16	A	1-16	
W-410	Q	1-15	Q	1-16	
W-411	A	2-15	A	1-16	
W-412	E	4-16	E	4-16	
W-416	O	2-15	O	4-17	
W-417	O	4-15	O	4-17	
W-418	E	4-16	O	4-17	
W-419	O	4-15	O	2-17	
W-420	E	4-16	O	4-17	
W-421	Q	1-15	Q	1-16	
W-422	Q	1-15	Q	1-16	
W-423	A	4-15	A	1-16	
W-424	A	4-15	A	1-16	
W-446	O	1-15	O	1-17	
W-447	E	2-16	O	2-17	
W-448	A	1-15	A	1-16	
W-449	A	1-15	A	1-16	
W-450	E	2-16	E	2-16	
W-451	O	1-15	O	1-17	
W-452	S	1-15	A	1-16	
W-453	E	4-16	E	4-16	
W-454	S	2-15	S	1-16	
W-455	O	2-15	O	2-17	
W-458	E	2-16	E	2-16	
W-459	O	4-15	O	4-15	
W-462	E	1-16	E	1-16	
W-463	O	1-15	O	1-17	
W-464	A	1-15	A	1-16	
W-481	Q	1-15	Q	1-16	
W-482	A	2-15	O	2-17	
W-483	O	4-15	E	1-16	
W-484	O	3-15	O	3-17	
W-485	O	1-15	O	1-17	
W-486	E	2-16	E	2-16	

Table D-1. 2015 and 2016 LLNL Livermore Site VOC ground water sampling schedules.

Well number	2015		2016		Additional analytes (Q1-10)
	VOC sampling frequency	Next quarter sample date	VOC sampling frequency	Next quarter sample date	
W-487	O	2-15	O	2-17	
W-501	A	1-15	A	1-16	
W-502	O	1-15	A	1-16	
W-503	Q	1-15	O	4-17	
W-504	E	1-16	E	1-16	
W-505	E	3-16	E	3-16	
W-506	E	4-16	O	4-17	
W-507	O	4-15	O	4-17	
W-509	S	1-15	A	1-16	
W-510	O	1-15	O	1-17	
W-511	E	1-16	E	1-16	
W-512	A	1-15	O	1-17	
W-513	O	1-15	O	1-17	
W-514	E	1-16	E	1-16	
W-515	Q	1-15	Q	1-16	
W-516	O	4-15	S	2-16	
W-517	Q	1-15	Q	1-16	
W-519	O	1-15	O	1-17	
W-520	E	1-16	E	1-16	
W-521	O	1-15	O	1-17	
W-551	A	1-15	O	2-17	
W-552	E	2-16	O	2-17	
W-553	O	2-15	O	2-17	
W-554	E	4-16	E	4-16	
W-555	O	4-15	O	4-17	
W-556	E	2-16	O	2-17	EFA
W-557	O	1-15	O	1-17	
W-558	Q	1-15	Q	1-16	
W-559	O	1-15	O	1-17	
W-560	O	1-15	O	1-17	
W-561	E	4-16	E	4-16	
W-562	O	1-15	O	1-17	
W-563	A	4-15	A	4-16	
W-564	E	2-16	E	2-16	
W-565	S	1-15	O	1-17	
W-567	O	3-15	O	3-17	
W-568	Q	1-15	Q	1-16	
W-569	S	1-15	A	1-16	
W-570	O	1-15	O	1-17	
W-571	S	1-15	A	1-16	EFA
W-592	E	1-16	E	1-16	
W-593	O	1-15	O	1-17	
W-594	E	1-16	E	1-16	

Table D-1. 2015 and 2016 LLNL Livermore Site VOC ground water sampling schedules.

Well number	2015		2016		Additional analytes (Q1-10)
	VOC sampling frequency	Next quarter sample date	VOC sampling frequency	Next quarter sample date	
W-601	E	1-16	E	1-16	
W-602	E	1-16	E	1-16	
W-603	O	4-15	O	4-17	
W-604	S	1-15	A	1-16	
W-606	S	1-15	A	1-16	
W-607	E	3-16	E	3-16	
W-608	O	1-15	O	1-17	
W-609	E	1-16	E	1-16	
W-611	A	1-15	A	1-16	
W-612	E	3-16	O	3-17	
W-613	A	1-15	A	1-16	
W-615	A	1-15	A	1-16	
W-616	E	1-16	E	1-16	
W-617	E	1-16	O	2-17	
W-618	Q	1-15	Q	1-16	
W-619	O	3-15	O	3-17	
W-622	A	1-15	A	1-16	
W-651	Q	1-15	Q	1-16	
W-652	O	2-15	O	2-17	
W-654	Q	1-15	S	2-16	
W-702	S	2-15	O	2-17	
W-703	S	1-15	A	3-16	
W-705	A	1-15	A	1-16	
W-706	E	3-16	A	1-16	
W-750	E	3-16	O	3-17	
W-901	O	1-15	O	1-17	
W-902	A	2-15	A	2-16	
W-905	O	4-15	O	4-17	
W-908	O	1-15	O	1-17	
W-909	Q	1-15	S	2-16	
W-911	A	3-15	Q	1-16	
W-912	S	1-15	S	1-16	
W-913	Q	1-15	Q	1-16	
W-1002	O	1-15	O	1-17	
W-1003	O	4-15	O	4-17	
W-1008	O	1-15	O	1-17	
W-1010	E	1-16	E	1-16	
W-1011	E	2-16	E	2-16	
W-1012	A	1-15	A	1-16	EFA
W-1013	A	1-15	A	1-16	
W-1014	A	3-15	A	3-16	

Table D-1. 2015 and 2016 LLNL Livermore Site VOC ground water sampling schedules.

Well number	2015		2016		Additional analytes (Q1-10)
	VOC sampling frequency	Next quarter sample date	VOC sampling frequency	Next quarter sample date	
W-1101	E	4-16	O	4-17	
W-1105	O	3-15	O	3-17	
W-1106	A	1-15	O	1-17	
W-1107	S	1-15	A	2-16	
W-1110	A	1-15	A	1-16	
W-1112	E	3-16	O	3-17	
W-1113	O	1-15	A	1-16	
W-1115	O	1-15	O	1-17	
W-1117	S	1-15	S	1-16	
W-1118	S	2-15	A	4-16	
W-1201	S	2-15	S	1-16	
W-1202	A	1-15	A	1-16	
W-1203	A	2-15	A	2-16	
W-1204	S	1-15	O	1-17	
W-1205	A	1-15	A	1-16	
W-1207	E	4-16	O	4-17	
W-1209	A	1-15	A	1-16	
W-1210	A	1-15	S	2-16	
W-1212	Q	1-15	Q	1-16	
W-1214	Q	1-15	Q	1-16	
W-1217	Q	1-15	S	1-16	
W-1219	A	1-15	S	1-16	
W-1222	Q	1-15	A	3-16	
W-1223	A	1-15	A	1-16	
W-1224	O	2-15	O	2-17	
W-1225	Q	1-15	Q	1-16	
W-1226	E	2-16	O	2-17	
W-1227	E	3-16	O	3-17	
W-1250	Q	1-15	Q	1-16	
W-1251	Q	1-15	A	1-16	
W-1252	A	2-15	A	2-16	
W-1253	Q	1-15	Q	1-16	
W-1255	Q	1-15	A	1-16	
W-1303	Q	1-15	Q	1-16	EFA
W-1304	Q	1-15	Q	1-16	
W-1306	Q	1-15	Q	1-16	EFA
W-1308	Q	1-15	Q	1-16	EFA
W-1311	A	1-15	A	1-16	
W-1401	A	4-15	A	4-15	
W-1402	A	3-15	O	3-17	
W-1404	Q	1-15	A	1-16	
W-1405	Q	4-15	A	1-16	
W-1406	A	2-15	A	1-16	

Table D-1. 2015 and 2016 LLNL Livermore Site VOC ground water sampling schedules.

Well number	2015		2016		Additional analytes (Q1-10)
	VOC sampling frequency	Next quarter sample date	VOC sampling frequency	Next quarter sample date	
W-1407	S	2-15	A	1-16	
W-1408	S	1-15	A	1-16	
W-1411	E	2-16	E	2-16	
W-1412	S	1-15	S	1-16	
W-1413	A	1-15	A	1-16	
W-1414	Q	1-15	Q	1-16	
W-1416	E	3-16	E	3-16	
W-1417	S	1-15	O	3-17	
W-1418	A	1-15	A	1-16	
W-1419	E	3-16	E	3-16	
W-1420	Q	1-15	Q	1-16	
W-1421	A	1-15	A	1-16	
W-1422	Q	1-15	S	1-16	
W-1424	Q	1-15	Q	1-16	
W-1425	Q	1-15	O	4-17	
W-1426	A	1-15	A	1-16	
W-1427	S	1-15	O	4-17	
W-1428	S	2-15	O	2-17	
W-1501	E	3-16	O	3-17	
W-1502	E	2-16	E	2-16	
W-1505	Q	1-15	Q	1-16	
W-1506	S	2-15	O	4-17	
W-1507	A	1-15	Q	1-16	
W-1508	E	3-16	E	3-16	
W-1509	A	1-15	A	1-16	
W-1511	A	4-15	A	4-16	
W-1512	E	4-16	E	4-16	
W-1517	S	1-15	A	1-16	
W-1519	Q	1-15	Q	1-16	
W-1551	A	2-15	S	1-16	
W-1553	S	2-15	Q	1-16	
W-1604	Q	1-15	S	1-16	
W-1605	Q	1-15	Q	1-16	
W-1606	Q	1-15	S	2-16	
W-1607	S	1-15	S	1-16	
W-1608	Q	1-15	A	4-16	
W-1609	Q	1-15	Q	1-16	
W-1610	Q	1-15	A	4-16	
W-1613	O	1-15	O	1-17	
W-1614	A	1-15	A	1-16	

Table D-1. 2015 and 2016 LLNL Livermore Site VOC ground water sampling schedules.

Well number	2015		2016		Additional analytes (Q1-10)
	VOC sampling frequency	Next quarter sample date	VOC sampling frequency	Next quarter sample date	
W-1701	S	1-15	Q	1-16	
W-1703	O	1-15	O	1-17	
W-1704	E	3-16	E	3-16	
W-1705-1	E	4-16	E	3-16	
W-1705-2	Q	1-15	Q	1-16	
W-1705-3	Q	1-15	Q	1-16	
W-1802	S	2-15	A	4-16	
W-1803-1[a]	S	2-15	A	3-16	
W-1803-2[a]	Q	1-15	A	2-16	
W-1804-1[a]	S	1-15	A	3-16	
W-1804-2[a]	Q	1-15	Q	1-16	
W-1805	E	4-16	A	1-16	
W-1901-1[a]	A	1-15	A	1-16	
W-1901-2[a]	S	1-15	S	1-16	
W-1905-1[a]	Q	1-15	A	2-16	
W-1905-2[a]	Q	1-15	Q	1-16	
W-2103	Q	1-15	Q	1-16	
W-2113	O	4-15	O	4-17	
W-2202	A	1-15	Q	1-16	
W-2211	A	1-15	A	1-16	
W-2212	Q	1-15	Q	1-16	
W-2215A	Q	1-15	Q	1-16	
W-2215B	S	2-15	S	2-17	
W-2216B	Q	1-15	Q	1-16	
W-2302	Q	1-15	Q	1-16	
W-2304	Q	1-15	Q	1-16	
W-2602	S	2-15	A	2-16	
W-2603	A	1-15	A	1-16	
W-2604A	A	2-15	A	2-16	
W-2604B	A	2-15	A	2-16	
W-2605A	A	1-15	A	1-16	
W-2606	Q	1-15	S	1-16	
W-2607	Q	1-15	A	4-16	
W-2611	S	2-15	Q	1-16	
W-2612	Q	1-15	Q	1-16	
W-2616	S	1-15	S	1-16	
W-2617	Q	1-15	Q	1-16	
W-2618	A	1-15	A	1-16	
W-2619	Q	1-15	Q	1-16	
W-2620A	Q	1-15	Q	1-16	
W-2621	A	2-15	A	1-16	

Table D-1. 2015 and 2016 LLNL Livermore Site VOC ground water sampling schedules.

Well number	2015		2016		Additional analytes (Q1-10)
	VOC sampling frequency	Next quarter sample date	VOC sampling frequency	Next quarter sample date	
W-2622	S	2-15	S	2-16	EFA
W-2623	Q	1-15	Q	1-16	
W-3001	Q	1-15	Q	1-16	
W-3002	Q	1-15	A	3-16	
W-3003	Q	1-15	A	3-16	
W-3004	Q	1-15	Q	1-16	
TW-11	S	1-15	S	1-16	
TW-11A	E	2-16	O	2-17	
TW-21	E	1-16	E	1-16	
11C1	O	1-15	O	1-17	
14A11	E	2-16	E	2-16	
14A3	O	4-15	E	1-16	
14B1	O	3-15	O	3-17	
14B4	E	2-16	E	2-16	
14C2	O	4-15	E	1-16	
18D1	O	1-15	O	1-17	
GSW-006	E	1-16	E	1-16	
GSW-007	O	1-15	O	1-17	
GSW-008	E	3-16	E	3-16	
GSW-009	Q	1-15	Q	1-16	
GSW-011	E	4-16	E	4-16	
GSW-013	O	1-15	O	1-17	
GSW-215	E	1-16	E	1-16	
GSW-216	O	2-15	O	2-17	
GSW-266	E	3-16	E	3-17	
GSW-326	O	3-15	O	3-17	
GSW-367	E	3-16	E	3-16	
GSW-442	E	1-16	E	1-16	
GSW-443	E	3-16	E	3-16	
GSW-444	O	1-15	O	2-17	

Notes:

All analyses are by EPA Method 601 for purgeable halocarbons.

E = **Even years.**

O = **Odd years.**

A = **Annual.**

S = **Semiannual.**

Q = **Quarterly.**

Q1 = **First Quarter.**

EFA = **Environmental Functional Area. Analyses are for the environmental surveillance monitoring programs carried out at DOE sites to complement restoration activities.**

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

Appendix E

The Remediation Evaluation (REVAL) Process

Appendix E

The Remediation Evaluation (REVAL) Process

DOE/ERD developed the REVAL process (Table E-1) to systematically evaluate treatment facility performance. REVAL ensures that each system operates in a safe and optimal manner to remove and treat contaminated soil vapor and ground water, and ultimately expedite cleanup of the subsurface. The process was designed to ensure that the following procedures and activities are implemented properly at each facility undergoing repairs and upgrades:

- Track maintenance and repair work required for each facility;
- Document existing facility, pipeline and extraction well conditions;
- Standardize equipment, instrumentation, and data acquisition systems;
- When necessary, upgrade and expand system components;
- Collect ground water analytical data from extraction and performance monitoring wells to assess potential rebound during a hiatus in operations;
- Collect information on the specific capacity of extraction wells; and
- Collect subsurface hydraulic and pneumatic interference information during extraction well field startup.

See Table E-1 on the following page.

Table E-1. Summary of the Remediation Evaluation (REVAL) Process.

REVAL Process Step	Description of Activities
1 - Project Initiation	The project is initiated with a document that identifies the project objectives and personnel, and details individual roles and responsibilities. The document also refers to all applicable site safety and security procedures, standard operating procedures, and all relevant regulatory documentation.
2 - Remedial System Review/Design	The hydrogeology team reviews the effectiveness of the extraction well field and recommends adjustments. The engineering team performs a treatment facility assessment to identify necessary repairs, modifications, and upgrades to achieve optimal treatment facility performance. During this step, all facility design, operation, and maintenance documentation is reviewed and updated as necessary. If applicable, well field expansion may be incorporated into the design during this step.
3 - Facility Repairs, Modifications, and Construction	The engineering team performs the necessary repairs and modifications to the facility and documents “as-built” drawings. Repairs and modifications increase data accuracy and reliability, improve treatment facility and extraction well field operations, and standardization of equipment, instrumentation and control systems.
4 - Initial Well Field Sampling	If applicable, the hydrogeology team identifies the extraction and monitoring wells that require sampling. Field personnel sample these wells prior to the startup of the facility. The analytical results are used to evaluate potential rebound in contaminant concentrations while the facility was shutdown.
5 - Facility Testing and Verification	The engineering team performs testing and verification of the treatment facility components. The facility is then operated on a day-only (test) basis until all facility systems are verified. Once all applicable operational functions and interlocks are verified, the facility can run on a 24-hour basis.
6 - Extraction Well Field Startup	The hydrogeology team prepares an extraction well field startup plan using data gathered during the verification and validation step. The startup plan may include specific capacity testing of each well or a phased startup of the entire extraction well field to determine hydraulic or pneumatic interference and achieve stable operations of the extraction well field and treatment facility. Analysis of the test data provides a foundation for evaluating long-term well performance and improving/optimizing extraction well field performance.

Appendix F

Rule-based Algorithms for Generating Ground Water Elevation and Isoconcentration Contour Maps

Appendix F

Rule-based Algorithms for Generating Ground Water Elevation and Isoconcentration Contour Maps

In 1997, the U.S. Department of Energy/Lawrence Livermore National Laboratory Environmental Restoration Division (DOE/ERD) developed a process to assist hydrogeologists in developing a consistent set of ground water elevation and isoconcentration maps that cover the entire Livermore Site project history. The process is called the Optimized Environmental Restoration Analysis (OPERA) and consists of a set of rule-based algorithms that utilize all site data and knowledge into an automated system for creating representative maps over the project history. It was developed primarily to provide hydrogeologists a means to focus on data analysis rather than data compilation. In addition to generating representative maps in a short period of time, the process also provides consistent interpolations over time and provides a platform for improved quality assurance and quality control. The process and resulting maps also provide a feedback loop where the database and site conceptual model are continually updated.

The resulting maps are used in regulatory reports, presentations, remediation planning, remedial performance evaluation, numerical modeling input, and most importantly, as an overall communication tool between all stakeholders.

The rules for the algorithms have been developed over time and represent the collective experience of the past and present Livermore Site hydrogeologists. In essence, OPERA is DOE/ERD's knowledge management tool for preserving and improving the site conceptual model by maintaining a record of the interpreted subsurface data.

There are four main parts to the OPERA process: 1) environmental database, 2) site conceptual model (i.e., hydrostratigraphic unit (HSU) designations), 3) site and project knowledge, and 4) computer programs that consist of algorithms and visualization packages.

The process is designed to be inherently conservative. For example, the highest observed concentration in a well that was sampled twice in a given quarter (e.g., duplicate samples) is always selected as the representative result. The use of a three-point moving average was incorporated into the rules to prevent concentration fluctuations in a well over time from incorrectly influencing decision-making. As a result, the data set used in generating ground water elevation and isoconcentration maps will not always exactly match the value stored in the database for a given well (Attachment B). OPERA is used to generate the data files and preliminary maps. The final maps are always generated and reviewed by a hydrogeologist. The resulting ground water elevation and isoconcentration maps have been shown to be significantly more effective in evaluating the progress of remediation progress at the Livermore Site because the change in ground water elevations and isoconcentration contours can be viewed as a time-series and temporal variations are minimized.

The OPERA process is run each quarter and ground water elevation and isoconcentration maps for each HSU are updated. During this process, isoconcentration maps for individual volatile organic compounds (VOCs), total VOCs, and total VOCs above their respective maximum contaminant levels (MCLs) are generated for each HSU. The primary components of the OPERA process are described in Table F-1.

Table F-1. Primary components of the Optimized Environmental Restoration Analysis (OPERA) Process.

OPERA Process Step	Description of Step
1 - Hydrostratigraphic Unit and Hydraulic Analysis (HSUHA)	A structural representation of the site conceptual model is developed using all the information from site boreholes and wells. The HSU picks are determined using lithological, geophysical, soil chemistry, water level and hydraulic testing data. Using these data, the boundaries, extent and thickness of each HSU are defined. In addition, distribution of hydraulic parameters within an HSU, isopachs for different lithological types, and well-specific parameters such as well losses are also determined in this step.
2 - Ground Water Elevation History Analysis (GWELHA)	The ground water elevation history of each well is reviewed and data are interpolated using rule-based algorithms where there is less than adequate areal and temporal coverage. The well loss information is incorporated into the data set for extraction wells. The hydraulic test results are used to draw cones of depression around each extraction well that honors Darcy's Law of ground water flow through porous media. The resulting ground water elevation surfaces are used to define the extent of saturation when combined with the HSU information from step number one above.
3 - Plume History Analysis (PLUHA)	The concentration history of each volatile organic compound is reviewed and data are interpolated using conservative assumptions and a rule-based algorithm where there is less than adequate areal and temporal coverage. Ground water chemistry data are augmented with data from bailed ground water and soil samples collected during drilling of a borehole. The extent of HSUs and extent of saturation information from the two steps above are also incorporated into the data files to generate representative plume maps.

Appendix G

TFD Helipad Enhanced Source Area Remediation

Appendix G

TFD Helipad Enhanced Source Area Remediation

Summary

This Appendix summarizes the Treatment Facility D (TFD) Helipad (HPD) Enhanced Source Area Remediation (ESAR) treatability test. As the yearly ESAR treatability test appendices to the Livermore Site Annual Report are meant to serve as stand-alone status updates for these tests, all relevant information is included from the previous years (McKereghan et al., 2015). Performance monitoring data, analyses and interpretations are updated on an annual basis as new information becomes available.

During 2015, periodic injections of ethyl lactate continued to create anaerobic conditions in the subsurface. The injection method and frequency were modified in 2015 to maintain and continue improving anaerobic conditions, while reducing biofouling and preventing low acidity in ground water. Ten gallons of ethyl lactate was injected into well W-1552 and well W-1652, followed by injection of formation water to distribute the ethyl lactate in the subsurface. Injections were typically performed every other week by circulating ground water from two extraction wells and injecting into the center well. The two-week interval was determined as the optimal duration based on frequent measurements of field parameters, including dissolved oxygen, pH, temperature, specific conductance, and oxidation-reduction potential (ORP).

As discussed in Section 4, there was further progress reducing nitrate and sulfate concentrations in ground water in 2015. This change is largely attributed to the change in injection method and frequency.

1. Introduction

In situ bioremediation of moderate to low-permeability source area sediments is one of several technologies identified during the Source Area Cleanup Technology Evaluation (SACTE) that may accelerate clean up of Livermore Site source areas, and is one of four technologies being field-tested at the site under the Department of Energy Enhanced Source Area Remediation initiative (see Section 3.2 of the 2015 Annual Report).

The TFD Helipad source area is located cross gradient from a former landfill that operated from the mid-1950s until about 1970. Although sediment and debris in the former landfill were excavated in 1984, subsequent investigations confirmed that the subsurface in the vicinity of the former helipad is impacted by volatile organic compounds (VOCs), primarily trichloroethene (TCE).

Currently, depth to water is approximately 90 feet below ground surface (ft-bgs) and is hydraulically influenced by long-term ground water extraction in the area. The site sedimentary sequence consists of alluvial fan deposits, primarily unconsolidated clay and silt, with minor sand and gravel deposits. The source area extends vertically downwards from the unsaturated zone, in HSU-1B and HSU-2, to the bottom of saturated HSU-3A/3B, approximately 132 ft-bgs.

Source area remediation began in 1999 with ground water extraction from wells W-1551 and W-1552 (Figure G-1). The U.S. Department of Energy (DOE)/Lawrence Livermore (LLNL) (DOE/LLNL) quickly determined that ground water extraction alone was not adequate to efficiently remediate this source area and began investigating innovative treatment technologies. In 2000, a series of wells, W-1650 through W-1657, were installed as part of a treatability test to evaluate the feasibility of electro-osmosis (EO) as a means of extracting ground water containing VOCs from fine-grained sediments at TFD Helipad (McNab et al., 2001). Between October of 2000 and February of 2001, the EO system was operated in combination with ground water extraction from cathode wells W-1552, W-1651, and W-1654 (Figure G-1). After completion of the EO treatability test, the same extraction wells were operated until 2004 as source area remediation wells connected to the TFD Helipad ground water treatment facility. In 2004, the nine source area wells completed in HSU-3A/3B were converted to dual extraction wells and HSU-2 soil vapor extraction wells W-HPA-002A and W-HPA-002B were connected to the VTFD Helipad soil vapor treatment facility. Both the ground water and soil vapor treatment facilities were operated continuously until October 2007, and a significant reduction in ground water and soil vapor concentrations were observed. In 1999, TCE concentrations in the source area wells ranged between 3,000 and 10,000 parts per billion (ppb). After eight years of remediation, the TCE concentrations in the TFD Helipad source area wells ranged from 25 to 750 ppb. Because the mass removal rates were declining and VOC concentrations remained above the cleanup levels, DOE/LLNL selected the TFD Helipad source area for an *in situ* bioremediation treatability test.

2. Objectives and Overview

The primary objective of the treatability test is to evaluate the efficacy of *in situ* bioremediation involving the application of sodium lactate (which was later switched to ethyl lactate in 2013) and bioaugmentation using the dechlorinating microorganism, KB-1. In addition, the test was intended to help identify optimal design parameters for future potential application of the technology at other LLNL source areas.

Initial tracer test results (see Section 3) indicated that HSU-3A/3B was sufficiently permeable to allow injection of a carbon source (i.e., sodium lactate or ethyl lactate) while the microcosm study determined that bioaugmentation would be necessary at this site since dechlorinating microorganisms were not present in the subsurface.

3. Design and Implementation

In 2007, DOE/LLNL conducted a tracer test and a microcosm study to support the *in situ* bioremediation system design. The TFD Helipad *in situ* bioremediation system (ISB01) was designed and constructed in 2010. The ISB01 system began operating in

November 2010 and includes four extraction wells, W-1650, W-1653, W-1655 and W-1657, and one central injection well, W-1552. There are four main performance monitor wells: W-1651, W-1652, W-1654 and W-1656. Downgradient and cross-gradient monitor wells completed in the HSU-3A/3B *in situ* bioremediation zone are also being monitored. In addition, there are several HSU-4 wells in the area to monitor deeper intervals for potential vertical migration.

The extraction and injection well pattern is designed to create a circulation cell that is vertically contained within HSU-3A/3B and horizontally contained within the TFD Helipad source area. In August 2012, the extraction pattern was modified from a four-well extraction system to a two-well extraction system, to minimize biofouling and increase the amount of sodium lactate circulation in a portion of treatability zone where most of the hydraulic circulation is occurring. Ground water continues to be extracted in a cyclic mode from wells W-1650 and W-1653, and injected into the central well W-1552. Stopping extraction from wells W-1655 and W-1657 did not negatively impact the total facility flow rate or hydraulic circulation in the subsurface.

From 2010 to 2013, sodium lactate (4% by volume) was injected into well W-1552. The sodium lactate dose and injection rate were limited due to the viscosity of the product and the reduction of hydraulic conductivity near injection well W-1552 due to biofouling.

In May 2013, DOE/LLNL proposed a change from sodium lactate to ethyl lactate, a less viscous and more effective carbon source. Following regulatory approval, ethyl lactate injection (10% by volume (10%v)) began in August 2013. Between August 2013 and September 2014, more that 60 gallons of 10%v ethyl lactate were injected into the circulation system using a dilute solution. In late 2014, the injection procedure was modified and 55 gallons of pure 100%v ethyl lactate were injected into wells W-1552 and W-1652 in two separate events, September and November, 2014.

In 2015, the injection procedure was modified based on the field parameter data (dissolved oxygen, pH, temperature, specific conductivity, and ORP) collected on a bi-weekly basis. Ten gallons of 100%v ethyl lactate was injected into well W-1552 and well W-1652 in sixteen separate events. The timing of the injection events was based on the pH data (Figure G-2) with the goal of maintaining a pH level of 5 or above in injection well W-1652. The injection frequency was approximately every two weeks when the facility was operational.

4. Results and Conclusions

Since the start of the treatability test, average dissolved oxygen levels in the circulation cell have been reduced from 2.2 parts per million (ppm) to 0.9 ppm. The ORP remains dependent on the continual injection of the carbon source and has been reduced from +150 millivolts to -150 millivolts. Although the parameters above are indicative of subsurface conditions becoming increasingly anaerobic, until 2015, average nitrate and sulfate concentrations have remained at approximately 60 ppm and 100 ppm, respectively.

Field parameters (e.g., dissolved oxygen, ORP) indicate that the system is more amenable to addition of ethyl lactate as opposed to sodium lactate (less biofouling and the ability to inject at higher concentrations at a lower viscosity). The injection of approximately 110 gallons of 100%v ethyl lactate in late 2014 significantly changed the subsurface biogeochemical conditions. TCE concentrations in the treatability test wells range from 25 to 1,100 ppb, with an average concentration of about 150 ppb.

In 2015, a significant reduction in nitrate and sulfate concentrations were observed in several wells, attributed mostly to the new ethyl lactate injection procedure. In extraction well W-1650, nitrate concentrations initially were reduced to below 10 ppm, however they have since increased to about 50 ppm and sulfate concentrations have not changed, remaining about 100 ppm (Figure G-3). In extraction well W-1653, nitrate and sulfate concentrations were reduced to below 10 ppm, and ideal conditions for anaerobic bioremediation have been achieved (Figure G-4). In monitoring well W-1654, nitrate concentrations were reduced to below 10 ppm and sulfate concentrations initially were reduced to below 20 ppm, however sulfate concentrations have since increased to about 60 ppm (Figure G-5). In addition, extraction well W-1653 and monitoring well W-1654 both are now showing the presence of cis-1,2-dichloroethene (cis-1,2-DCE), which is a daughter product of TCE biodegradation.

The treatability test results thus far indicate that anaerobic subsurface conditions favorable to the introduction of KB-1 has been achieved in the vicinity of wells W-1552, W-1652, W-1653, and W-1654. Nitrate and sulfate concentrations still remain at levels too high to implement bioaugmention in the vicinity of wells W-1650 and W-1656. Wells W-1651, W-1655, and W-1657 are considered to be outside the area of ground water circulation. In 2016, DOE/LLNL plans to continue injection of ethyl lactate into wells W-1552 and W-1652, and to continue sampling area wells for VOCs, field parameters, nitrate, and sulfate. The bioaugmentation is planned to occur when nitrate has been depleted and sulfate concentrations decrease to approximately 50 ppm or below. Once KB-1 is introduced, the system will be continually operated to determine whether VOC levels can be reduced below regulatory limits.

5. References

McNab, W.W. Jr., J. A. Karachewski, and G. S. Weissmann (2001), *Field Measurements of Electro-osmotic Transport of Ground Water Contaminants in a Lithologically Heterogeneous Alluvial-Fan Setting,* Lawrence Livermore National Laboratory, Livermore, Calif. (UCRL-ID-144879).

McKereghan, P., C. Noyes, Z. Demir, M. Buscheck, and M. Dresen (Eds.) (2014), *LLNL Ground Water Project, 2014 Annual Report*, Lawrence Livermore National Laboratory, Livermore, Calif. (UCRL-AR-126020-14).

ERD-S3R-15-0019

Figure G-1. Locations of wells and treatment facilities in the TFD Helipad *in situ* bioremediation treatability test area.

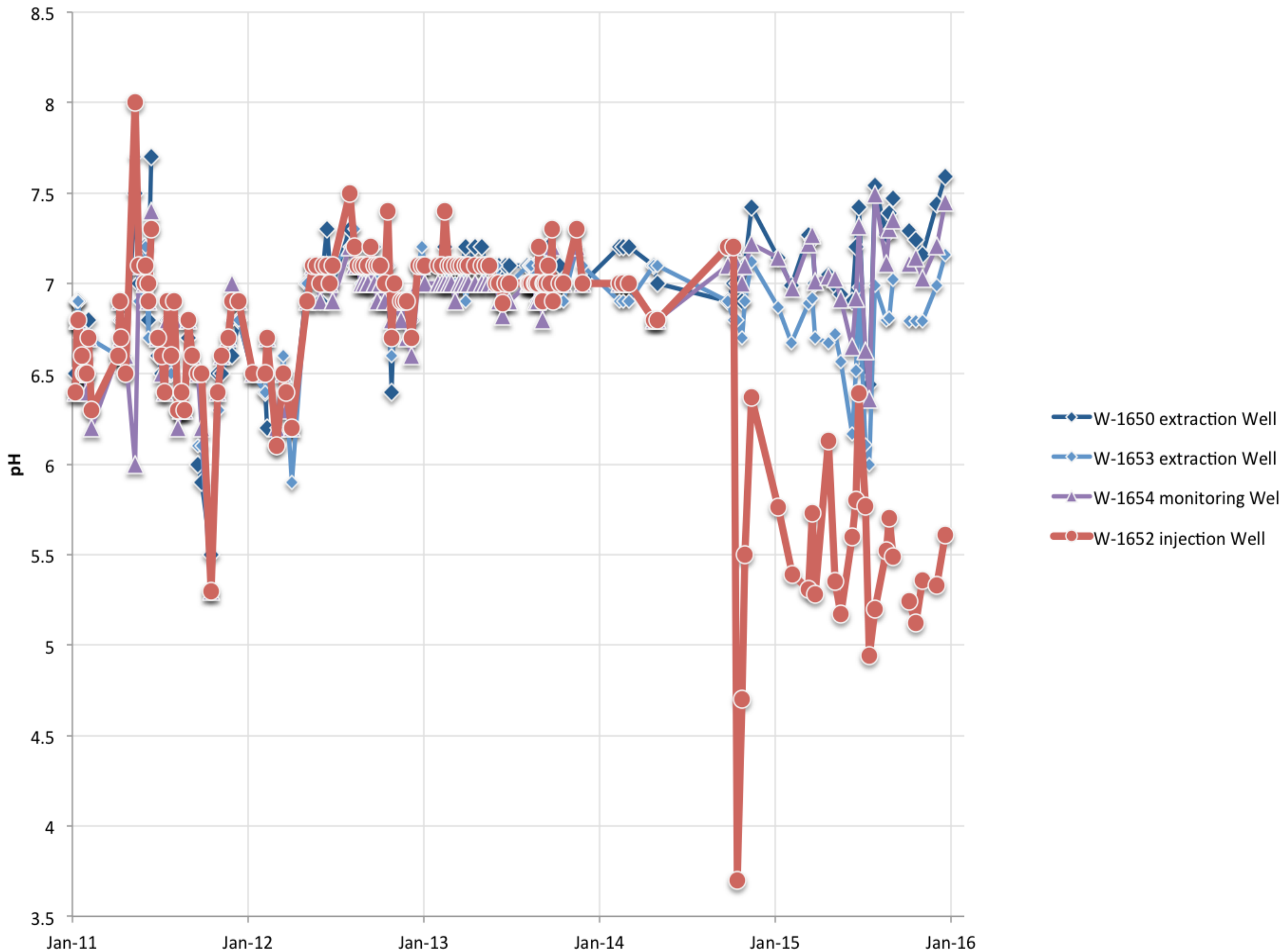


Figure G-2. Ground water pH trends in wells W-1650, W-1652, W-1653 and W-1654.

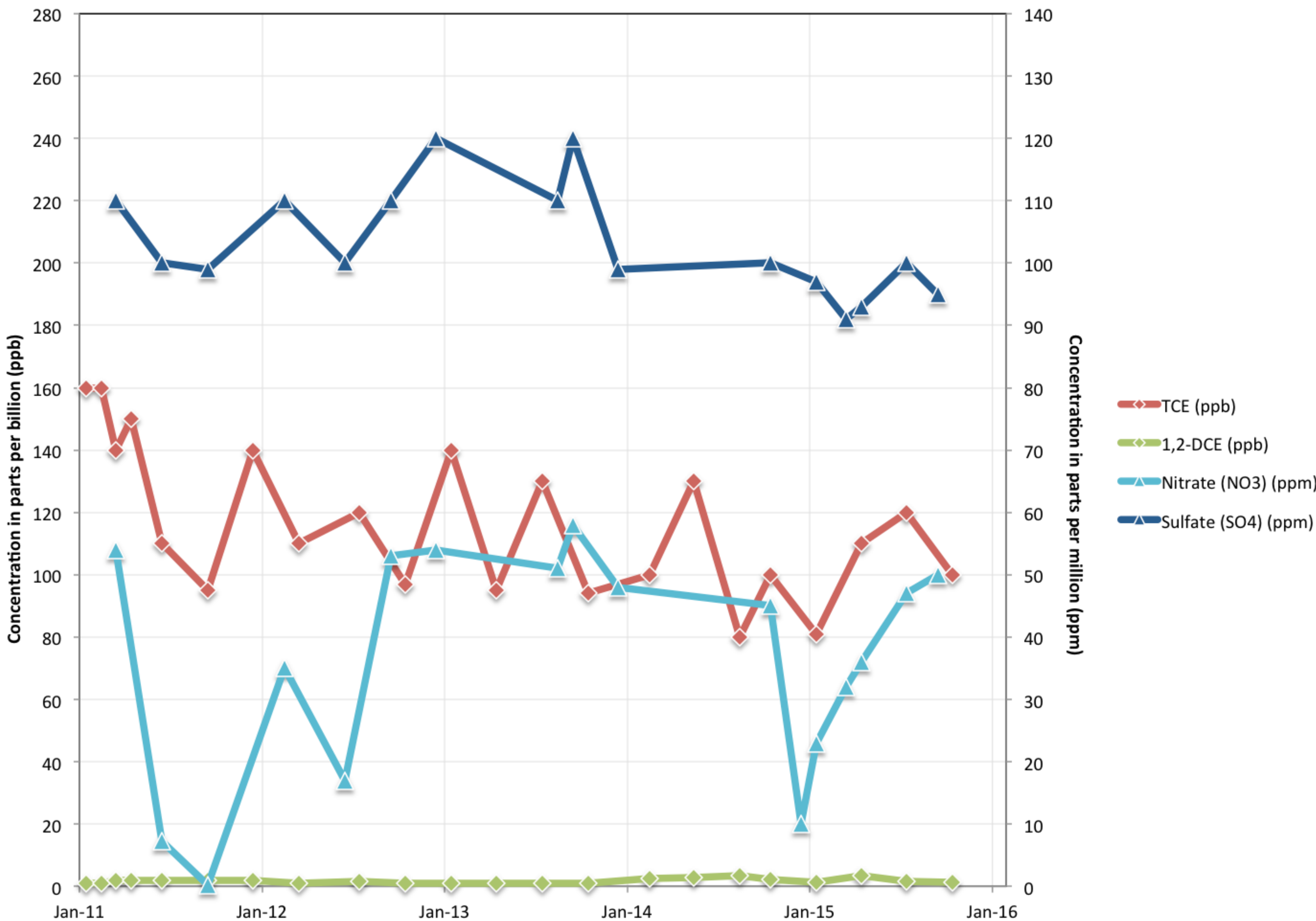


Figure G-3. Concentration trends in extraction well W-1650.

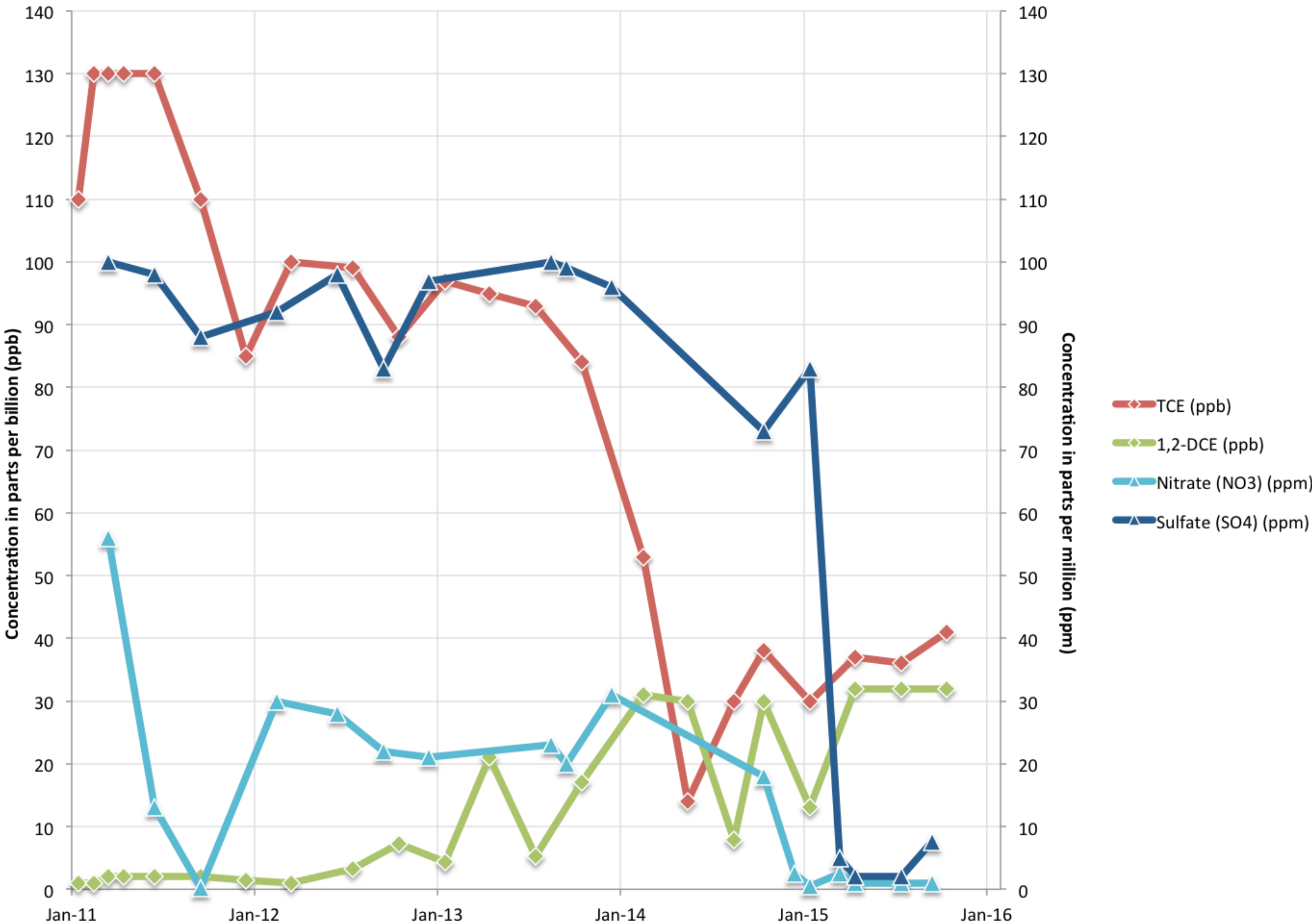


Figure G-4. Concentration trends in extraction well W-1653.

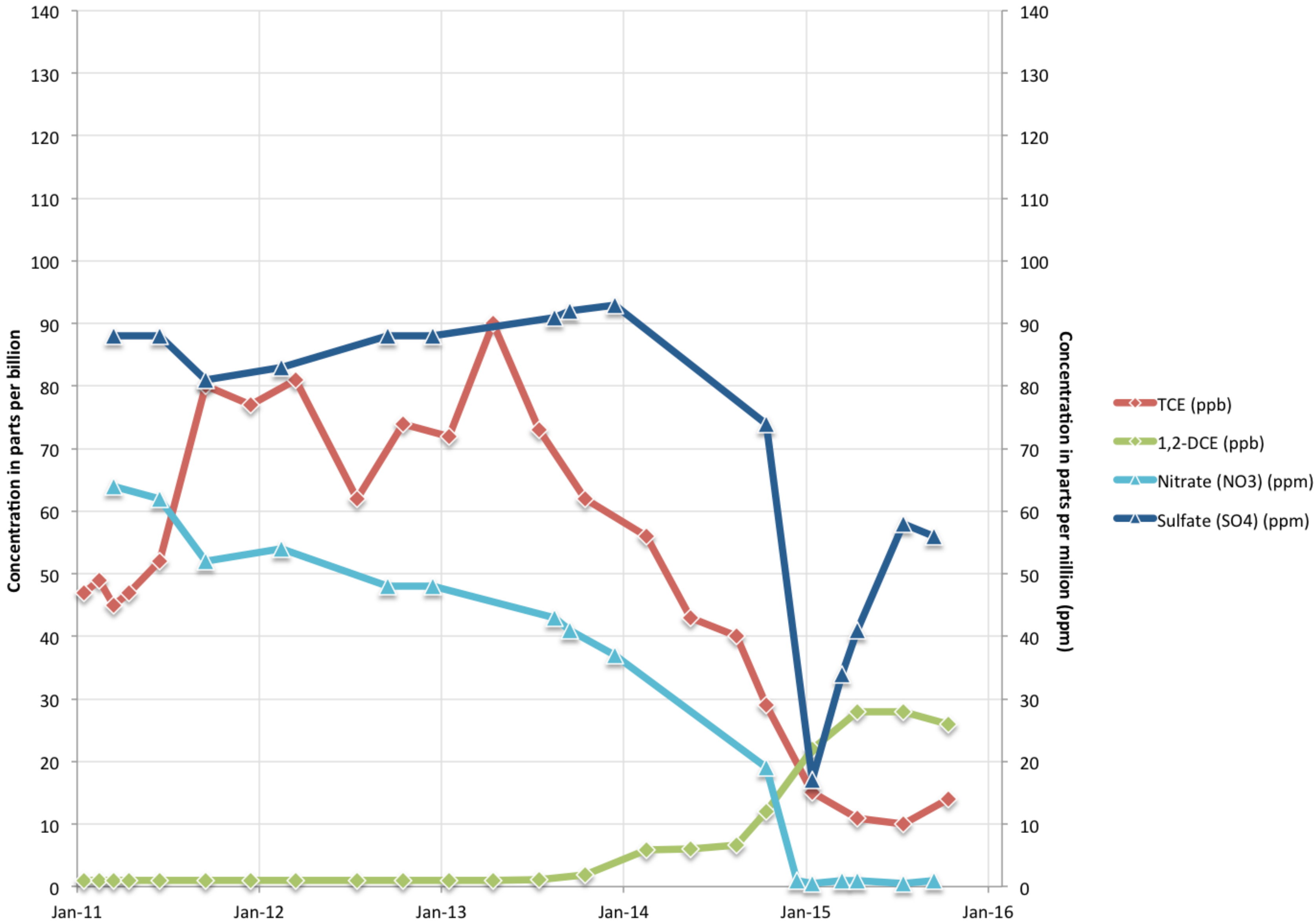


Figure G-5. Concentration trends in monitoring well W-1654.

Appendix H

TFE Eastern Landing Mat Enhanced Source Area Remediation

Appendix H

TFE Eastern Landing Mat Enhanced Source Area Remediation

Summary

This Appendix summarizes the Treatment Facility E (TFE) Eastern Landing Mat (ELM) Enhanced Source Area Remediation (ESAR) treatability test. As the yearly ESAR treatability test appendices to the Livermore Site Annual Report are meant to serve as stand-alone status updates for these tests, all relevant information is included from the previous years (McKereghan et al., 2015). However, performance monitoring data, analyses and interpretations are updated on an annual basis as new information becomes available.

During 2015, ground water and soil vapor were extracted from well W-1903, and ambient air was injected into wells W-1909 and W-2305. Both the air injected into W-1909 and W-2305 and ground water were heated using two heating-elements in each well.

As discussed further in Section 4, the system continued to remove volatile organic compound (VOC) mass at a rate higher than pre-2011 rates. Mass removal rates declined slightly during 2015 as the concentrations in the wells declined. In late December 2015, a new extraction well-field configuration was implemented to improve mass removal from the subsurface.

1. Introduction

Thermally-enhanced remediation of lower-permeability source area sediments is one of several technologies identified during the Source Area Cleanup Technology Evaluation (SACTE) that may accelerate the clean up of Livermore Site source areas, and is one of four technologies being field-tested at the site under the Department of Energy Enhanced Source Area Remediation initiative (see Section 3.2 of the 2015 Annual Report).

The TFE Eastern Landing Mat (TFE-ELM) source area is located in an area formerly used by LLNL for salvage and storage of reclaimable materials. Source investigations conducted during the late 1980s, 1990s and 2000s, determined that both the unsaturated and saturated zones were impacted by VOCs, primarily trichloroethene (TCE). Currently, depth to water is approximately 100 feet below ground surface and is influenced by long-term ground water extraction in the area. The site sedimentary sequence consists of alluvial fan deposits, primarily unconsolidated clay and silt, with minor sand and gravel deposits. The source area vertically extends from the unsaturated zone to the bottom of the first water bearing zone, within hydrostratigraphic unit 2 (HSU-2).

Source area control at TFE-ELM began in 1996 with ground water extraction from downgradient well W-1109 (Figure H-1) to capture VOCs emanating from both the low permeability saturated sediments and the unsaturated zone in HSU-2. Source area remediation began in 2004 with dual extraction (soil vapor and ground water) from well W-1903 and soil vapor extraction from shallower wells W-543-001, W-543-003, and W-543-1908 (Figure H-1). From 2004 to 2011, a total of 117 kg of VOCs were removed and treated from the three soil vapor extraction wells. Slightly less than 3 kg of VOCs were removed using dual extraction from well W-1903 (and occasionally from well W-2305) during the same period.

In May 2011, before the start of the treatability test, soil vapor concentrations in shallower wells W-543-001, W-543-003 and W-543-1908 were 0.27, 0.43 and 0.73 parts per million on a volume-to-volume basis ($ppm_{v/v}$), respectively. Prior to soil vapor extraction and treatment, VOC concentrations in these wells ranged between 100 to 200 $ppm_{v/v}$. The reduction in concentrations is largely due to the effectiveness of soil vapor extraction in the more permeable, unsaturated sediments in the eastern portion of the source area. By contrast, concentrations in the western portion of the source area remained high and the mass removal rates were much lower due the presence of low permeability sediments in the area. Therefore, DOE/LLNL targeted the western portion of the TFE-ELM source area for the thermally enhanced remediation treatability test. The target source area is about 100 feet in diameter centered on the source investigation piezometer SIP-543-101. The remediation wells are W-1903, W-1909 and W-2305 (Figure H-1).

2. Objectives and Overview

The primary objective of the treatability test is to evaluate the additional benefit of thermal heating as a means of reducing clean up time by accelerating contaminant mass transfer from the liquid and adsorbed phases to the vapor phase. The treatability test utilizes the existing ground water and soil vapor treatment systems that are part of the current remedy. A secondary objective is to apply the dynamic well-field operations (DWFO) strategy by changing soil vapor extraction and clean air injection locations to alter the subsurface flow pathways, prevent stagnation zones, and therefore improve mass recovery rates from the subsurface.

Thermally-enhanced remediation, for the purposes of the treatability test, is defined as utilizing ambient air temperature as well as using cost-efficient electrical heating elements inside the remediation wells to heat both ground water and injected clean air. Ambient air temperatures in Livermore can be more than 100 degrees Fahrenheit (°F) in summer months, which may boost thermal remediation seasonally. This approach is vastly different than steam injection and electrical resistivity heating which require significantly more energy input and costly infrastructure.

The thermally-enhanced remediation treatability test is expected to provide valuable information on the design parameters for future applications of a full-scale system.

3. Design and Implementation

The TFE Eastern Landing Mat treatability test is designed to evaluate thermally enhanced remediation in the saturated and unsaturated zones by injecting heated air and by electrically heating ground water into certain wells, while extracting both soil vapor and ground water from others. The treatability test system consists of the VTFE Eastern Landing Mat soil vapor treatment facility, the TFE East ground water treatment facility, an ambient-air injection blower, and electrical heating elements in remediation wells. In early 2011, TFE Eastern Landing Mat source area wells, W-1903, W-1909 and W-2305, were modified for the treatability test. Well W-1903 is the primary dual extraction well, and wells W-1909 and W-2305 are air injection and heating wells. In addition, well W-2305 can be used for dual extraction and well W-1909 can be used as a soil vapor extraction well. This operational flexibility enables dynamic well-field operation at this source area. Wells W-1909 and W-2305 contain heating elements that are installed both above and below the static water level to facilitate heating of injected air and ground water. All three wells are equipped with thermocouples to monitor subsurface temperatures. Well SIP-543-101, situated at the center of the three wells, serves as the primary performance monitoring well for the test and is equipped with pressure transducers and thermocouples, in both ground water and soil vapor.

Treatability testing began in October 2011 and continued in 2012 through 2015. Since 2011, the system has been operated in the primary operational mode of dual extraction from W-1903, and ambient air injection and heating in wells W-1909 and W-2305. The average subsurface soil vapor temperature is 70°F. The injected air is heated up to 100°F in in wells W-1909 and W-2305. The water is heated up to 130°F in well W-1909 and up to 110°F in well W-2305. These values were determined by the thermal properties of the casing and screen materials next to the heating elements.

The system has been fully operational since 2011, except when taken offline for maintenance and freeze protection. Whenever possible, DOE/LLNL continued dual extraction from W-1903 even when the thermal system was under maintenance.

4. Results and Conclusions

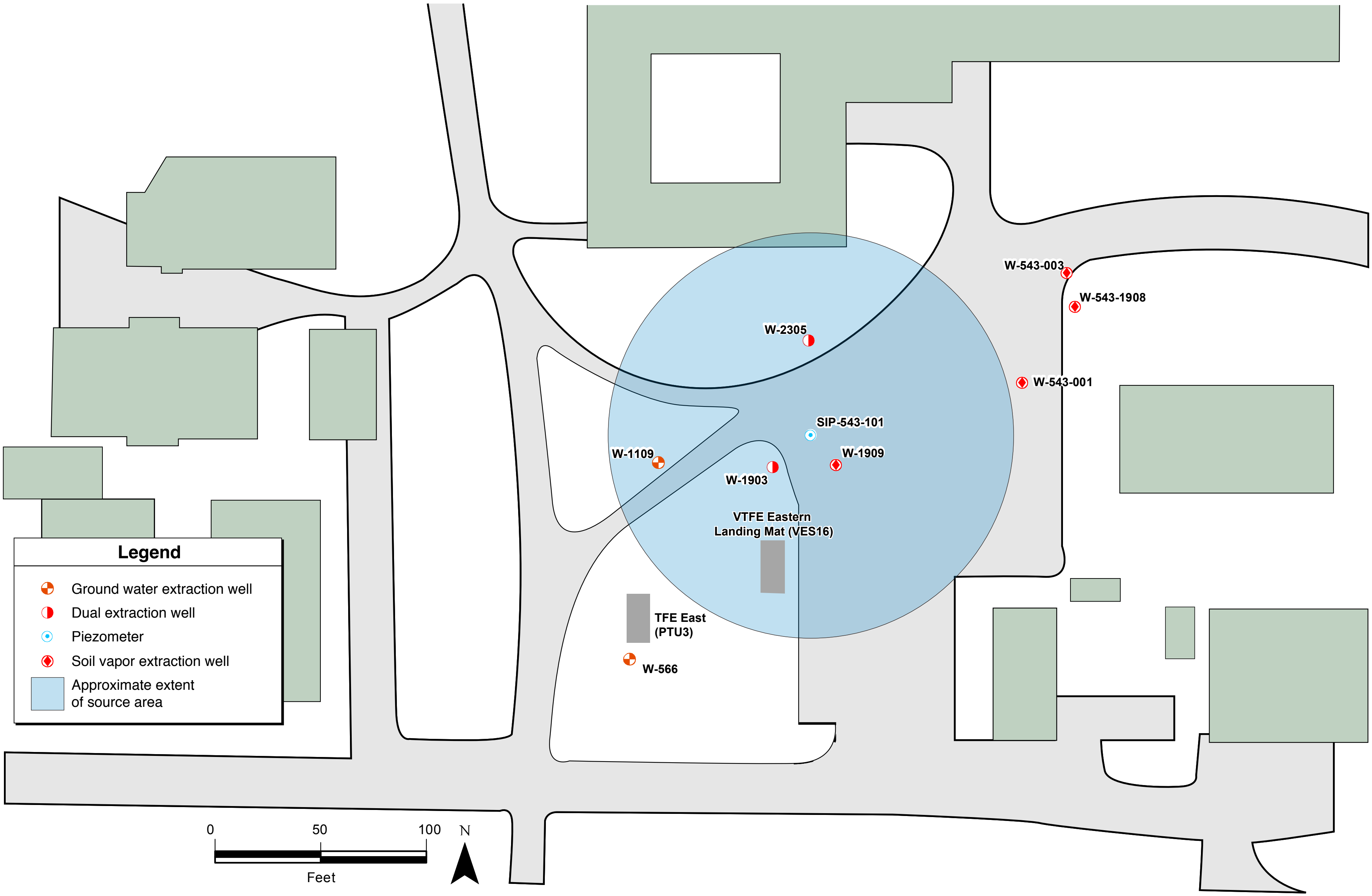
The thermally enhanced remediation system has now been in operation for over four years. During this period, the thermocouples in the dual extraction well W-1903 and the performance monitoring well SIP-543-101 have not measured an increase in temperature. This result is expected since the heat capacitance of the subsurface, especially the saturated zone, is very high and a much-higher energy input is required to increase temperatures in the area. However, several data sets indicate that the thermally enhanced remediation and the DWFO strategy have positively influenced the remediation in the TFE-ELM source area. First, post-implementation VOC concentrations and mass removal rates from dual extraction well W-1903 are consistently higher than those measured prior to the start of the treatability test when the system was operating in an extraction-only configuration without heat. Second, a significant reduction in vapor phase mass removal rates has not occurred, as would be expected due to a short-circuit of ambient clean air from the injection wells to the extraction well. The relatively constant vapor phase mass removal is likely due to heating of the injected air, and potentially due to a new vapor circulation pattern established in the subsurface.

In 2015, the VOC mass removal rate from ground water extraction continued to decline due to declining water levels and corresponding lower extraction flow rates (Figure H-2). VOC mass removal per unit volume of soil vapor removed also began to decline during the same time period. Figure H-3 shows that the soil vapor extraction rate improved during 2015; however the mass removal rate only showed a modest increase. In late December 2015, the DWFO strategy was evaluated and the operational mode of the system was changed. Well W-1903 remained a dual-extraction well. Well W-1909 remained an air injection and heating well. Well W-2305 was converted from an air injection and heating well to a soil vapor extraction well.

The system will be operated in its new mode until a decline of influent concentrations is observed. The system will then be re-configured to inject and extract from different wells, following the DWFO strategy.

5. References

McKereghan, P., C. Noyes, Z. Demir, M. Buscheck, and M. Dresen (Eds.) (2014), *LLNL Ground Water Project, 2014 Annual Report*, Lawrence Livermore National Laboratory, Livermore, Calif. (UCRL-AR-126020-14).



ERD-S3R-15-0020

Figure H-1. Locations of wells and treatment facilities in the TFE Eastern Landing Mat thermally-enhanced remediation treatability test area.

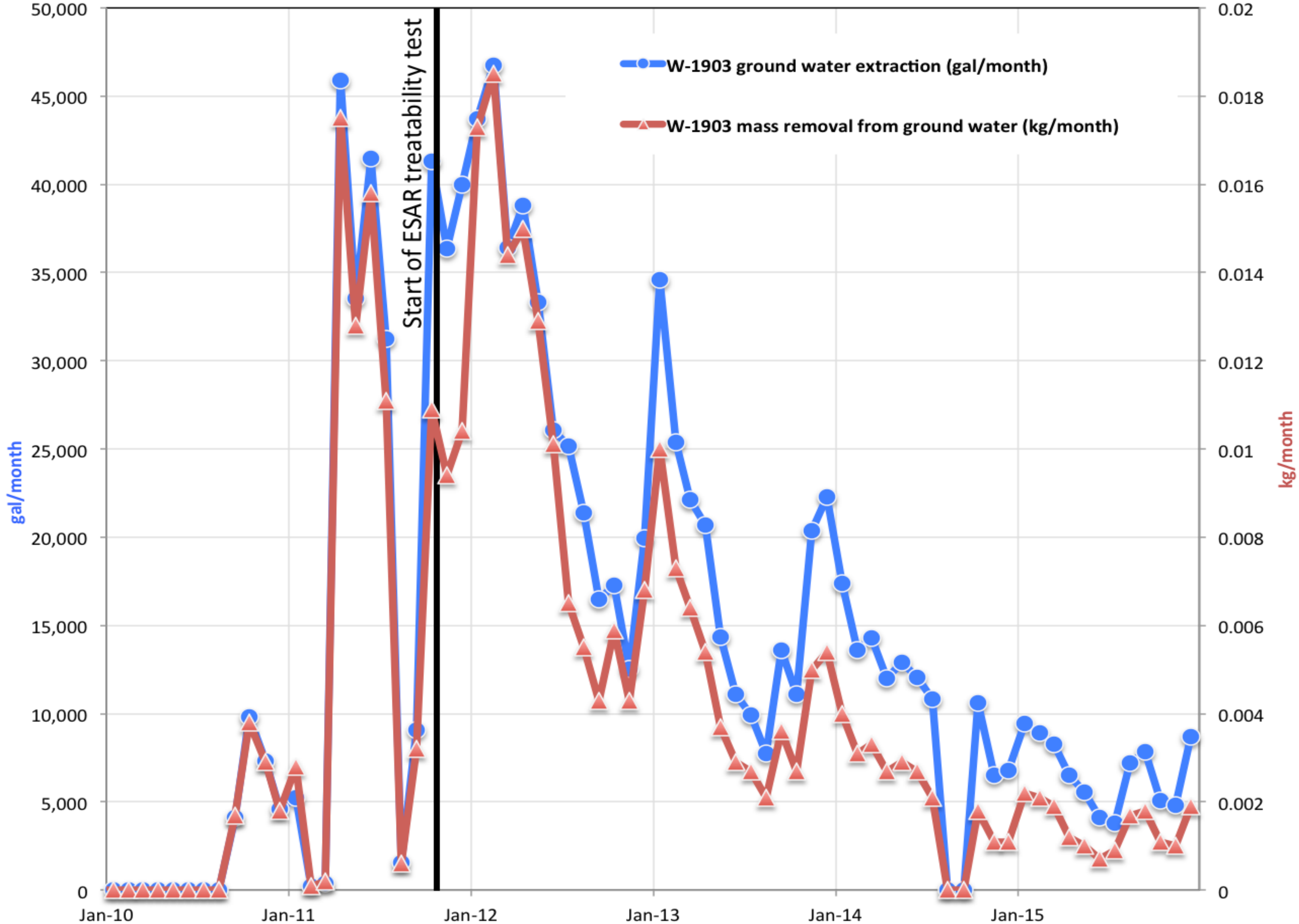


Figure H-2. Monthly ground water and VOC mass removal at extraction well W-1903.

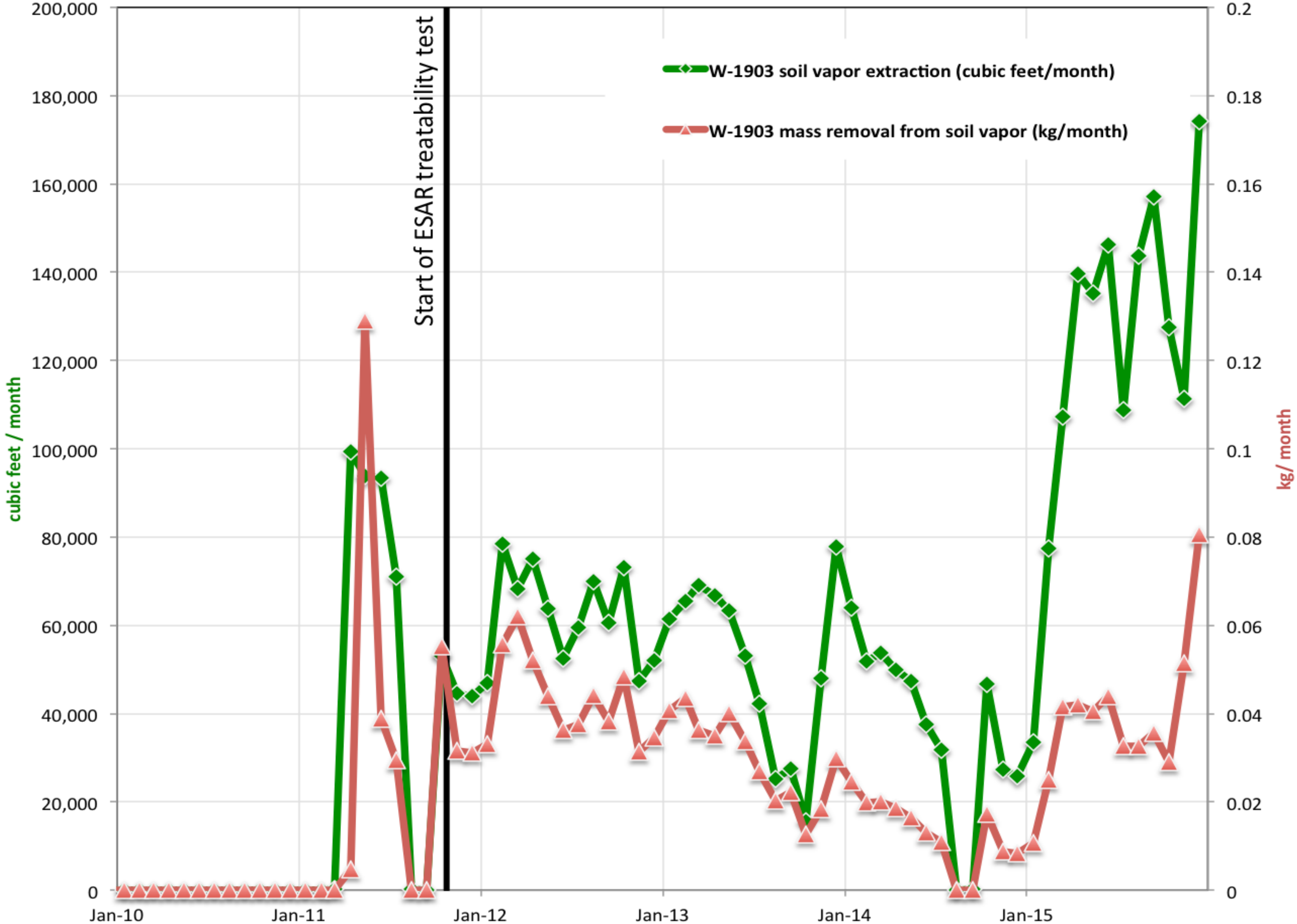


Figure H-3. Monthly soil vapor and VOC mass removal at extraction well W-1903.

Appendix I

TFC Hotspot Enhanced Source Area Remediation

Appendix I

TFC Hotspot Enhanced Source Area Remediation

Summary

This appendix summarizes the Treatment Facility C (TFC) Hotspot Enhanced Source Area Remediation (ESAR) treatability test. As the yearly ESAR treatability test appendices to the Livermore Site Annual Report are meant to serve as stand-alone status updates for these tests, all relevant information is included from the previous years (McKereghan et al., 2015). Performance monitoring data, analyses and interpretations are updated on an annual basis as new information becomes available.

During 2015, post-implementation performance monitoring continued at the TFC Hotspot source area ESAR treatability test with hydraulic testing of area wells and collection of periodic analytical samples and field parameters (Figure I-1). Over the course of the year, ten rounds of analytical samples were collected on a bi-weekly, monthly, then bi-monthly basis. Fourteen post-implementation rounds of sampling were completed through the end of 2015. Field parameter measurements were also made each month in 2015.

As discussed further in Section 4, volatile organic compound (VOC) concentrations and field parameters have remained relatively constant and unchanged based on a comparison of the pre- and post-implementation data. No significant changes that could be attributed to the emplaced zero-valent iron (ZVI) were detected during 2015. This suggests that ground water that has come into contact with ZVI has yet to arrive at the performance monitoring wells. This is likely due primarily to the low permeability, fine-grained nature of TFC Hotspot source area sediments and the resultant extremely slow ground water flow velocities.

1. Introduction

This appendix summarizes the performance-monitoring phase of the zero-valent iron (ZVI) emplacement treatability test that began at the Lawrence Livermore National Laboratory (LLNL) Livermore Site Treatment Facility C (TFC) Hotspot source area in the fall of 2014. The emplacement of a reactive amendment into lower-permeability source area sediments to promote *in situ* destruction of contaminants through abiotic reductive dechlorination is one of several technologies identified during the Source Area Cleanup Technology Evaluation (SACTE) that may accelerate clean up of Livermore Site source areas. It is one of four technologies being field-tested at the site under the Department of Energy Enhanced Source Area Remediation initiative (see Section 3.2 of the 2015 Annual Report).

The TFC Hotspot source area was identified during source investigations conducted by LLNL in the early 1990s. These investigations discovered trichloroethene (TCE) and other VOCs in ground water, most likely due to electronic fabrication activities at Building 171 during the U.S. Navy use of the site. TCE concentrations up to 2,800 parts per billion (ppb) were present in the first saturated hydrostratographic unit 1B (HSU-1B) at relatively shallow depths of 50 to 75 feet below ground surface (ft-bgs). The TFC Hotspot VOC source area is dominated by fine-grained sediments consisting of silty sand to sandy silt and clayey silt with occasional coarser-grained units. The ground water yield from wells in this source area is low to very low, less than 0.5 gallons per minute in the zone of interest. The ground water table at the time of treatability test implementation in 2014 was 62 ft-bgs.

While the entire source area was determined to cover approximately 120 feet by 170 feet laterally, the area with elevated TCE concentrations in ground water (i.e., greater than 100 ppb) is reasonably small, approximately 30 feet in diameter and extending to a depth of about 75 ft-bgs. This is the portion of the source area that was targeted for treatment during the treatability test.

Hydraulic containment using ground water extraction and treatment was initiated in 1997 at the TFC Southeast (PTU1) facility. Prior to the beginning of the test, approximately 18 kilograms of VOCs had been removed and TCE had declined from 2,800 ppb in the 1990s to approximately 240 ppb in September 2014. Prior to implementation, TCE concentrations in TFC Hotspot ground water wells ranged from about 58 to 240 ppb. In addition, 1,1-dichloroethene and 1,2-dichloroethane were above their maximum contaminant levels in ground water. Although vinyl chloride had not been detected in ground water (less than 0.5 ppb), low concentrations of cis-1,2-dichloroethene (below 6 ppb) were present in the area in one well, W-2612 (Figure I-1).

During and following treatability test implementation, contaminant concentrations in ground water located outside the study area (below the 100 ppb concentration level) continued to be remediated using TFC Southeast ground water extraction and treatment infrastructure. Contaminants known to occur in the vadose zone may require soil vapor extraction remediation once the treatability test has been completed.

2. Objectives and Overview

The primary objective of this treatability test is to assess whether VOCs can be effectively dechlorinated in the low permeability, silt- and clay-rich TFC Hotspot source area sediments by emplacing ZVI within dual-azimuth vertical inclusions (see Section 3) and creating chemically reductive zones *in situ*.

Application of injectable ZVI has been developed and applied for *in situ* chemical reduction (ISCR) of chlorinated solvents, such as TCE. The most common metal used in ISCR is ZVI, and the primary degradation pathway of chlorinated ethenes in the presence of the reduced metal is β-elimination. During β-elimination, chlorines on adjacent carbon (C) atoms are removed, forming a third C-C bond. TCE is thereby converted to chloroacetylene, which is further converted to acetylene and ultimately ethene and ethane, benign final end products.

To assess the test's primary objective, the treatability test was designed to include the following steps:

- Installing expansion casing in nine emplacement boreholes within the treatment area;
- Installing an interconnected grid network of controlled vertical inclusions between 55 and 75 ft-bgs, and emplacing 21 tons of ZVI;
- Monitoring vertical inclusion emplacement in real time during the ZVI injections by deploying resistivity strings;
- Conducting pre- and post-implementation ground water monitoring of TFC Hotspot wells for VOCs and dechlorination daughter products, metals and general minerals;
- Conducting pre- and post-implementation hydraulic testing of TFC Hotspot wells; and
- Video logging of TFC Hotspot wells to document pre-and post-implementation conditions.

3. Design and Implementation

The implementation phase of the treatability test was conducted by GeoSierra Environmental (GeoSierra), Inc. of Medford, NJ, utilizing its patented controlled vertical inclusion process (VIP) for the injection of ZVI. Figure I-1 shows the location of the emplacement boreholes and resistivity strings installed during the treatability test. The primary benefit of the VIP emplacement technique is that the azimuth (or orientation) of the inclusions (granular ZVI at this location) can be controlled and directed by manipulating pore pressure in the subsurface through the drilling of nearby pressure relief boreholes. The net effect is to coalesce the injected inclusions with that emplaced from adjacent injection boreholes, thereby creating an interconnected network of vertical panels or walls of granular, permeable ZVI throughout the treatment area. The ZVI is emplaced into the subsurface through injection as a highly viscous inclusion fluid/proppant mixture. The inclusion fluid consists of a cross-linked guar gum gel that includes enzymes that break down the gel starches into sugars within about an hour after injection. Emplacement of a reactive amendment in the vertical plane dramatically increases the likelihood that source area ground water containing VOCs travelling laterally will come into direct contact with the amendment.

The VIP ZVI emplacement system was installed over an area approximately 45-feet long and 45-feet wide (Figure I-1), between approximately 55 to 75 ft-bgs. The VIP ZVI emplacement was constructed as one continuous grid system, with the upper vertical panels of ZVI oriented perpendicular to the lower panels. Installation of the panels was tracked using well-head pressure monitoring and electrical resistance tomography. Construction of the VIP ZVI emplacement system commenced on September 15, 2014 and was completed on September 30, 2014. The following materials were used to install the ZVI multi-azimuth grid in the TFC Hotspot source area:

- Nine emplacement boreholes were installed with two 5-foot expansion casings (i.e., upper and lower) utilizing the mud-rotary drilling technique to a depth of approximately 75 ft-bgs (GeoSierra, 2014);
- Seven resistivity strings with five receivers each, for a total of 35 receivers, were installed to approximately 75 ft-bgs utilizing a direct-push drilling rig;

- A total of 21 tons of granular ZVI were injected, about 33% in the upper zone and 67% in the lower zone; and
- A total of approximately 5,820 gallons of inclusion fluid was utilized during the emplacement process.

4. Results and Discussion

Video-logging and re-development of area wells following implementation indicate that there were no adverse impacts to existing wells due to the ZVI emplacement process. In addition, pre-implementation hydraulic tests of area wells, including W-2201, W-1212, W-2611, W-2612, were repeated in early 2015. Preliminary analyses of the test results indicate that no significant changes in hydraulic conductivity or other hydraulic parameters attributable to the ZVI emplacement process have occurred.

Post-implementation sampling for VOC analysis, dechlorination daughter products, metals, and general minerals began in November 2014. Bi-weekly sampling was conducted for the first quarter (through January 22, 2015), monthly sampling for the next six months (through July 23, 2015), then bi-monthly sampling was conducted through the remainder of the year. Through the end of 2015, fourteen post-implementation rounds of sampling had been completed.

Ground water field parameters, including dissolved oxygen, specific conductance, oxidation-reduction potential, pH, and temperature, were measured weekly, bi-weekly, then monthly. In total, sixteen rounds of field parameter measurements were made during 2015.

As shown in Figures I-2 through I-4, possible degradation daughter products from the dechlorination of TCE by ZVI have been entirely absent in the study area to date, with the exception of low concentrations of cis-1,2 DCE present in well W-2612. However, low levels of cis-1,2 DCE have been observed in the well since April 2012 (5.6 ppb), predating the beginning of the test by more than two years.

Ground water pH measurements are shown in Figure I-5 for W-1212, W-2611, and W-2612. Similar to other field parameter measurement data acquired at the test site, no significant trends were observed in the data following the start of the test.

Based on a comparison of all the pre-implementation and post-implementation ground water data, no significant changes that could be attributed to the ZVI emplacement have been observed to date. This suggests that ground water that has come into contact with ZVI has yet to arrive at the performance monitoring wells. This is likely due primarily to the low permeability, fine-grained nature of TFC Hotspot source area sediments and the resultant extremely slow ground water flow velocities.

In 2016, DOE/LLNL plans to continue measuring field parameters monthly and performance monitoring analyses on a bi-monthly basis. This schedule may be modified in response to changing conditions in the field. Further analysis and interpretation of post-implementation performance monitoring data will be presented in upcoming 2016 Remedial Project Manager meetings and in subsequent status reports.

5. References

GeoSierra Environmental, Inc. (2014), *Final Completion Report, Vertical Inclusion Propagation ZVI Emplacement Project, TFC-HS Area, Lawrence Livermore National Laboratory, Livermore, California,* GeoSierra Environmental, Inc., Medford NJ, December 19, 2014.

McKereghan, P., C. Noyes, Z. Demir, M. Buscheck, and M. Dresen (Eds.) (2014), *LLNL Ground Water Project, 2014 Annual Report*, Lawrence Livermore National Laboratory, Livermore, Calif. (UCRL-AR-126020-14).

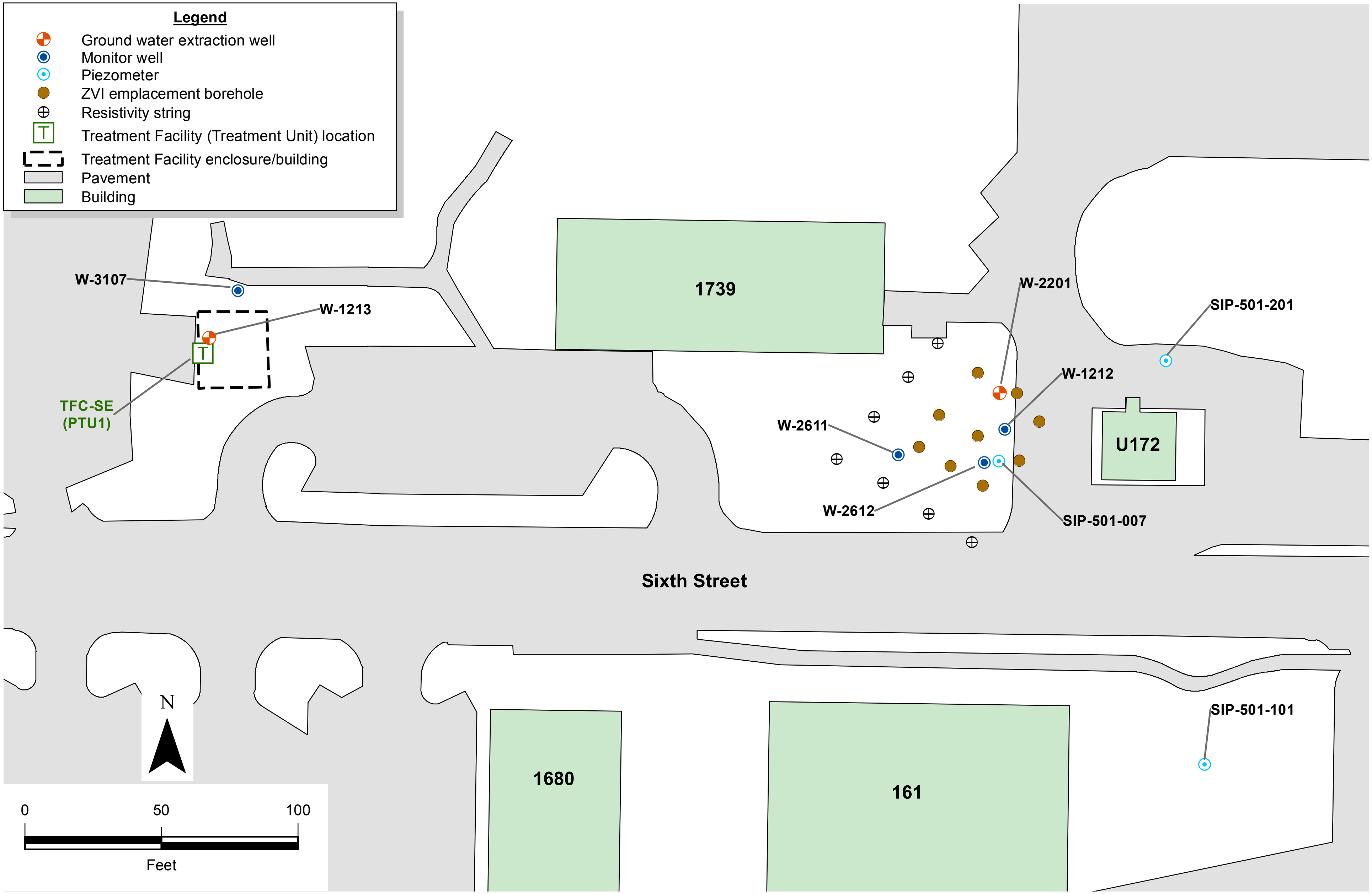


Figure I-1. TFC Hotspot Enhanced Source Area Remediation treatability test site and performance monitoring well locations.

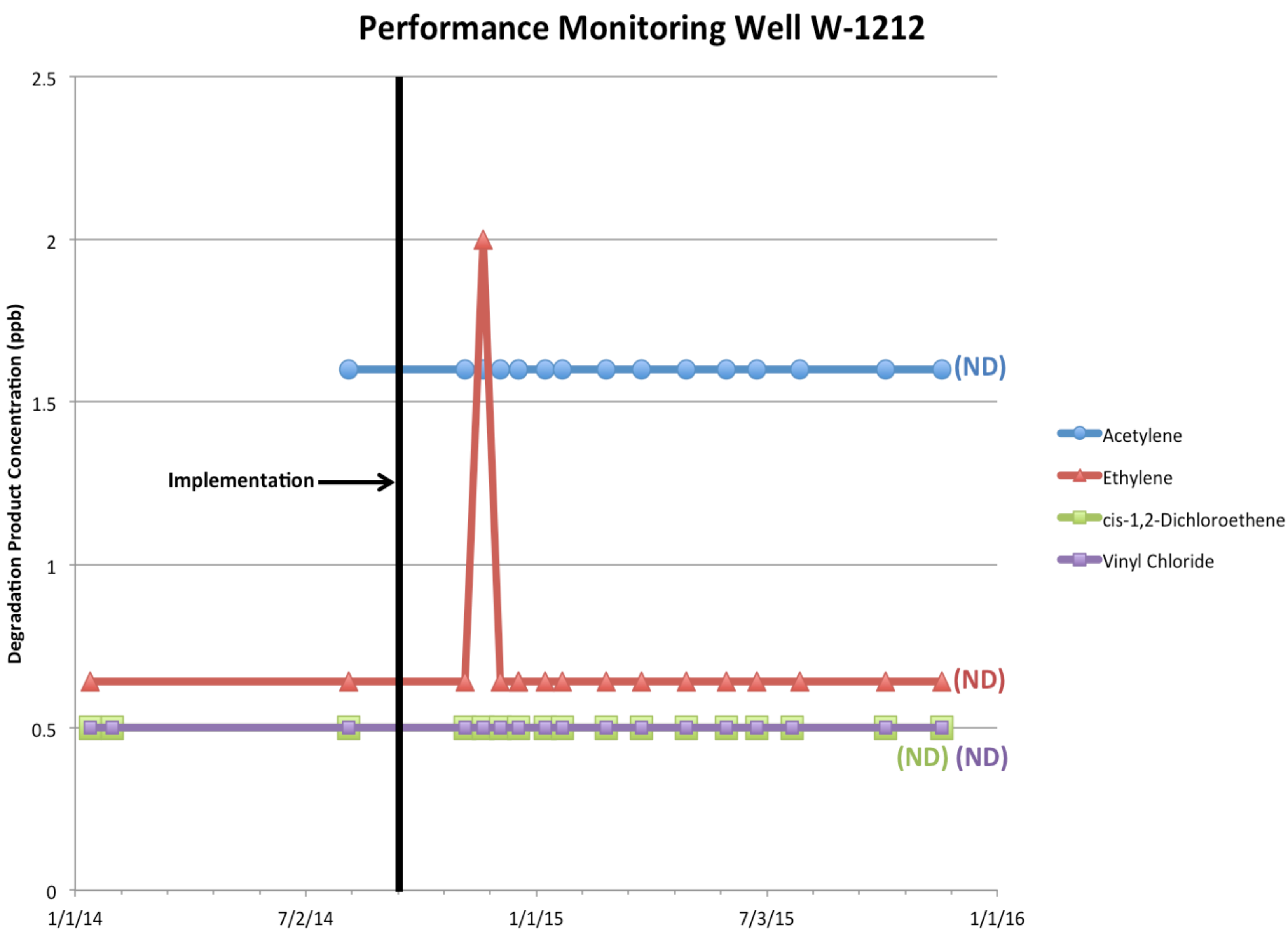


Figure I-2. TCE degradation product concentrations at performance monitoring well W-1212.

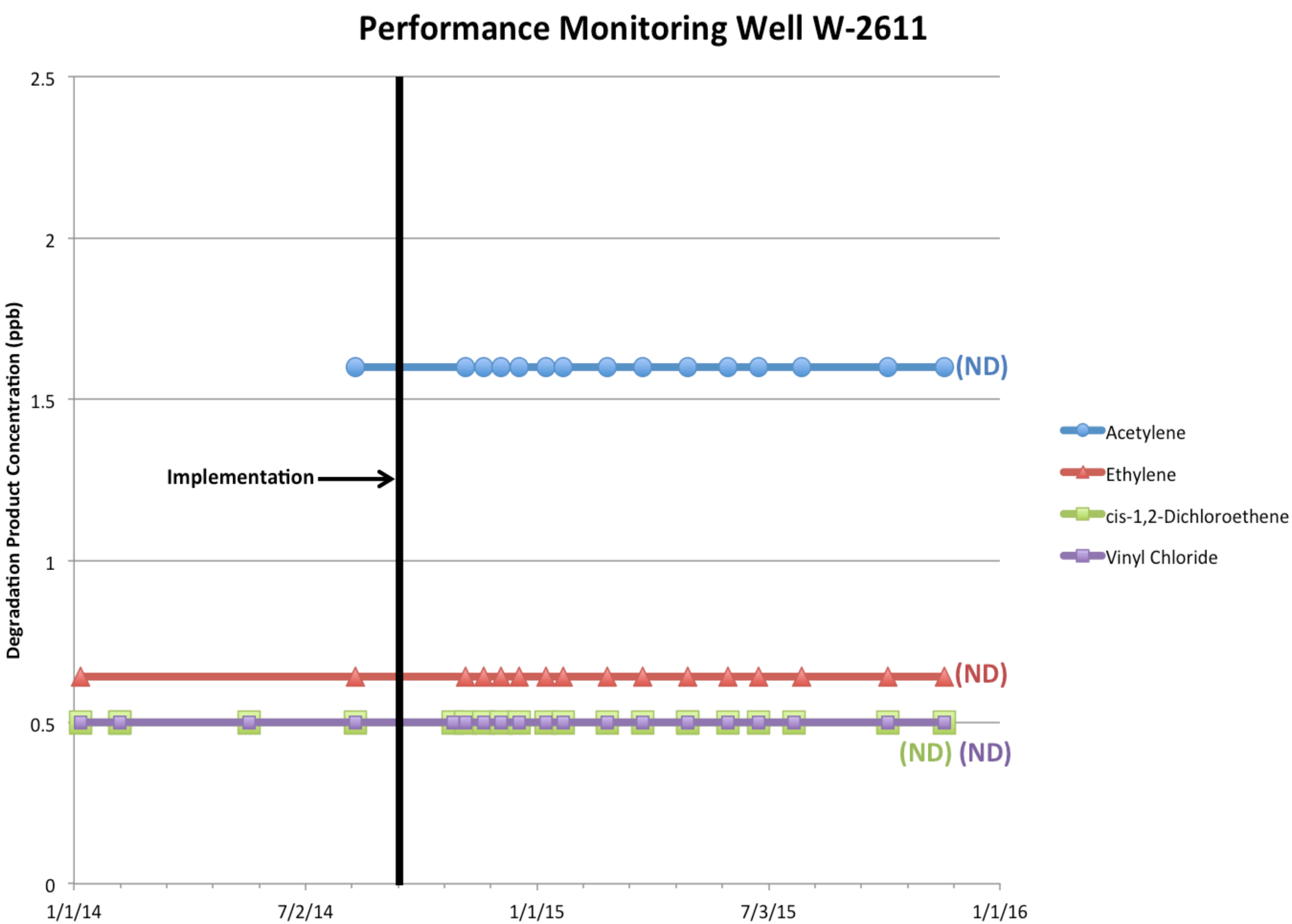


Figure I-3. TCE degradation product concentrations at performance monitoring well W-2611.

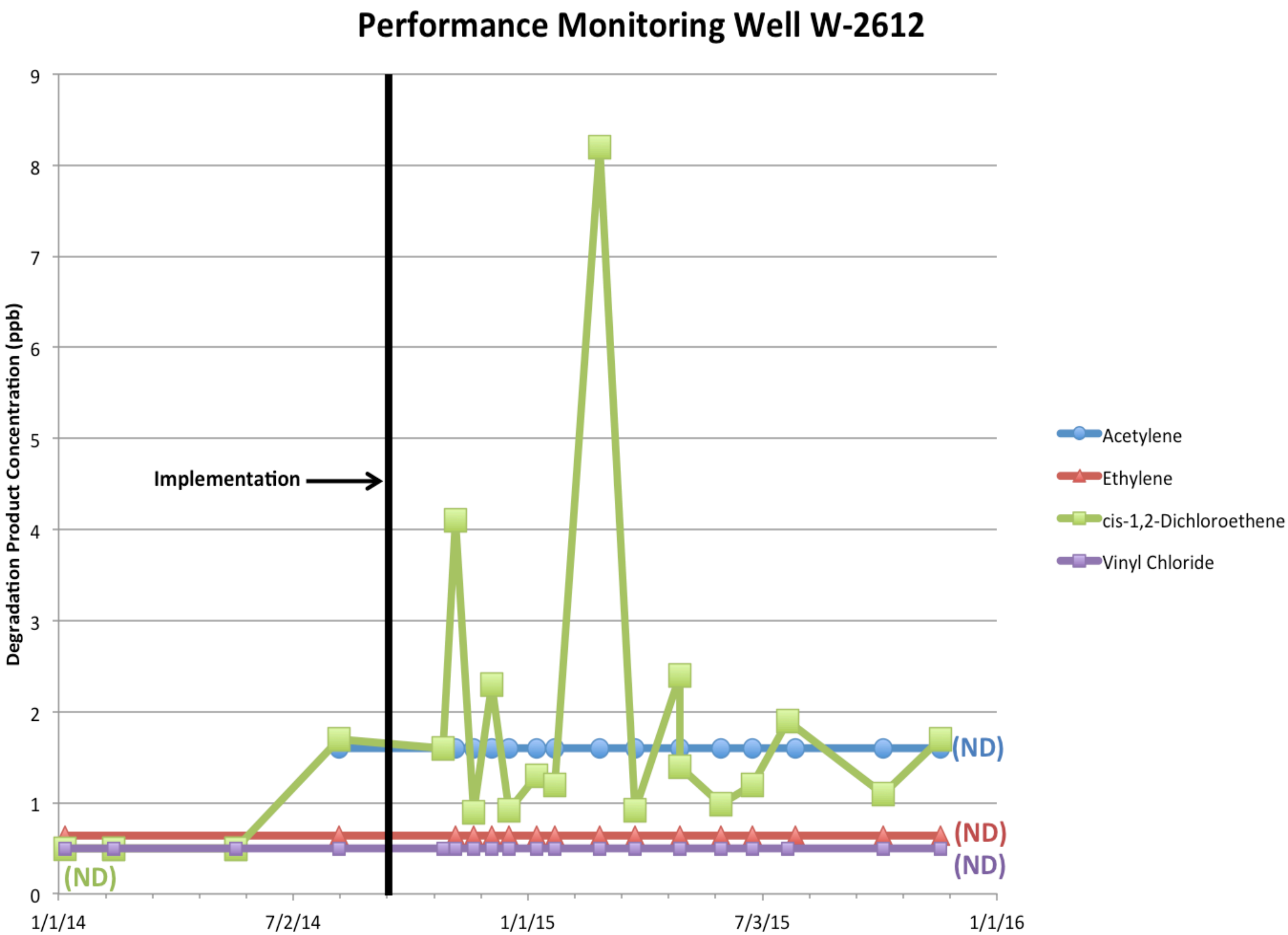


Figure I-4. TCE degradation product concentrations at performance monitoring well W-2612.

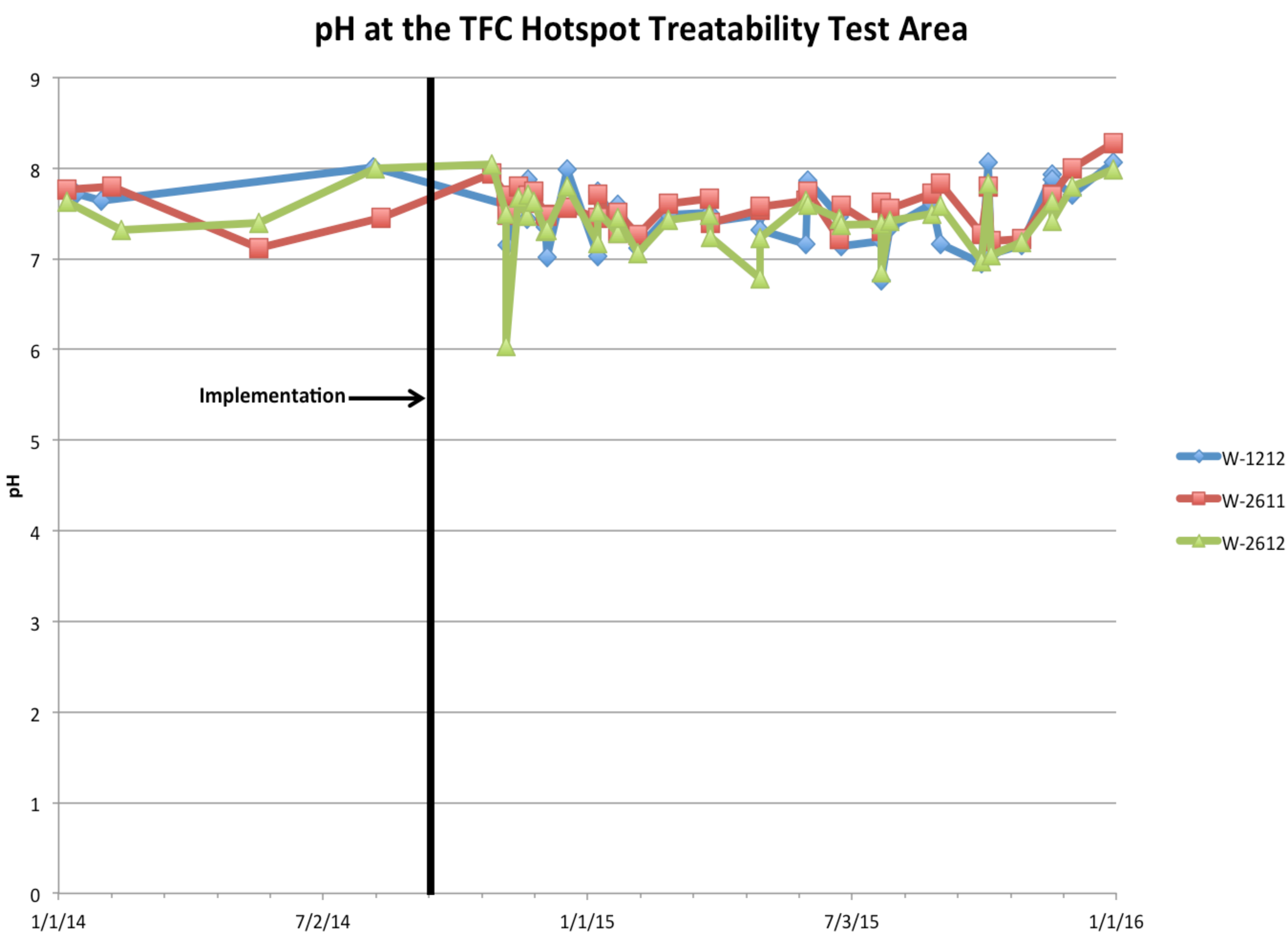


Figure I-5. TFC Hotspot treatability test pre- and post-implementation pH measurements.

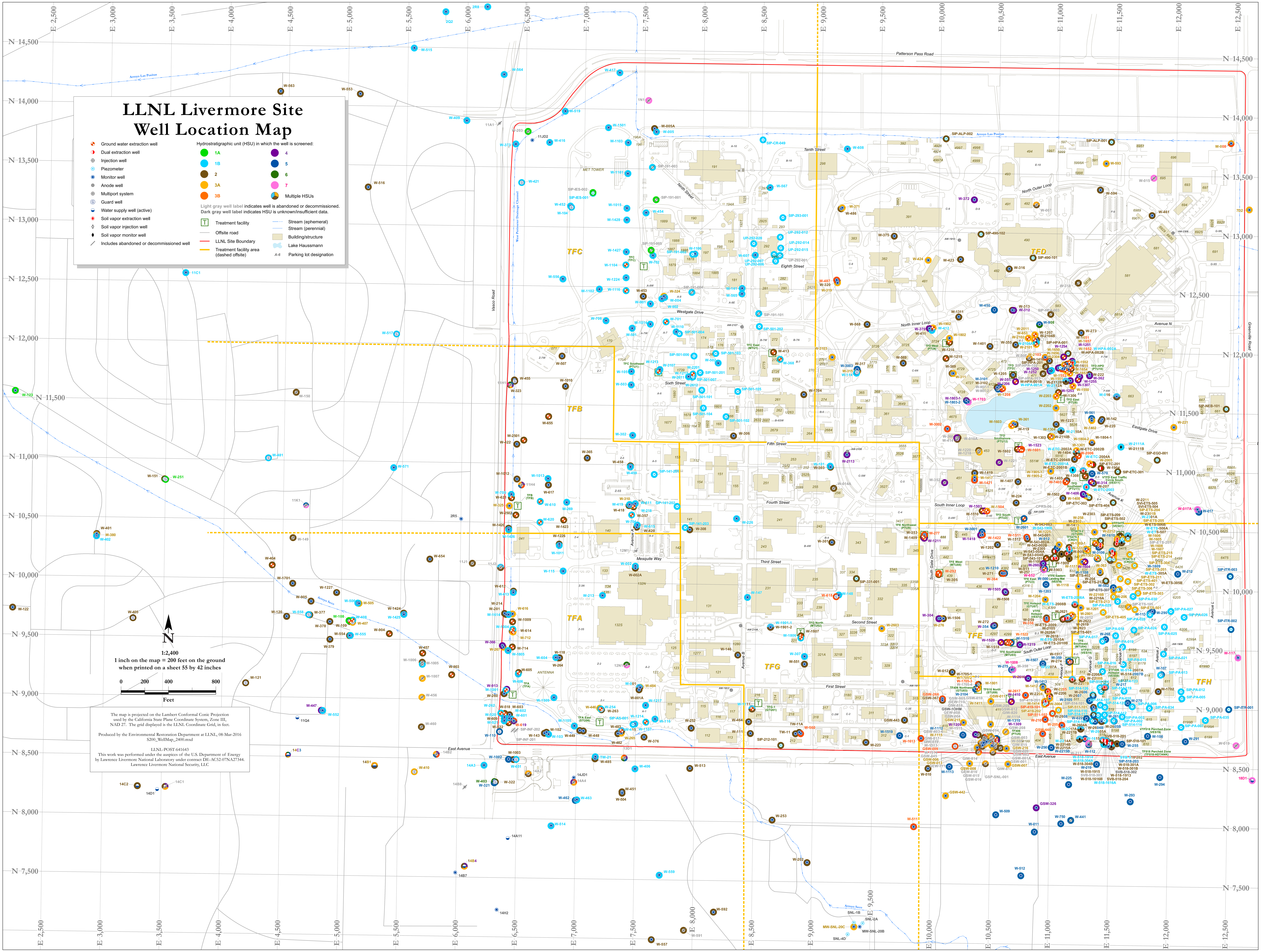
Attachments A and B

(see attached CD)

Attachments

Attachment A—LLNL Livermore Site well location map (see attached CD)

Attachment B—2015 ground water monitoring analytical results (see attached CD)


LLNL Livermore Site
Well Location Map
Ground water extraction well
Dual extraction well
Injection well
Piezometer
Monitor well
Anode well
Multiport system
Guard well
Water supply well (active)
Soil vapor extraction well
Soil vapor injection well
Soil vapor monitor well
Includes abandoned or decommissioned well
Hydrostratigraphic unit (HSU) in which the well is screened:
1A
1B
2
3A
3B
4
5
6
7
Multiple HSUs
Light gray well label indicates well is abandoned or decommissioned.
Dark gray well label indicates HSU is unknown/insufficient data.
Treatment facility
Offsite road
LLNL Site Boundary
Treatment facility area (dashed offsite)
Stream (ephemeral)
Stream (perennial)
Building/structure
Lake Haussmann
A-6
Parking lot designation
N
1:2,400
1 inch on the map = 200 feet on the ground
when printed on a sheet 55 by 42 inches
0
200
400
800
Feet
The map is projected on the Lambert Conformal Conic Projection used by the California State Plane Coordinate System, Zone III, NAD 27. The grid displayed is the LLNL Coordinate Grid, in feet.
Produced by the Environmental Restoration Department at LLNL, 08-Mar-2016
S200_WellMap_2400.mxd
LLNL-POST-641643
This work was performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under contract DE-AC52-07NA27344.
Lawrence Livermore National Security, LLC
TFA
TFB
TFC
TFD
TFE
TFG
TFH
Patterson Pass Road
Vasco Road
Greenville Road
East Avenue
Arroyo Las Positas
Arroyo Seco

Attachment B Table 1. 2015 Livermore Site ground water monitoring analytical results for VOCs.

Year	Well Name	Type	Date	1,1,1-Trichloroethane (µg/L)	1,1,2-Trichloroethane (µg/L)	1,1-Dichloroethane (µg/L)	1,1-Dichloroethene (µg/L)	1,2-Dichloroethane (µg/L)	1,2-Dichloroethene (total) (µg/L)	Carbon tetrachloride (µg/L)	Chloroform (µg/L)	Freon 113 (µg/L)	Tetrachloroethene (µg/L)	Trichloroethene (µg/L)	Trichlorofluoro methane (µg/L)	cis-1,2-Dichloroethene (µg/L)	trans-1,2-Dichloroethene (µg/L)
2015	W-001A	MW	1/14/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	0.5	3.7 O	<0.5	<0.5	<0.5
2015	W-002	MW	3/18/15	<0.5	<0.5	<0.5	3.4	<0.5	<1	0.85	9.3	0.77	5	6.6	<0.5	<0.5	<0.5
2015	W-002A	MW	9/24/15	<0.5	<0.5	<0.5	2	<0.5	<1	<0.5	1.4	0.56	1.5	1.7	2.2	<0.5	<0.5
2015	W-002A	MW	12/28/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	0.67	<0.5	<0.5	<0.5	4	<0.5	<0.5
2015	W-004	MW	6/2/15	<0.5	<0.5	<0.5	0.68	<0.5	<1	<0.5	1.1	11	<0.5	13	<0.5	<0.5	<0.5
2015	W-007	MW	1/27/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-011	MW	9/16/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-012	MW	2/11/15	<0.5	<0.5	<0.5	1.6	<0.5	<1	<0.5	<0.5	2.1	7.1	15	<0.5	<0.5	<0.5
2015	W-017A	MW	1/7/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-102	MW	1/15/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-103	MW	1/15/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	0.89	<0.5	<0.5	<0.5	<0.5
2015	W-104	MW	1/12/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-104	MW	5/14/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-104	MW	7/14/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-104	MW	11/17/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-105	MW	1/21/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	1.2	6.7	<0.5	0.51	<0.5	<0.5	<0.5
2015	W-105	MW	4/22/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-105	MW	12/3/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	1.1	5.6	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-105	MW	12/3/15 DUP	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	1	5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-106	MW	3/4/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-109	MW	1/21/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	0.59	0.81	<0.5	<0.5	<0.5	<0.5
2015	W-109	MW	4/14/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	0.53	0.9	<0.5	<0.5	<0.5	<0.5
2015	W-109	MW	7/28/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	0.73	0.86	<0.5	<0.5	<0.5	<0.5
2015	W-109	MW	11/4/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	0.51	0.88	<0.5	<0.5	<0.5	<0.5
2015	W-110	MW	2/17/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-110	MW	5/12/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-110	MW	7/7/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-110	MW	11/16/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-111	MW	6/22/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	15	0.58	<0.5	4	<0.5	<0.5	<0.5
2015	W-115	MW	4/20/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	1.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-116	MW	1/12/15	<0.5	<0.5	1.2	0.63	<0.5	78	<0.5	0.51	<0.5	150 D	40	<0.5	65	13
2015	W-116	MW	4/15/15	<0.5	<0.5	1.2	0.63	<0.5	28	<0.5	0.95	<0.5	200 D	20	<0.5	25	3.6
2015	W-116	MW	4/15/15 DUP	<0.5	<0.5	1.2	0.54	<0.5	24	<0.5	0.93	<0.5	210 D	19	<0.5	21	3.1
2015	W-117	MW	9/10/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-118	MW	5/21/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	12	<0.5	<0.5	<0.5	<0.5
2015	W-119	MW	1/6/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	0.61	1.3	<0.5	<0.5
2015	W-120	MW	2/18/15	<0.5 S	<0.5 S	<0.5 S	<0.5 S	<0.5 S	<1 S	<0.5 S	5.6 S	<0.5 S	<0.5 S	<0.5 S	<0.5 S	<0.5 S	<0.5 S
2015	W-120	MW	2/18/15 DUP	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1	<0.5	<0.5	<0.5	<0.5
2015	W-120	MW	7/21/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	0.74	<0.5	<0.5	<0.5	<0.5
2015	W-121	MW	2/19/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-121	MW	5/14/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-121	MW	7/14/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-121	MW	11/12/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-141	MW	7/15/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	7	<0.5	1.2	<0.5	<0.5	<0.5
2015	W-143	MW	1/15/15	<0.5	<0.5	14	11	<0.5	<1	<0.5	0.52	<0.5	5.4	0.91	<0.5	0.73	<0.5
2015	W-146	MW	3/18/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	1.5	2.8	<0.5	<0.5	<0.5
2015	W-146	MW	4/29/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	1.5	2.8	<0.5	<0.5	<0.5
2015	W-146	MW	9/24/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	1.4	2.4	<0.5	<0.5	<0.5
2015	W-146	MW	12/28/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	1.6	2.8	<0.5	<0.5	<0.5
2015	W-151	MW	1/5/15	<0.5	<0.5	0.97	1.1	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-151	MW	2/4/15	<0.5	<0.5	0.84	1.1	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-151	MW	3/2/15	<0.5	<0.5	1	1.4	<0.5	<1	<0.5	<0.5	<0.5	0.54	<0.5	<0.5	<0.5	<0.5
2015	W-151	MW	4/8/15	<0.5	<0.5	0.91	1.2	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5

Attachment B Table 1. 2015 Livermore Site ground water monitoring analytical results for VOCs.

Year	Well Name	Type	Date	1,1,1-Trichloroethane (µg/L)	1,1,2-Trichloroethane (µg/L)	1,1-Dichloroethane (µg/L)	1,1-Dichloroethene (µg/L)	1,2-Dichloroethane (µg/L)	1,2-Dichloroethene (total) (µg/L)	Carbon tetrachloride (µg/L)	Chloroform (µg/L)	Freon 113 (µg/L)	Tetrachloroethene (µg/L)	Trichloroethene (µg/L)	Trichlorofluoro methane (µg/L)	cis-1,2-Dichloroethene (µg/L)	trans-1,2-Dichloroethene (µg/L)
2015	W-151	MW	5/11/15	<0.5	<0.5	0.93	1.2	<0.5	<1	<0.5	<0.5	<0.5	0.5	<0.5	<0.5	<0.5	<0.5
2015	W-151	MW	6/2/15	<0.5	<0.5	0.93	1.3	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-151	MW	7/6/15	<0.5	<0.5	0.98	1.2	<0.5	<1	<0.5	<0.5	<0.5	0.54	<0.5	<0.5	<0.5	<0.5
2015	W-151	MW	8/3/15	<0.5	<0.5	0.96	1.3	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-151	MW	9/8/15	<0.5	<0.5	0.88	1.1	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-151	MW	11/10/15	<0.5	<0.5	0.96	1.2	<0.5	<1	<0.5	<0.5	<0.5	0.51	<0.5	<0.5	<0.5	<0.5
2015	W-151	MW	11/23/15	<0.5	<0.5	0.96	1.2	<0.5	<1	<0.5	<0.5	<0.5	0.5	<0.5	<0.5	<0.5	<0.5
2015	W-151	MW	12/29/15	<0.5	<0.5	0.99	1.2	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-201	MW	4/27/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	0.66	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-204	MW	1/12/15	<0.5	<0.5	<0.5	1.3	<0.5	<1	1.4	3.8	28	0.97	17	<0.5	<0.5	<0.5
2015	W-205	MW	5/4/15	<0.5	<0.5	<0.5	2.3	<0.5	1.8	0.69	1.1	1.2	0.74	430 D	<0.5	1.8	<0.5
2015	W-205	MW	8/20/15	<0.5	<0.5	<0.5	2.2	<0.5	1.6	0.53	1.1	0.96	<0.5	520 D	<0.5	1.6	<0.5
2015	W-205	MW	8/20/15 DUP	<0.5	<0.5	<0.5	3	<0.5	2.1	0.77 IJ	1.5	1.9	<0.5	430 DH	<0.5	2.1	<0.5
2015	W-205	MW	12/7/15	<0.5	<0.5	<0.5	2.3	<0.5	1.6	0.54	1	1.2	<0.5	490 D	<0.5	1.6	<0.5
2015	W-206	MW	2/11/15	<0.5	<0.5	1.1	23	5.4	<1	2.7	30	11	55	380 D	<0.5	<0.5	<0.5
2015	W-206	MW	2/11/15 DUP	<0.5	<0.5	1.2	25	5.5	<1	2.7	32	12	60	460 D	<0.5	<0.5	<0.5
2015	W-212	MW	3/3/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-214	MW	1/20/15	<0.5	<0.5	0.75	2.9	<0.5	<1	0.6	3.2	<0.5	5.4	1.2	<0.5	<0.5	<0.5
2015	W-219	MW	9/15/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-223	MW	9/17/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-226	MW	1/21/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	1.5	2.9	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-251	MW	1/12/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	4.1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-251	MW	4/8/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	4.4	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-251	MW	7/6/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	3.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-251	MW	11/16/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	3.3	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-252	MW	3/31/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	16	<0.5	<0.5	1	<0.5	<0.5	<0.5
2015	W-252	MW	9/17/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	13	<0.5	<0.5	1	<0.5	<0.5	<0.5
2015	W-253	MW	9/15/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-254	MW	3/30/15	<0.5	<0.5	0.67	<0.5	<0.5	5.9	<0.5	<0.5	<0.5	52	1.8	<0.5	5.9	<0.5
2015	W-254	MW	4/20/15	<0.5	<0.5	0.79	0.64	<0.5	4.1	<0.5	<0.5	<0.5	72	2	<0.5	4.1	<0.5
2015	W-254	MW	9/3/15	<0.5	<0.5	0.86	0.72	<0.5	1.6	<0.5	<0.5	<0.5	86	2.2	<0.5	1.6	<0.5
2015	W-254	MW	11/11/15	<0.5	<0.5	0.89	0.79	<0.5	2.2	<0.5	<0.5	<0.5	85	2.6	<0.5	2.2	<0.5
2015	W-255	MW	3/25/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	1.6	<0.5	<0.5	<0.5
2015	W-256	MW	10/27/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	1	<0.5	<0.5	<0.5	0.5	<0.5	<0.5	<0.5
2015	W-258	MW	6/8/15	<0.5	<0.5	<0.5	13	<0.5	<1	1	1.1	<0.5	5.5	100	<0.5	<0.5	<0.5
2015	W-260	MW	10/6/15	<0.5	<0.5	28	8.5	<0.5	<1	<0.5	<0.5	<0.5	3.2	0.73	<0.5	0.58	<0.5
2015	W-261	MW	5/4/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	0.78	7.2	<0.5	<0.5	<0.5
2015	W-261	MW	9/15/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-262	MW	1/21/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-262	MW	4/14/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-262	MW	7/28/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-262	MW	11/4/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-263	MW	1/12/15	<0.5	<0.5	<0.5	1.2	<0.5	<1	<0.5	1.4	<0.5	14	1.5	<0.5	<0.5	<0.5
2015	W-263	MW	4/15/15	<0.5	<0.5	<0.5	1.3	<0.5	<1	<0.5	1.6	<0.5	15	1.5	<0.5	<0.5	<0.5
2015	W-263	MW	7/9/15	<0.5	<0.5	<0.5	1.4	<0.5	<1	<0.5	1.6	<0.5	14	1.6	<0.5	<0.5	<0.5
2015	W-263	MW	10/6/15	<0.5	<0.5	<0.5	1.3	<0.5	<1	<0.5	1.5	<0.5	14	1.5	<0.5	<0.5	<0.5
2015	W-264	MW	1/14/15	<0.5	<0.5	0.67	1.8	<0.5	<1	<0.5	1.9	<0.5	25	1.8 O	<0.5	<0.5	<0.5
2015	W-265	MW	8/4/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-267	MW	1/20/15	<0.5	<0.5	3.2	4.9	<0.5	<1	0.62	0.78	<0.5	5.2	1.3	<0.5	<0.5	<0.5
2015	W-267	MW	8/5/15	<0.5	<0.5	3.4	5.7	<0.5	<1	0.59	0.84	<0.5	5.5	1.3	<0.5	0.55	<0.5
2015	W-268	MW	9/8/15	<0.5	<0.5	<0.5	2.5	<0.5	<1	<0.5	1.2	2.4	0.55	9	<0.5	<0.5	<0.5
2015	W-269	MW	4/27/15	<0.5	<0.5	<0.5	3.8	<0.5	<1	<0.5	0.78	0.51	0.79	2.1	<0.5	<0.5	<0.5
2015	W-269	MW	4/27/15 DUP	<0.5	<0.5	<0.5	2.9	<0.5	<1	<0.5	0.6	<0.5	0.62	1.6	<0.5	<0.5	<0.5
2015	W-269	MW	12/23/15	<0.5	<0.5	<0.5	7.7	<0.5	<1	<0.5	0.75	3	1.3	3	<0.5	<0.5	<0.5
2015	W-269	MW	12/23/15 DUP	<0.5	<0.5	<0.5	6.8	<0.5	<1	<0.5	0.68	2.6	1.2	2.9	<0.5	<0.5	<0.5
2015	W-270	MW	3/4/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-271	MW	2/11/15	<0.5	<0.5	<0.5	2.9	<0.5	<1	<0.5	<0.5	1.1	2.8	10	<0.5	<0.5	<0.5
2015	W-272	MW	9/8/15	<0.5	<0.5	<0.5	0.88	<0.5	<1	<0.5	<0.5	<0.5	<0.5	4.8	<0.5	<0.5	<0.5
2015	W-274	MW	2/12/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	56	<0.5	<0.5	<0.5
2015	W-275	MW	10/21/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	5.3	<0.5	<0.5	<0.5
2015	W-276	MW	2/11/15	<0.5	<0.5	<0.5	7.8	<0.5	1.9	<0.5	<0.5	11	14	55	0.67	1.9	<0.5
2015	W-276	MW	2/11/15 DUP	<0.5	<0.5	<0.5	5.9	<0.5	1.8	<0.5	<0.5	9	9.6	48	<0.5	1.8	<0.5

Attachment B Table 1. 2015 Livermore Site ground water monitoring analytical results for VOCs.

Year	Well Name	Type	Date	1,1,1-Trichloroethane (µg/L)	1,1,2-Trichloroethane (µg/L)	1,1-Dichloroethane (µg/L)	1,1-Dichloroethene (µg/L)	1,2-Dichloroethane (µg/L)	1,2-Dichloroethene (total) (µg/L)	Carbon tetrachloride (µg/L)	Chloroform (µg/L)	Freon 113 (µg/L)	Tetrachloroethene (µg/L)	Trichloroethene (µg/L)	Trichlorofluoro methane (µg/L)	cis-1,2-Dichloroethene (µg/L)	trans-1,2-Dichloroethene (µg/L)
2015	W-276	MW	9/8/15	<0.5	<0.5	<0.5	8.9	<0.5	1.6	<0.5	<0.5	15	15	60	0.8	1.6	<0.5
2015	W-277	MW	6/4/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	1.9	<0.5	<0.5	3.2	1.2	<0.5	<0.5
2015	W-290	MW	3/4/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-291	MW	3/4/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-292	MW	1/13/15	<0.5	<0.5	<0.5	0.84	<0.5	2	<0.5	0.76	1.1	1.2	17	<0.5	2	<0.5
2015	W-292	MW	4/8/15	<0.5	<0.5	<0.5	0.95	<0.5	2.3	<0.5	0.83	1.2	1.3	18	<0.5	2.3	<0.5
2015	W-292	MW	7/16/15	<0.5	<0.5	<0.5	0.96	<0.5	2.1	<0.5	0.81	1.1	1.3	18	<0.5	2.1	<0.5
2015	W-292	MW	10/6/15	<0.5	<0.5	<0.5	0.97	<0.5	2	<0.5	0.82	1.1	1.2	17	<0.5	2	<0.5
2015	W-293	MW	3/19/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-294	MW	3/19/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-301	MW	9/24/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	0.62	2.5	2.5	2.5	<0.5	<0.5	<0.5
2015	W-301	MW	12/28/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	0.66	2.8	2.8	2.8	<0.5	<0.5	<0.5
2015	W-302	MW	11/9/15	<0.5	<0.5	<0.5	0.68	<0.5	<1	0.77	7.4	5.8	<0.5	2.7	<0.5	<0.5	<0.5
2015	W-304	MW	6/4/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	0.65	<0.5	7	<0.5	<0.5	<0.5
2015	W-305	MW	1/13/15	<0.5	<0.5	<0.5	1.5	<0.5	<1	<0.5	0.94	9.8	8.3	29	<0.5	<0.5	<0.5
2015	W-305	MW	4/8/15	<0.5	<0.5	<0.5	1.7	<0.5	<1	<0.5	1	10	8.6	29	<0.5	<0.5	<0.5
2015	W-305	MW	7/16/15	<0.5	<0.5	<0.5	1.6	<0.5	<1	<0.5	1	9.4	8.6	29	<0.5	<0.5	<0.5
2015	W-305	MW	10/6/15	<0.5	<0.5	<0.5	1.6	<0.5	<1	<0.5	0.91	9.7	7.8	26	<0.5	<0.5	<0.5
2015	W-307	MW	3/18/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	2.3	<0.5	21	30	<0.5	<0.5	<0.5
2015	W-308	MW	8/5/15	<0.5	<0.5	<0.5	1.2	<0.5	<1	0.93	2.1	0.58	1.6	9.6	<0.5	<0.5	<0.5
2015	W-310	MW	1/21/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	1.1	4.4	5.8	4	<0.5	<0.5	<0.5
2015	W-310	MW	8/5/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	1.1	4.1	5.1	3.6	<0.5	<0.5	<0.5
2015	W-310	MW	8/5/15 DUP	<0.5	<0.5	<0.5	0.5	<0.5	<0.5	<0.5	1.3	5.6	6.2	4.2 L	<0.5	<0.5	<0.5
2015	W-311	MW	1/28/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	5.7	<0.5	<0.5	7.3	23	<0.5	<0.5
2015	W-312	MW	6/19/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-313	MW	2/5/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	0.82	0.85	<0.5	<0.5	<0.5	2.4	<0.5	<0.5
2015	W-314	MW	1/7/15	<0.5	<0.5	<0.5	0.95	<0.5	<1	<0.5	<0.5	<0.5	1.8	9.6	<0.5	<0.5	<0.5
2015	W-314	MW	4/1/15	<0.5	<0.5	0.55	0.96	<0.5	<1	<0.5	<0.5	<0.5	1.7	8.1	<0.5	<0.5	<0.5
2015	W-314	MW	7/9/15	<0.5	<0.5	0.52	0.8	<0.5	<1	<0.5	<0.5	<0.5	1.5	5.9	<0.5	<0.5	<0.5
2015	W-314	MW	10/1/15	<0.5	<0.5	<0.5	0.69	<0.5	<1	<0.5	<0.5	<0.5	1.2	5.1	<0.5	<0.5	<0.5
2015	W-315	MW	2/18/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	0.52	3	<0.5	<0.5	9.2	22	<0.5	<0.5
2015	W-315	MW	4/14/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	3.3	<0.5	<0.5	8.7	19	<0.5	<0.5
2015	W-315	MW	7/14/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	3.2	<0.5	<0.5	9.3	20	<0.5	<0.5
2015	W-315	MW	11/17/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	2.9	<0.5	<0.5	8.9	21	<0.5	<0.5
2015	W-315	MW	11/17/15 DUP	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	2.9	<0.5	<0.5	8.9	21	<0.5	<0.5
2015	W-317	MW	12/1/15	<0.5	<0.5	<0.5	0.87	<0.5	<1	<0.5	16	1.8	<0.5	12	20	<0.5	<0.5
2015	W-320	MW	12/9/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	3.6	14	0.63	3.9	17	<0.5	<0.5
2015	W-322	MW	2/19/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-322	MW	5/12/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-322	MW	7/13/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-322	MW	11/16/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-323	MW	2/24/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	0.94	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-323	MW	5/18/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	0.99	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-323	MW	7/21/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	0.88	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-323	MW	11/17/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	0.88	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-325	MW	4/22/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	0.73	3.2	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-351	MW	1/5/15	<0.5	<0.5	<0.5	6.1	0.79	<1	20	3.4	3.7	5.7	340 D	1.3	<0.5	<0.5
2015	W-351	MW	4/8/15	<0.5	<0.5	<0.5	7	0.82	<1	26	4.6	4.6	6	460 D	1.3	<0.5	<0.5
2015	W-353	MW	3/31/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	3	<0.5	<0.5	<0.5
2015	W-353	MW	9/16/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	0.51	6.4	<0.5	<0.5	<0.5
2015	W-354	MW	3/25/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	10	<0.5	<0.5	<0.5
2015	W-354	MW	6/4/15	<0.5	<0.5	<0.5	2	1.3	1.9	4.1	3.2	<0.5	5.4	110 D	<0.5	1.9	<0.5
2015	W-354	MW	9/16/15	<0.5	<0.5	<0.5	0.72	<0.5	<1	1.7	1.2	<0.5	2.2	44	<0.5	0.61	<0.5
2015	W-354	MW	9/16/15 DUP	<0.5	<0.5	<0.5	0.72	<0.5	<1	1.7	1.2	<0.5	2.1	44	<0.5	0.65	<0.5
2015	W-354	MW	12/17/15	<0.5	<0.5	<0.5	0.86	0.51	<1	2.2	1.4	<0.5	2.6	53	<0.5	0.75	<0.5
2015	W-355	MW	1/28/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	36	5.5	<0.5	<0.5
2015	W-356	MW	5/7/15	<0.5	<0.5	<0.5	17	<0.5	2	<0.5	0.65	3	9	60	<0.5	2	<0.5
2015	W-356	MW	10/21/15 DUP	<0.5	<0.5	<0.5	14	<0.5	1.9	<0.5	0.62	2.4	7.6	60	<0.5	1.9	<0.5
2015	W-356	MW	10/21/15	<0.5	<0.5	<0.5	13	<0.5	1.8	<0.5	0.61	2.3	7	57	<0.5	1.8	<0.5
2015	W-357	MW	1/7/15	<0.5	<0.5	<0.5	1	<0.5	<1	1.6	2.8	3.7	1.2	31	<0.5	<0.5	<0.5
2015	W-357	MW	4/2/15	<0.5	<0.5	<0.5	1.2	<0.5	<1	1.5	3.1	3.2	1.1	28	<0.5	<0.5	<0.5
2015	W-357	MW	7/13/15	<0.5	<0.5	<0.5	1.2	<0.5	<1	1.4	3.3	3.1	1.2	31	<0.5	<0.5	<0.5
2015	W-357	MW	10/8/15	<0.5	<0.5	<0.5	1.1	<0.5	<1	1.4	3.1	2.7	1	28	<0.5	<0.5	<0.5

Attachment B Table 1. 2015 Livermore Site ground water monitoring analytical results for VOCs.

Year	Well Name	Type	Date	1,1,1-Trichloroethane (µg/L)	1,1,2-Trichloroethane (µg/L)	1,1-Dichloroethane (µg/L)	1,1-Dichloroethene (µg/L)	1,2-Dichloroethane (µg/L)	1,2-Dichloroethene (total) (µg/L)	Carbon tetrachloride (µg/L)	Chloroform (µg/L)	Freon 113 (µg/L)	Tetrachloroethene (µg/L)	Trichloroethene (µg/L)	Trichlorofluoro methane (µg/L)	cis-1,2-Dichloroethene (µg/L)	trans-1,2-Dichloroethene (µg/L)
2015	W-359	MW	1/12/15	<0.5	<0.5	<0.5	9.9	<0.5	<1	2.4	1.5	4.8	6	150 D	<0.5	<0.5	<0.5
2015	W-359	MW	4/1/15	<0.5	<0.5	<0.5	12	<0.5	<1	2.3	2.2	5.7	6.8	150 D	<0.5	<0.5	<0.5
2015	W-359	MW	7/9/15	<0.5	<0.5	<0.5	13	<0.5	<1	2.4	3.8	5.9	8.1	150 D	<0.5	<0.5	<0.5
2015	W-359	MW	10/1/15	<0.5	<0.5	<0.5	10	0.51	<1	2.1	3.6	5.3	7.4	140 D	<0.5	<0.5	<0.5
2015	W-363	MW	2/11/15	<0.5	<0.5	<0.5	5.3	1.4	<1	1.2	9.6	18	9.1	89	<0.5	<0.5	<0.5
2015	W-363	MW	6/23/15	<0.5	<0.5	<0.5	7.8	1.7	<1	1.7	13	22	13	99 D	<0.5	<0.5	<0.5
2015	W-363	MW	9/17/15	<0.5	<0.5	<0.5	7.4	2.6	<1	1.4	14	12	15	130 D	<0.5	<0.5	<0.5
2015	W-363	MW	10/21/15	<0.5	<0.5	0.73	12	3.3	<1	2.1	21	17	25	190 D	<0.5	<0.5	<0.5
2015	W-364	MW	9/16/15	<0.5	<0.5	<0.5	5.7	<0.5	1.4	<0.5	<0.5	1.3	4.7	41	<0.5	1.4	<0.5
2015	W-365	MW	8/5/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	1.2	1.4	<0.5	<0.5	13	<0.5	<0.5	<0.5
2015	W-368	MW	1/15/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	3.4	17	2.8	11	2.7	<0.5	<0.5
2015	W-368	MW	4/9/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	4	17	2.8	12	2.6	<0.5	<0.5
2015	W-368	MW	7/20/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	4.9	15	2.5	12	2.7	<0.5	<0.5
2015	W-368	MW	10/8/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	4.5	14	2.4	11	2.7	<0.5	<0.5
2015	W-369	MW	3/5/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	7.9	<0.5	<0.5	5.8	19	<0.5	<0.5
2015	W-370	MW	5/5/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-372	MW	1/28/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	2.8	0.62	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-373	MW	2/19/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	11	<0.5	<0.5	<0.5
2015	W-376	MW	4/20/15	<0.5	<0.5	<0.5	1.6	<0.5	<1	<0.5	0.84	<0.5	0.8	3.9	<0.5	<0.5	<0.5
2015	W-377	MW	10/12/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	0.53	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-378	MW	1/20/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	1.1	<0.5	<0.5	<0.5	<0.5
2015	W-379	MW	1/15/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-379	MW	1/15/15 DUP	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-379	MW	4/15/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	2.6	<0.5	<0.5	<0.5	<0.5
2015	W-379	MW	12/1/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	0.88	<0.5	<0.5	<0.5	<0.5
2015	W-379	MW	12/1/15 DUP	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	0.78	<0.5	0.77	<0.5	<0.5	<0.5	<0.5
2015	W-380	MW	4/16/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-402	MW	4/16/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-403	MW	4/27/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-404	MW	1/21/15	<0.5	<0.5	0.58	0.82	<0.5	<1	<0.5	<0.5	<0.5	3.5	<0.5	<0.5	<0.5	<0.5
2015	W-404	MW	4/14/15	<0.5	<0.5	0.59	0.91	<0.5	<1	<0.5	<0.5	<0.5	3.9	<0.5	<0.5	<0.5	<0.5
2015	W-404	MW	7/22/15	<0.5	<0.5	0.58	0.92	<0.5	<1	<0.5	<0.5	<0.5	3.5	<0.5	<0.5	<0.5	<0.5
2015	W-404	MW	11/4/15	<0.5	<0.5	0.56	0.79	<0.5	<1	<0.5	<0.5	<0.5	3.5	<0.5	<0.5	<0.5	<0.5
2015	W-405	MW	2/17/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-405	MW	5/11/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-405	MW	7/13/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-405	MW	11/11/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-407	MW	2/4/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-407	MW	4/13/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-407	MW	7/7/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-407	MW	11/10/15	<0.5	<0.5 IJ	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5 IJ	<0.5	<0.5	<0.5	<0.5
2015	W-408	MW	1/21/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-408	MW	4/14/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-408	MW	7/22/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-408	MW	11/4/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	0.55	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-409	MW	11/30/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	16	<0.5	<0.5	<0.5
2015	W-410	MW	1/15/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-410	MW	4/15/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-410	MW	7/30/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-410	MW	11/11/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-411	MW	12/2/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	8.8	<0.5	<0.5	<0.5	18	<0.5	<0.5
2015	W-413	MW	1/15/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	3.9	17	<0.5	4.3	0.69	<0.5	<0.5
2015	W-413	MW	4/9/15	<0.5	<0.5	<0.5	0.93	<0.5	<1	<0.5	13	12	<0.5	7.8	4	<0.5	<0.5
2015	W-413	MW	7/20/15	<0.5	<0.5	<0.5	0.93	<0.5	<1	<0.5	14	11	<0.5	8.1	4	<0.5	<0.5
2015	W-413	MW	10/8/15	<0.5	<0.5	<0.5	0.83	<0.5	<1	<0.5	12	10	<0.5	7.6	3.8	<0.5	<0.5
2015	W-415	MW	1/21/15	<0.5	<0.5	0.51	1.1	<0.5	<1	<0.5	1.6	<0.5	9.4	0.93	<0.5	<0.5	<0.5
2015	W-415	MW	4/14/15	<0.5	<0.5	0.55	1.2	<0.5	<1	<0.5	1.8	<0.5	9.7	0.95	<0.5	<0.5	<0.5
2015	W-415	MW	7/22/15	<0.5	<0.5	0.66	1.6	<0.5	<1	<0.5	2.1	<0.5	9.8	1.1	<0.5	<0.5	<0.5
2015	W-415	MW	11/4/15	<0.5	<0.5	0.61	1.3	<0.5	<1	<0.5	1.9	<0.5	8.7	1	<0.5	<0.5	<0.5
2015	W-416	MW	11/11/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	4.4	<0.5	<0.5	<0.5
2015	W-417	MW	11/16/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-418	MW	11/9/15	<0.5	<0.5	<0.5	0.64	<0.5	<1	1.6	4.4	3.1	<0.5	7.5	<0.5	<0.5	<0.5
2015	W-419	MW	4/20/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	4.6	2	1.3	3.6	<0.5	<0.5	<0.5

Attachment B Table 1. 2015 Livermore Site ground water monitoring analytical results for VOCs.

Year	Well Name	Type	Date	1,1,1-Trichloroethane (µg/L)	1,1,2-Trichloroethane (µg/L)	1,1-Dichloroethane (µg/L)	1,1-Dichloroethene (µg/L)	1,2-Dichloroethane (µg/L)	1,2-Dichloroethene (total) (µg/L)	Carbon tetrachloride (µg/L)	Chloroform (µg/L)	Freon 113 (µg/L)	Tetrachloroethene (µg/L)	Trichloroethene (µg/L)	Trichlorofluoro methane (µg/L)	cis-1,2-Dichloroethene (µg/L)	trans-1,2-Dichloroethene (µg/L)
2015	W-420	MW	11/9/15	<0.5	<0.5	<0.5	5.3	<0.5	<1	<0.5	3.5	1.1	2.5	7.2	<0.5	<0.5	<0.5
2015	W-421	MW	2/19/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-421	MW	5/20/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-421	MW	7/22/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-421	MW	11/11/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-422	MW	2/24/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	4.6	<0.5	<0.5	<0.5
2015	W-422	MW	2/24/15 DUP	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.53	<0.5	4.5	<0.5	<0.5	<0.5
2015	W-422	MW	5/18/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	4.5	<0.5	<0.5	<0.5
2015	W-422	MW	7/21/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	0.51	<0.5	5.6	<0.5	<0.5	<0.5
2015	W-422	MW	7/21/15 DUP	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	4.1	<0.5	<0.5	<0.5
2015	W-422	MW	11/19/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	3.9	<0.5	<0.5	<0.5
2015	W-423	MW	12/2/15	IR	IR	IR	IR	IR	IR	IR	IR	IR	IR	IR	9.1 IJ	IR	IR
2015	W-424	MW	12/2/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	2.6	<0.5	<0.5	<0.5	<0.5	35	<0.5
2015	W-446	MW	1/20/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-447	MW	4/15/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-448	MW	1/14/15	<0.5	<0.5	1.9	4.5	<0.5	<1	<0.5	1.3	0.81	5.4	3.5 O	<0.5	<0.5	<0.5
2015	W-449	MW	1/14/15	<0.5	<0.5	6.6	4.4	<0.5	<1	<0.5	<0.5	<0.5	0.57	0.81 O	<0.5	<0.5	<0.5
2015	W-451	MW	3/19/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-452	MW	1/26/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-454	MW	4/21/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	1	3.8	<0.5	<0.5	<0.5
2015	W-454	MW	4/21/15 DUP	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.1	4.3	<0.5	<0.5	<0.5
2015	W-454	MW	12/3/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	0.76	1.2	4.1	<0.5	<0.5	<0.5
2015	W-455	MW	4/22/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-457	MW	1/21/15	<0.5	<0.5	<0.5	0.52	<0.5	<1	<0.5	<0.5	<0.5	4.4	<0.5	<0.5	<0.5	<0.5
2015	W-457	MW	4/14/15	<0.5	<0.5	<0.5	0.56	<0.5	<1	<0.5	<0.5	<0.5	4.6	<0.5	<0.5	<0.5	<0.5
2015	W-457	MW	7/22/15	<0.5	<0.5	<0.5	0.6	<0.5	<1	<0.5	<0.5	<0.5	4.4	<0.5	<0.5	<0.5	<0.5
2015	W-457	MW	11/4/15	<0.5	<0.5	<0.5	0.51	<0.5	<1	<0.5	<0.5	<0.5	4.5	<0.5	<0.5	<0.5	<0.5
2015	W-463	MW	3/20/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	0.76	<0.5	<0.5	<0.5	<0.5
2015	W-464	MW	3/30/15	<0.5	<0.5	<0.5	1.2	<0.5	<1	<0.5	6.8	<0.5	<0.5	3.2	<0.5	<0.5	<0.5
2015	W-481	MW	2/18/15	<0.5 S	<0.5 S	<0.5 S	<0.5 S	<0.5 S	<1 S	<0.5 S	<0.5 S	<0.5 S	0.96 S	<0.5 S	<0.5 S	<0.5 S	<0.5 S
2015	W-481	MW	5/18/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	5.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-481	MW	7/13/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	6.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-481	MW	11/12/15	<0.5	<0.5 IJ	<0.5	<0.5	<0.5	<1	<0.5	5.1	<0.5	<0.5 IJ	<0.5	<0.5	<0.5	<0.5
2015	W-482	MW	5/21/15	<0.5	<0.5	10	11	<0.5	1.3	<0.5	0.99	<0.5	2.8	3.1	<0.5	1.3	<0.5
2015	W-483	MW	11/30/15	<0.5	<0.5	<0.5	0.52	<0.5	<1	<0.5	<0.5	<0.5	2.5	<0.5	<0.5	<0.5	<0.5
2015	W-484	MW	7/9/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-485	MW	3/19/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-487	MW	5/5/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	0.58	<0.5	<0.5	<0.5	7.4	<0.5	<0.5
2015	W-501	MW	1/21/15	<0.5	<0.5	<0.5	0.59	<0.5	<1	<0.5	3.6	17	<0.5	0.99	<0.5	<0.5	<0.5
2015	W-503	MW	1/26/15	<0.5	<0.5	<0.5	2.5	<0.5	<1	<0.5	<0.5	18	<0.5	1.1	<0.5	<0.5	<0.5
2015	W-503	MW	4/22/15	<0.5	<0.5	<0.5	2.9	<0.5	<1	<0.5	0.51	19	<0.5	1.2	<0.5	<0.5	<0.5
2015	W-503	MW	10/8/15	<0.5	<0.5	<0.5	3.8	<0.5	<1	<0.5	0.58	25	<0.5	1.7	<0.5	<0.5	<0.5
2015	W-506	MW	4/16/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	2	<0.5	<0.5	<0.5	<0.5
2015	W-506	MW	10/12/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	1.6	<0.5	<0.5	<0.5	<0.5
2015	W-507	MW	10/14/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	0.66	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-509	MW	3/19/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	2.7	<0.5	<0.5	<0.5
2015	W-510	MW	3/31/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	0.69	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-512	MW	3/19/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-513	MW	3/19/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	3	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-515	MW	1/21/15	<0.5	<0.5	<0.5	0.53	<0.5	<1	<0.5	<0.5	<0.5	0.77	86 D	<0.5	0.94	<0.5
2015	W-515	MW	4/16/15	<0.5	<0.5	<0.5	1.4	<0.5	2.1	<0.5	0.77	<0.5	1.7	140 D	<0.5	2.1	<0.5
2015	W-515	MW	7/15/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	24	<0.5	<0.5	<0.5
2015	W-515	MW	10/8/15	<0.5	<0.5	<0.5	0.62	<0.5	<1	<0.5	<0.5	<0.5	0.63	77	<0.5	0.86	<0.5
2015	W-516	MW	10/14/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	14	<0.5	<0.5	<0.5
2015	W-517	MW	1/21/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	1.1	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-517	MW	4/20/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-517	MW	7/9/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	0.94	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-517	MW	10/8/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	0.76	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-518	MW	1/21/15	<0.5	<0.5	5.3	2.7	<0.5	<1	<0.5	<0.5	<0.5	3.9	<0.5	<0.5	<0.5	<0.5
2015	W-518	MW	4/14/15	<0.5	<0.5	5.4	3	<0.5	<1	<0.5	<0.5	<0.5	4.4	<0.5	<0.5	<0.5	<0.5
2015	W-518	MW	7/28/15	<0.5	<0.5	3.8	2.1	<0.5	<1	<0.5	<0.5	<0.5	2.9	<0.5	<0.5	<0.5	<0.5
2015	W-518	MW	11/4/15	<0.5	<0.5	6.3	3.1	<0.5	<1	<0.5	<0.5	<0.5	4.3	<0.5	<0.5	<0.5	<0.5
2015	W-519	MW	3/3/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	1.5	<0.5	<0.5	<0.5

Attachment B Table 1. 2015 Livermore Site ground water monitoring analytical results for VOCs.

Year	Well Name	Type	Date	1,1,1-Trichloroethane (µg/L)	1,1,2-Trichloroethane (µg/L)	1,1-Dichloroethane (µg/L)	1,1-Dichloroethene (µg/L)	1,2-Dichloroethane (µg/L)	1,2-Dichloroethene (total) (µg/L)	Carbon tetrachloride (µg/L)	Chloroform (µg/L)	Freon 113 (µg/L)	Tetrachloroethene (µg/L)	Trichloroethene (µg/L)	Trichlorofluoro methane (µg/L)	cis-1,2-Dichloroethene (µg/L)	trans-1,2-Dichloroethene (µg/L)
2015	W-521	MW	1/20/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	0.79	<0.5	<0.5	<0.5	<0.5
2015	W-522	MW	1/21/15	<0.5	<0.5	1.3	0.78	<0.5	<1	<0.5	<0.5	<0.5	2.5	<0.5	<0.5	<0.5	<0.5
2015	W-522	MW	4/14/15	<0.5	<0.5	1.3	0.9	<0.5	<1	<0.5	<0.5	<0.5	2.6	<0.5	<0.5	<0.5	<0.5
2015	W-522	MW	7/28/15	<0.5	<0.5	0.91	0.68	<0.5	<1	<0.5	<0.5	<0.5	2.2	<0.5	<0.5	<0.5	<0.5
2015	W-522	MW	11/4/15	<0.5	<0.5	1.3	0.83	<0.5	<1	<0.5	<0.5	<0.5	2.5	<0.5	<0.5	<0.5	<0.5
2015	W-551	MW	4/29/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	2.7	1.4	13	6	<0.5	<0.5	<0.5
2015	W-551	MW	12/28/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	2.4	1.5	12	5.9	<0.5	<0.5	<0.5
2015	W-552	MW	4/16/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	0.94	<0.5	<0.5	<0.5	<0.5
2015	W-553	MW	4/27/15	<0.5	<0.5	<0.5	<0.5	<0.5	1.4	<0.5	<0.5	<0.5	<0.5	4.7	<0.5	1.3	<0.5
2015	W-555	MW	10/12/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-556	MW	5/20/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	1.2	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-557	MW	3/19/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-558	MW	1/12/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-558	MW	5/14/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	0.55	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-558	MW	7/7/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	0.59	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-558	MW	11/11/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	0.65	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-559	MW	3/19/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-560	MW	3/30/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-562	MW	3/25/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	0.84	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-563	MW	10/14/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	8.2	<0.5	<0.5	<0.5
2015	W-565	MW	3/31/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	0.8	10	<0.5	3.9	<0.5	<0.5	<0.5
2015	W-566	MW	1/13/15	<0.5	<0.5	<0.5	4.8	<0.5	<1	0.51	3.1	6.7	4.4	52	<0.5	<0.5	<0.5
2015	W-566	MW	4/2/15	<0.5	<0.5	<0.5	6.3	0.53	<1	0.7	4.7	7.1	6.3	68	<0.5	<0.5	<0.5
2015	W-566	MW	7/14/15	<0.5	<0.5	<0.5	6.8	0.67	<1	0.69	5.8	6.4	8.1	87	<0.5	<0.5	<0.5
2015	W-566	MW	10/1/15	<0.5	<0.5	<0.5	6.2	0.73	<1	0.7	5.6	6	8.4	87	<0.5	<0.5	<0.5
2015	W-567	MW	8/11/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-568	MW	1/28/15	<0.5	<0.5	<0.5	1.1	<0.5	<1	<0.5	16	1.3	<0.5	11	13	<0.5	<0.5
2015	W-568	MW	8/18/15	<0.5	<0.5	<0.5	1.2	<0.5	<1	<0.5	18	1.2	<0.5	11	11	<0.5	<0.5
2015	W-568	MW	10/15/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	2.7	1.8	<0.5	2.9	7.3	<0.5	<0.5
2015	W-568	MW	10/15/15 DUP	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	3	1.7	<0.5	3.1	7	<0.5	<0.5
2015	W-569	MW	1/28/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	7.2	<0.5	<0.5	6.6	26	0.52	<0.5
2015	W-570	MW	2/5/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-571	MW	2/25/15	<0.5	<0.5	<0.5	0.72	<0.5	<1	<0.5	<0.5	0.65	1.4	1.9	<0.5	<0.5	<0.5
2015	W-593	MW	3/5/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	1.4	<0.5	<0.5	<0.5	<0.5
2015	W-603	MW	12/1/15	<0.5	<0.5	1.6	0.96	<0.5	<1	<0.5	<0.5	<0.5	1.2	<0.5	<0.5	<0.5	<0.5
2015	W-604	MW	3/31/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	6.6	<0.5	<0.5	<0.5	<0.5
2015	W-605	MW	1/21/15	<0.5	<0.5	0.7	0.82	<0.5	<1	<0.5	<0.5	<0.5	11	0.51	<0.5	<0.5	<0.5
2015	W-605	MW	4/14/15	<0.5	<0.5	0.66	0.8	<0.5	<1	<0.5	<0.5	<0.5	11	0.53	<0.5	<0.5	<0.5
2015	W-605	MW	7/22/15	<0.5	<0.5	0.79	0.93	<0.5	<1	<0.5	<0.5	<0.5	9.6	0.5	<0.5	<0.5	<0.5
2015	W-605	MW	11/4/15	<0.5	<0.5	0.68	0.77	<0.5	<1	<0.5	<0.5	<0.5	10	0.55	<0.5	<0.5	<0.5
2015	W-606	MW	1/20/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	1	<0.5	<0.5	<0.5	<0.5
2015	W-608	MW	1/28/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-610	MW	1/7/15	<0.5	<0.5	<0.5	0.83	<0.5	<1	<0.5	<0.5	0.94	0.6	1.3	<0.5	<0.5	<0.5
2015	W-610	MW	4/2/15	<0.5	<0.5	<0.5	0.68	<0.5	<1	<0.5	<0.5	0.77	0.54	1.1	<0.5	<0.5	<0.5
2015	W-610	MW	7/13/15	<0.5	<0.5	<0.5	0.56	<0.5	<1	<0.5	<0.5	0.76	<0.5	1.1	<0.5	<0.5	<0.5
2015	W-610	MW	10/8/15	<0.5	<0.5	<0.5	0.84	<0.5	<1	<0.5	<0.5	0.9	0.54	1.3	<0.5	<0.5	<0.5
2015	W-611	MW	1/21/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	3	2.8	2	3.4	<0.5	<0.5	<0.5
2015	W-612	MW	8/4/15	<0.5	<0.5	0.57	2.3	<0.5	<1	0.57	3.3	<0.5	2.7	0.68	<0.5	<0.5	<0.5
2015	W-613	MW	2/24/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	1.3	<0.5	<0.5	<0.5	<0.5
2015	W-614	MW	1/21/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	4.1	<0.5	<0.5	<0.5	<0.5
2015	W-614	MW	4/14/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	0.51	<0.5	4.2	<0.5	<0.5	<0.5	<0.5
2015	W-614	MW	7/22/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	0.5	<0.5	3.7	<0.5	<0.5	<0.5	<0.5
2015	W-614	MW	11/4/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	0.5	<0.5	3.8	<0.5	<0.5	<0.5	<0.5
2015	W-615	MW	1/21/15	<0.5	<0.5	<0.5	4.6	<0.5	<1	<0.5	3.9	0.68	1.3	10	<0.5	<0.5	<0.5
2015	W-617	MW	4/22/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	5.6	<0.5	1.2	<0.5	<0.5	<0.5
2015	W-618	MW	3/18/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	0.81	1.3	<0.5	<0.5	<0.5	<0.5
2015	W-618	MW	4/29/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	0.8	1.4	<0.5	<0.5	<0.5	<0.5
2015	W-618	MW	9/24/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	0.8	1.5	<0.5	<0.5	<0.5	<0.5
2015	W-618	MW	12/28/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	0.68	<0.5	<0.5	<0.5	<0.5
2015	W-619	MW	8/5/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-620	MW	4/2/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	0.55	1.6	<0.5	<0.5	<0.5
2015	W-620	MW	7/13/15	<0.5	<0.5	<0.5	0.76	<0.5	<1	<0.5	0.7	0.97	0.79	2.6	<0.5	<0.5	<0.5
2015	W-620	MW	10/8/15	<0.5	<0.5	<0.5	0.7	<0.5	<1	<0.5	0.71	0.99	0.72	2.5	<0.5	<0.5	<0.5

Attachment B Table 1. 2015 Livermore Site ground water monitoring analytical results for VOCs.

Year	Well Name	Type	Date	1,1,1-Trichloroethane (µg/L)	1,1,2-Trichloroethane (µg/L)	1,1-Dichloroethane (µg/L)	1,1-Dichloroethene (µg/L)	1,2-Dichloroethane (µg/L)	1,2-Dichloroethene (total) (µg/L)	Carbon tetrachloride (µg/L)	Chloroform (µg/L)	Freon 113 (µg/L)	Tetrachloroethene (µg/L)	Trichloroethene (µg/L)	Trichlorofluoromethane (µg/L)	cis-1,2-Dichloroethene (µg/L)	trans-1,2-Dichloroethene (µg/L)
2015	W-621	MW	1/7/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	1.1	<0.5	<0.5	<0.5
2015	W-621	MW	4/2/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	1.1	<0.5	<0.5	<0.5
2015	W-621	MW	7/13/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	1.1	<0.5	<0.5	<0.5
2015	W-621	MW	10/8/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	1.1	<0.5	<0.5	<0.5
2015	W-651	MW	1/12/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	0.74	<0.5	<0.5	<0.5	<0.5
2015	W-651	MW	4/20/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	0.84	<0.5	<0.5	<0.5	<0.5
2015	W-651	MW	7/9/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	0.86	<0.5	<0.5	<0.5	<0.5
2015	W-651	MW	10/8/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	0.72	<0.5	<0.5	<0.5	<0.5
2015	W-652	MW	6/23/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-653	MW	1/5/15	<0.5	<0.5	<0.5	0.57	<0.5	<1	15	4.7	2.2	0.62	410 D	<0.5	<0.5	<0.5
2015	W-653	MW	4/8/15	<0.5	<0.5	<0.5	0.64	<0.5	<1	17	5.3	2.3	0.67	420 D	<0.5	<0.5	<0.5
2015	W-654	MW	1/21/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	1.2	<0.5	<0.5	<0.5	<0.5
2015	W-654	MW	4/27/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	1.5	<0.5	<0.5	<0.5	<0.5
2015	W-654	MW	4/27/15 DUP	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	1.4	<0.5	<0.5	<0.5	<0.5
2015	W-654	MW	8/5/15	<0.5	<0.5	<0.5	0.51	<0.5	<1	<0.5	<0.5	<0.5	2.5	<0.5	<0.5	<0.5	<0.5
2015	W-654	MW	11/30/15	<0.5	<0.5	0.69	1.8	<0.5	<1	<0.5	0.8	<0.5	8.7	<0.5	<0.5	<0.5	<0.5
2015	W-654	MW	11/30/15 DUP	<0.5	<0.5	0.68	1.6	<0.5	<1	<0.5	0.72	<0.5	8.5	<0.5	<0.5	<0.5	<0.5
2015	W-655	MW	1/7/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	5.3	<0.5	0.62	<0.5	<0.5	<0.5
2015	W-655	MW	4/2/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	5.6	<0.5	0.62	<0.5	<0.5	<0.5
2015	W-655	MW	7/13/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	5.9	<0.5	0.63	<0.5	<0.5	<0.5
2015	W-655	MW	10/8/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	5.7	<0.5	0.58	<0.5	<0.5	<0.5
2015	W-701	MW	1/5/15	<0.5	<0.5	<0.5	1.5	<0.5	<1	<0.5	2	21	1.7	16	<0.5	<0.5	<0.5
2015	W-701	MW	4/2/15	<0.5	<0.5	<0.5	1.6	<0.5	<1	<0.5	2.1	21	1.9	17	<0.5	<0.5	<0.5
2015	W-701	MW	7/8/15	<0.5	<0.5	<0.5	1.5	<0.5	<1	<0.5	2	21	2.1	20	<0.5	<0.5	<0.5
2015	W-701	MW	11/2/15	<0.5	<0.5	<0.5	1.3	<0.5	<1	<0.5	1.8	19	1.9	19	<0.5	<0.5	<0.5
2015	W-702	MW	4/22/15	<0.5	<0.5	<0.5	0.82	<0.5	<1	<0.5	1.2	3	7.4	4.4	<0.5	<0.5	<0.5
2015	W-703	MW	1/7/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-703	MW	8/4/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-704	MW	1/7/15	<0.5	<0.5	<0.5	1.8	<0.5	<1	0.55	3.4	5.6	2.2	16	<0.5	<0.5	<0.5
2015	W-704	MW	4/2/15	<0.5	<0.5	<0.5	2.2	<0.5	<1	0.59	4	6	2.3	17	<0.5	<0.5	<0.5
2015	W-704	MW	7/13/15	<0.5	<0.5	<0.5	2.2	<0.5	<1	0.57	4.2	6	2.4	18	<0.5	<0.5	<0.5
2015	W-704	MW	10/8/15	<0.5	<0.5	<0.5	2	<0.5	<1	0.57	3.8	5.3	2.1	16	<0.5	<0.5	<0.5
2015	W-705	MW	2/25/15	<0.5	<0.5	<0.5	0.71	<0.5	<1	<0.5	<0.5	0.67	1.4	1.9	<0.5	<0.5	<0.5
2015	W-712	MW	1/21/15	<0.5	<0.5	0.94	3.2	<0.5	<1	2.8	2.7	<0.5	1.9	2.9	<0.5	<0.5	<0.5
2015	W-712	MW	4/14/15	<0.5	<0.5	1	3.6	<0.5	<1	2.7	3	<0.5	2	3.1	<0.5	<0.5	<0.5
2015	W-712	MW	7/22/15	<0.5	<0.5	1	3.6	<0.5	<1	2.7	3	<0.5	1.9	3	<0.5	<0.5	<0.5
2015	W-712	MW	11/4/15	<0.5	<0.5	1	3.3	<0.5	<1	2.7	3	<0.5	1.9	3.2	<0.5	<0.5	<0.5
2015	W-714	MW	1/21/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	5.4	<0.5	<0.5	<0.5	<0.5
2015	W-714	MW	4/14/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	5.6	<0.5	<0.5	<0.5	<0.5
2015	W-714	MW	7/22/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	4.7	<0.5	<0.5	<0.5	<0.5
2015	W-714	MW	11/4/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	4.9	<0.5	<0.5	<0.5	<0.5
2015	W-750	MW	9/15/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	2.3	<0.5	<0.5	<0.5
2015	W-901	MW	1/26/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	0.97	3.1	0.65	<0.5	<0.5	<0.5
2015	W-902	MW	5/21/15	<0.5	<0.5	<0.5	0.57	<0.5	<1	<0.5	1.5	18	<0.5	7.8	<0.5	<0.5	<0.5
2015	W-903	MW	1/21/15	<0.5	<0.5	0.69	0.6	<0.5	<1	<0.5	<0.5	<0.5	3.8	<0.5	<0.5	<0.5	<0.5
2015	W-903	MW	4/14/15	<0.5	<0.5	0.64	0.65	<0.5	<1	<0.5	<0.5	<0.5	4	<0.5	<0.5	<0.5	<0.5
2015	W-903	MW	7/22/15	<0.5	<0.5	0.77	0.68	<0.5	<1	<0.5	<0.5	<0.5	3.7	<0.5	<0.5	<0.5	<0.5
2015	W-903	MW	11/4/15	<0.5	<0.5	0.65	0.55	<0.5	<1	<0.5	<0.5	<0.5	3.8	<0.5	<0.5	<0.5	<0.5
2015	W-904	MW	2/4/15	<0.5	<0.5	<0.5	0.58	<0.5	<1	<0.5	<0.5	<0.5	3.9	<0.5	<0.5	<0.5	<0.5
2015	W-904	MW	4/14/15	<0.5	<0.5	<0.5	0.64	<0.5	<1	<0.5	<0.5	<0.5	4.1	<0.5	<0.5	<0.5	<0.5
2015	W-904	MW	7/22/15	<0.5	<0.5	<0.5	0.77	<0.5	<1	<0.5	<0.5	<0.5	4.6	<0.5	<0.5	<0.5	<0.5
2015	W-904	MW	11/4/15	<0.5	<0.5	<0.5	0.56	<0.5	<1	<0.5	<0.5	<0.5	3.8	<0.5	<0.5	<0.5	<0.5
2015	W-905	MW	10/12/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-906	MW	2/4/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	3.2	<0.5	<0.5	<0.5
2015	W-907-1	MW	2/2/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	6.3	<0.5	<0.5	11	<0.5	<0.5	<0.5
2015	W-908	MW	2/10/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-909	MW	3/24/15	<0.5	0.63	<0.5	15	<0.5	<1	<0.5	<0.5	2.4	14	59	<0.5	<0.5	<0.5
2015	W-909	MW	6/8/15	<0.5	<0.5	<0.5	5.1	<0.5	<1	<0.5	<0.5	0.83	7.7	66	<0.5	<0.5	<0.5
2015	W-909	MW	9/10/15	<0.5	<0.5	<0.5	2.8	<0.5	<1	<0.5	<0.5	<0.5	4.9	44	<0.5	<0.5	<0.5
2015	W-909	MW	10/27/15	<0.5	<0.5	<0.5	8.6	<0.5	<1	<0.5	<0.5	2.2	10	55	<0.5	<0.5	<0.5
2015	W-909	MW	10/27/15 DUP	<0.5	<0.5	<0.5	7.4	<0.5	<1	<0.5	<0.5	1.8	9.1	53	<0.5	<0.5	<0.5
2015	W-911	MW	6/4/15	<0.5	<0.5	<0.5	23	<0.5	<1	<0.5	<0.5	8.2	24	53	<0.5	<0.5	<0.5
2015	W-911	MW	9/10/15	<0.5	<0.5	<0.5	18	<0.5	<1	<0.5	<0.5	6.9	20	47	<0.5	<0.5	<0.5

Attachment B Table 1. 2015 Livermore Site ground water monitoring analytical results for VOCs.

Year	Well Name	Type	Date	1,1,1-Trichloroethane (µg/L)	1,1,2-Trichloroethane (µg/L)	1,1-Dichloroethane (µg/L)	1,1-Dichloroethene (µg/L)	1,2-Dichloroethane (µg/L)	1,2-Dichloroethene (total) (µg/L)	Carbon tetrachloride (µg/L)	Chloroform (µg/L)	Freon 113 (µg/L)	Tetrachloroethene (µg/L)	Trichloroethene (µg/L)	Trichlorofluoro methane (µg/L)	cis-1,2-Dichloroethene (µg/L)	trans-1,2-Dichloroethene (µg/L)
2015	W-911	MW	10/27/15	<0.5	<0.5	<0.5	3.9	<0.5	<1	<0.5	<0.5	1.6	4.8	11	<0.5	<0.5	<0.5
2015	W-911	MW	10/27/15 DUP	<0.5	<0.5	<0.5	4	<0.5	<1	<0.5	<0.5	1.6	4.8	12	<0.5	<0.5	<0.5
2015	W-912	MW	6/8/15	<0.5	<0.5	<0.5	3.8	<0.5	<1	0.51	3.4	2.6	5.4	72	<0.5	<0.5	<0.5
2015	W-912	MW	12/17/15	<0.5	<0.5	<0.5	3	<0.5	<1	0.55	2.6	1.8	3.9	62	<0.5	<0.5	<0.5
2015	W-912	MW	12/17/15 DUP	<0.5	<0.5	<0.5	3.2	<0.5	<1	0.57	2.7	1.8	4.3	65	<0.5	<0.5	<0.5
2015	W-913	MW	2/24/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-913	MW	5/18/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-913	MW	7/21/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-913	MW	11/17/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-1001	MW	1/21/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-1001	MW	4/14/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-1001	MW	7/22/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-1001	MW	11/4/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-1002	MW	3/20/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	1.7	<0.5	<0.5	<0.5	<0.5
2015	W-1003	MW	10/12/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-1004	MW	1/21/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	1.9	<0.5	<0.5	<0.5	<0.5
2015	W-1004	MW	4/14/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	2.1	<0.5	<0.5	<0.5	<0.5
2015	W-1004	MW	7/22/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	1.9	<0.5	<0.5	<0.5	<0.5
2015	W-1004	MW	11/4/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	1.9	<0.5	<0.5	<0.5	<0.5
2015	W-1008	MW	3/2/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-1009	MW	1/21/15	<0.5	<0.5	0.54	2.4	<0.5	<1	0.95	4	<0.5	9	1.5	<0.5	<0.5	<0.5
2015	W-1009	MW	4/14/15	<0.5	<0.5	0.59	2.7	<0.5	<1	0.96	4.4	<0.5	9.6	1.6	<0.5	<0.5	<0.5
2015	W-1009	MW	7/22/15	<0.5	<0.5	0.61	2.8	<0.5	<1	0.95	4.4	<0.5	8.6	1.6	<0.5	<0.5	<0.5
2015	W-1009	MW	11/4/15	<0.5	<0.5	0.62	2.6	<0.5	<1	0.93	4.1	<0.5	8.7	1.6	<0.5	<0.5	<0.5
2015	W-1012	MW	1/6/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-1013	MW	3/31/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-1014	MW	8/11/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	1.7	5.9	1.4	3	<0.5	<0.5	<0.5
2015	W-1015	MW	2/2/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	0.55	2.4	1.6	5.4	<0.5	<0.5	<0.5
2015	W-1015	MW	6/19/15	<0.5	<0.5	<0.5	0.5	<0.5	<1	<0.5	<0.5	1	0.78	4.8	<0.5	<0.5	<0.5
2015	W-1015	MW	7/16/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	1.1	0.88	5	<0.5	<0.5	<0.5
2015	W-1015	MW	11/30/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	0.99	0.9	4.7	<0.5	<0.5	<0.5
2015	W-1015	MW	11/30/15 DUP	<0.5	<0.5	<0.5	0.5	<0.5	<1	<0.5	<0.5	1.3	0.79	4.5	<0.5	<0.5	<0.5
2015	W-1101	MW	4/21/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	1.3	<0.5	1.9	<0.5	<0.5	<0.5
2015	W-1101	MW	10/14/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	0.98	<0.5	1.9	<0.5	<0.5	<0.5
2015	W-1102	MW	2/2/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	2.3	<0.5	1.4	<0.5	<0.5	<0.5
2015	W-1102	MW	6/19/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	1.8	<0.5	1.3	<0.5	<0.5	<0.5
2015	W-1102	MW	7/16/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	2	<0.5	1.3	<0.5	<0.5	<0.5
2015	W-1102	MW	11/24/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	1.8	<0.5	1.2	<0.5	<0.5	<0.5
2015	W-1103	MW	2/2/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	0.63	<0.5	<0.5	<0.5
2015	W-1103	MW	6/19/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	0.77	<0.5	<0.5	<0.5
2015	W-1103	MW	7/16/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	0.94	<0.5	<0.5	<0.5
2015	W-1103	MW	11/24/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	0.78	<0.5	<0.5	<0.5
2015	W-1104	MW	1/5/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	0.6	2.4	4.1	7.8	<0.5	<0.5	<0.5
2015	W-1104	MW	4/2/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	0.65	2.3	4.6	8.3	<0.5	<0.5	<0.5
2015	W-1104	MW	7/8/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	0.56	1.9	4.1	7.4	<0.5	<0.5	<0.5
2015	W-1104	MW	10/5/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	0.53	1.8	3.5	6.7	<0.5	<0.5	<0.5
2015	W-1105	MW	8/4/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	1.2	<0.5	<0.5	<0.5	<0.5
2015	W-1106	MW	1/26/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-1108	MW	1/7/15	<0.5	<0.5	0.51	14	2.6	<1	1.6	18	4.9	32	230 D	<0.5	<0.5	<0.5
2015	W-1108	MW	4/1/15	<0.5	<0.5	0.5	15	2.5	<1	1.7	17	4.3	30	230 D	<0.5	<0.5	<0.5
2015	W-1108	MW	7/22/15	<0.5	<0.5	0.7	19	3.3	<1	2.2	23	5.3	37	310 D	<0.5	<0.5	<0.5
2015	W-1108	MW	10/2/15	<0.5	<0.5	<0.5	11	1.9	<1	1.3	12	2.7	22	180 D	<0.5	<0.5	<0.5
2015	W-1109	MW	1/13/15	<0.5	<0.5	<0.5	17	<0.5	<1	<0.5	<0.5	3.2	30	130 D	<0.5	<0.5	<0.5
2015	W-1109	MW	4/2/15	<0.5	<0.5	<0.5	21	<0.5	<1	<0.5	<0.5	3.7	32	110 D	<0.5	<0.5	<0.5
2015	W-1109	MW	7/14/15	<0.5	<0.5	<0.5	18	<0.5	<1	<0.5	<0.5	3	28	130 D	<0.5	<0.5	<0.5
2015	W-1109	MW	10/1/15	<0.5	<0.5	<0.5	16	<0.5	<1	<0.5	<0.5	2.9	23	100 D	<0.5	<0.5	<0.5
2015	W-1110	MW	1/26/15	<0.5	<0.5	<0.5	1	<0.5	<1	<0.5	2.5	7.2	0.7	6.9	<0.5	<0.5	<0.5
2015	W-1111	MW	1/7/15	<0.5	<0.5	<0.5	0.72	<0.5	<1	3.6	8.6	<0.5	0.89	3.7	<0.5	<0.5	<0.5
2015	W-1111	MW	4/15/15	<0.5	<0.5	<0.5	0.79	<0.5	<1	3.2	9.4	<0.5	1	4.1	<0.5	<0.5	<0.5
2015	W-1111	MW	7/23/15	<0.5	<0.5	<0.5	0.78	<0.5	<1	3.9	8.8	<0.5	0.92	3.9	<0.5	<0.5	<0.5
2015	W-1111	MW	10/5/15	<0.5	<0.5	<0.5	0.73	<0.5	<1	4.7	7.9	<0.5	0.89	4	<0.5	<0.5	<0.5
2015	W-1112	MW	9/17/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	0.69	<0.5	<0.5	<0.5
2015	W-1113	MW	3/19/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	0.94	<0.5	<0.5	<0.5

Attachment B Table 1. 2015 Livermore Site ground water monitoring analytical results for VOCs.

Year	Well Name	Type	Date	1,1,1-Trichloroethane (µg/L)	1,1,2-Trichloroethane (µg/L)	1,1-Dichloroethane (µg/L)	1,1-Dichloroethene (µg/L)	1,2-Dichloroethane (µg/L)	1,2-Dichloroethene (total) (µg/L)	Carbon tetrachloride (µg/L)	Chloroform (µg/L)	Freon 113 (µg/L)	Tetrachloroethene (µg/L)	Trichloroethene (µg/L)	Trichlorofluoromethane (µg/L)	cis-1,2-Dichloroethene (µg/L)	trans-1,2-Dichloroethene (µg/L)
2015	W-1115	MW	3/25/15	<0.5	0.56	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-1116	MW	1/5/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	1.3	4.2	2.7	3	<0.5	<0.5	<0.5
2015	W-1116	MW	6/11/15	<0.5	<0.5	<0.5	0.51	<0.5	<1	<0.5	1.2	5.2	3	3.1	<0.5	<0.5	<0.5
2015	W-1116	MW	7/8/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	1	5	3.1	6.4	<0.5	<0.5	<0.5
2015	W-1116	MW	10/5/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	0.88	4	3	5.7	<0.5	<0.5	<0.5
2015	W-1117	MW	3/24/15	<0.5	3.6	1.2	35	8.3	<1	3.7	42	9.7	76	540 D	<0.5	<0.5	<0.5
2015	W-1117	MW	9/10/15	<0.5	<0.5	1.2	27	7.6	<1	2.7	37	7.4	59	450 D	<0.5	<0.5	<0.5
2015	W-1117	MW	9/10/15 DUP	<0.5	<0.5	1.1	27	7.6	<1	2.9	38	7.6	61	450 D	<0.5	<0.5	<0.5
2015	W-1118	MW	10/22/15	<0.5	<0.5	<0.5	6.6	<0.5	<1	<0.5	<0.5	6.9	1.4	4.6	<0.5	<0.5	<0.5
2015	W-1201	MW	5/27/15	<0.5	<0.5	<0.5	3.3	<0.5	<1	0.76	3.4	11	23	210 D	<0.5	<0.5	<0.5
2015	W-1201	MW	9/2/15	<0.5	<0.5	<0.5	2.5	<0.5	<1	0.89	2.3	6.3	13	190 D	<0.5	<0.5	<0.5
2015	W-1201	MW	9/9/15 DUP	<0.5	<0.5 L	<0.5	1.3	<0.5	<1	<0.5	1.8	7.6	14	140 D	<0.5	<0.5	<0.5
2015	W-1201	MW	12/7/15	<0.5	<0.5	<0.5	2.6	<0.5	<1	0.5	2.9	11	23	190 D	<0.5	<0.5	<0.5
2015	W-1202	MW	3/25/15	<0.5	0.52	<0.5	4.6	<0.5	<1	<0.5	<0.5	0.72	11	75	<0.5	<0.5	<0.5
2015	W-1203	MW	6/23/15	<0.5	<0.5	<0.5	0.78	<0.5	<1	1.2	0.51	5.2	0.6	110 D	<0.5	<0.5	<0.5
2015	W-1204	MW	3/31/15	<0.5	<0.5	<0.5	4	<0.5	<1	<0.5	<0.5	0.93	4	15	<0.5	<0.5	<0.5
2015	W-1204	MW	3/31/15 DUP	<0.5	<0.5	<0.5	3.8	<0.5	<1	<0.5	<0.5	0.84	3.6	14	<0.5	<0.5	<0.5
2015	W-1206	MW	1/5/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	0.68	2.9	<0.5	<0.5	11	<0.5	<0.5	<0.5
2015	W-1206	MW	4/8/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	0.66	2.8	<0.5	<0.5	11	<0.5	<0.5	<0.5
2015	W-1207	MW	10/15/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	5.7	<0.5	<0.5	<0.5
2015	W-1208	MW	3/3/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	1.7	1.8	<0.5	<0.5	36	26	<0.5	<0.5
2015	W-1208	MW	4/8/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	1.8	1.8	<0.5	<0.5	35	22	<0.5	<0.5
2015	W-1209	MW	3/25/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-1210	MW	3/24/15	<0.5	<0.5	<0.5	1.1	<0.5	<1	<0.5	<0.5	<0.5	1.4	7.9	<0.5	<0.5	<0.5
2015	W-1210	MW	8/27/15	<0.5	<0.5	<0.5	6.3	<0.5	<1	<0.5	0.91	1.5	3.7	21	<0.5	<0.5	<0.5
2015	W-1210	MW	8/27/15 DUP	<0.5	<0.5	<0.5	6.6	<0.5	<1	<0.5	0.93	1.5	3.7	21	<0.5	<0.5	<0.5
2015	W-1210	MW	10/22/15	<0.5	<0.5	<0.5	2.9	<0.5	<1	<0.5	0.51	0.77	2.4	14	<0.5	<0.5	<0.5
2015	W-1211	MW	1/13/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	1.5	1.4	<0.5	7.9	<0.5	<0.5	<0.5
2015	W-1211	MW	4/8/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	1.5	1.4	<0.5	8	<0.5	<0.5	<0.5
2015	W-1211	MW	7/14/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	1.3	1.2	<0.5	7.5	<0.5	<0.5	<0.5
2015	W-1211	MW	10/2/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	1.2	1.1	<0.5	7	<0.5	<0.5	<0.5
2015	W-1212	MW	1/8/15	<0.5	<0.5	<0.5	18	2	<1	<0.5	2.9	20	<0.5	240 D	<0.5	<0.5	<0.5
2015	W-1212	MW	1/22/15	<0.5	<0.5	<0.5	18	2.1	<1	<0.5	3.1	20	<0.5	240 D	<0.5	<0.5	<0.5
2015	W-1212	MW	2/26/15	<0.5	<0.5	<0.5	16	2.2	<1	<0.5	3	14	<0.5	220 D	<0.5	<0.5	<0.5
2015	W-1212	MW	3/26/15	<0.5	<0.5	<0.5	19	2.5	<1	<0.5	3.4	18	<0.5	270 D	<0.5	<0.5	<0.5
2015	W-1212	MW	4/30/15	<0.5	<0.5	<0.5	21	3	<1	<0.5	3.5	17	<0.5	270 D	<0.5	<0.5	<0.5
2015	W-1212	MW	6/1/15	<0.5	<0.5	<0.5	17	2.4	<1	<0.5	3.8	16	<0.5	210 D	<0.5	<0.5	<0.5
2015	W-1212	MW	6/25/15	<0.5	<0.5	<0.5	19	2.8	<1	<0.5	4.4	17	<0.5	190 D	<0.5	<0.5	<0.5
2015	W-1212	MW	7/23/15	<0.5	<0.5	<0.5	15	2.4	<1	<0.5	3.5	12	<0.5	170 D	<0.5	<0.5	<0.5
2015	W-1212	MW	10/5/15	<0.5	<0.5	<0.5	12	2.2	<1	<0.5	3	10	<0.5	160 D	<0.5	<0.5	<0.5
2015	W-1212	MW	11/18/15	<0.5	<0.5	<0.5	10	2.2	<1	<0.5	2.9	9.7	<0.5	110 D	<0.5	<0.5	<0.5
2015	W-1213	MW	1/8/15	<0.5	<0.5	<0.5	3.6	<0.5	<1	<0.5	6.1	7.1	<0.5	22	0.58	<0.5	<0.5
2015	W-1213	MW	1/12/15	<0.5	<0.5	<0.5	3.9	<0.5	<1	<0.5	7	7.6	<0.5	23	0.63	<0.5	<0.5
2015	W-1213	MW	1/22/15	<0.5	<0.5	<0.5	3.6	<0.5	<1	<0.5	6.8	7.6	<0.5	23	0.61	<0.5	<0.5
2015	W-1213	MW	2/26/15	<0.5	<0.5	<0.5	3.9	<0.5	<1	<0.5	6.9	7.4	<0.5	23	0.6	<0.5	<0.5
2015	W-1213	MW	3/26/15	<0.5	<0.5	<0.5	3.7	<0.5	<1	<0.5	6.5	7.6	<0.5	22	0.56	<0.5	<0.5
2015	W-1213	MW	4/2/15	<0.5	<0.5	<0.5	3.8	<0.5	<1	<0.5	7.7	8.4	<0.5	20	0.69	<0.5	<0.5
2015	W-1213	MW	4/30/15	<0.5	<0.5	<0.5	2.8	<0.5	<1	<0.5	7.7	7.7	<0.5	16	0.68	<0.5	<0.5
2015	W-1213	MW	6/1/15	<0.5	<0.5	<0.5	2.2	<0.5	<1	<0.5	7.8	7.4	<0.5	14	0.68	<0.5	<0.5
2015	W-1213	MW	6/25/15	<0.5	<0.5	<0.5	2.2	<0.5	<1	<0.5	7.6	7.6	<0.5	13	0.7	<0.5	<0.5
2015	W-1213	MW	7/8/15	<0.5	<0.5	<0.5	2.3	<0.5	<1	<0.5	8.1	7.8	<0.5	14	0.74	<0.5	<0.5
2015	W-1213	MW	7/23/15	<0.5	<0.5	<0.5	2.3	<0.5	<1	<0.5	6.2	6.7	<0.5	14	0.57	<0.5	<0.5
2015	W-1213	MW	10/5/15	<0.5	<0.5	<0.5	2.3	<0.5	<1	<0.5	6.2	6.5	<0.5	15	0.58	<0.5	<0.5
2015	W-1213	MW	10/5/15 RTN2	<0.5	<0.5	<0.5	2.6	<0.5	<1	<0.5	6.4	7.5	<0.5	16	0.66	<0.5	<0.5
2015	W-1213	MW	11/18/15	<0.5	<0.5	<0.5	2	<0.5	<1	<0.5	5.8	6.6	<0.5	13	0.56	<0.5	<0.5
2015	W-1214	MW	3/5/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	8.3	0.51	<0.5	<0.5	<0.5
2015	W-1214	MW	6/30/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	5.6	<0.5	<0.5	<0.5	<0.5
2015	W-1214	MW	6/30/15 DUP	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	6.5	<0.5	<0.5	<0.5	<0.5
2015	W-1214	MW	7/22/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	5.8	<0.5	<0.5	<0.5	<0.5
2015	W-1214	MW	11/19/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	0.52	<0.5	6.2	<0.5	<0.5	<0.5	<0.5
2015	W-1214	MW	11/19/15 RTN2	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	0.51	<0.5	42	1.6	<0.5	<0.5	<0.5
2015	W-1215	MW	1/14/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	8.3	<0.5	<0.5	3.9	16	<0.5	<0.5
2015	W-1215	MW	4/8/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	9.2	<0.5	<0.5	4.3	16	<0.5	<0.5

Attachment B Table 1. 2015 Livermore Site ground water monitoring analytical results for VOCs.

Year	Well Name	Type	Date	1,1,1-Trichloroethane (µg/L)	1,1,2-Trichloroethane (µg/L)	1,1-Dichloroethane (µg/L)	1,1-Dichloroethene (µg/L)	1,2-Dichloroethane (µg/L)	1,2-Dichloroethene (total) (µg/L)	Carbon tetrachloride (µg/L)	Chloroform (µg/L)	Freon 113 (µg/L)	Tetrachloroethene (µg/L)	Trichloroethene (µg/L)	Trichlorofluoro methane (µg/L)	cis-1,2-Dichloroethene (µg/L)	trans-1,2-Dichloroethene (µg/L)
2015	W-1215	MW	7/9/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	7.3	<0.5	<0.5	3.6	12	<0.5	<0.5
2015	W-1215	MW	10/2/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	7.9	<0.5	<0.5	4.2	14	<0.5	<0.5
2015	W-1216	MW	1/14/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	4.6	<0.5	<0.5	2	23	<0.5	<0.5
2015	W-1216	MW	4/8/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	4.7	<0.5	<0.5	2	20	<0.5	<0.5
2015	W-1216	MW	7/9/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	4.9	<0.5	<0.5	2.3	21	<0.5	<0.5
2015	W-1216	MW	10/2/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	4.1	<0.5	<0.5	2	19	<0.5	<0.5
2015	W-1217	MW	1/14/15	<0.5	<0.5	<0.5	1	<0.5	<1	<0.5	0.65	<0.5	210 D	3.9 O	<0.5	<0.5	<0.5
2015	W-1217	MW	1/14/15 DUP	<0.5	<0.5	<0.5	1.1	<0.5	<0.5	<0.5	0.67	<0.5	270 D	4.1	<0.5	<0.5	<0.5
2015	W-1217	MW	7/9/15	<0.5	<0.5	<0.5	0.91	<0.5	<1	<0.5	0.72	<0.5	190 D	3.8	<0.5	<0.5	<0.5
2015	W-1219	MW	2/12/15	<0.5	<0.5	<0.5	3.5	<0.5	6.2	<0.5	0.94	<0.5	<0.5	15	<0.5	6.2	<0.5
2015	W-1219	MW	8/19/15	<0.5	<0.5	<0.5	1.5	<0.5	3.3	<0.5	<0.5	<0.5	<0.5	7	<0.5	3.3	<0.5
2015	W-1222	MW	3/24/15	<0.5	2.1	<0.5	40	<0.5	<1	<0.5	2.3	12	41	120 D	<0.5	<0.5	<0.5
2015	W-1222	MW	5/27/15	<0.5	<0.5	<0.5	45	<0.5	<1	<0.5	2.2	14	47	120 D	<0.5	<0.5	<0.5
2015	W-1222	MW	5/27/15 DUP	<0.5	<0.5	<0.5	40	<0.5	<1	<0.5	2.1	13	42	110 D	<0.5	<0.5	<0.5
2015	W-1222	MW	9/3/15	<0.5	<0.5	<0.5	38	<0.5	<1	<0.5	2.1	12	43	120 D	<0.5	<0.5	<0.5
2015	W-1223	MW	2/10/15	<0.5	<0.5	<0.5	7.5	2	<1	2.1	2.2	<0.5	7.3	99	1.6	<0.5	<0.5
2015	W-1224	MW	4/22/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	0.62	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-1225	MW	3/24/15	<0.5	<0.5	<0.5	26	<0.5	<1	<0.5	1.1	2	33	210 D	<0.5	<0.5	<0.5
2015	W-1225	MW	6/8/15	<0.5	<0.5	<0.5	26	<0.5	<1	<0.5	1.1	2	32	220 D	<0.5	<0.5	<0.5
2015	W-1225	MW	9/2/15	<0.5	<0.5	<0.5	20	<0.5	<1	<0.5	0.97	1.6	27	230 D	<0.5	<0.5	<0.5
2015	W-1225	MW	9/9/15 DUP	<0.5	<0.5 L	<0.5	32	<0.5	<1	<0.5	1.5	2.7	48	380 D	<0.5	<0.5	<0.5
2015	W-1225	MW	10/27/15	<0.5	<0.5	<0.5	23	<0.5	<1	<0.5	1	1.7	30	260	<0.5	<0.5	<0.5
2015	W-1226	MW	4/27/15	<0.5	<0.5	<0.5	3.6	<0.5	<1	1.4	10	2.1	<0.5	6.6	<0.5	<0.5	<0.5
2015	W-1227	MW	7/30/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-1250	MW	2/2/15	<2.5 D	<2.5 D	<2.5 D	<2.5 D	<2.5 D	<5 D	57 D	24 D	8.9 D	<2.5 D	2,800 D	<2.5 D	<2.5 D	<2.5 D
2015	W-1250	MW	4/29/15	<5 D	<5 D	<5 D	<5 D	<5 D	<10 D	53 D	26 D	7.9 D	<5 D	2,800 D	<5 D	<5 D	<5 D
2015	W-1250	MW	4/29/15 DUP	<0.5	<0.5	<0.5	2.5	<0.5	<1	76	34	12	2.4	3,000 D	<0.5	<0.5	<0.5
2015	W-1250	MW	10/15/15	<2.5 D	<2.5 D	<2.5 D	<2.5 D	<2.5 D	<5 D	57 D	25 D	8.4 D	<2.5 D	3,000 D	<2.5 D	<2.5 D	<2.5 D
2015	W-1251	MW	2/2/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	0.75	2.2	<0.5	<0.5	71	<0.5	<0.5	<0.5
2015	W-1252	MW	5/5/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	13	4.2	4.2	<0.5	430 D	<0.5	<0.5	<0.5
2015	W-1253	MW	2/5/15	<0.5	<0.5	1.4	16	1.5	3.2	6.2	4.5	12	12	1,800 D	<0.5	2.5	0.7
2015	W-1253	MW	5/5/15	<2.5 D	<2.5 D	<2.5 D	15 D	<2.5 D	<5 D	3.2 D	<2.5 D	11 D	11 D	1,600 D	<2.5 D	<2.5 D	<2.5 D
2015	W-1253	MW	8/19/15	<2.5 D	<2.5 D	<2.5 D	15 D	<2.5 D	<5 D	<2.5 D	<2.5 D	10 D	11 D	1,800 D	<2.5 D	<2.5 D	<2.5 D
2015	W-1253	MW	8/19/15 DUP	<0.5	<0.5	1.6	18	1.6	3.1	1.8	1.7	12	12	1,800 D	<0.5	2.4	0.7
2015	W-1253	MW	10/19/15	<2.5 D	<2.5 D	<2.5 D	14 D	<2.5 D	<5 D	<2.5 D	<2.5 D	10 D	11 D	1,800 D	<2.5 D	<2.5 D	<2.5 D
2015	W-1254	MW	1/20/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	1.4	<0.5	<0.5	<0.5	36	<0.5	<0.5	<0.5
2015	W-1254	MW	4/9/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	1.5	<0.5	<0.5	<0.5	35	<0.5	<0.5	<0.5
2015	W-1254	MW	7/13/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	1.4	<0.5	<0.5	<0.5	35	<0.5	<0.5	<0.5
2015	W-1254	MW	10/12/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	1.4	<0.5	<0.5	<0.5	33	<0.5	<0.5	<0.5
2015	W-1255	MW	2/5/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	2	<0.5	<0.5	26	<0.5	<0.5	<0.5
2015	W-1301	MW	1/7/15	<0.5	<0.5	1.4	38	4.7	<1	7.6	2.3	0.69	28	210 D	<0.5	<0.5	<0.5
2015	W-1301	MW	4/8/15	<0.5	<0.5	1.8	56	6.4	<1	7.1	2.9	0.72	40	270 D	<0.5	0.7	<0.5
2015	W-1301	MW	7/21/15	<0.5	<0.5	1.8	53	5.9	<1	7.1	3	0.71	40	280 D	<0.5	0.61	<0.5
2015	W-1301	MW	10/13/15	<0.5	<0.5	1.8	50	5.4	<1	7.4	2.9	0.74	40	270 D	<0.5	0.61	<0.5
2015	W-1302-2	MW	2/23/15	<0.5	<0.5	1.4	26	5	2.4	2.1	37	10	56	400 D	<0.5	2.4	<0.5
2015	W-1302-2	MW	4/22/15	<0.5	<0.5	1.5	29	5.1	2.2	2.5	40	9.1	58	420 D	<0.5	2.2	<0.5
2015	W-1302-2	MW	7/30/15	<0.5	<0.5	1.4	29	5	1.4	2.3	38	8.8	57	440 D	<0.5	1.4	<0.5
2015	W-1302-2	MW	10/21/15	<0.5	<0.5	1.4	26	5	1.8	2.2	36	8.4	56	340 D	<0.5	1.8	<0.5
2015	W-1303	MW	1/7/15	<0.5	<0.5	<0.5	3.2	1	<1	2.9	1.7	<0.5	3.8	98 D	6.4	<0.5	<0.5
2015	W-1303	MW	4/8/15	<0.5	<0.5	<0.5	3.8	1.1	<1	3.2	2.2	<0.5	4.4	95 D	5.4	<0.5	<0.5
2015	W-1303	MW	7/21/15	<0.5	<0.5	<0.5	3.8	1.1	<1	2.8	2	<0.5	4.1	99 D	5.1	<0.5	<0.5
2015	W-1303	MW	10/13/15	<0.5	<0.5	<0.5	3.1	0.88	<1	2.7	1.7	<0.5	3.6	100	4.4	<0.5	<0.5
2015	W-1304	MW	2/10/15	<0.5	<0.5	3.3	120 D	16	1.8	1.4	2.7	<0.5	30	1,300 D	<0.5	1.8	<0.5
2015	W-1304	MW	9/8/15	<2.5 D	<2.5 D	2.8 D	100 D	13 D	<5 D	<2.5 D	<2.5 D	<2.5 D	24 D	1,200 D	<2.5 D	<2.5 D	<2.5 D
2015	W-1304	MW	9/8/15 DUP	<0.5	<0.5	3	100 D	14	1.6	1.9	2.5	<0.5	27	1,100 D	<0.5	1.6	<0.5
2015	W-1304	MW	12/9/15	<0.5	<0.5	3.4	120 D	16	1.9	2.1	2.7	<0.5	31	1,300 D	0.5	1.9	<0.5
2015	W-1306	MW	1/7/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	2	1.1	<0.5	1.6	42	<0.5	<0.5	<0.5
2015	W-1306	MW	4/8/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	1.7	1.2	<0.5	2	45	<0.5	<0.5	<0.5
2015	W-1306	MW	7/21/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	1.8	1.5	<0.5	1.9	55	<0.5	<0.5	<0.5
2015	W-1306	MW	10/13/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	2	1.4	<0.5	1.7	51	<0.5	<0.5	<0.5
2015	W-1307	MW	1/7/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	3	0.59	<0.5	0.64	35	<0.5	<0.5	<0.5
2015	W-1307	MW	4/8/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	2.6	0.62	<0.5	0.65	32	<0.5	<0.5	<0.5
2015	W-1307	MW	7/21/15	<0.5	<0.5	<0.5	0.65	<0.5	<1	4.1	1.1	<0.5	0.84	68	<0.5	<0.5	<0.5

Attachment B Table 1. 2015 Livermore Site ground water monitoring analytical results for VOCs.

Year	Well Name	Type	Date	1,1,1-Trichloroethane (µg/L)	1,1,2-Trichloroethane (µg/L)	1,1-Dichloroethane (µg/L)	1,1-Dichloroethene (µg/L)	1,2-Dichloroethane (µg/L)	1,2-Dichloroethene (total) (µg/L)	Carbon tetrachloride (µg/L)	Chloroform (µg/L)	Freon 113 (µg/L)	Tetrachloroethene (µg/L)	Trichloroethene (µg/L)	Trichlorofluoro methane (µg/L)	cis-1,2-Dichloroethene (µg/L)	trans-1,2-Dichloroethene (µg/L)
2015	W-1307	MW	10/13/15	<0.5	<0.5	<0.5	0.53	<0.5	<1	3.6	0.85	<0.5	0.73	54	<0.5	<0.5	<0.5
2015	W-1308	MW	1/7/15	<0.5	<0.5	0.76	12	2.4	<1	<0.5	1.3	<0.5	55	90	<0.5	<0.5	<0.5
2015	W-1308	MW	4/1/15	<0.5	<0.5	0.84	14	2.4	<1	<0.5	1.3	<0.5	57	89	<0.5	<0.5	<0.5
2015	W-1308	MW	7/9/15	<0.5	<0.5	0.86	15	2.4	<1	<0.5	1.2	<0.5	59	93	<0.5	<0.5	<0.5
2015	W-1308	MW	10/1/15	<0.5	<0.5	0.89	14	2.7	<1	0.55	1.3	<0.5	52	98	<0.5	<0.5	<0.5
2015	W-1309	MW	1/14/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	2.2	<0.5	<0.5	<0.5
2015	W-1309	MW	4/8/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	0.6	<0.5	<0.5	<0.5	2.8	<0.5	<0.5	<0.5
2015	W-1309	MW	7/16/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	0.58	<0.5	<0.5	<0.5	2.9	<0.5	<0.5	<0.5
2015	W-1309	MW	10/8/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	0.57	<0.5	<0.5	<0.5	2.6	<0.5	<0.5	<0.5
2015	W-1310	MW	1/14/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	3.7	<0.5	<0.5	<0.5
2015	W-1310	MW	4/8/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	3.5	<0.5	<0.5	<0.5
2015	W-1310	MW	7/16/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	3.4	<0.5	<0.5	<0.5
2015	W-1310	MW	10/8/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	3.3	<0.5	<0.5	<0.5
2015	W-1311	MW	2/2/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	6.5	<0.5	<0.5	<0.5	8.9	<0.5	<0.5
2015	W-1401	MW	12/2/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	0.88	1.4	<0.5	<0.5	2.3	13	<0.5	<0.5
2015	W-1402	MW	8/4/15	<0.5	<0.5	<0.5	2.9	1.1	<1	<0.5	<0.5	<0.5	2.5	20	<0.5	<0.5	<0.5
2015	W-1403	MW	1/7/15	<0.5	<0.5	1.1	32	4.4	<1	1.8	15	3.5	81	270 D	<0.5	<0.5	<0.5
2015	W-1403	MW	4/1/15	<0.5	<0.5	1.2	36	4.7	<1	2	16	3.6	80	290 D	<0.5	<0.5	<0.5
2015	W-1403	MW	7/9/15	<0.5	<0.5	1.2	34	4.5	<1	1.8	15	3.2	85	320 D	<0.5	<0.5	<0.5
2015	W-1403	MW	10/1/15	<0.5	<0.5	1.2	31	4.1	<1	1.8	14	3.3	75	280 D	<0.5	<0.5	<0.5
2015	W-1406	MW	12/2/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	0.56	3.2	<0.5	<0.5	<0.5
2015	W-1407	MW	12/2/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	1.1	<0.5	<0.5	<0.5
2015	W-1408	MW	3/3/15	<0.5	<0.5	<0.5	13	0.53	<1	1.6	1	<0.5	24	70	<0.5	<0.5	<0.5
2015	W-1408	MW	3/3/15 DUP	<0.5	<0.5	<0.5	13	0.62	<0.5	1.8	1	<0.5	24	70	<0.5	<0.5	<0.5
2015	W-1409	MW	1/13/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	1.5	32	<0.5	<0.5	<0.5
2015	W-1409	MW	4/8/15	<0.5	<0.5	<0.5	0.51	<0.5	<1	<0.5	0.5	<0.5	1.4	28	<0.5	<0.5	<0.5
2015	W-1409	MW	7/14/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	1.2	24	<0.5	<0.5	<0.5
2015	W-1409	MW	10/2/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	1	21	<0.5	<0.5	<0.5
2015	W-1410	MW	3/4/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	2	2.2	<0.5	<0.5	12	<0.5	<0.5	<0.5
2015	W-1410	MW	4/20/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	1.9	2	<0.5	<0.5	12	<0.5	<0.5	<0.5
2015	W-1410	MW	9/3/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	1.7	1.8	<0.5	<0.5	10	<0.5	<0.5	<0.5
2015	W-1410	MW	11/6/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	1.8	2	<0.5	<0.5	12	<0.5	<0.5	<0.5
2015	W-1413	MW	11/23/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	1.3	2.9	<0.5	1.2	62	<0.5	<0.5	<0.5
2015	W-1414	MW	3/25/15	<0.5	<0.5	0.67	2.6	42 L	<0.5	11	3.1	<0.5	68 L	1,700 DL	<0.5	<0.5	<0.5
2015	W-1414	MW	6/16/15	<0.5	<0.5	1.4	3.9	84 D	0.62	21	6.1	<0.5	110 D	1,400 D	<0.5	<0.5	<0.5
2015	W-1414	MW	8/20/15	<0.5	<0.5	2	13	40 DH	<1	38	8.7	<0.5	68 DH	760 DH	<0.5	<0.5	<0.5
2015	W-1414	MW	12/17/15	<0.5	<0.5	0.64	1.2	39	<1	9	2.8	<0.5	61	730 D	<0.5	<0.5	<0.5
2015	W-1417	MW	2/10/15	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-1417	MW	8/6/15	<0.5	<0.5	<0.5	0.87	<0.5	<0.5	<0.5	2.4	<0.5	0.51	10 L	1	<0.5	<0.5
2015	W-1417	MW	8/6/15 DUP	<0.5	<0.5	<0.5	0.78	<0.5	<0.5	<0.5	2.2	<0.5	<0.5	9.4 L	0.92	<0.5	<0.5
2015	W-1418	MW	3/25/15	<0.5	<0.5	<0.5	2.6	<0.5 L	1.5	<0.5	0.93	0.55	3.2 L	42 L	<0.5	1.5	<0.5
2015	W-1418	MW	3/25/15 DUP	<0.5	<0.5	<0.5	2.8	<0.5 L	1.5	<0.5	0.94	<0.5	3.2 L	43 L	<0.5	1.5	<0.5
2015	W-1420	MW	2/25/15	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.56	1.3	4.7	<0.5	<0.5	<0.5
2015	W-1420	MW	2/25/15 DUP	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	4.7	<0.5	<0.5	<0.5
2015	W-1420	MW	5/19/15	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.3	4.1	<0.5	<0.5	<0.5
2015	W-1420	MW	7/22/15	<0.5 H	<0.5 H	<0.5 H	<0.5 H	<0.5 H	<0.5 H	<0.5 H	<0.5 H	0.59 H	1.3 H	4.3 H	<0.5 H	<0.5 H	<0.5 H
2015	W-1420	MW	7/22/15 DUP	<0.5 H	<0.5 H	<0.5 H	<0.5 H	<0.5 H	<0.5 H	<0.5 H	<0.5 H	0.59 H	1.4 H	4.4 H	<0.5 H	<0.5 H	<0.5 H
2015	W-1420	MW	11/19/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	0.59	1.2	4	<0.5	<0.5	<0.5
2015	W-1421	MW	2/10/15	<0.5	<0.5	<0.5	1.9	<0.5	<1	<0.5	1.6	<0.5	1.4	27	0.63	<0.5	<0.5
2015	W-1422	MW	3/25/15	<0.5	<0.5	<0.5	5.3	<0.5 L	4.3	<0.5	<0.5	1.4	3.9 L	35 L	<0.5	4.3	<0.5
2015	W-1422	MW	3/25/15 DUP	<0.5	<0.5	<0.5	5	<0.5	4.4	<0.5	<0.5	1.2	3.9	32	<0.5	4.4	<0.5
2015	W-1422	MW	6/22/15	<0.5	<0.5	<0.5	6.9	<0.5	3.4	<0.5	<0.5	2	5.7	40	<0.5	3.4	<0.5
2015	W-1422	MW	9/8/15	<0.5	<0.5 L	<0.5	4.8	<0.5	<1	<0.5	<0.5	1.4	4.9	30	<0.5	<0.5	<0.5
2015	W-1422	MW	9/8/15 DUP	<0.5	<0.5	<0.5	9.4	<0.5	<1	<0.5	<0.5	2.2	7.6	50	<0.5	<0.5	<0.5
2015	W-1422	MW	12/17/15	<0.5	<0.5	<0.5	3.3	<0.5	5.4	<0.5	<0.5	0.81	3	27	<0.5	5.4	<0.5
2015	W-1423	MW	1/7/15	<0.5	<0.5	<0.5	2.6	<0.5	<1	0.68	4	2.9	1.7	7.8	<0.5	<0.5	<0.5
2015	W-1423	MW	4/2/15	<0.5	<0.5	<0.5	3.1	<0.5	<1	0.76	4.6	3	1.7	8.2	<0.5	<0.5	<0.5
2015	W-1423	MW	7/13/15	<0.5	<0.5	<0.5	3.1	<0.5	<1	0.74	4.9	3	1.7	8.7	<0.5	<0.5	<0.5
2015	W-1423	MW	10/8/15	<0.5	<0.5	<0.5	3	<0.5	<1	0.78	4.5	2.8	1.6	8.4	<0.5	<0.5	<0.5
2015	W-1424	MW	1/15/15	<0.5	<0.5	<0.5	0.63	<0.5	<1	<0.5	<0.5	<0.5	5.4	<0.5	<0.5	<0.5	<0.5
2015	W-1424	MW	4/20/15	<0.5	<0.5	<0.5	0.78	<0.5	<1	<0.5	<0.5	<0.5	6.4	<0.5	<0.5	<0.5	<0.5
2015	W-1424	MW	10/6/15	<0.5	<0.5	<0.5	0.67	<0.5	<1	<0.5	<0.5	<0.5	6	<0.5	<0.5	<0.5	<0.5
2015	W-1424	MW	10/6/15 DUP	<0.5	<0.5	<0.5	0.69	<0.5	<1	<0.5	<0.5	<0.5	5.7	<0.5	<0.5	<0.5	<0.5

Attachment B Table 1. 2015 Livermore Site ground water monitoring analytical results for VOCs.

Year	Well Name	Type	Date	1,1,1-Trichloroethane (µg/L)	1,1,2-Trichloroethane (µg/L)	1,1-Dichloroethane (µg/L)	1,1-Dichloroethene (µg/L)	1,2-Dichloroethane (µg/L)	1,2-Dichloroethene (total) (µg/L)	Carbon tetrachloride (µg/L)	Chloroform (µg/L)	Freon 113 (µg/L)	Tetrachloroethene (µg/L)	Trichloroethene (µg/L)	Trichlorofluoro methane (µg/L)	cis-1,2-Dichloroethene (µg/L)	trans-1,2-Dichloroethene (µg/L)
2015	W-1425	MW	1/15/15	<0.5	<0.5	<0.5	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	4.9	<0.5	<0.5	<0.5	<0.5
2015	W-1425	MW	4/20/15	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	4	<0.5	<0.5	<0.5	<0.5
2015	W-1425	MW	4/20/15 DUP	<0.5	<0.5	<0.5	0.54	<0.5	<0.5	<0.5	<0.5	<0.5	4.8	<0.5	<0.5	<0.5	<0.5
2015	W-1425	MW	7/9/15	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	2.9	<0.5	<0.5	<0.5	<0.5
2015	W-1425	MW	10/6/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	0.51	<0.5	<0.5	<0.5	<0.5
2015	W-1425	MW	10/6/15 DUP	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	0.57	<0.5	<0.5	<0.5	<0.5
2015	W-1426	MW	1/15/15	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.53	<0.5	<0.5	<0.5
2015	W-1427	MW	2/25/15	<0.5	<0.5	<0.5	0.56	<0.5	<0.5	<0.5	0.57	1.5	2.5	3.9	<0.5	<0.5	<0.5
2015	W-1428	MW	4/21/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	2.5	<0.5	<0.5	<0.5
2015	W-1428	MW	12/3/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	3	<0.5	<0.5	<0.5
2015	W-1501	MW	7/16/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-1503	MW	1/8/15	<0.5	<0.5	<0.5	1	<0.5	<1	1.5	1.3	<0.5	1.8	41	<0.5	<0.5	<0.5
2015	W-1503	MW	4/8/15	<0.5	<0.5	<0.5	1.2	<0.5	<1	1.4	1.6	<0.5	1.8	41	<0.5	<0.5	<0.5
2015	W-1503	MW	7/22/15	<0.5	<0.5	<0.5	0.79	<0.5	<1	0.87	1.3	<0.5	1.1	26	<0.5	<0.5	<0.5
2015	W-1503	MW	10/2/15	<0.5	<0.5	<0.5	1.1	<0.5	<1	1.1	1.4	<0.5	1.8	35	<0.5	<0.5	<0.5
2015	W-1504	MW	1/8/15	<0.5	<0.5	<0.5	7.4	<0.5	<1	<0.5	0.86	2.1	11	57	<0.5	0.75	<0.5
2015	W-1504	MW	4/8/15	<0.5	<0.5	<0.5	8	<0.5	<1	<0.5	1.1	2	11	59	<0.5	0.74	<0.5
2015	W-1504	MW	7/22/15	<0.5	<0.5	<0.5	8.1	<0.5	<1	<0.5	0.66	1.8	11	53	<0.5	<0.5	<0.5
2015	W-1504	MW	10/2/15	<0.5	<0.5	<0.5	7	<0.5	<1	<0.5	1	1.7	10	55	<0.5	0.66	<0.5
2015	W-1505	MW	3/24/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	0.67	<0.5	<0.5	19	<0.5	<0.5	<0.5
2015	W-1505	MW	6/4/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	0.54	<0.5	<0.5	12	<0.5	<0.5	<0.5
2015	W-1505	MW	9/8/15	<0.5	<0.5	<0.5	1	<0.5	<1	1.9	1.3	<0.5	1.7	56	<0.5	0.51	<0.5
2015	W-1505	MW	12/1/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	11	<0.5	<0.5	<0.5
2015	W-1505	MW	12/1/15 DUP	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	1.3	<0.5	<0.5	11	<0.5	<0.5	<0.5
2015	W-1506	MW	10/22/15	<0.5	<0.5	<0.5	3.1	<0.5	<1	0.94	<0.5	2.2	3.6	12	<0.5	<0.5	<0.5
2015	W-1507	MW	2/12/15	<0.5	<0.5	<0.5	0.6	<0.5	<1	0.57	0.61	0.78	0.53	13	<0.5	<0.5	<0.5
2015	W-1507	MW	6/4/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	0.5	<0.5	9	<0.5	<0.5	<0.5
2015	W-1507	MW	8/19/15	<0.5	<0.5	<0.5	0.5	<0.5	<1	0.64	2.1	<0.5	<0.5	27	<0.5	<0.5	<0.5
2015	W-1507	MW	8/19/15 DUP	<0.5	<0.5	<0.5	0.54 IJ	<0.5	<1	0.74 IJ	2.7 IJ	<0.5	<0.5	32 IJ	<0.5	<0.5	<0.5
2015	W-1507	MW	10/22/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	0.81	3.4	<0.5	<0.5	49	<0.5	<0.5	<0.5
2015	W-1509	MW	1/20/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	0.57	<0.5	1.5	<0.5	<0.5	<0.5	<0.5
2015	W-1510	MW	1/8/15	<0.5	<0.5	<0.5	3.1	<0.5	<1	<0.5	1.2	0.63	6.1	43	<0.5	<0.5	<0.5
2015	W-1510	MW	4/8/15	<0.5	<0.5	<0.5	2.2	<0.5	<1	<0.5	1.1	<0.5	4.1	29	<0.5	<0.5	<0.5
2015	W-1510	MW	7/22/15	<0.5	<0.5	<0.5	1.7	<0.5	<1	<0.5	1.5	<0.5	3.1	22	<0.5	<0.5	<0.5
2015	W-1510	MW	10/2/15	<0.5	<0.5	<0.5	1.3	<0.5	<1	<0.5	1.4	<0.5	2.7	19	<0.5	<0.5	<0.5
2015	W-1511	MW	12/9/15	<0.5	<0.5	<0.5	16	1.6	<1	0.8	8.4	4.7	26	180 D	<0.5	<0.5	<0.5
2015	W-1514	MW	3/30/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-1515	MW	3/30/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-1516	MW	1/13/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	1	0.55	<0.5	7.3	<0.5	<0.5	<0.5
2015	W-1516	MW	4/8/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	1.3	0.61	<0.5	7.9	<0.5	<0.5	<0.5
2015	W-1516	MW	7/15/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	1.5	0.56	<0.5	7.9	<0.5	<0.5	<0.5
2015	W-1516	MW	10/6/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	1.4	0.51	<0.5	7	<0.5	<0.5	<0.5
2015	W-1517	MW	2/12/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	0.6	23	<0.5	<0.5	<0.5
2015	W-1518	MW	1/13/15	<0.5	<0.5	<0.5	1.4	<0.5	1.1	<0.5	<0.5	0.63	0.55	9.5	<0.5	1.1	<0.5
2015	W-1519	MW	3/30/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	0.92	<0.5	<0.5	<0.5	13	<0.5	<0.5	<0.5
2015	W-1519	MW	6/16/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	0.78	<0.5	<0.5	<0.5	11	<0.5	<0.5	<0.5
2015	W-1519	MW	6/16/15 DUP	<0.5	<0.5	<0.5	<0.5	<0.5	<1	0.64	<0.5	<0.5	<0.5	9.7	<0.5	<0.5	<0.5
2015	W-1519	MW	9/16/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	7.5	<0.5	<0.5	<0.5
2015	W-1519	MW	12/16/15 DUP	<0.5	<0.5	<0.5	<0.5	<0.5	<1	0.85	<0.5	<0.5	<0.5	12	<0.5	<0.5	<0.5
2015	W-1519	MW	12/16/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	0.76	<0.5	<0.5	<0.5	11	<0.5	<0.5	<0.5
2015	W-1520	MW	1/13/15	<0.5	<0.5	<0.5	0.94	1.4	<1	4.8	2.9	<0.5	5.3	98 D	<0.5	0.89	<0.5
2015	W-1520	MW	4/8/15	<0.5	<0.5	<0.5	1.1	1.4	1	5.1	3.4	<0.5	5.7	110 D	<0.5	1	<0.5
2015	W-1520	MW	7/15/15	<0.5	<0.5	<0.5	0.76	1	<1	4	2.7	<0.5	4.5	92	<0.5	0.77	<0.5
2015	W-1520	MW	10/6/15	<0.5	<0.5	<0.5	0.76	0.9	<1	4	2.5	<0.5	3.8	82	<0.5	0.79	<0.5
2015	W-1522	MW	1/13/15	<0.5	<0.5	<0.5	5	2	4.7	8.5	4.6	0.63	8.8	200 D	<0.5	4.7	<0.5
2015	W-1522	MW	4/8/15	<0.5	<0.5	<0.5	6.2	2.3	5.8	10	5.8	0.67	10	220 D	<0.5	5.8	<0.5
2015	W-1522	MW	7/15/15	<0.5	<0.5	<0.5	5.9	2.2	4.9	8.3	5.4	0.64	9.8	220 D	<0.5	4.9	<0.5
2015	W-1522	MW	10/6/15	<0.5	<0.5	<0.5	5.5	2.1	4.8	8.5	4.9	0.63	8.4	200 D	<0.5	4.8	<0.5
2015	W-1523	MW	1/13/15	<0.5	<0.5	<0.5	12	1.5	<1	3.3	2.8	1.2	16	120 D	<0.5	<0.5	<0.5
2015	W-1523	MW	4/1/15	<0.5	<0.5	<0.5	14	1.5	<1	3.6	3	1.2	16	140 D	<0.5	<0.5	<0.5
2015	W-1523	MW	7/15/15	<0.5	<0.5	<0.5	16	1.8	<1	3.9	3.3	1.4	19	150 D	<0.5	<0.5	<0.5
2015	W-1523	MW	10/2/15	<0.5	<0.5	<0.5	16	1.9	<1	5.9	3.4	1.6	16	180 D	<0.5	<0.5	<0.5
2015	W-1550	MW	1/7/15	<0.5	<0.5	<0.5	0.63	<0.5	<1	5.6	3.7	<0.5	1.8	130 D	<0.5	<0.5	<0.5

Attachment B Table 1. 2015 Livermore Site ground water monitoring analytical results for VOCs.

Year	Well Name	Type	Date	1,1,1-Trichloroethane (µg/L)	1,1,2-Trichloroethane (µg/L)	1,1-Dichloroethane (µg/L)	1,1-Dichloroethene (µg/L)	1,2-Dichloroethane (µg/L)	1,2-Dichloroethene (total) (µg/L)	Carbon tetrachloride (µg/L)	Chloroform (µg/L)	Freon 113 (µg/L)	Tetrachloroethene (µg/L)	Trichloroethene (µg/L)	Trichlorofluoro methane (µg/L)	cis-1,2-Dichloroethene (µg/L)	trans-1,2-Dichloroethene (µg/L)
2015	W-1550	MW	4/8/15	<0.5	<0.5	<0.5	0.71	<0.5	<1	5.5	4.1	<0.5	1.8	130 D	<0.5	<0.5	<0.5
2015	W-1550	MW	7/21/15	<0.5	<0.5	<0.5	0.75	<0.5	<1	5.6	4.2	<0.5	1.9	140 D	<0.5	<0.5	<0.5
2015	W-1550	MW	10/13/15	<0.5	<0.5	<0.5	0.51	<0.5	<1	3.6	2.6	<0.5	1.2	140 D	<0.5	<0.5	<0.5
2015	W-1551	MW	8/31/15	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.84	1	0.51	<0.5	81	<0.5	1.2	<0.5
2015	W-1552	MW	1/21/15	<0.5	<0.5	<0.5	<0.5	<0.5	61	<0.5	<0.5	<0.5	<0.5	1.3	<0.5	61	<0.5
2015	W-1552	MW	4/23/15	<0.5	<0.5	<0.5	<0.5	<0.5	3.7	<0.5	1.2	<0.5	1.1	36	<0.5	3.7	<0.5
2015	W-1552	MW	7/23/15	<0.5	<0.5	<0.5	<0.5	<0.5	13	0.9	1.1	0.58	<0.5	83	<0.5	13	<0.5
2015	W-1552	MW	10/22/15	<0.5	<0.5	<0.5	<0.5	<0.5	1.8	<0.5	0.97	<0.5	1.4	36	<0.5	1.8	<0.5
2015	W-1553	MW	4/29/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	0.87	2	<0.5	<0.5	99	<0.5	<0.5	<0.5
2015	W-1553	MW	8/19/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	12	2.2	4.9	<0.5	320 D	<0.5	<0.5	<0.5
2015	W-1553	MW	8/19/15 DUP	<0.5	<0.5	<0.5	<0.5	<0.5	<1	14 IJ	2.8 IJ	7.8 IJ	<0.5	260 DH	<0.5	<0.5	<0.5
2015	W-1553	MW	10/19/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	11	2	4.6	<0.5	310 D	<0.5	<0.5	<0.5
2015	W-1601	MW	1/13/15	<0.5	<0.5	1.1	20	4.5	<1	3.1	3.2	1.1	78	200 D	<0.5	0.8	<0.5
2015	W-1601	MW	4/1/15	<0.5	<0.5	1.3	24	5.2	1	3.5	3.9	1.2	83	210 D	<0.5	1	<0.5
2015	W-1601	MW	7/15/15	<0.5	<0.5	1.2	21	4.8	<1	3.2	3.6	1.1	77	210 D	<0.5	0.85	<0.5
2015	W-1601	MW	10/2/15	<0.5	<0.5	1.1	18	4.2	<1	3	3.1	1	70	200 D	<0.5	0.74	<0.5
2015	W-1602	MW	1/13/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	1.8	<0.5	0.91	9.2	3	<0.5	<0.5
2015	W-1602	MW	4/1/15	<0.5	<0.5	<0.5	0.5	<0.5	<1	<0.5	1.4	<0.5	0.98	8.9	1.2	<0.5	<0.5
2015	W-1602	MW	7/15/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	1.7	<0.5	0.94	9.2	1.9	<0.5	<0.5
2015	W-1602	MW	10/2/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	1.5	<0.5	0.94	8.2	2.4	<0.5	<0.5
2015	W-1603	MW	1/13/15	<0.5	<0.5	<0.5	4.6	1	<1	1.5	1.8	<0.5	7.9	78	14	<0.5	<0.5
2015	W-1603	MW	4/1/15	<0.5	<0.5	0.71	11	2.4	<1	1.2	2.2	<0.5	17	120 D	6.2	0.79	<0.5
2015	W-1603	MW	7/15/15	<0.5	<0.5	<0.5	5	1.1	<1	1.4	2	<0.5	8	80	13	<0.5	<0.5
2015	W-1603	MW	10/2/15	<0.5	<0.5	<0.5	4.4	0.98	<1	1.4	1.8	<0.5	7.1	72	13	<0.5	<0.5
2015	W-1604	MW	3/24/15	<1.2 D	3.7 D	1.7 D	29 D	19 D	<2.5 D	3.7 D	67 D	7.7 D	75 D	890 D	<1.2 D	2.2 D	<1.2 D
2015	W-1604	MW	3/24/15 DUP	<0.5	<0.5	2.2	38	21	2.9	4.8	79	11	94	800 D	<0.5	2.9	<0.5
2015	W-1604	MW	6/11/15	<1 D	<1 D	1.5 D	39 D	14 D	3.6 D	4.1 D	59 D	9.6 D	91 D	730 D	<1 D	3.6 D	<1 D
2015	W-1604	MW	12/9/15	<0.5	<0.5	0.93	20	7	1.2	2.1	25	4.4	49	440 D	<0.5	1.2	<0.5
2015	W-1604	MW	12/9/15 DUP	<0.5	<0.5	1.2	24	8.8	2.4	2.5	34	5.6	61	610 D	<0.5	2.4	<0.5
2015	W-1605	MW	3/12/15	<0.5	<0.5	<0.5	1.1	2.1	<1	<0.5	21	<0.5	3.2	41	<0.5	<0.5	<0.5
2015	W-1605	MW	5/27/15	<0.5	<0.5	<0.5	<0.5	1.2	<1	<0.5	12	<0.5	2	23	<0.5	<0.5	<0.5
2015	W-1605	MW	9/1/15	<0.5	<0.5	<0.5	1.2	2.2	<1	<0.5	27	<0.5	3.2	45	<0.5	<0.5	<0.5
2015	W-1605	MW	10/13/15	<0.5	<0.5	<0.5	1.2	2.3	<1	<0.5	26	<0.5	3.4	46	<0.5	<0.5	<0.5
2015	W-1606	MW	3/24/15	<0.5	<0.5	<0.5	<0.5	0.93	<1	<0.5	9.8	<0.5	1.7	20	<0.5	<0.5	<0.5
2015	W-1606	MW	6/10/15	<0.5	<0.5	<0.5	<0.5	1.4	<1	<0.5	12	<0.5	1.8	22	<0.5	<0.5	<0.5
2015	W-1606	MW	9/2/15	<0.5	<0.5	<0.5	<0.5	1.1	<1	<0.5	10	<0.5	1.6	21	<0.5	<0.5	<0.5
2015	W-1606	MW	10/13/15	<0.5	<0.5	<0.5	<0.5	1.5	<1	<0.5	12	<0.5	1.9	24	<0.5	<0.5	<0.5
2015	W-1607	MW	3/12/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	13	<0.5	2.9	28	<0.5	<0.5	<0.5
2015	W-1607	MW	9/2/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	11	<0.5	2.4	23	<0.5	<0.5	<0.5
2015	W-1607	MW	12/16/15	<0.5	<0.5	<0.5	<0.5	0.51	<1	<0.5	16	<0.5	2.8	29	<0.5	<0.5	<0.5
2015	W-1608	MW	3/12/15	<0.5	<0.5	<0.5	0.63	2.4	<1	<0.5	16	<0.5	2.2	16	<0.5	<0.5	<0.5
2015	W-1608	MW	5/27/15	<0.5	<0.5	<0.5	<0.5	1.8	<1	<0.5	12	<0.5	1.5	14	<0.5	<0.5	<0.5
2015	W-1608	MW	10/13/15	<0.5	<0.5	<0.5	0.67	1.6	<1	<0.5	11	<0.5	2	20	<0.5	<0.5	<0.5
2015	W-1609	MW	3/12/15	<0.5	<0.5	<0.5	2.9	1.9	<1	<0.5	24	<0.5	7.4	60	<0.5	<0.5	<0.5
2015	W-1609	MW	5/27/15	<0.5	<0.5	<0.5	3.6	2.1	<1	<0.5	29	0.53	9.8	82	<0.5	<0.5	<0.5
2015	W-1609	MW	10/13/15	<0.5	<0.5	<0.5	3.7	1.9	<1	<0.5	28	0.6	9.9	79	<0.5	<0.5	<0.5
2015	W-1610	MW	3/12/15	<0.5	<0.5	0.67	6	2.7	<1	0.55	37	<0.5	17	120 D	<0.5	0.67	<0.5
2015	W-1610	MW	5/27/15	<0.5	<0.5	0.68	7.1	3	<1	0.7	38	0.59	19	130 D	<0.5	<0.5	<0.5
2015	W-1610	MW	9/1/15	<0.5	<0.5	0.54	4.3	2.7	<1	<0.5	32	<0.5	13	110 D	<0.5	<0.5	<0.5
2015	W-1610	MW	9/9/15 DUP	<0.5	<0.5 L	0.59	5.1	2.8	<1	0.58	34	0.71	16	130 D	<0.5	<0.5	<0.5
2015	W-1610	MW	10/13/15	<0.5	<0.5	0.5	3.3	2.1	<1	<0.5	31	<0.5	11	91	<0.5	<0.5	<0.5
2015	W-1613	MW	3/30/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	W-1614	MW	1/20/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	0.81	<0.5	<0.5	<0.5	<0.5
2015	W-1615	MW	3/18/15	<0.5	<0.5	<0.5	2.4	<0.5	<1	<0.5	<0.5	<0.5	28	160 D	<0.5	<0.5	<0.5
2015	W-1615	MW	4/30/15	<0.5	<0.5	<0.5	2.8	<0.5	<1	<0.5	<0.5	<0.5	26	150 D	<0.5	<0.5	<0.5
2015	W-1615	MW	8/24/15	<0.5	<0.5	<0.5	2.2	<0.5	<1	<0.5	<0.5	<0.5	22	130 D	<0.5	<0.5	<0.5
2015	W-1615	MW	11/18/15	<0.5	<0.5	<0.5	2.5	<0.5	<1	<0.5	<0.5	<0.5	28	150 D	<0.5	<0.5	<0.5
2015	W-1650	MW	1/21/15	<0.5	<0.5	<0.5	<0.5	<0.5	1.3	1.1	1.5	<0.5	<0.5	81 D	<0.5	1.3	<0.5
2015	W-1650	MW	4/23/15	<0.5	<0.5	<0.5	<0.5	<0.5	3.6	1.7	1.3	0.99	<0.5	110 D	<0.5	3.6	<0.5
2015	W-1650	MW	7/23/15	<0.5	<0.5	<0.5	<0.5	<0.5	1.7	1.7	1.4	1.1	<0.5	120 D	<0.5	1.7	<0.5
2015	W-1650	MW	10/22/15	<0.5	<0.5	<0.5	<0.5	<0.5	1.3	1.9	1.2	1.2	<0.5	100 D	<0.5	1.3	<0.5
2015	W-1651	MW	1/21/15	<0.5	<0.5	<0.5	<0.5	<0.5	4	<0.5	0.57	<0.5	<0.5	36	<0.5	4	<0.5
2015	W-1651	MW	4/23/15	<0.5	<0.5	<0.5	<0.5	<0.5	4.5	0.6	0.79	<0.5	<0.5	52	<0.5	4.5	<0.5

Attachment B Table 1. 2015 Livermore Site ground water monitoring analytical results for VOCs.

Year	Well Name	Type	Date	1,1,1-Trichloroethane (µg/L)	1,1,2-Trichloroethane (µg/L)	1,1-Dichloroethane (µg/L)	1,1-Dichloroethene (µg/L)	1,2-Dichloroethane (µg/L)	1,2-Dichloroethene (total) (µg/L)	Carbon tetrachloride (µg/L)	Chloroform (µg/L)	Freon 113 (µg/L)	Tetrachloroethene (µg/L)	Trichloroethene (µg/L)	Trichlorofluoro methane (µg/L)	cis-1,2-Dichloroethene (µg/L)	trans-1,2-Dichloroethene (µg/L)
2015	W-1651	MW	7/23/15	<0.5	<0.5	<0.5	<0.5	<0.5	4.2	0.94	0.8	<0.5	<0.5	45	<0.5	4.2	<0.5
2015	W-1651	MW	10/22/15	<0.5	<0.5	<0.5	<0.5	<0.5	3.6	0.8	0.81	<0.5	<0.5	40	<0.5	3.6	<0.5
2015	W-1652	MW	1/21/15	<0.5	<0.5	<0.5	<0.5	<0.5	28	<0.5	<0.5	<0.5	<0.5	37	<0.5	28	<0.5
2015	W-1652	MW	4/23/15	<0.5	<0.5	<0.5	<0.5	<0.5	20	<0.5	<0.5	<0.5	<0.5	24	<0.5	20	<0.5
2015	W-1652	MW	7/23/15	<0.5	<0.5	<0.5	<0.5	<0.5	13	<0.5	<0.5	<0.5	<0.5	15	<0.5	13	<0.5
2015	W-1652	MW	10/22/15	<0.5	<0.5	<0.5	<0.5	<0.5	7.2	<0.5	<0.5	<0.5	<0.5	19	<0.5	7.2	<0.5
2015	W-1653	MW	1/21/15	<0.5	<0.5	<0.5	<0.5	<0.5	13	<0.5	0.5	<0.5	<0.5	30	<0.5	13	<0.5
2015	W-1653	MW	4/23/15	<0.5	<0.5	<0.5	<0.5	<0.5	32	<0.5	<0.5	<0.5	<0.5	37	<0.5	32	<0.5
2015	W-1653	MW	7/23/15	<0.5	<0.5	<0.5	<0.5	<0.5	32	<0.5	<0.5	<0.5	<0.5	36	<0.5	32	<0.5
2015	W-1653	MW	10/22/15	<0.5	<0.5	<0.5	<0.5	<0.5	32	<0.5	<0.5	<0.5	<0.5	41	<0.5	32	<0.5
2015	W-1654	MW	1/21/15	<0.5	<0.5	<0.5	<0.5	<0.5	22	<0.5	<0.5	<0.5	<0.5	15	<0.5	22	<0.5
2015	W-1654	MW	4/23/15	<0.5	<0.5	<0.5	<0.5	<0.5	28	<0.5	<0.5	<0.5	<0.5	11	<0.5	28	<0.5
2015	W-1654	MW	7/23/15	<0.5	<0.5	<0.5	<0.5	<0.5	28	<0.5	<0.5	<0.5	<0.5	10	<0.5	28	<0.5
2015	W-1654	MW	10/22/15	<0.5	<0.5	<0.5	<0.5	<0.5	26	<0.5	<0.5	<0.5	<0.5	14	<0.5	26	<0.5
2015	W-1655	MW	1/21/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	1	<0.5	0.94	32	<0.5	0.67	<0.5
2015	W-1655	MW	4/23/15	<0.5	<0.5	<0.5	<0.5	<0.5	1	<0.5	1.3	<0.5	1.6	39	<0.5	1	<0.5
2015	W-1655	MW	7/23/15	<0.5	<0.5	<0.5	<0.5	<0.5	1	<0.5	1.1	<0.5	1.3	29	<0.5	1	<0.5
2015	W-1655	MW	10/22/15	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	<0.5	1.3	<0.5	2.2	41	<0.5	1.2	<0.5
2015	W-1656	MW	1/21/15	<0.5	<0.5	<0.5	<0.5	<0.5	2.9	<0.5	0.7	<0.5	<0.5	33	<0.5	2.9	<0.5
2015	W-1656	MW	4/23/15	<0.5	<0.5	<0.5	<0.5	<0.5	3.7	<0.5	0.73	<0.5	<0.5	30	<0.5	3.7	<0.5
2015	W-1656	MW	7/23/15	<0.5	<0.5	<0.5	<0.5	<0.5	2.8	<0.5	0.62	<0.5	<0.5	28	<0.5	2.8	<0.5
2015	W-1656	MW	10/22/15	<0.5	<0.5	<0.5	<0.5	<0.5	3.2	<0.5	0.66	<0.5	<0.5	33	<0.5	3.2	<0.5
2015	W-1657	MW	1/21/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	7.4	3.3	2.2	<0.5	780 D	<0.5	0.81	<0.5
2015	W-1657	MW	4/23/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	8.4	4	2.6	<0.5	940 D	<0.5	<0.5	<0.5
2015	W-1657	MW	7/23/15	<0.5	<0.5	<0.5	<0.5	<0.5	2.7	7	3.8	2.1	<0.5	820 D	<0.5	2.7	<0.5
2015	W-1657	MW	10/22/15	<0.5	<0.5	<0.5	<0.5	<0.5	3.4	7.4	3.9	2.2	<0.5	660 D	<0.5	3.4	<0.5
2015	W-1701	MW	1/20/15	<0.5	<0.5	2.3	3	<0.5	<1	<0.5	0.63	<0.5	5	<0.5	<0.5	<0.5	<0.5
2015	W-1701	MW	4/20/15	<0.5	<0.5	2.5	3.7	<0.5	<1	<0.5	0.78	<0.5	5.7	<0.5	<0.5	<0.5	<0.5
2015	W-1701	MW	7/9/15	<0.5	<0.5	2.2	2.8	<0.5	<1	<0.5	0.66	<0.5	4.7	<0.5	<0.5	<0.5	<0.5
2015	W-1701	MW	7/9/15 DUP	<0.5	<0.5	2.7	3.4	<0.5	<0.5	<0.5	0.81	<0.5	4.9	<0.5	<0.5	<0.5	<0.5
2015	W-1701	MW	10/6/15	<0.5	<0.5	2.5	3.2	<0.5	<1	<0.5	0.67	<0.5	5	<0.5	<0.5	<0.5	<0.5
2015	W-1703	MW	2/10/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	0.75	<0.5	<0.5	<0.5
2015	W-1705-2	MW	2/4/15	<0.5	<0.5	<0.5	0.65	<0.5	1.7	<0.5	1.2	7.4	2.7	75	<0.5	1.7	<0.5
2015	W-1705-2	MW	6/24/15	<0.5	<0.5	<0.5	<0.5	<0.5	28	<0.5	3.2	5.3	1.4	80	<0.5	28	<0.5
2015	W-1705-2	MW	8/27/15	<0.5	<0.5	<0.5	<0.5	<0.5	48	<0.5	19	0.62	<0.5	16	<0.5	48	<0.5
2015	W-1705-2	MW	12/15/15	<0.5	<0.5	<0.5	<0.5	<0.5	29	<0.5	22	<0.5	<0.5	12	<0.5	29	<0.5
2015	W-1705-3	MW	2/3/15	<0.5	<0.5	<0.5	<0.5	<1	17	<0.5	0.54	<0.5	<0.5	16	<0.5	17	<0.5
2015	W-1705-3	MW	2/3/15 RTN2	<0.5	<0.5	<0.5	<0.5	<1	23	<0.5	<0.5	<0.5	<0.5	13	<0.5	23	<0.5
2015	W-1705-3	MW	2/3/15 RTN3	<0.5	<0.5	<0.5	<0.5	<1	11	<0.5	1.2	<0.5	<0.5	20	<0.5	11	<0.5
2015	W-1705-3	MW	6/24/15	<0.5	<0.5	<0.5	<0.5	<0.5	77	<0.5	6.8	<0.5	<0.5	6	<0.5	77	<0.5
2015	W-1705-3	MW	8/27/15	<0.5	<0.5	<0.5	<0.5	<0.5	30	<0.5	26	<0.5	<0.5	5.9	<0.5	30	<0.5
2015	W-1705-3	MW	12/15/15	<0.5	<0.5	<0.5	<0.5	<0.5	30	<0.5	0.61	<0.5	<0.5	11	<0.5	30	<0.5
2015	W-1801	MW	1/7/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	1.4	2.8	0.76	19	<0.5	<0.5	<0.5
2015	W-1801	MW	4/15/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	1.7	3.5	0.82	15	<0.5	<0.5	<0.5
2015	W-1801	MW	7/22/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	1.5	3	0.82	17	<0.5	<0.5	<0.5
2015	W-1801	MW	10/5/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	1.4	2.7	0.79	17	<0.5	<0.5	<0.5
2015	W-1802	MW	5/21/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	1.1	1.4	<0.5	<0.5	15	38	<0.5	<0.5
2015	W-1802	MW	5/21/15 DUP	<0.5	<0.5	<0.5	<0.5	<0.5	<1	0.95	1.3	<0.5	<0.5	14	34	<0.5	<0.5
2015	W-1802	MW	10/19/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	1.5	1.3	<0.5	<0.5	21	47	<0.5	<0.5
2015	W-1803-1	MW	6/3/15	<0.5	<0.5	0.55	10	3.7	<0.5	2.5	3.5	2.1	17	140 D	<0.5	<0.5	<0.5
2015	W-1803-1	MW	6/3/15 DUP	<0.5	<0.5	0.51	11	3.3	<1	2.5	3.5	1.6	17	120 D	<0.5	<0.5	<0.5
2015	W-1803-1	MW	8/6/15	<0.5	<0.5	0.61	10	3.6	<0.5	2.6	3.7	2	18	120 DHL	<0.5	<0.5	<0.5
2015	W-1803-2	MW	2/10/15	<0.5	<0.5	<0.5	0.77	<0.5	<0.5	<0.5	1.1	<0.5	0.96	15	<0.5	<0.5	<0.5
2015	W-1803-2	MW	6/3/15	<0.5	<0.5	<0.5	0.94	<0.5	<0.5	<0.5	1.3	<0.5	1.3	19	<0.5	<0.5	<0.5
2015	W-1803-2	MW	6/3/15 DUP	<0.5	<0.5	<0.5	0.96	<0.5	<0.5	<0.5	1.3	<0.5	1.3	20	<0.5	<0.5	<0.5
2015	W-1804-1	MW	2/2/15	<0.5	<0.5	0.92	0.69	<0.5	<0.5	<0.5	0.58	<0.5	5.8	32	<0.5	<0.5	<0.5
2015	W-1804-1	MW	2/2/15 DUP	<0.5	<0.5	0.76	0.61	<0.5	<1	<0.5	<0.5	<0.5	5.9	31	<0.5	<0.5	<0.5
2015	W-1804-1	MW	4/28/15	<0.5	<0.5	1	1.3	<0.5	1.4	<0.5	0.57	<0.5	7.3 L	39	<0.5	1.4	<0.5
2015	W-1804-1	MW	4/28/15 DUP	<0.5	<0.5	0.92	1.1	<0.5	1.3	<0.5	0.5	<0.5	7.2	37	<0.5	1.3	<0.5
2015	W-1804-1	MW	8/6/15	<0.5	<0.5	0.88	2.5	<0.5	4.2	<0.5	<0.5	<0.5	6.7	29 L	<0.5	4.2	<0.5
2015	W-1804-1	MW	12/2/15	<0.5	<0.5	<0.5	2.6	<0.5	<1	<0.5	<0.5	<0.5	6.8	25	<0.5	0.5	<0.5
2015	W-1804-2	MW	2/2/15	<0.5	<0.5	3.6	190 D	1.6	0.67	0.56	1.1	<0.5	77	340 D	<0.5	0.67	<0.5
2015	W-1804-2	MW	4/28/15	<0.5	<0.5	2.8	140 D	1.3	0.54	<0.5	0.98	<0.5	40 L	260 D	<0.5	0.54	<0.5

Attachment B Table 1. 2015 Livermore Site ground water monitoring analytical results for VOCs.

Year	Well Name	Type	Date	1,1,1-Trichloroethane (µg/L)	1,1,2-Trichloroethane (µg/L)	1,1-Dichloroethane (µg/L)	1,1-Dichloroethene (µg/L)	1,2-Dichloroethane (µg/L)	1,2-Dichloroethene (total) (µg/L)	Carbon tetrachloride (µg/L)	Chloroform (µg/L)	Freon 113 (µg/L)	Tetrachloroethene (µg/L)	Trichloroethene (µg/L)	Trichlorofluoro methane (µg/L)	cis-1,2-Dichloroethene (µg/L)	trans-1,2-Dichloroethene (µg/L)
2015	W-1804-2	MW	4/28/15 DUP	<0.5	<0.5	2.9	160 D	1.3	0.51	<0.5	0.98	<0.5	45 L	270 D	<0.5	0.51	<0.5
2015	W-1804-2	MW	8/6/15	<0.5 H	<0.5 H	2.6 H	120 DH	1.5 H	0.52 H	<0.5 H	0.98 H	<0.5 H	38 H	220 DHL	<0.5 H	0.52 H	<0.5 H
2015	W-1804-2	MW	12/2/15	<0.5	<0.5	2.6	190	1.3	<1	<0.5	0.93	<0.5	48	290	<0.5	0.63	<0.5
2015	W-1804-2	MW	12/2/15 DUP	<0.5	<0.5	2.8	130 D	1.3	<1	<0.5	0.86	<0.5	44	240 D	<0.5	0.56	<0.5
2015	W-1805	MW	11/30/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	0.88	<0.5	<0.5	<0.5	<0.5
2015	W-1806	MW	1/14/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	5.5	1.6	<0.5	<0.5	<0.5
2015	W-1806	MW	4/15/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	8	2	<0.5	<0.5	<0.5
2015	W-1806	MW	7/15/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	8.3	2	<0.5	<0.5	<0.5
2015	W-1806	MW	10/5/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	5.1	1.3	<0.5	<0.5	<0.5
2015	W-1807	MW	1/14/15	<0.5	<0.5	<0.5	1.4	<0.5	<1	<0.5	1.3	1.3	18	4.7	<0.5	<0.5	<0.5
2015	W-1807	MW	4/15/15	<0.5	<0.5	<0.5	1.6	<0.5	<1	<0.5	1.4	1.5	19	5.1	<0.5	<0.5	<0.5
2015	W-1807	MW	7/15/15	<0.5	<0.5	<0.5	1.6	<0.5	<1	<0.5	1.5	1.4	19	5.5	<0.5	<0.5	<0.5
2015	W-1807	MW	10/5/15	<0.5	<0.5	<0.5	1.2	<0.5	<1	<0.5	1.3	1.2	16	4.4	<0.5	<0.5	<0.5
2015	W-1901-1	MW	12/28/15	<0.5	<0.5	<0.5	7.5	<0.5	<1	<0.5	<0.5	<0.5	3.1	3.6	<0.5	0.73	<0.5
2015	W-1901-2	MW	3/18/15	<0.5	<0.5	<0.5	25	<0.5	<1	<0.5	1.7	0.51	5.4	11	<0.5	<0.5	<0.5
2015	W-1901-2	MW	9/24/15	<0.5	<0.5	<0.5	0.79	<0.5	<1	<0.5	0.71	<0.5	0.74	0.81	<0.5	<0.5	<0.5
2015	W-1901-2	MW	12/28/15	<0.5	<0.5	<0.5	0.99	<0.5	<1	<0.5	1.6	<0.5	3.2	7.3	<0.5	<0.5	<0.5
2015	W-1901-2	MW	12/28/15 DUP	<0.5	<0.5	<0.5	0.91	<0.5	<1	<0.5	1.2	<0.5	3.2	6.5	<0.5	<0.5	<0.5
2015	W-1902	MW	1/14/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	3	<0.5	<0.5	3.3	47	<0.5	<0.5
2015	W-1902	MW	4/8/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	3.4	<0.5	<0.5	3.7	42	<0.5	<0.5
2015	W-1902	MW	7/9/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	3.4	<0.5	<0.5	4	42	<0.5	<0.5
2015	W-1902	MW	10/2/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	3.2	<0.5	<0.5	3.4	42	<0.5	<0.5
2015	W-1903	MW	1/13/15	<0.5	<0.5	<0.5	15	<0.5	<1	<0.5	<0.5	4.4	14	29	<0.5	<0.5	<0.5
2015	W-1903	MW	4/2/15	<0.5	<0.5	<0.5	12	<0.5	<1	<0.5	<0.5	3.2	10	22	<0.5	<0.5	<0.5
2015	W-1903	MW	7/14/15	<0.5	<0.5	<0.5	13	<0.5	<1	<0.5	<0.5	3.5	13	32	<0.5	<0.5	<0.5
2015	W-1903	MW	10/1/15	<0.5	<0.5	<0.5	13	<0.5	<1	<0.5	<0.5	3.4	13	28	<0.5	<0.5	<0.5
2015	W-1905-1	MW	2/2/15	<0.5	<0.5	2.3	49	5.2	2.8	<0.5	1.4	<0.5	34	440 D	<0.5	2.8	<0.5
2015	W-1905-1	MW	5/5/15	<0.5	<0.5	1.9	41	4	2.2	<0.5	1.2	<0.5	31	290 D	<0.5	2.2	<0.5
2015	W-1905-2	MW	2/2/15	<0.5	<0.5	<0.5	1.7	0.54	<1	<0.5	<0.5	<0.5	1.5	14	<0.5	<0.5	<0.5
2015	W-1905-2	MW	5/5/15	<0.5	<0.5	<0.5	5.2	0.71	<1	<0.5	<0.5	<0.5	8.8	45	<0.5	<0.5	<0.5
2015	W-1905-2	MW	8/18/15	<0.5	<0.5	<0.5	5	0.55	<1	<0.5	<0.5	<0.5	9.9	43	<0.5	<0.5	<0.5
2015	W-1905-2	MW	8/18/15 DUP	<0.5	<0.5	<0.5	5.4	0.57	<1	<0.5	<0.5	<0.5	10	46	<0.5	<0.5	<0.5
2015	W-1905-2	MW	10/20/15	<0.5	<0.5	<0.5	3.9	0.53	<1	<0.5	<0.5	<0.5	9.2	40	<0.5	<0.5	<0.5
2015	W-2005	MW	1/7/15	<0.5	<0.5	<0.5	14	1.1	<1	0.55	0.6	<0.5	32	71	<0.5	<0.5	<0.5
2015	W-2005	MW	4/1/15	<0.5	<0.5	<0.5	11	0.69	<1	<0.5	0.98	<0.5	25	49	<0.5	<0.5	<0.5
2015	W-2005	MW	7/9/15	<0.5	<0.5	0.56	19	1.6	<1	<0.5	1.3	<0.5	44	100	<0.5	<0.5	<0.5
2015	W-2005	MW	10/1/15	<0.5	<0.5	<0.5	6.1	<0.5	<1	<0.5	0.92	<0.5	15	29	<0.5	<0.5	<0.5
2015	W-2006	MW	1/7/15	<0.5	<0.5	2.9	99	9.5	1.5	0.98	1.8	<0.5	84 D	500 D	<0.5	1.5	<0.5
2015	W-2006	MW	4/8/15	<0.5	<0.5	3.3	95 D	10	1.6	1.1	2.1	<0.5	92 D	540 D	<0.5	1.6	<0.5
2015	W-2006	MW	7/21/15	<0.5	<0.5	3.5	96 D	11	1.5	0.99	2.3	<0.5	92 D	560 D	<0.5	1.5	<0.5
2015	W-2006	MW	10/13/15	<0.5	<0.5	3.5	96 D	10	1.5	1.1	2	<0.5	94 D	580 D	<0.5	1.5	<0.5
2015	W-2011	MW	1/5/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	0.75	0.7	<0.5	<0.5	17	<0.5	<0.5	<0.5
2015	W-2011	MW	4/8/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	0.82	0.75	<0.5	<0.5	18	<0.5	<0.5	<0.5
2015	W-2101	MW	1/5/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	3.1	1.5	<0.5	<0.5	110 D	<0.5	<0.5	<0.5
2015	W-2101	MW	4/8/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	3.1	1.6	<0.5	<0.5	110 D	<0.5	<0.5	<0.5
2015	W-2102	MW	1/5/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	11	3.7	1.2	<0.5	300 D	1.8	<0.5	<0.5
2015	W-2102	MW	4/8/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	12	3.8	1.4	<0.5	320 D	1.1	<0.5	<0.5
2015	W-2103	MW	2/2/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	12	3	3.1	<0.5	340 D	<0.5	<0.5	<0.5
2015	W-2103	MW	4/29/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	8.2	<0.5	<0.5	<0.5
2015	W-2103	MW	4/29/15 DUP	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	8.5	<0.5	<0.5	<0.5
2015	W-2103	MW	9/17/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	8.7	2.4	2.6	<0.5	230 D	<0.5	<0.5	<0.5
2015	W-2103	MW	12/2/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	9.9	2.6	3.1	<0.5	290 D	<0.5	<0.5	<0.5
2015	W-2103	MW	12/2/15 DUP	<0.5	<0.5	<0.5	<0.5	<0.5	<1	10	2.7	3.6	<0.5	330	<0.5	<0.5	<0.5
2015	W-2105	MW	1/12/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	0.57	3.3	44	<0.5	<0.5	<0.5
2015	W-2105	MW	4/1/15	<0.5	<0.5	<0.5	0.77	<0.5	<1	<0.5	<0.5	1.4	5.7	83	<0.5	0.75	<0.5
2015	W-2105	MW	7/14/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	3.4	43	<0.5	<0.5	<0.5
2015	W-2105	MW	10/5/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	1	4.6	66	<0.5	<0.5	<0.5
2015	W-2113	MW	10/19/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	7.6	<0.5	<0.5	1.7	0.58	<0.5	<0.5
2015	W-2201	MW	1/8/15	<0.5	<0.5	<0.5	3.5	<0.5	<1	<0.5	4.4	12	0.73	84	0.73	<0.5	<0.5
2015	W-2201	MW	1/22/15	<0.5	<0.5	<0.5	0.98	<0.5	<1	<0.5	5.9	19	0.84	14	1.3	<0.5	<0.5
2015	W-2201	MW	1/22/15 CON	<0.5	<0.5	<0.5	2.8	<0.5	<1	<0.5	3.8	9.4	<0.5	57	0.65	<0.5	<0.5
2015	W-2201	MW	2/26/15	<0.5	<0.5	<0.5	3.4	<0.5	<1	<0.5	4.3	12	0.59	77	0.66	<0.5	<0.5
2015	W-2201	MW	3/26/15	<0.5	<0.5	<0.5	0.84	<0.5	<1	<0.5	5.4	17	0.73	14	1.2	<0.5	<0.5

Attachment B Table 1. 2015 Livermore Site ground water monitoring analytical results for VOCs.

Year	Well Name	Type	Date	1,1,1-Trichloroethane (µg/L)	1,1,2-Trichloroethane (µg/L)	1,1-Dichloroethane (µg/L)	1,1-Dichloroethene (µg/L)	1,2-Dichloroethane (µg/L)	1,2-Dichloroethene (total) (µg/L)	Carbon tetrachloride (µg/L)	Chloroform (µg/L)	Freon 113 (µg/L)	Tetrachloroethene (µg/L)	Trichloroethene (µg/L)	Trichlorofluoro methane (µg/L)	cis-1,2-Dichloroethene (µg/L)	trans-1,2-Dichloroethene (µg/L)
2015	W-2201	MW	3/26/15 CON	<0.5	<0.5	<0.5	4.9	<0.5	<1	<0.5	4.5	12	0.72	100 D	0.67	<0.5	<0.5
2015	W-2201	MW	4/20/15	<0.5	<0.5	<0.5	1.5	<0.5	<1	<0.5	5	20	0.97	15	1.1	<0.5	<0.5
2015	W-2201	MW	4/30/15	<0.5	<0.5	<0.5	1.4	<0.5	<1	<0.5	5	18	0.89	14	0.92	<0.5	<0.5
2015	W-2201	MW	6/1/15	<0.5	<0.5	<0.5	1.5	<0.5	<1	<0.5	5.7	19	0.92	15	1.1	<0.5	<0.5
2015	W-2201	MW	6/25/15	<0.5	<0.5	<0.5	1.4	<0.5	<1	<0.5	5.8	17	0.86	14	1	<0.5	<0.5
2015	W-2201	MW	7/8/15	<0.5	<0.5	<0.5	1.6	<0.5	<1	<0.5	6.7	20	1.1	18	1.2	<0.5	<0.5
2015	W-2201	MW	7/23/15	<0.5	<0.5	<0.5	1.4	<0.5	<1	<0.5	5.7	17	0.83	14	1	<0.5	<0.5
2015	W-2201	MW	10/5/15	<0.5	<0.5	<0.5	1.1	<0.5	<1	<0.5	4.9	15	0.84	13	0.92	<0.5	<0.5
2015	W-2201	MW	10/5/15 RTN2	<0.5	<0.5	<0.5	1.2	<0.5	<1	<0.5	4.8	16	0.89	13	0.95	<0.5	<0.5
2015	W-2201	MW	11/18/15	<0.5	<0.5	<0.5	1.2	<0.5	<1	<0.5	5.2	15	0.86	14	0.92	<0.5	<0.5
2015	W-2202	MW	2/2/15	<0.5	<0.5	<0.5	9.5	<0.5	<1	8.6	2.5	1.2	9.2	99 D	<0.5	<0.5	<0.5
2015	W-2202	MW	2/2/15 DUP	<0.5	<0.5	<0.5	9	0.54	<1	8	2.4	1.2	8.6	100	<0.5	<0.5	<0.5
2015	W-2202	MW	5/21/15	<0.5	<0.5	<0.5	11	0.62	<1	8.5	2.9	1.3	9.7	97 D	<0.5	<0.5	<0.5
2015	W-2202	MW	8/6/15	<0.5	<0.5	<0.5	0.87	<0.5	<1	0.65	<0.5	<0.5	0.81	11	<0.5	<0.5	<0.5
2015	W-2202	MW	8/6/15 DUP	<0.5 H	<0.5 H	<0.5 H	0.86 H	<0.5 H	<0.5 H	0.58 H	<0.5 H	<0.5 H	0.76 H	10 HL	<0.5 H	<0.5 H	<0.5 H
2015	W-2202	MW	10/20/15	<0.5	<0.5	<0.5	7	<0.5	<1	9.3	2.8	1.3	10	98	<0.5	<0.5	<0.5
2015	W-2203	MW	1/7/15	<0.5	<0.5	<0.5	1.6	<0.5	<1	8.4	2.3	1.7	5.1	87	<0.5	<0.5	<0.5
2015	W-2203	MW	4/8/15	<0.5	<0.5	<0.5	2	<0.5	<1	8.6	2.5	1.8	5.7	89	<0.5	<0.5	<0.5
2015	W-2203	MW	7/21/15	<0.5	<0.5	<0.5	1.8	<0.5	<1	8.3	2.7	1.7	5.5	94	<0.5	<0.5	<0.5
2015	W-2203	MW	10/13/15	<0.5	<0.5	<0.5	1.5	<0.5	<1	7.3	2.2	1.5	4.6	80	<0.5	<0.5	<0.5
2015	W-2204	MW	2/9/15	<2.5 D	<2.5 D	<2.5 D	15 D	80 D	<5 D	23 D	7 D	<2.5 D	150 D	2,000 D	<2.5 D	<2.5 D	<2.5 D
2015	W-2204	MW	4/15/15	<2.5 D	<2.5 D	<2.5 D	13 D	90 D	<5 D	25 D	7.8 D	<2.5 D	170 D	2,000 D	<2.5 D	<2.5 D	<2.5 D
2015	W-2204	MW	8/12/15	<2.5 D	<2.5 D	<2.5 D	12 D	96 D	<5 D	24 D	7.9 D	<2.5 D	160 D	2,000 D	<2.5 D	<2.5 D	<2.5 D
2015	W-2204	MW	11/18/15	<2.5 D	<2.5 D	<2.5 D	9.6 D	110 D	<5 D	25 D	8.2 D	<2.5 D	180 D	2,100 D	<2.5 D	<2.5 D	<2.5 D
2015	W-2205	MW	2/9/15	<2.5 D	<2.5 D	<2.5 D	9.9 D	5.6 D	<5 D	29 D	5.1 D	<2.5 D	27 D	1,000 D	<2.5 D	<2.5 D	<2.5 D
2015	W-2205	MW	4/15/15	<0.5	<0.5	0.55	11	9.9	<1	36	6.5	<0.5	35	930 D	<0.5	<0.5	<0.5
2015	W-2205	MW	8/12/15	<1 D	<1 D	<1 D	6.8 D	8.2 D	<2 D	23 D	5.4 D	<1 D	24 D	820 D	<1 D	<1 D	<1 D
2015	W-2205	MW	11/18/15	<0.5	<0.5	0.5	6.2	8.5	<1	21	5.5	<0.5	24	760 D	<0.5	<0.5	<0.5
2015	W-2207B	MW	2/9/15	<5 D	<5 D	<5 D	14 D	<5 D	<10 D	6 D	6.8 D	<5 D	6 D	4,700 D	<5 D	<5 D	<5 D
2015	W-2207B	MW	4/15/15	<12 D	<12 D	<12 D	12 D	<12 D	<25 D	<12 D	<12 D	<12 D	<12 D	3,900 D	<12 D	<12 D	<12 D
2015	W-2207B	MW	8/12/15	<10 D	<10 D	<10 D	21 D	<10 D	<20 D	16 D	<10 D	<10 D	<10 D	6,100 D	<10 D	<10 D	<10 D
2015	W-2207B	MW	11/18/15	<12 D	<12 D	<12 D	12 D	<12 D	<25 D	<12 D	<12 D	<12 D	<12 D	3,600 D	<12 D	<12 D	<12 D
2015	W-2208B	MW	4/15/15	<0.5	8	3	14	7	2.5	2.7	5.7	<0.5	15	500 D	<0.5	2.5	<0.5
2015	W-2208B	MW	8/12/15	<0.5	5.6	2.2	12	5.3	1.5	2.4	4.4	<0.5	12	340 D	<0.5	1.5	<0.5
2015	W-2208B	MW	11/18/15	<0.5	3.7	0.76	4.7	2.5	<1	1.1	2	<0.5	6.6	160 D	<0.5	0.76	<0.5
2015	W-2211	MW	3/17/15	<0.5	<0.5	<0.5	1.3	3.8	<1	<0.5	17	<0.5	2.9	27	<0.5	<0.5	<0.5
2015	W-2212	MW	3/17/15	<0.5	<0.5	<0.5	4.7	1.5	<1	<0.5	14	<0.5	5.1	49	<0.5	<0.5	<0.5
2015	W-2212	MW	9/1/15	<0.5	<0.5	0.51	7.4	1.8	<1	0.7	17	<0.5	13	120 D	<0.5	<0.5	<0.5
2015	W-2212	MW	12/16/15	<0.5	<0.5	0.6	9.1	2	<1	0.85	19	<0.5	16	160 D	<0.5	<0.5	<0.5
2015	W-2215B	MW	5/4/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	0.75	<0.5	<0.5	<0.5
2015	W-2216B	MW	3/23/15	<1 D	<1 D	2.2 D	35 D	10 D	<2 D	5.1 D	66 D	13 D	58 D	810 D	<1 D	<1 D	<1 D
2015	W-2216B	MW	5/27/15	<0.5	<0.5	2.2	36	11	<1	5	72	13	61	830 D	<0.5	<0.5	<0.5
2015	W-2216B	MW	5/27/15 DUP	<0.5	<0.5	2.2	34	12	<0.5	5.4	69	15	62	980 D	<0.5	<0.5	<0.5
2015	W-2216B	MW	9/3/15	<0.5	<0.5	2	29	10	<1	4.2	60	10	61	750 D	<0.5	<0.5	<0.5
2015	W-2216B	MW	12/7/15	<0.5	<0.5	0.81	11	6.4	<1	1.7	27	4.2	39	330 D	<0.5	<0.5	<0.5
2015	W-2216B	MW	12/7/15 DUP	<0.5	<0.5	0.86	12	6.4	<1	1.8	29	4.7	41	380 D	<0.5	<0.5	<0.5
2015	W-2302	MW	3/17/15	<0.5	<0.5	<0.5	24	1.3	<1	0.97	12	5.6	31	200 D	<0.5	<0.5	<0.5
2015	W-2302	MW	6/9/15	<0.5	<0.5	0.51	26	1.3	<1	1.1	15	4.9	34	250 D	<0.5	<0.5	<0.5
2015	W-2302	MW	9/1/15	<0.5	<0.5	<0.5	18	1.3	<1	1.1	14	2.8	28	230 D	<0.5	<0.5	<0.5
2015	W-2302	MW	9/1/15 DUP	<0.5	<0.5	0.5	18	1.3	<1	1.1	15	3	29	280 D	<0.5	<0.5	<0.5
2015	W-2302	MW	12/16/15	<0.5	<0.5	<0.5	20	0.85	<1	1.2	8.8	3.6	24	170 D	<0.5	<0.5	<0.5
2015	W-2304	MW	2/5/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	8.2	<0.5	<0.5	<0.5
2015	W-2304	MW	8/19/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	17	<0.5	0.55	<0.5
2015	W-2305	MW	11/17/15	<0.5	<0.5	<0.5	2.5	<0.5	<1	<0.5	<0.5	<0.5	6	16	<0.5	<0.5	<0.5
2015	W-2501	MW	1/7/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	1.3	<0.5	4	<0.5	<0.5	<0.5
2015	W-2501	MW	4/2/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	1.1	<0.5	4	<0.5	<0.5	<0.5
2015	W-2501	MW	7/13/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	1.1	<0.5	3.9	<0.5	<0.5	<0.5
2015	W-2501	MW	10/8/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	1	<0.5	3.5	<0.5	<0.5	<0.5
2015	W-2502	MW	1/7/15	<0.5	<0.5	<0.5	1.3	<0.5	<1	0.5	2.4	<0.5	<0.5	2.2	<0.5	<0.5	<0.5
2015	W-2502	MW	4/2/15	<0.5	<0.5	<0.5	1.4	<0.5	<1	0.54	2.3	<0.5	<0.5	2.2	<0.5	<0.5	<0.5
2015	W-2502	MW	7/13/15	<0.5	<0.5	<0.5	1.4	<0.5	<1	<0.5	2.3	<0.5	<0.5	2.2	<0.5	<0.5	<0.5
2015	W-2502	MW	10/8/15	<0.5	<0.5	<0.5	1.3	<0.5	<1	<0.5	2.1	<0.5	<0.5	2.1	<0.5	<0.5	<0.5
2015	W-2601	MW	1/8/15	<0.5	<0.5	<0.5	2.4	<0.5	<1	<0.5	6	1.5	4.5	49	<0.5	<0.5	<0.5

Attachment B Table 1. 2015 Livermore Site ground water monitoring analytical results for VOCs.

Year	Well Name	Type	Date	1,1,1-Trichloroethane (µg/L)	1,1,2-Trichloroethane (µg/L)	1,1-Dichloroethane (µg/L)	1,1-Dichloroethene (µg/L)	1,2-Dichloroethane (µg/L)	1,2-Dichloroethene (total) (µg/L)	Carbon tetrachloride (µg/L)	Chloroform (µg/L)	Freon 113 (µg/L)	Tetrachloroethene (µg/L)	Trichloroethene (µg/L)	Trichlorofluoro methane (µg/L)	cis-1,2-Dichloroethene (µg/L)	trans-1,2-Dichloroethene (µg/L)
2015	W-2601	MW	4/8/15	<0.5	<0.5	<0.5	2.9	<0.5	<1	<0.5	6.3	1.6	4.8	53	<0.5	<0.5	<0.5
2015	W-2601	MW	7/22/15	<0.5	<0.5	<0.5	2.6	<0.5	<1	<0.5	5.6	1.4	4.1	47	<0.5	<0.5	<0.5
2015	W-2601	MW	10/2/15	<0.5	<0.5	<0.5	2.4	<0.5	<1	<0.5	5.2	1.3	4.2	48	<0.5	<0.5	<0.5
2015	W-2602	MW	6/10/15	<0.5	<0.5	<0.5	5.6	<0.5	1.6	1.4	2	1.2	3.3	190 D	0.53	1.6	<0.5
2015	W-2602	MW	6/10/15 DUP	<0.5	<0.5	<0.5	4.8	<0.5	1.7	1.4	2	1.3	3.3	190 D	<0.5	1.7	<0.5
2015	W-2603	MW	3/18/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	1.3	0.73	<0.5	1.3	<0.5	<0.5	<0.5
2015	W-2604A	MW	5/4/15	<0.5	<0.5	<0.5	<0.5	<0.5	1.3	<0.5	2.1	<0.5	14	32	<0.5	1.3	<0.5
2015	W-2604A	MW	9/3/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	1.4	4.6	<0.5	<0.5	<0.5
2015	W-2604A	MW	11/19/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	0.89	<0.5	3.9	9.1	<0.5	<0.5	<0.5
2015	W-2604B	MW	5/4/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	2.6	<0.5	<0.5	<0.5
2015	W-2605A	MW	3/23/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	0.89	<0.5	2.9	8.6	<0.5	<0.5	<0.5
2015	W-2605B	MW	3/23/15	<0.5	<0.5	<0.5	0.74	<0.5	<1	<0.5	<0.5	<0.5	7.5	60	<0.5	<0.5	<0.5
2015	W-2606	MW	3/23/15	<0.5	11	7.1	17	21	34	3.6	8	<0.5	25	140 D	<0.5	34	<0.5
2015	W-2606	MW	3/23/15 DUP	<0.5	13	7.4	19	18	35	4.3	8.5	<0.5	34	150 D	<0.5	35	<0.5
2015	W-2606	MW	5/4/15	0.55	12	8.2	17	22	44	2.8	9.3	<0.5	32	140 D	<0.5	44	<0.5
2015	W-2606	MW	11/24/15	<0.5	11	5.8	6.7	21	32	0.78	6.7	<0.5	16	100	<0.5	32	<0.5
2015	W-2607	MW	3/23/15	<0.5	<0.5	7.7	58	8.5	73	27	18	3.5	140 D	170 D	<0.5	73	0.55
2015	W-2607	MW	3/23/15 DUP	<0.5	<0.5	8	60	9.3	77	29	18	3.7	130 D	160 D	<0.5	76	0.55
2015	W-2607	MW	5/4/15	<0.5	<0.5	7.5	63	8.2	82	27	18	4.2	140 D	170 D	<0.5	81	0.56
2015	W-2607	MW	11/19/15	<0.5	<0.5	7.8	59	8.4	84	24	19	4.5	150 D	170 D	<0.5	84	0.6
2015	W-2611	MW	1/8/15	<0.5	<0.5	<0.5	14	<0.5	<1	<0.5	2.5	11	<0.5	180 D	<0.5	<0.5	<0.5
2015	W-2611	MW	1/22/15	<0.5	<0.5	<0.5	14	0.55	<1	<0.5	2.5	12	<0.5	170 D	<0.5	<0.5	<0.5
2015	W-2611	MW	2/26/15	<0.5	<0.5	<0.5	16	0.59	<1	<0.5	3	12	<0.5	190 D	<0.5	<0.5	<0.5
2015	W-2611	MW	3/26/15	<0.5	<0.5	<0.5	16	0.51	<1	<0.5	2.8	12	<0.5	200 D	<0.5	<0.5	<0.5
2015	W-2611	MW	4/30/15	<0.5	<0.5	<0.5	18	<0.5	<1	<0.5	3.4	12	0.51	200 D	<0.5	<0.5	<0.5
2015	W-2611	MW	4/30/15 DUP	<0.5	<0.5	<0.5	14	<0.5	<1	<0.5	2.9	10	<0.5	160 D	<0.5	<0.5	<0.5
2015	W-2611	MW	6/1/15	<0.5	<0.5	<0.5	13	<0.5	<1	<0.5	3.3	11	<0.5	180 D	<0.5	<0.5	<0.5
2015	W-2611	MW	6/25/15	<0.5	<0.5	<0.5	12	<0.5	<1	<0.5	3.4	9.8	<0.5	160 D	<0.5	<0.5	<0.5
2015	W-2611	MW	7/23/15	<0.5	<0.5	<0.5	10	<0.5	<1	<0.5	3.3	8.7	<0.5	150 D	<0.5	<0.5	<0.5
2015	W-2611	MW	10/5/15	<0.5	<0.5	<0.5	7.7	<0.5	<1	<0.5	2.6	7.3	<0.5	140 D	<0.5	<0.5	<0.5
2015	W-2611	MW	11/18/15	<0.5	<0.5	<0.5	7.3	<0.5	<1	<0.5	2.7	7.6	<0.5	120 D	<0.5	<0.5	<0.5
2015	W-2612	MW	1/8/15	<0.5	<0.5	<0.5	5.9	0.51	1.3	<0.5	1.9	5.2	<0.5	180 D	<0.5	1.3	<0.5
2015	W-2612	MW	1/22/15	<0.5	<0.5	<0.5	5.8	0.55	1.2	<0.5	1.9	5	<0.5	160 D	<0.5	1.2	<0.5
2015	W-2612	MW	2/26/15	<0.5	<0.5	<0.5	8.4	0.6	8.2	<0.5	2.3	5.2	<0.5	160 D	<0.5	8.2	<0.5
2015	W-2612	MW	3/26/15	<0.5	<0.5	<0.5	6.6	0.6	<1	<0.5	2.3	4.2	<0.5	190 D	<0.5	0.92	<0.5
2015	W-2612	MW	4/30/15	<0.5	<0.5	<0.5	7	0.52	1.4	<0.5	2.3	4.2	<0.5	180 D	<0.5	1.4	<0.5
2015	W-2612	MW	4/30/15 DUP	<0.5	<0.5	<0.5	6	0.71	2.4	<0.5	2.3	4.5	<0.5	190 D	<0.5	2.4	<0.5
2015	W-2612	MW	6/1/15	<0.5	<0.5	<0.5	7	0.55	<1	<0.5	2.4	4.2	<0.5	190 D	<0.5	0.98	<0.5
2015	W-2612	MW	6/25/15	<0.5	<0.5	<0.5	6.6	<0.5	1.2	<0.5	2.3	4.2	<0.5	180 D	<0.5	1.2	<0.5
2015	W-2612	MW	7/23/15	<0.5	<0.5	<0.5	6.6	<0.5	1.9	<0.5	2.3	3.8	<0.5	190 D	<0.5	1.9	<0.5
2015	W-2612	MW	10/5/15	<0.5	<0.5	<0.5	5.3	<0.5	1.1	<0.5	1.9	4.2	<0.5	180 D	<0.5	1.1	<0.5
2015	W-2612	MW	11/18/15	<0.5	<0.5	<0.5	6.3	<0.5	1.7	<0.5	2.1	5.5	<0.5	190 D	<0.5	1.7	<0.5
2015	W-2616	MW	3/23/15	<0.5	<0.5	<0.5	1.5	<0.5	3.7	<0.5	1.9	<0.5	1.1	92	<0.5	3.7	<0.5
2015	W-2616	MW	3/23/15 DUP	<0.5	<0.5	<0.5	1.6	<0.5	3.8	<0.5	2	<0.5	1.4	94	<0.5	3.8	<0.5
2015	W-2617	MW	3/23/15	<1.2 D	<1.2 D	<1.2 D	3.5 D	<1.2 D	41 D	5 D	6.9 D	<1.2 D	3 D	1,000 D	<1.2 D	41 D	<1.2 D
2015	W-2617	MW	6/10/15	<1 D	<1 D	<1 D	3 D	<1 D	2.7 D	5 D	6.4 D	<1 D	2.1 D	930 D	<1 D	2.7 D	<1 D
2015	W-2617	MW	6/10/15 DUP	<0.5	<0.5	<0.5	2.9	<0.5	3.2	5.5	7.2	<0.5	2.1	970 D	<0.5	3.2	<0.5
2015	W-2617	MW	8/27/15	<0.5	<0.5	<0.5	2.8	<0.5	110 D	0.91	1.8	<0.5	1.1	650 D	<0.5	110 D	<25 D
2015	W-2617	MW	12/9/15	<0.5	<0.5	<0.5	3.2	<0.5	2.6	6	6.8	<0.5	2.4	950 D	<0.5	2.6	<0.5
2015	W-2617	MW	12/9/15 DUP	<0.5	<0.5	<0.5	3.5	<0.5	2.7	6.5	7.1	<0.5	2.6	980 D	<0.5	2.7	<0.5
2015	W-2801	MW	1/12/15	<0.5	<0.5	<0.5	5.2	<0.5	2	3.8	2	1.8	3.9	240 D	<0.5	2	<0.5
2015	W-2801	MW	4/1/15	<0.5	<0.5	<0.5	5.6	<0.5	2.2	3.7	2.1	2.3	7.5	250 D	<0.5	2.2	<0.5
2015	W-2801	MW	7/14/15	<0.5	<0.5	<0.5	6.3	<0.5	2.3	3.7	2.2	1.9	5	250 D	<0.5	2.3	<0.5
2015	W-2801	MW	10/5/15	<0.5	<0.5	<0.5	5.7	<0.5	2.3	3.5	1.8	1.8	4.4	220 D	<0.5	2.3	<0.5
2015	W-3001	MW	3/30/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	11	<0.5	<0.5	<0.5
2015	W-3001	MW	3/30/15 DUP	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.52	<0.5	11 L	<0.5	<0.5	<0.5
2015	W-3001	MW	6/4/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	2.6	1.4	<0.5	16	<0.5	<0.5	<0.5
2015	W-3001	MW	9/16/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	2.1	1.1	<0.5	13	<0.5	<0.5	<0.5
2015	W-3001	MW	10/21/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	2.4	1.2	<0.5	14	<0.5	<0.5	<0.5
2015	W-3002	MW	1/28/15	<0.5	<0.5	<0.5	1.7	<0.5	<1	0.91	<0.5	<0.5	1.5	32	<0.5	<0.5	<0.5
2015	W-3002	MW	1/28/15 DUP	<0.5	<0.5	<0.5	1.8	<0.5	<1	1	<0.5	<0.5	1.6	35	<0.5	<0.5	<0.5
2015	W-3002	MW	5/26/15	<0.5	<0.5	<0.5	1.8	<0.5	<1	0.97	<0.5	<0.5	1.7	34	<0.5	<0.5	<0.5
2015	W-3002	MW	8/18/15	<0.5	<0.5	<0.5	1.5	<0.5	<1	0.87	<0.5	<0.5	1.2	28	<0.5	<0.5	<0.5

Attachment B Table 1. 2015 Livermore Site ground water monitoring analytical results for VOCs.

Year	Well Name	Type	Date	1,1,1-Trichloroethane (µg/L)	1,1,2-Trichloroethane (µg/L)	1,1-Dichloroethane (µg/L)	1,1-Dichloroethene (µg/L)	1,2-Dichloroethane (µg/L)	1,2-Dichloroethene (total) (µg/L)	Carbon tetrachloride (µg/L)	Chloroform (µg/L)	Freon 113 (µg/L)	Tetrachloroethene (µg/L)	Trichloroethene (µg/L)	Trichlorofluoro methane (µg/L)	cis-1,2-Dichloroethene (µg/L)	trans-1,2-Dichloroethene (µg/L)
2015	W-3003	MW	1/28/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	4.2	<0.5	<0.5	<0.5
2015	W-3003	MW	1/28/15 DUP	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	4.1	<0.5	<0.5	<0.5
2015	W-3003	MW	5/26/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	4.2	<0.5	<0.5	<0.5
2015	W-3003	MW	8/17/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	4.7	0.53	<0.5	<0.5
2015	W-3004	MW	3/31/15	<1 D	<1 D	<1 D	5.7 D	12 D	<2 D	8 D	4.3 D	<1 D	13 D	700 D	<1 D	<1 D	<1 D
2015	W-3004	MW	6/23/15	<0.5	<0.5	<0.5	14	14	<1	20	8.9	0.96	30	980 D	0.89	<0.5	<0.5
2015	W-3004	MW	8/20/15	<0.5	<0.5	<0.5	6.1	9.8	<1	8.7	4.9	<0.5	14	510 D	<0.5	<0.5	<0.5
2015	W-3004	MW	12/15/15	<1 D	<1 D	<1 D	7.8 D	10 D	<2 D	13 D	6.1 D	<1 D	20 D	820 D	<1 D	<1 D	<1 D
2015	W-3004	MW	12/15/15 DUP	<0.5	<0.5	<0.5	10	10	<1	16	6.9	0.68	25	840 D	0.71	<0.5	<0.5
2015	W-3101	MW	6/11/15	<0.5	<0.5	<0.5	4	<0.5	<1	<0.5	4.4	2	8.9	72	<0.5	<0.5	<0.5
2015	W-3101	MW	9/10/15	<0.5	<0.5	<0.5	2	<0.5	<1	<0.5	3.1	1.1	4.8	45	<0.5	<0.5	<0.5
2015	W-3102	MW	6/16/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	0.55	1.5	<0.5	<0.5	4.7	7.5	<0.5	<0.5
2015	W-3102	MW	9/10/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	1.2	<0.5	<0.5	3	4.4	<0.5	<0.5
2015	W-3103	MW	8/12/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	3.4	1.5	<0.5	3.2	6.3	<0.5	<0.5
2015	W-3103	MW	10/14/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	3.5	1.1	<0.5	3	6.1	<0.5	<0.5
2015	W-3104	MW	8/11/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	0.77	3.2	0.82	<0.5	5.3	<0.5	<0.5	<0.5
2015	W-3104	MW	12/23/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	2.2	0.5	<0.5	3	<0.5	<0.5	<0.5
2015	W-3104	MW	12/23/15 DUP	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	2.2	<0.5	<0.5	2.9	<0.5	<0.5	<0.5
2015	W-3105	MW	11/23/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	3.7	<0.5	<0.5	<0.5
2015	W-3106	MW	11/9/15	<0.5	<0.5	<0.5	6.9	1.2	<1	0.68	7.1	1.3	9.4	96	<0.5	<0.5	<0.5
2015	W-3106	MW	11/11/15	<0.5	<0.5	<0.5	7.3	1.2	<1	0.75	7.2	1.4	11	100 D	<0.5	<0.5	<0.5
2015	W-3107	MW	9/28/15	<0.5	<0.5	<0.5	5	<0.5	<1	<0.5	5.2	6.8	<0.5	28	<0.5	<0.5	<0.5
2015	SIP-141-201	PZ	1/27/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	2.7	1.5	1.8	0.6	<0.5	<0.5	<0.5
2015	SIP-141-202	PZ	1/27/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	0.62	6.8	0.65	<0.5	38	<0.5	<0.5	<0.5
2015	SIP-141-203	PZ	1/27/15	<1 D	<1 D	<1 D	<1 D	<1 D	<2 D	1.1 D	1.1 D	18 D	<1 D	13 D	<1 D	<1 D	<1 D
2015	SIP-191-002	PZ	1/26/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	2.2	2.6	47	<0.5	<0.5	<0.5
2015	SIP-191-002	PZ	8/10/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	0.53	2.7	3.9	58	<0.5	<0.5	<0.5
2015	SIP-331-001	PZ	4/23/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	1.2	2.5	2	<0.5	<0.5	<0.5
2015	SIP-419-101	PZ	3/25/15	<0.5	<0.5	<0.5	2.5	<0.5	<1	5.4	0.52	<0.5	1.2	63	<0.5	<0.5	<0.5
2015	SIP-419-202	PZ	3/25/15	<0.5	<0.5	0.68	9.1	43	<1	19	5.7	<0.5	55	590 D	<0.5	<0.5	<0.5
2015	SIP-419-202	PZ	8/20/15	<0.5	<0.5	0.6	7.5	41	<1	16	5.7	<0.5	47	530 D	<0.5	<0.5	<0.5
2015	SIP-501-101	PZ	1/8/15	<0.5	<0.5	<0.5	1.5	<0.5	<1	<0.5	7.3	9.5	<0.5	8.5	0.53	<0.5	<0.5
2015	SIP-501-101	PZ	1/22/15	<0.5	<0.5	<0.5	1.3	<0.5	<1	<0.5	6.9	8.9	<0.5	8.2	0.5	<0.5	<0.5
2015	SIP-501-101	PZ	2/26/15	<0.5	<0.5	<0.5	1.4	<0.5	<1	<0.5	7.4	9.5	<0.5	9.4	<0.5	<0.5	<0.5
2015	SIP-501-101	PZ	3/26/15	<0.5	<0.5	<0.5	1.4	<0.5	<1	<0.5	7	10	<0.5	7.9	<0.5	<0.5	<0.5
2015	SIP-501-101	PZ	4/30/15	<0.5	<0.5	<0.5	2.1	<0.5	<1	<0.5	7.2	9.5	<0.5	10	0.5	<0.5	<0.5
2015	SIP-501-101	PZ	6/1/15	<0.5	<0.5	<0.5	1.8	<0.5	<1	<0.5	7.5	9.6	<0.5	9.7	0.5	<0.5	<0.5
2015	SIP-501-101	PZ	6/25/15	<0.5	<0.5	<0.5	1.6	<0.5	<1	<0.5	7.1	8.1	<0.5	9	<0.5	<0.5	<0.5
2015	SIP-501-101	PZ	7/23/15	<0.5	<0.5	<0.5	1.6	<0.5	<1	<0.5	7.2	8.1	<0.5	9.1	<0.5	<0.5	<0.5
2015	SIP-501-101	PZ	10/5/15	<0.5	<0.5	<0.5	0.92	<0.5	<1	<0.5	5.9	6.3	<0.5	5.9	<0.5	<0.5	<0.5
2015	SIP-501-101	PZ	11/18/15	<0.5	<0.5	<0.5	1	<0.5	<1	<0.5	6	6.9	<0.5	7	<0.5	<0.5	<0.5
2015	SIP-501-102	PZ	5/21/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	2	6.7	<0.5	2.6	<0.5	<0.5	<0.5
2015	W-518-1914	MW	3/18/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	46	3.2	<0.5	<0.5	<0.5
2015	W-518-1914	MW	4/30/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	59	5.1	<0.5	<0.5	<0.5
2015	W-518-1914	MW	8/24/15	<0.5	<0.5	<0.5	<0.5	<0.5	4	<0.5	<0.5	<0.5	34	3.6	<0.5	4	<0.5
2015	W-518-1914	MW	11/18/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	13	1.6	<0.5	0.7	<0.5
2015	W-518-1915	MW	3/18/15	<0.5	<0.5	<0.5	2.3	<0.5	<1	<0.5	0.72	<0.5	44	390 D	<0.5	<0.5	<0.5
2015	W-518-1915	MW	4/30/15	<0.5	<0.5	<0.5	2.6	<0.5	<1	<0.5	0.74	<0.5	44	410 D	<0.5	<0.5	<0.5
2015	W-518-1915	MW	8/24/15	<0.5	<0.5	<0.5	1.5	<0.5	<1	<0.5	0.57	<0.5	30	170 D	<0.5	<0.5	<0.5
2015	W-518-1915	MW	11/18/15	<0.5	<0.5	<0.5	1.5	<0.5	<1	<0.5	0.62	<0.5	19	150 D	<0.5	<0.5	<0.5
2015	SIP-ETC-201	PZ	3/18/15	<0.5	<0.5	2.5	70	0.88	<1	<0.5	0.67	<0.5	380 D	230 D	<0.5	<0.5	<0.5
2015	SIP-ETC-201	PZ	8/12/15	<0.5	<0.5	2.2	66	0.83	<1	<0.5	0.66	<0.5	310 D	200 D	<0.5	<0.5	<0.5
2015	SIP-ETC-201	PZ	11/18/15	<0.5	<0.5	2.5	72	0.94	<1	<0.5	0.68	<0.5	370 D	240 D	<0.5	<0.5	<0.5
2015	SIP-ETS-401	PZ	12/7/15	<0.5	<0.5	1.1	7.1	1.4	<1	0.93	5	4.3	15	100 D	<0.5	<0.5	<0.5
2015	SIP-ETS-402	PZ	6/24/15	<0.5	<0.5	1.2	13	1.3	<1	1.6	4.5	16	21	120 D	<0.5	<0.5	<0.5
2015	SIP-ETS-405	PZ	12/29/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	0.75	6.3	<0.5	<0.5	<0.5
2015	SIP-ETS-502	PZ	12/16/15	<0.5	<0.5	0.76	5.9	<0.5	<1	<0.5	17	<0.5	10	100	<0.5	<0.5	<0.5
2015	TW-11	MW	3/31/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	43	<0.5	<0.5	3.2	<0.5	<0.5	<0.5
2015	TW-11	MW	9/30/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	25	<0.5	<0.5	3.6	<0.5	<0.5	<0.5
2015	TW-11A	MW	6/22/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	1.6	<0.5	<0.5	7.6	<0.5	<0.5	<0.5
2015	GSW-007	MW	3/19/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	GSW-009	MW	3/3/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	1.4	0.59	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	GSW-009	MW	5/19/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	1.4	0.62	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5

Attachment B Table 1. 2015 Livermore Site ground water monitoring analytical results for VOCs.

Year	Well Name	Type	Date	1,1,1-Trichloroethane (µg/L)	1,1,2-Trichloroethane (µg/L)	1,1-Dichloroethane (µg/L)	1,1-Dichloroethene (µg/L)	1,2-Dichloroethane (µg/L)	1,2-Dichloroethene (total) (µg/L)	Carbon tetrachloride (µg/L)	Chloroform (µg/L)	Freon 113 (µg/L)	Tetrachloroethene (µg/L)	Trichloroethene (µg/L)	Trichlorofluoro methane (µg/L)	cis-1,2-Dichloroethene (µg/L)	trans-1,2-Dichloroethene (µg/L)
2015	GSW-009	MW	7/30/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	1.4	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	GSW-009	MW	11/24/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	1.3	0.56	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	GSW-013	MW	3/30/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	GSW-216	MW	6/3/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2015	GSW-266	MW	9/24/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	2.3	11	7.9	8.3	<0.5	0.6	<0.5
2015	GSW-326	MW	9/16/15	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5

Attachment B Table 2. 2015 Livermore Site ground water monitoring analytical results for tritium.

Year	Well Name	Type	Date	Tritium (pCi/L)
2015	W-007	MW	4/2/15	<100
2015	W-008	MW	1/5/15	<100
2015	W-008	MW	1/5/15 DUP	<100
2015	W-017	MW	1/7/15	<100
2015	W-119	MW	1/6/15	<100
2015	W-121	MW	2/19/15	<100
2015	W-148	MW	5/20/15	537
2015	W-148	MW	12/28/15	594
2015	W-151	MW	1/5/15	<100
2015	W-204	MW	1/12/15	102
2015	W-221	MW	3/2/15	<100
2015	W-270	MW	4/9/15	<100
2015	W-304	MW	6/4/15	<100
2015	W-304	MW	10/21/15	<100
2015	W-305	MW	4/9/15	154
2015	W-354	MW	6/4/15	1920
2015	W-354	MW	10/27/15	418
2015	W-356	MW	5/7/15	<100
2015	W-359	MW	4/9/15	171
2015	W-363	MW	2/11/15	334
2015	W-373	MW	2/19/15	<100
2015	W-556	MW	3/2/15	<100
2015	W-566	MW	1/13/15	<100
2015	W-566	MW	4/2/15	<100
2015	W-566	MW	7/14/15	250
2015	W-566	MW	10/1/15	<100
2015	W-571	MW	2/25/15	<100
2015	W-593	MW	4/2/15	<100
2015	W-594	MW	4/2/15	<100
2015	W-653	MW	4/14/15	<100
2015	W-906	MW	1/7/15	<100
2015	W-912	MW	6/8/15	140
2015	W-1012	MW	1/6/15	<100
2015	W-1106	MW	8/10/15	121 O
2015	W-1108	MW	1/7/15	374
2015	W-1108	MW	4/1/15	444
2015	W-1108	MW	7/22/15	561
2015	W-1108	MW	10/2/15	290
2015	W-1117	MW	6/22/15	849
2015	W-1117	MW	10/27/15	1010
2015	W-1118	MW	6/8/15	111
2015	W-1203	MW	9/16/15	<100
2015	W-1207	MW	4/2/15	<100
2015	W-1211	MW	1/13/15	<100
2015	W-1211	MW	4/8/15	<100
2015	W-1211	MW	7/14/15	149
2015	W-1211	MW	10/2/15	<100
2015	W-1219	MW	6/8/15	147

Attachment B Table 2. 2015 Livermore Site ground water monitoring analytical results for tritium.

Year	Well Name	Type	Date	Tritium (pCi/L)
2015	W-1222	MW	5/27/15	802
2015	W-1222	MW	12/7/15	712
2015	W-1223	MW	10/15/15	127
2015	W-1225	MW	6/8/15	233
2015	W-1225	MW	10/27/15	199
2015	W-1302-2	MW	2/23/15	3300
2015	W-1302-2	MW	4/22/15	3700
2015	W-1302-2	MW	7/30/15	3940
2015	W-1302-2	MW	10/21/15	3840
2015	W-1303	MW	1/6/15	121 F
2015	W-1304	MW	12/9/15	222
2015	W-1306	MW	1/7/15	<100
2015	W-1308	MW	1/5/15	222
2015	W-1309	MW	1/14/15	<100
2015	W-1309	MW	4/8/15	<100
2015	W-1309	MW	7/16/15	<100
2015	W-1309	MW	10/8/15	<100
2015	W-1410	MW	3/4/15	<100
2015	W-1410	MW	4/20/15	<100
2015	W-1410	MW	9/3/15	<100
2015	W-1410	MW	11/6/15	<100
2015	W-1413	MW	11/23/15	<100
2015	W-1414	MW	12/17/15	2590
2015	W-1418	MW	6/22/15	<100
2015	W-1503	MW	1/8/15	288
2015	W-1503	MW	4/8/15	251
2015	W-1503	MW	7/22/15	147
2015	W-1503	MW	10/2/15	230
2015	W-1505	MW	6/4/15	<100
2015	W-1505	MW	12/1/15	<100
2015	W-1516	MW	1/13/15	<100
2015	W-1516	MW	4/8/15	<100
2015	W-1516	MW	7/15/15	<100
2015	W-1516	MW	10/6/15	<100
2015	W-1518	MW	1/13/15	150
2015	W-1520	MW	1/13/15	1770
2015	W-1520	MW	3/5/15	2350
2015	W-1520	MW	4/8/15	2070
2015	W-1520	MW	5/7/15	1770
2015	W-1520	MW	6/16/15	1410
2015	W-1520	MW	7/15/15	1290
2015	W-1520	MW	8/5/15	1370
2015	W-1520	MW	9/14/15	983
2015	W-1520	MW	10/6/15	1180
2015	W-1520	MW	11/4/15	1000
2015	W-1520	MW	12/3/15	974
2015	W-1522	MW	1/13/15	3410
2015	W-1522	MW	3/5/15	2820

Attachment B Table 2. 2015 Livermore Site ground water monitoring analytical results for tritium.

Year	Well Name	Type	Date	Tritium (pCi/L)
2015	W-1522	MW	4/8/15	3220
2015	W-1522	MW	5/7/15	2950
2015	W-1522	MW	6/16/15	2970
2015	W-1522	MW	7/15/15	3200
2015	W-1522	MW	8/5/15	3010
2015	W-1522	MW	9/14/15	3050
2015	W-1522	MW	10/6/15	2880
2015	W-1522	MW	11/4/15	2740
2015	W-1522	MW	12/3/15	2630
2015	W-1604	MW	3/24/15	1550
2015	W-1604	MW	6/11/15	1030
2015	W-1604	MW	9/1/15	806
2015	W-1604	MW	12/9/15	1490
2015	W-1605	MW	3/12/15	1450
2015	W-1605	MW	5/27/15	2950
2015	W-1605	MW	9/1/15	617
2015	W-1605	MW	10/13/15	618
2015	W-1606	MW	9/2/15	4110
2015	W-1606	MW	10/13/15	3910
2015	W-1607	MW	12/16/15	1430
2015	W-1608	MW	3/12/15	1580
2015	W-1608	MW	5/27/15	1920
2015	W-1608	MW	9/1/15	2400
2015	W-1608	MW	10/13/15	2460
2015	W-1609	MW	3/12/15	1500
2015	W-1609	MW	5/27/15	2160
2015	W-1609	MW	9/1/15	2000
2015	W-1609	MW	10/13/15	1560
2015	W-1610	MW	3/12/15	2560
2015	W-1610	MW	5/27/15	3270
2015	W-1610	MW	9/1/15	3020
2015	W-1610	MW	10/13/15	2300
2015	W-1801	MW	1/7/15	<100
2015	W-1801	MW	4/15/15	127
2015	W-1801	MW	7/22/15	<100
2015	W-1801	MW	10/5/15	<100
2015	W-2204	MW	2/9/15	4250
2015	W-2204	MW	4/15/15	4890
2015	W-2204	MW	8/12/15	6010
2015	W-2204	MW	11/18/15	6730
2015	W-2205	MW	2/9/15	4210
2015	W-2205	MW	4/15/15	7070
2015	W-2205	MW	8/12/15	6260
2015	W-2205	MW	11/18/15	5740
2015	W-2207B	MW	2/9/15	<100
2015	W-2207B	MW	4/15/15	<100
2015	W-2207B	MW	8/12/15	<100
2015	W-2207B	MW	11/18/15	<100

Attachment B Table 2. 2015 Livermore Site ground water monitoring analytical results for tritium.

Year	Well Name	Type	Date	Tritium (pCi/L)
2015	W-2208B	MW	4/15/15	<100
2015	W-2208B	MW	8/12/15	106
2015	W-2208B	MW	11/18/15	175
2015	W-2211	MW	3/17/15	13200
2015	W-2212	MW	3/17/15	330
2015	W-2212	MW	9/1/15	385
2015	W-2212	MW	12/16/15	398
2015	W-2302	MW	3/17/15	3200
2015	W-2302	MW	6/9/15	4900
2015	W-2302	MW	9/1/15	5720
2015	W-2302	MW	12/16/15	2330
2015	W-2601	MW	4/8/15	<100
2015	W-2606	MW	11/24/15	5000
2015	W-2607	MW	11/19/15	5070
2015	W-3004	MW	3/31/15	17100
2015	W-3004	MW	6/23/15	11300
2015	W-3004	MW	8/20/15	15600
2015	W-3004	MW	12/15/15	9350
2015	W-3101	MW	6/11/15	<100
2015	W-3102	MW	6/16/15	<100
2015	W-3103	MW	8/12/15	117 O
2015	W-3104	MW	8/11/15	<100 O
2015	W-3105	MW	11/23/15	<100
2015	W-3106	MW	11/11/15	319
2015	W-3107	MW	9/28/15	<100
2015	SIP-331-001	PZ	4/23/15	320
2015	SIP-419-202	PZ	6/3/15	15400
2015	SIP-419-202	PZ	12/17/15	15700
2015	GSW-011	MW	4/9/15	<100