LA-UR-09-3067
June 2009
EP2009-0256

Completion Report for Regional Aquifer Well R-40

Los Alamos
NATIONAL LABORATORY
EST. 1943

Prepared by the Environmental Programs Directorate

LA-UR-09-3067
EP2009-0256

Completion Report for Regional Aquifer Well R-40

June 2009

Responsible project leader:

Mark Everett	Mark Everett	Project Leader	Environmental Programs	6-2-09
Printed Name	Signature	Title	Organization	Date

Responsible LANS representative:

Michael J. Graham		Associate Director	Environmental Programs	5/29/09
Printed Name	Signature	Title	Organization	Date

Responsible DOE representative:

David R. Gregory	Chris P. Watts for	Project Director	DOE-LASO	6/4/09
Printed Name	Signature	Title	Organization	Date

EXECUTIVE SUMMARY

The primary purpose of well R-40 is to provide detection monitoring for potential releases of hazardous or radioactive chemicals from Material Disposal Area H at Technical Area 54.

The “Drilling Work Plan for Regional and Intermediate Wells at Technical Area 54” states that “R-40 shall be drilled 100 ft into the regional aquifer, and [a] single completion well will be installed in the uppermost transmissive zone that is identified as optimal based on variations in production and on stratigraphic considerations within the Cerros del Rio basalt.” Based on the stratigraphy encountered in production well PM-2 located approximately 500 ft south-south east from R-40, the R-40 borehole and well were expected to remain in basalt, and the regional groundwater was expected to be at 853 ft below ground surface (bgs).

Well R-40 was drilled and completed from September 24, 2008, to January 5, 2009. The borehole was drilled to a total depth of 910 ft bgs, extending approximately 75 ft into the saturated portion of the regional aquifer. Groundwater-screening samples were collected during drilling and well development. Cased-borehole geophysical logging was conducted to aid well design.

A multiple completion well was installed in the borehole. R-40 screen 1 is 33.4 ft long, positioned from 751.6 to 785.0 ft bgs in perched groundwater, and contains a 2.1-ft-long blank casing. R-40 screen 2 is 20.7 ft long and positioned from 849.7 to 870.0 ft bgs in the regional aquifer. A 3-in.-diameter polyvinyl chloride well designated as R-40i was also installed in the R-40 borehole to monitor perched groundwater. R-40i contains a 19.3-ft-long screen positioned from 649.7 to 669.0 ft bgs.

This well completion report describes site preparation, drilling, sampling, well installation, well completion, well development, aquifer testing, surface completion, geodetic survey, permanent pump and sampling system installation. Ongoing activities include permanent pump and sampling system installation, waste management, and site restoration.

CONTENTS

1.0 INTRODUCTION 1
- 1.1 Overview of R-40 Well Completion Report 1
- 1.2 Overview of Regional Well R-40 2

2.0 SCOPE OF ACTIVITIES 2
- 2.1 Preliminary Activities 2
  - 2.1.1 Administrative Preparation 2
  - 2.1.2 Site Preparation 3
- 2.2 Drilling Activities 3
  - 2.2.1 Drilling Strategy 3
  - 2.2.2 Chronological Drilling Activities 4
- 2.3 Sampling Activities 6
- 2.4 Geophysical Testing 7

3.0 FIELD INVESTIGATION RESULTS 7
- 3.1 Geology and Hydrogeology 7
  - 3.1.1 Stratigraphy 7
  - 3.1.2 Groundwater 9

4.0 WELL INSTALLATION 9
- 4.1 Well Design 9
- 4.2 R-40 Well Construction 9
  - 4.2.1 R-40i Construction 10

5.0 WELL COMPLETION 11
- 5.1 Well Development 11
  - 5.1.1 R-40 Screen 2 11
  - 5.1.2 R-40 Screen 2 Aquifer Testing 11
  - 5.1.3 R-40 Screen 1 12
  - 5.1.4 R-40i 12
  - 5.1.5 R-40i Aquifer Testing 12
- 5.2 Continued Development Pumping 13
  - 5.2.1 R-40 Screen 1 13
  - 5.2.2 R-40i 13
  - 5.2.3 R-40 Screen 2 13
- 5.3 Dedicated Sampling System Installation 14
- 5.4 Wellhead Completion 14
- 5.5 Geodetic Survey 15
- 5.6 Waste Management and Site Restoration 15

6.0 DEVIATIONS FROM PLANNED ACTIVITIES 15

7.0 REFERENCES 16

Figures

Figure 1.0-1 Area G in TA-54 with respect to Laboratory technical areas and surrounding land holdings 17
Figure 1.0-2 Regional aquifer well R-40 19
Figure 3.1-1 Borehole summary data sheet 20
Figure 4.2-1 As-built well construction diagram 21
Figure 5.3-1 As-built completion schematic for regional aquifer well R-40 22
Figure 5.3-2 As-built completion schematic for regional aquifer well R-40 and intermediate well R-40i 23

Tables

Table 2.2-1 Municipal Water and AQF-2 Foam Used during Drilling and Well Construction at Well R-40 25
Table 2.3-1 Summary of Groundwater-Screening Samples Collected during Drilling, Well Development, and Aquifer Testing of Well R-40 27
Table 3.1-1 Summary of Water-Level Measurements during Drilling and Well Construction at |Well R-40 30
Table 5.1-1 Summary of Water-Level Measurements at Well R-40 Screen 2 31
Table 5.1-2 Well Development and Aquifer Test Volumes and Field Water-Quality Parameter Measurements at Well R-40 Screen 2 32
Table 5.1-3 Summary of Water-Level Measurements at Well R-40 Screen 1 37
Table 5.1-4 Summary of Water-Level Measurements at Well R-40i 38
Table 5.2-1 Well Development Volumes and Field Water-Quality Parameter Measurements at Well R-40 Screen 1 39
Table 5.2-2 Well Development and Aquifer Test Volumes and Field Water-Quality Parameter Measurements at Well R-40i 42
Table 5.5-1 R-40 Survey Coordinates 55
Table 5.6-1 Summary of Waste Samples Collected during Drilling and Development of R-40 55

Appendixes

Appendix A Acronyms and Abbreviations, Metric Conversion Table, and Data Qualifier Definitions
Appendix B Well R-40 Lithologic Log
Appendix C Groundwater Analytical Results
Appendix D Borehole Video Logging (on DVD included with this document)
Appendix E Schlumberger Geophysical Logging Report (on CD included with this document)
Appendix F Aquifer Testing Report
Appendix G Borehole Abandonment Information Form

1.0 INTRODUCTION

Los Alamos National Laboratory (LANL or the Laboratory) is a multidisciplinary research facility that is located in north-central New Mexico, approximately 60 mi northeast of Albuquerque and 20 mi northwest of Santa Fe. The Laboratory site covers 40 mi^2 of the Pajarito Plateau, which consists of a series of fingerlike mesas separated by deep canyons containing perennial and intermittent streams running from west to east. Mesa tops range in elevation from approximately 6200 to 7800 ft above sea level.

Technical Area 54 (TA-54) is used for the management of radioactive solid and hazardous chemical wastes pursuant to the Laboratory's Resource Conservation and Recovery Act (RCRA) operating permit. TA-54 consists of Material Disposal Areas (MDAs) G, H, J, and L atop Mesita del Buey on the Pajarito Plateau at TA-54 (Figure 1.0-1). These four MDAs, consisting of underground pits, shafts, and trenches that contain hazardous chemicals and radionuclides, are located within the unsaturated units of Bandelier Tuff. MDA H is no longer actively receiving wastes; MDAs L and G currently are accepting wastes.

Well R-40 is one of several regional aquifer wells at TA-54 installed for groundwater monitoring to comply with the RCRA permit. Well R-40 is located approximately 1500 ft southeast of MDA H and upgradient of MDAs L and G (Figure 1.0-2).

Well R-40 was proposed in the "Technical Area 54 Well Evaluation and Network Recommendations, Revision 1" (LANL 2007, 098548) and "Drilling Work Plan for Regional and Intermediate Wells at Technical Area 54" (LANL 2007, 099662). The New Mexico Environment Department (NMED) approved these documents in 2007 (NMED 2007, 099257). This completion report summarizes the site preparation, drilling and sampling, well installation, and well completion activities for well R-40, in accordance with the requirements in Section IV.A.3.e.iv of the March 1, 2005, Compliance Order on Consent (the Consent Order).

1.1 Overview of R-40 Well Completion Report

The information presented in this report is compiled from field reports and daily activity summaries. Records, including field reports, field logs, and survey information, are on file at the Laboratory's Records Processing Facility (RPF). This report contains brief descriptions of all activities associated with the R-40 project, as well as supporting figures, tables, and appendixes.

Section 1 of this completion report describes the site, the purposes of well R-40, and an overview of the installation activities. Section 2 presents the scope of activities for site preparation, drilling, and sampling. Section 3 presents the results of field investigations. Well installation activities and well completion activities are described in Sections 4 and 5, respectively. Section 6 explains deviations from planned activities. References are provided in Section 7.

Appendixes include acronyms and abbreviations, a metric conversion table, and definitions of the data qualifiers used in this report (Appendix A); lithologic log (Appendix B); groundwater analytical results (Appendix C); borehole video logging (Appendix D, on DVD); Sclumberger geophysical logging report (Appendix E on CD); aquifer testing report (Appendix F); and a borehole abandonment information form (Appendix G).

1.2 Overview of Regional Well R-40

The purpose of well R-40 is to provide detection monitoring for potential releases of hazardous or radioactive chemicals from MDA H (Figure 1.0-2). The first R-40 borehole was drilled dry from July 11 to September 23, 2008, and was abandoned before reaching the regional aquifer due to stuck drilling tools. Perched groundwater was noted at 584 ft below ground surface (bgs).

The second R-40 borehole was drilled from September 24, 2008, to November 12, 2008, using the foam-assisted air-rotary casing hammer drilling method in an open and cased borehole. Perched groundwater was first observed at 784 ft bgs, and the regional aquifer was encountered at approximately 835 ft bgs. LANL Water Stewardship Program (LWSP) had predicted the regional groundwater at 853 ft bgs. A multiple screened well was designed and well installation activities were completed on November 20 and November 21, 2008.

R-40 screen 1 is 33.5 ft long, positioned from 751.6 to 785.1 ft bgs in perched groundwater. R-40 screen 2 is 20.7 ft long and positioned from 849.3 to 870.0 ft bgs in the regional aquifer. A 3-in.-diameter polyvinyl chloride (PVC) intermediate well designated as R-40i was also installed in the R-40 borehole to monitor perched groundwater higher in the borehole. R-40i contains a 19.4-ft-long screen positioned from 649.6 to 669.0 ft bgs.

Annular backfill materials were installed from November 22, 2008, to January 5, 2009, as the 11.75-in. removable casing was withdrawn from the borehole. As stipulated by the Consent Order, the R-40 borehole was drilled, and the well was installed, causing minimal impact to the in situ characteristics of the regional groundwater.

On January 6, 2009, well development activities were initiated on screen 2, and a 24-h aquifer test was conducted from January 14 to January 15, 2009. On January 16, 2009, a TAM packer was installed above screen 2 to isolate screen 1 and evaluate the perched groundwater above the regional aquifer. The perched groundwater in screen 1 was bailed dry and indicated a meager recovery rate of approximately 7 gpd. On January 25, 2009, well development activities were initiated on R-40i, and a 24-h aquifer test was conducted from January 27 to January 28, 2009.

In March and April 2009, well development pumping of R-40i and R-40 screen 1 was continued to meet the total organic carbon (TOC) target water-quality parameter. Once achieved, the TAM packer was removed and well development pumping continued at R-40 screen 2 to meet the turbidity water-quality parameter.

2.0 SCOPE OF ACTIVITIES

2.1 Preliminary Activities

Preliminary activities included preparing administrative planning documents, receiving contractual notice to proceed with field activities, and constructing the drill pad and access road.

2.1.1 Administrative Preparation

The following documents were prepared to support the implementation of the scope of work: “LSRS TA-54 Wells IWD” (Work Document # 327703-01); “R-37, R-40, and R-40 Construction Project Storm Water Pollution Prevention Plan Addendum” (LANL 2008); and “Waste Characterization Strategy Form for Drilling and Installation of Wells at TA-54 R-37, R-40 and R40.”

2.1.2 Site Preparation

Site preparation activities were performed between June 25 and July 3, 2008, and involved constructing a drill pad and a 350-ft access road north of Pajarito Road and south of Mesita del Buey (Figure 1.0-2); excavating and lining a cuttings containment pit; and installing straw waddles to limit stormwater flow and prevent erosion. The drill pad was 21,800 ft^2 and elongated because of its location between Pajarito Road and an archeological buffer area at the slope of the south-facing cliff of Mesita del Buey. An existing gate off Pajarito Road was enlarged and used to control access to the R-40 access road and drill site. Except for the pit, the pad area and road were surfaced with base coarse gravel. Because of space limitations, the cuttings pit was obliquely trapezoidal and measured at an approximate depth of 50 ft × 30 ft × 15 ft × 8 ft. Radiation control technicians from the Laboratory's Radiation Protection Group performed radiological screening of the site before pad and road construction and of samples and equipment before transport from the site, as needed.

LATA/SHARP Remediation Service, LLC, set up an office trailer and generator, and WDC Exploration & Wells (WDC) mobilized drilling equipment on July 11, 2008. Municipal water for construction and drilling activities was obtained from a fire hydrant located at TA-18. A safety fence was installed around the cuttings containment pit, and signs were posted at the entrance to the site to limit access to authorized personnel.

2.2 Drilling Activities

This section describes the drilling strategy and provides a chronology of drilling activities conducted at R-40.

2.2.1 Drilling Strategy

The R-40 boreholes were drilled using a Speedstar 50K air-rotary drilling rig manufactured by George E. Failing & Co. The field crew worked one 10-h shift per day, 10 d on and 4 d off. From July 11 to September 23, 2008, the first R-40 borehole was drilled with air as the primary drilling fluid. On July 30, 2008, perched groundwater was encountered at a depth of 594 ft bgs, and a screening sample was bailed from 608.2 ft bgs. This borehole encountered multiple drilling problems, including stuck tools, and was abandoned before reaching the regional aquifer.

From September 24 to November 10, 2008, the second R-40 borehole was drilled to a total depth (TD) of 910 ft bgs using air rotary and casing advance. The second borehole was located 20 ft north-northeast from the first borehole. A relatively thick mixture of municipal water and Baroid AQF-2 foaming agent were added from below the surface casing to 750 ft bgs to cool the bit and lift cuttings from the borehole. From 750 to 910 ft bgs, no foam was added and only municipal water and air were used as the drilling fluids; this allowed for drilling and completion of the well in the saturated portion of the regional aquifer without using drilling mud or additives. The estimated cumulative total of liquid drilling fluids introduced to and recovered from the borehole is presented in Table 2.2-1.

Below the surface conductor casing, the borehole was drilled "open" to a depth of 753 ft bgs using 14.75-in. tricone or downhole hammer bits. Because of injection of municipal water and foaming agent in the second borehole, the perched groundwater encountered at 594 ft bgs in the first borehole was obscured. From 753 to 902 ft, 11.75-in. diameter removable threaded casing was advanced using a hammer and Stradex underreamer bit. From 902 to 910 ft bgs, the borehole was finished using an 11.5-in. tricone bit, and the casing freely advanced because of the weight of the casing string.

Groundwater was first noted during drilling the second R-40 borehole at 778 ft bgs on October 27, 2008. After that, water levels were collected each morning before drilling resumed; the measurements rose and stabilized at approximately 633 ft bgs. Subsequent evaluation determined this groundwater to be perched. After the borehole and casing advanced beyond 872 ft bgs, the morning water levels steadily dropped and stabilized at approximately 835 ft bgs. LWSP had predicted the regional groundwater level at R-40 to be 853 ft bgs.

2.2.2 Chronological Drilling Activities

On September 24, 2008, the drilling rig was moved to the second borehole location, 20 ft north-northeast of the first borehole.

On September 25, 2008, drilling started and a 16-in. surface conductor casing was installed to 40.5 ft bgs.

On September 26, 2008, the open borehole beneath the surface casing reached 85 ft bgs using a 14.75-in. tricone button bit in the Tshirege Member of the Bandelier Tuff.

On September 27, 2008, the open borehole reached 260 ft bgs using the 14.75-in. tricone button bit in the Tshirege and Otowi Members of the Bandelier Tuff.

On September 28, 2008, the drilling rate slowed significantly upon encountering the Guaje Pumice Bed at 430 ft bgs. At 445 ft bgs, WDC tripped out to replace the tricone bit with the hammer bit.

On September 29, 2008, WDC removed the tricone bit and started tripping in the hammer bit. The open borehole depth remained at 445 ft bgs.

On September 30, 2008, the hammer bit encountered the Cerros del Rio basalt at 448 ft bgs and loose material lodged the bit at 490 ft bgs. The bit was free by the end of the day.

On October 1, 2008, the hammer bit was replaced by the tricone button bit, which reached 510 ft bgs by the end of the day.

On October 2, 2008, the open borehole and tricone button bit reached 523 ft bgs at the end of the day.

From October 3 to October 6, 2008, drilling activities were suspended for a 4-d break.

On October 7, 2008, the open borehole and tricone button bit reached 563 ft bgs at the end of the day.

On October 8, 2008, the open borehole and tricone button bit reached 615 ft bgs at the end of the day. Because of injecting municipal water and foam, the perched groundwater observed at 594 ft bgs in the first borehole was not observed.

On October 9, 2008, recovery of drill cuttings stopped at 643 ft bgs and the open borehole and tricone button bit reached 646 ft bgs. The Laboratory camera was mobilized to the site to assess the borehole.

On October 10, 2008, the Laboratory camera was deployed to 645 ft bgs. The results of the video log indicated that the borehole was enlarged and irregular from 470 to 490 ft bgs but relatively consistent below 500 ft bgs. Open borehole drilling continued using the 14.75-in. tricone button bit and reached 655 ft bgs at the end of the day.

On October 11, 2008, the open borehole and tricone button bit reached 670 ft bgs at the end of the day. Foamy water was recovered but not drill cuttings.

On October 12, 2008, the open borehole and tricone button bit reached 690 ft bgs at the end of the day. Foamy water was recovered but not drill cuttings.

On October 13, 2008, the open borehole and tricone button bit reached 702 ft bgs at the end of the day. Foamy water was recovered but not drill cuttings.

On October 14, 2008, the open borehole and tricone button bit reached 717 ft bgs at the end of the day. Foamy water was recovered but not drill cuttings.

On October 15, 2008, the drilling rate increased slightly at 725 ft bgs and reached 743 ft bgs at the end of the day. Sandstone fragments were observed in the returned drill cuttings.

On October 16, 2008, the borehole reached 750 ft bgs and foam was no longer added to the municipal water drilling fluid. At 753 ft bgs, the drilling rate slowed significantly and preparation began for installing 11.75-in. casing next week.

From October 17 to October 20, 2008, drilling activities were suspended for a 4-d break.

On October 21, 2008, bulk sand was transported from the Pajarito Lay-Down Yard to the R-40 site and backfilled into the open borehole from 753 to 664 ft bgs. The sand was required to support the weight of the 11.75-in. casing.

On October 22, 2008, the sand backfill rose to 427 ft bgs in the open borehole and 11.75-in. casing was tripped in 327 ft bgs.

On October 23, 2008, the 11.75-in. casing was tripped in to 427 ft bgs. The drill rods, hammer, and Stradex bit were tripped in and advanced the casing within the sand backfill to 487 ft bgs.

On October 24, 2008, the 11.75-in. casing was advanced within the sand backfill to 587 ft bgs.

On October 25, 2008, the 11.75-in. casing was advanced within the sand backfill to 687 ft bgs.

On October 26, 2008, the 11.75-in. casing reached the bottom of the sand backfill at 753 ft bgs.

On October 27, 2008, WDC advanced the 11.75-in. casing below the 14.75-in borehole at 753 ft bgs. From 778 to 784 ft bgs, the driller reported that the borehole was making water; injecting municipal water was stopped because formation water was sufficient to recover cuttings.

On October 28, 2008, the depth to water (DTW) was measured at 734 ft bgs inside the 11.75-in. casing with the drill string (rods, hammer, Stradex bit) in-place. A groundwater-screening sample was air-lifted from 784 ft bgs and the casing was advanced to 798 ft bgs. At the end of the day, the Stradex bit was retracted and the casing was lowered to the bottom of the borehole.

On October 29, 2008, the DTW was measured at 633.4 ft bgs inside the 11.75-in. casing. The casing was advanced and groundwater-screening samples were air-lifted at casing joint connections at 807 and 827 ft bgs. At the end of the day, the Stradex bit was retracted and the casing was lowered to the bottom of the borehole.

On October 30, 2008, the DTW was measured at 633.8 ft bgs inside the 11.75-in. casing. The casing was advanced, and a groundwater-screening sample was air-lifted at the 847 ft bgs casing joint connection. At the end of the day, the Stradex bit was retracted and the casing was lowered to the bottom of the borehole.

From October 31 to November 3, 2008, drilling activities were suspended for a 4-d break.

On November 4, 2008, the DTW was measured at 636 ft bgs inside the 11.75-in. casing. The casing was advanced from 847 ft bgs and a groundwater-screening sample was air-lifted at the 867 ft bgs casing joint connection. As the casing was advanced from 867 to 872 ft bgs, no water or cuttings were recovered, although municipal water was injected to aid cuttings recovery. At the end of the day, the Stradex bit was retracted and the casing was lowered to the bottom of the borehole.

On November 5, 2008, the DTW was measured at 769 ft bgs inside the 11.75-in. casing, and a groundwater-screening sample was air-lifted from 872 ft bgs. The casing was advanced from 872 ft bgs in Puye Formation dacitic gravel and pebbles; a groundwater-screening sample was air-lifted at the 887 ft bgs casing joint connection. At the end of the day, the 11.75-in. casing was advanced to 892 ft bgs; the Stradex bit was retracted and the casing was lowered to the bottom of the borehole.

On November 6, 2008, the DTW was measured at 811 ft bgs inside the 11.75-in. casing. The casing was advanced from 892 to 902 ft bgs and WDC tripped out the Stradex bit for evaluation. The DTW was measured at 840 ft bgs inside the 11.75-in. casing with the drill string removed. LWSP indicated that the well could be installed with the casing at 910 ft. Schlumberger, Inc., was called to perform cased-borehole geophysical logging to aid the well design.

On November 7, 2008, the DTW was measured at 839 ft bgs inside the 11.75-in. casing and WDC tripped in the drill string with an 11.5-in. tricone bit. The tricone bit drilled and removed poorly sorted Puye Formation dacitic pebbles and cobbles from the borehole, allowing the casing to advance from 902 to 910 ft bgs. The TD of the R-40 borehole was 910 ft bgs.

2.3 Sampling Activities

The following sampling activities were performed at R-40.

Drill cuttings were collected at 2- to 5-ft intervals from the cuttings discharged into the lined cuttings containment pit. The cuttings were sieved, collected in chip trays, and examined to characterize the lithology and stratigraphy of the R-40 borehole and to generate the lithologic log in Appendix B.

In the first borehole, a screening sample was bailed from perched groundwater at 608.2 ft bgs and analyzed for volatile organic compounds (VOCs), high explosives (HE), and low-level tritium at off-site laboratories and for dissolved cations/metals and anions at the Laboratory’s Earth and Environmental Science Group (EES-14) chemistry laboratory.

In the second borehole, a screening sample was air-lifted from perched groundwater at 784 ft bgs and analyzed for the same suite (VOCs, HE, and low-level tritium at off-site laboratories and for dissolved cations/metals and anions at the EES-14 chemistry laboratory).

Subsequent groundwater-screening samples from the second borehole were collected at 807 ft, 827 ft, 847 ft, 867 ft, 872 ft, 887 ft, and 910 ft bgs and analyzed for dissolved cations/metals and anions at the EES-14 chemistry laboratory.

After well installation, a predevelopment groundwater-screening sample was collected from screen 2 and analyzed for low-level tritium at an off-site laboratory and for dissolved cations/metals and anions at the EES-14 chemistry laboratory. Screen 2 development groundwater was sampled and measured for the following water parameters: pH, specific conductivity, temperature, turbidity, dissolved oxygen, and salinity. In addition, samples were also submitted for TOC analysis at the EES-14 chemistry laboratory. LWSP collected a full-suite groundwater sample from R-40 screen 2 on January 19, 2008, at the conclusion of the 24-h aquifer test.

From R-40i, a predevelopment perched groundwater-screening sample was collected and analyzed for low-level tritium at an off-site laboratory and for dissolved cations/metals and anions at the EES-14 chemistry laboratory. R-40i development water was sampled and measured for the following water parameters: pH, specific conductivity, temperature, turbidity, dissolved, and salinity. In addition, some samples were also submitted for TOC analysis at the EES-14 chemistry laboratory. On January 28, 2008, LWSP collected a full suite groundwater sample from R-40i at the conclusion of the 24-h aquifer test.

In March and April 2009, additional samples were collected from continued development pumping from R-40i and R-40 screens 1 and 2. These additional development samples were analyzed for TOC and dissolved cations/metals and anions at EES-14 chemistry laboratory.

Waste characterization samples were collected of dry cuttings dumped into rolloff containers, wet cuttings and drilling water discharged into the lined cuttings containment pit, and well development water contained in aboveground storage tanks.

Sampling documentation and containers were provided by the Laboratory and processed through the Laboratory's Sample Management Office. Groundwater analytical results and details of groundwater chemistry at R-40 are presented in Appendix C. Table 2.3-1 presents a summary of groundwater samples collected during drilling, well development, and aquifer testing at well R-40.

2.4 Geophysical Testing

On October 10, 2008, the Laboratory camera was used to evaluated the borehole and determine why drill cuttings were not returning to the surface. The borehole video is included as Appendix D.

On November 8, 2008, Schlumberger, Inc., performed geophysical logging of the cased borehole. The logging suite consisted of Accelerator Porosity Sonde, Triple Litho-Density, Natural Gamma, Natural Gamma-Ray Spectrometer, Elemental Capture Sonde, Thermal Neutron, and Epithermal Neutron. The results of the geophysical logging are included in Appendix E and were used to further define lithologic contacts (Appendix B) and design the R-40 well.

On November 10, 2008, the Laboratory ran natural gamma and induction logs of the cased borehole.

3.0 FIELD INVESTIGATION RESULTS

3.1 Geology and Hydrogeology

A brief description of the geologic and hydrogeologic features encountered at R-40 is presented here, and a more detailed log is included in Appendix B. The Laboratory's geology task leader and site geologists examined cuttings and geophysical logs to determine geologic contacts. Drilling observations, video logging, water-level measurements, and geophysical logs were used to characterize the perched and regional groundwater encountered at R-40.

3.1.1 Stratigraphy

The stratigraphy for the R-40 borehole is presented in order of youngest to oldest geologic units. Lithologic descriptions are based on samples of discharged cuttings. Cuttings and borehole geophysical logs were used to identify geologic contacts. Figure 3.1-1 illustrates the stratigraphy at R-40. A detailed lithologic log is presented in Appendix B.

Quaternary Alluvium, Qal (0–40 ft bgs)

Quaternary alluvium consisting of loamy soil and silty sand with volcaniclastic gravel and pebbles was encountered from 0 to 40 ft bgs. Alluvial groundwater was observed and sealed by the surface conductor casing.

Cooling Unit 1g, Tshirege Member of the Bandelier Tuff, Qbt 1g (40–154 ft bgs)

Cooling Unit 1g of the Tshirege Member of the Bandelier Tuff is present from 40 to 154 ft bgs. Unit 1g is a glassy, lithic-bearing, pumiceous, poorly welded ash-flow tuff. At its upper contact, the unit is reddish gray and moderately indurated and typically transitions within 10 to 20 ft to a light pinkish gray, less indurated (softer) ash-flow tuff. It contains reddish gray to gray, subangular to subrounded, intermediate composition volcanic rocks (lithics) up to 15 mm in diameter. Light olive-green vitric pumice lapilli have a waxy luster and well-developed flow-tube structure. The lapilli are harder than the surrounding tuff matrix.

Tephra and Volcaniclastic Rocks of the Cerro Toledo Interval, Qct (154–172 ft bgs)

Tephra and volcaniclastic rocks of the Cerro Toledo interval are present from 154 to 172 ft bgs. The Cerro Toledo interval is time hiatus, represented by tuffaceous sedimentary deposits separating the Tshirege and Otowi Members of the Bandelier Tuff. The deposits are predominantly reworked tuff with some sands, gravels, and cobbles derived from the Tshicoma dacite in the Jemez Mountains west of the Pajarito Plateau.

Otowi Member of the Bandelier Tuff, Qbo (172–430 ft bgs)

The Otowi Member of the Bandelier Tuff is present from 172 to 430 ft bgs. The Otowi Member is a glassy, lithic-bearing, pumiceous, poorly welded ash-flow tuff. It contains reddish gray to gray, subangular to subrounded, intermediate composition volcanic rocks up to 15 mm in diameter. Vitric pale yellow to white pumice lapilli contain conspicuous phenocrysts of quartz and sanidine.

Guaje Pumice Bed of the Otowi Member of the Bandelier Tuff, Qbog (430–448 ft bgs)

The Guaje Pumice Bed is present from 430 to 448 ft bgs. The pumice bed contains abundant pumice fragments (up to 97%) with subordinate amounts of volcanic lithics, quartz and sanidine phenocrysts, trace mafic minerals, and fine ash.

Cerros del Rio Basalt (448–795 ft bgs)

Cerros del Rio basalt, from 448 to 795 ft bgs, consists of multiple lava flows of vesicular to massive porphyritic basalt with an aphanitic groundmass. Local cinder and basaltic sedimentary deposits may represent interflow horizons. Basalt ranges from dark to medium gray; cinder is typically red to reddish gray.

Basalt-Rich Puye Formation Fanglomerate (795–845 ft bgs)

From 795 to 845 ft bgs, the cuttings consist predominantly of basalt and dacitic pebbles and cobbles; however, a small percentage (<5%) consists of sandstone, siltstone, and pre-Cambrian quartzite and granite. Because some of the fragments are well rounded (i.e., not caused by drilling), the origin of the unit was interpreted to be sedimentary. The presence of exotic lithologies and the sedimentary nature of the basalt and dacitic clasts designated this unit as basalt-rich Puye Formation fanglomerate.

Transition Zone (845–862 ft bgs)

Below 862 ft bgs, basalt fragments were absent. From 845 to 862 ft bgs, the bulk amount of basalt decreased and dacite increased; this indicated a transition zone.

Puye Formation Fanglomerate (862–910 ft bgs)

Puye Formation fanglomerate is present from 862 to 910 ft bgs and consists predominantly of porphyritic dacitic gravel, pebbles, and cobbles. Basalt fragments are absent.

3.1.2 Groundwater

On October 27, 2008, groundwater was first noted in the second R-40 borehole while drilling from 778 to 784 ft bgs. At the start of operations on October 28, 2008, the DTW was measured at 734 ft bgs inside the 11.75-in. casing. Table 3.1-1 provides water levels measured during R-40 drilling.

LWSP had predicted the depth to the regional aquifer at 853 ft bgs. From October 28 to November 4 as the casing and borehole advanced from 784 to 872 ft, the DTW measured inside the 11.75-in. casing ranged from 559.6 to 705 ft bgs; these measurements were interpreted to be perched water (Table 3.1-1). After advancing deeper than 872 ft, the DTW measurements progressively dropped to values more indicative of the regional aquifer.

After drilling ended at 910 ft bgs and before well construction, the DTW was measured from 833 to 838 ft bgs. During well construction and following periods of inactivity, DTW was measured from 852 to 855 ft bgs. Table 3.1-1 also provides DTW measurements before and during well construction.

4.0 WELL INSTALLATION

4.1 Well Design

The R-40 well was designed in accordance with the Consent Order and the well design was approved by NMED before installation. R-40 was designed as a multiple completion well using two screens; the lower screen (R-40 screen 2) was designed to monitor the regional groundwater. The upper screen (R-40 screen 1) was installed to monitor perched groundwater. In addition, a separate intermediate well designated as R-40i was designed to monitor perched groundwater at a higher elevation in the borehole.

4.2 R-40 Well Construction

R-40 well installation activities were started on November 20, 2008, and completed on January 5, 2009. The Speedstar 50K rig was used for all well construction activities.

The R-40 well was constructed of 5.0-in.-inside diameter (I.D.)/5.563-in.-outside diameter (O.D.) type A304 stainless-steel casing fabricated to American Society for Testing and Materials (ASTM) A312 standards. External couplings (also type A304 stainless steel fabricated to ASTM A312 standards) were used to connect individual casing and screen sections.

R-40 screen 2 was designed from 850 to 870 ft bgs and was positioned from 849.27 to 870.0 ft bgs. Screen 2 consisted of two 10-ft sections of 5.0-in.-I.D. rod-based 0.020-in. wire-wrapped screen slots. The coupled union between threaded sections was approximately 0.7 ft long. The bottom of screen 2 at 870.0 ft bgs exactly matched the design; however, the top depth was slightly off the target depth due to the threaded connection. The casing and screens were factory-cleaned and steam-cleaned on-site before installation. A 25-ft stainless-steel sump with bottom cap was placed below screen 2.

R-40 screen 1 was designed from 755 to 785 ft bgs and was positioned from 751.59 to 785.06 ft bgs. Screen 1 consisted of three 10-ft sections of 5.0-in.-I.D. rod-based 0.020-in. wire-wrapped screen slots. The coupled unions between threaded sections were 0.7 ft long, and a 2.1-ft-long blank casing was required to clamp the well on the drill rig table as the third screen section was hoisted into place. If applied incorrectly, the table clamp would have damaged the slotted portion of the second screen section. The bottom of screen 1 at 785.06 ft bgs nearly matches the design target; however, the top depth was 3.41 ft above the target depth due to the threaded connections and casing blank.

The well was assembled from the bottom up and lowered into the borehole. The bottom of the sump was positioned at 895 ft bgs. Figure 4.2-1 presents an as-built schematic showing construction details for the completed well.

After the well casing was assembled and lowered into the borehole, the process of installing annular backfill materials was started. A 2.0-in.-I.D. steel tremie pipe was used to deliver the annular backfill materials under pressure; the materials were mixed with municipal water and pumped through the tremie pipe. To document that the annular materials settled to the proper position, the depth of the annular material was repeatedly measured using a depth to bottom tagger and recorded. As the backfilling process progressed, the tremie pipe and 11.75-in. casing were withdrawn from the well.

Figure 4.2-1 also illustrates the types, depths, calculated volumes, and actual volumes of annular materials used in relation to the R-40 well screens. As the sand filter pack was installed around screen 2, over three times the calculated volume was required to fill fractures and voids in the basalt. During annular material installation, the screened intervals were mechanically surged to settle the sand filter packs before installing subsequent annular materials.

After annular material had been installed around R-40 screens 2 and 1 and a 10-ft bentonite seal was installed and hydrated above screen 1, water levels were repeatedly measured using a depth to water meter from 643 to 647 ft bgs outside the 5.0-in.-I.D. well casing. The bentonite chip seal was brought up to 675 ft bgs as the 11.75-in. casing was withdrawn in 40-ft increments. The remainder of the casing was removed in preparation for the installation of well R-40i.

4.2.1 R-40i Construction

Well R-40i installation activities were started on December 17, 2008, and completed on December 18, 2008.

Well R-40i was constructed of 3.0-in.-I.D./3.5-in.-O.D. flush-threaded schedule 80 PVC pipe. The screen was designed from 650 to 670 ft bgs and was positioned from 649.67 to 669.02 ft bgs. The screen consisted of two 10-ft sections (end-to-end) of 3.0-in.-I.D. 0.020-in. PVC screen slots and couplings. The slotted interval was 19.35 ft long, including the coupled union between the threaded sections. The casing and screens were factory-cleaned and steam-cleaned on-site before installation. A 5.58-ft PVC sump with bottom cap was placed below the screen.

The PVC well was assembled from the bottom up and lowered into the borehole adjacent to the R-40 stainless-steel well. The bottom of the PVC sump was positioned at 674.6 ft bgs. Figure 4.2-1 also illustrates the R-40i well and annular backfill material.

After the R-40i well casing was assembled and lowered into the borehole, the process of installing annular backfill materials continued. The 2.0-in.-I.D. steel tremie pipe was reinstalled to deliver the annular backfill materials under pressure using municipal water. To document that the annular materials settled to the proper position, the depth of the annular material was repeatedly measured using a depth-to-bottom tagger and recorded. The R-40i screen was mechanically surged to settle the sand filter pack before installing subsequent annular materials.

Once the transition sand and a 20-ft thick bentonite seal were installed above the R-40i screened interval, backfilling operations consisted of slowly pouring bentonite chips into the well annular space while the hydration water was pumped to depth. The tremie pipe was withdrawn in increments.

On January 5, 2009, the bentonite seal was brought up to 16 ft bgs. LWSP designated January 5, 2009, as the well completion date for R-40 and R-40i, as defined in Section IV.A.3.e.iv of the Consent Order.

5.0 WELL COMPLETION

5.1 Well Development

The R-40 screens (2 and 1), and R-40i were developed by mechanical means, including swabbing, bailing, and pumping. Target water-quality parameters were turbidity <5 nephelometric turbidity units (NTUs), TOC <2 ppm, and other parameters stable. A Pulstar 1200 work-over rig was used for all well development activities.

In general, development activities started at screen 2 and proceeded to screen 1 and R-40i.

5.1.1 R-40 Screen 2

Initial well development of screen 2 was conducted between January 6, 2009, and January 12, 2009. First, the well sump was bailed using a bailer fitted with a mechanical suction device to remove silt and sand accumulated in the sump. Next, the screen was swabbed to disturb formation fines settled in the sand filter pack. The swabbing tool was a 5.0-in.-O.D. 1-in.-thick nylon disc attached to a steel rod, lowered by wireline and drawn repeatedly across the screened interval. Then the bailer was used to remove groundwater until the recovered water was clear.

After swabbing and bailing, a 5.0-hp, 4-in.-O.D. Grundfos submersible pump was lowered into the well to continue well development. During well development pumping, water levels were measured to ensure that the pumping did not draw down the water column in the well and expose the pump. This also helped establish a preliminary flow rate of approximately 4 gpm for screen 2. Table 5.1-1 lists water levels measured in screen 2 during development.

Also during well development pumping, groundwater was sampled and measured on-site for pH, specific conductivity, temperature, turbidity, dissolved, and salinity. The instrument used was a Horiba Water Quality Checker Model U-10. Additional groundwater samples were collected for TOC analysis. The field parameter measurements for screen 2 are tabulated in Table 5.1-2 and included in Appendix C.

5.1.2 R-40 Screen 2 Aquifer Testing

On January 12, 2009, well development pumping was halted and preparation began for aquifer testing by David Schafer and Associates. To perform the aquifer testing, an inflatable packer was positioned above a 5-hp Grundfos submersible pump and deployed into the well. Simultaneously, nonvented In-Situ Level Troll 700 transducers were positioned below the pump, above the packer, and in R-40i. The packer was inflated to isolate screen 2 from screen 1 and minimize the effects of casing storage on the test data. Short-duration pumping tests were conducted on January 13, 2009, and a 24-h aquifer pumping test was conducted between January 14 and 15, 2009. The transducers remained in the well, collecting aquifer recovery data until they were removed on January 20, 2009. Results of the aquifer tests are described in Appendix E.

At the conclusion of the 24-h aquifer test, the measured water-quality parameters were turbidity at 8 NTUs and TOC at 1.47 mg/L. TOC was below the development target (2 mg/L; however, turbidity was above the target [5 NTUs]).

5.1.3 R-40 Screen 1

As preparation for development of screen 1, a TAM packer was deployed and positioned in the well above screen 2. Municipal water under pressure was used to inflate the packer. The top of the TAM packer element was set at 845 ft bgs. The delivery pipe was detached from the packer and removed from the well.

Development of screen 1 was initiated on January 21, 2009. The DTW measured in screen 1 (761.33 ft bgs) indicated that approximately 10 ft of screen 1 was not submerged in water (Table 5.1-3). Therefore, municipal water was injected to flood the screened interval to allow swabbing the screen. Following swabbing, the water and suspended sediment were bailed from the well. The recovery of groundwater in screen 1 following bailing indicated a meager recharge of approximately 7 gpd. The injection/swabbing process was repeated several times and had little impact on the sluggish recovery. The rate of groundwater flowing into screen 1 was insufficient to conduct a 24-h aquifer pumping test.

Development activities were directed to well R-40i.

5.1.4 R-40i

On January 8, 2009, the DTW was measured in R-40i at 640.45 ft bgs (Table 5.1-4). This measurement was collected 4 wk after R-40i was constructed and is approximately 9 ft above the screen slots.

The first perched groundwater recovered from R-40i was 12 gal. bailed on January 12, 2009. The sample was characterized as light brown and emitted a slight sulfur odor. Turbidity was measured at 60 NTUs. A TOC sample was not collected; however, a screening sample (RC54-09-1038) was collected. On January 25, 2009, a 1.5-hp, 3-in.-O.D. SQ submersible pump was positioned in the PVC well with the intake set at 656.5 ft bgs. The groundwater was very foamy and was measured on-site for pH, specific conductivity, temperature, turbidity, dissolved oxygen, and salinity. The instrument used was a Horiba Water Quality Checker Model U-10. Initial turbidity was 23 NTUs and quickly dropped to 1 NTU. TOC was analyzed at 8.75 mg/L. The field parameter measurements are included in Appendix C.

The flow rate was estimated at 1.5 to 2.0 gpm without drawing down the water column. The decision was reached to conduct a 24-h aquifer test in R-40i.

5.1.5 R-40i Aquifer Testing

On January 26, 2009, well-development pumping of R-40i was halted, and preparation began for aquifer testing by David Schafer and Associates. To perform the aquifer testing in R-40i, a nonvented In-Situ Level Troll 700 transducer was positioned below the pump in R-40i. Short-duration pumping tests were conducted on January 26, 2009, and a 24-h aquifer pumping test was conducted between January 27 and 28, 2009. The transducer remained in the well collecting aquifer recovery data until it was removed on February 3, 2009. Results of the aquifer tests are described in Appendix E.

At the end of the aquifer testing in R-40i, water-quality parameters were turbidity at 1 NTU and TOC at 11.22 mg/L. Turbidity was below the development threshold of 5 NTUs, but TOC was above the development threshold of 2 ppm (mg/L) due to the presence of drilling foam.

5.2 Continued Development Pumping

On March 3, 2009, the WDC Pulstar 1200 work-over rig returned to R-40 for continued development pumping to meet the target well-development parameters. The TAM packer remained at 845 ft bgs between screen 1 and 2. Separate pumps and discharge pipes were deployed into well R-40i and R-40 screen 1. Well R-40i was pumped daily at approximately 3 gpm without going dry. Periodically, the pump in R-40i was stopped, and the discharge apparatus (including meter) was transferred to the discharge pipe in R-40 screen 1. Because of the meager recovery, from 45 to 82 gal. was pumped following recovery of groundwater in R-40 screen 1. Development pumping resumed in R-40i on March 5, 2009, and R-40 screen 1 on March 6, 2009.

5.2.1 R-40 Screen 1

Continued development pumping from R-40 screen 1 occurred in seven periodic pumping events from March 6 to April 10, 2009. The dates and volumes of the pumping events are listed as bold subheadings in Table 5.2-1. On April 10, 2009, the concentrations of TOC in samples collected were 1.9 mg/L and 1.8 mg/L; turbidity was consistently 0 NTU. LWSP directed that development of R-40 screen 1 was complete. Water-quality parameters, TOC results, and end-of-day cumulative volume pumped from R-40 screen 1 are tabulated in Table 5.2-1.

To collect the first full suite groundwater sample from R-40 screen 1, the pump and discharge pipe remained in place while the groundwater recharged. On April 21, 2009, LWSP collected the end-of-development full suite groundwater sample. The total volume of water removed from R-40 screen 1, including the end-of-development sample event, was 1238.7 gal.

5.2.2 R-40i

Continued development pumping from R-40i extended from March 5 to April 28, 2009. On April 24, 2009, the concentrations of TOC in samples collected were 1.7 mg/L and 1.4 mg/L, respectively. On April 27, 2009, the concentrations of TOC in samples collected were 1.8 mg/L and 2.4 mg/L, respectively. Turbidity was consistently 0 NTU. Before receiving the TOC result for the second sample collected on April 27, 2009, LWSP directed that development of R-40i was complete.

A total volume of 37163.2 gal. of perched groundwater was removed from R-40i. Water-quality parameters, TOC results, and end-of-day cumulative volume pumped from R-40i are tabulated in Table 5.2-2.

5.2.3 R-40 Screen 2

On April 21, 2009, the pump and discharge pipe were removed from R-40 screen 1, and the TAM packer was removed from between screens 1 and 2. The 5.0-hp, 4-in.-O.D. Grundfos submersible pump was positioned below an inflatable packer and deployed to screen 2 to continue well development pumping. The packer was inflated to isolate screen 2 from screen 1.

Continued development pumping from R-40 screen 2 extended from April 23 to April 28, 2009. On April 27, 2009, the turbidity of groundwater collected for field parameters was at or below the threshold of 5 NTUs. On April 28, 2009, the final turbidity measurement was 2 NTUs. The concentration of TOC in all samples from R-40 screen 2 during continued development pumping was consistently below the threshold of 2 mg/L. LWSP directed that development of R-40 screen 2 was complete. Water-quality parameters, TOC results, and end-of-day cumulative volume pumped from R-40 screen 2 are tabulated in Table 5.1-2.

5.3 Dedicated Sampling System Installation

In June 2009, a dedicated Baski dual completion sampling system and transducers were installed for sampling and monitoring R-40 screens 1 and 2. The Baski system relies on a permanent packer and liquid inflation chamber to separate groundwater in screens 1 and 2. Details of the dedicated sampling system designed for R-40 are presented in Figure 5.3-1.

For screen 2, a 4.0-in.-O.D. Grundfos pump and 2-hp electric motor were deployed into the well on a type A304 grade stainless-steel 1.0-in.-I.D. discharge pipe. The intake for the Grundfos pump was set at 871 ft bgs. For screen 1, a 1.8-in.-O.D. Bennett pump and associated air tubes (supply and exhaust), water-level indicator, and discharge tube were deployed. The intake for the Bennett pump was set at 788 ft bgs. Simultaneously, two 1.0-in.-I.D. flush-threaded schedule 40 PVC pipes were installed for a dedicated In-Situ Level Troll 500 vented transducer in each screened interval. For passing through the Baski packer, the screen 2 transducer access tube was constructed of 1.0-in. type A304 grade stainless-steel pipe and adapters. The transducers must be removed to conduct manual water-level measurements.

For R-40i, a 1.8-in.-O.D. Bennett electric pump was deployed on type A304 grade stainless-steel 1.0-in.-I.D.discharge pipe. The intake for the Bennett pump in R-40i was set at 669 ft bgs. Simultaneously, a 1.0-in.-I.D. flush threaded schedule 40 PVC pipe was installed for a dedicated In-Situ Level Troll 500 vented transducer. The transducer must be removed to conduct manual water-level measurements.

For R-40, the sampling system discharge pipes and the transducer tubes rest on a 0.5-in. thick 6-in. diameter stainless-steel landing plate positioned atop the stainless-steel well riser. For R-40i, a PVC landing plate was positioned over the PVC well riser. Details of the dedicated sampling system installed in R-40 and R-40i are presented in Figures 5.3-1 and 5.3-2.

5.4 Wellhead Completion

On April 30, 2009, a surface pad consisting of 4000-psi reinforced concrete, 10 ft × 10 ft × 6 in. thick, was installed at the R-40 wellhead. A 10-in.-I.D. steel protective casing with a locking lid was positioned over the stainless-steel and PVC well risers and cemented into the pad. In addition, four removable 4-in. steel bollards were installed around the pad. The pad and bollards will provide long-term structural integrity for the wellhead. A brass survey monument displaying the well name and elevation was embedded in the northwest corner of the pad. The concrete pad was slightly elevated above the ground surface and crowned to promote runoff.

A permanent electric starter box with a connection for three-phase, 460-V portable generator power for the Gundfos pump, and for the electric Bennett pump were mounted by the Laboratory on the pad adjacent to the protective casing. The Laboratory connected the starter box and the power cables to the dedicated pumps in the well. During site restoration, base coarse gravel was graded around the edges of the pad. Details of the wellhead completion are also presented in Figure 5.3-2.

5.5 Geodetic Survey

On May 6, 2009, geodetic survey data for the center of the landing plates, 10-in. protective casing, brass monument, and ground surface at R-40 were collected by Precision Surveying, Inc. The survey data are presented in Table 5.5-1. Geodetic surveys were conducted using a Topcon Hiper+ global positioning system and Wild Heerbrugg NA1 level. The survey data were collected by a New Mexico licensed surveyor and conform to Laboratory Information Architecture project standards IA-CB02, “GIS Horizontal Spatial Reference System,” and IA-D802, “Geospatial Positioning Accuracy Standard for A/E/C and Facility Management.” All coordinates are expressed as New Mexico State Plane Coordinate System Central Zone (NAD 83); elevation is expressed in feet above mean sea level using the National Geodetic Vertical Datum of 1929.

5.6 Waste Management and Site Restoration

Wastes produced during drilling were managed in accordance with the “Waste Characterization Strategy Form for Drilling and Installation of Wells at TA-54 R-37, R-39, and R-40.” Wastes generated at the R-40 project include a small quantity of contact waste, drill cuttings, discharged drilling water, development groundwater, and New Mexico special waste (NMSW), consisting of base coarse gravel and hydraulic oil. Following the completion of drilling, waste characterization samples were collected from cuttings and drilling water in the lined retention pit, and drilling and development water was sampled in aboveground storage tanks during well development. A summary of waste characterization samples collected from the R-40 well is presented in Table 5.6-1.

On May 14, 2009, some of the dry drill cuttings were land-applied in accordance with the NMED-approved Notice of Intent (NOI): Land Application of IDW Solids from Construction of Wells and Boreholes (October 2007). Final disposition is ongoing of the rest of the dry drill cuttings, the drill wet cuttings, and drilling and development water. If approved, liquid wastes will be land applied in accordance with the NMED-approved NOI Decision Tree: Drilling, Development, Rehabilitation, and Sampling Purge Water (July 2006); wet drill cuttings will be land-applied in accordance with the NMED-approved NOI: Land Application of IDW Solids from Construction of Wells and Boreholes (October 2007).

Site restoration activities will include removing drilling fluids from the pit and managing the fluids in accordance with Standard Operating Procedure (SOP) 010.1, removing the polyethylene liner, removing the containment area berms, and backfilling and regrading the containment area, as appropriate. Cuttings will be removed from the pit and managed in accordance with SOP-011.1. The site will be reseeded with a Laboratory-approved seed mix consisting of Indian rice grass, mountain broam, blue stem, sand drop, and slender wheat grass seed.

6.0 DEVIATIONS FROM PLANNED ACTIVITIES

In general, drilling, sampling, and well construction at R-40 were performed as specified in the “Drilling Work Plan for Regional and Intermediate Wells at Technical Area 54” (LANL 2007, 099662) and LANS subcontract 22851-009-08, Exhibit D “Scope of Work and Technical Specifications—Drilling and Installation of Wells at TA-54.”

The following changes to the original work plan were implemented after approval by LWSP.

- Drilling TD: Drilling at R-40 stopped at 910 ft bgs after advancing approximately 75 ft into the saturated portion of the regional aquifer. The planned TD for the R-40 borehole in the approved work plan (LANL 2007, 099662) was 953 ft bgs, or 100 ft below the regional aquifer pieziometric surface estimated to be at 853 ft.

- Well Completion: R-40 was initially designed as a single completion well. However, the discovery of perched groundwater required the installation of a multiple screened well plus a separate intermediate well (R-40i) in the same borehole.

7.0 REFERENCES

The following list includes all documents cited in this report. Parenthetical information following each reference provides the author(s), publication date, and ER ID. This information is also included in text citations. ER IDs are assigned by the Environmental Programs Directorate's RPF and are used to locate the document at the RPF and, where applicable, in the master reference set.

Copies of the master reference set are maintained at the NMED Hazardous Waste Bureau and the Directorate. The set was developed to ensure that the administrative authority has all material needed to review this document, and it is updated with every document submitted to the administrative authority. Documents previously submitted to the administrative authority are not included.

LANL (Los Alamos National Laboratory), October 2007. "Technical Area 54 Well Evaluation and Network Recommendations, Revision 1," Los Alamos National Laboratory document LA-UR-07-6436, Los Alamos, New Mexico. (LANL 2007, 098548)

LANL (Los Alamos National Laboratory), November 2007. "Drilling Work Plan for Regional and Intermediate Wells at Technical Area 54," Los Alamos National Laboratory document LA-UR-07-7578, Los Alamos, New Mexico. (LANL 2007, 099662)

NMED (New Mexico Environment Department), December 7, 2007. "Approval with Direction, Drilling Work Plan for Regional and Intermediate Wells at Technical Area 54," New Mexico Environment Department letter to D. Gregory (DOE-LASO) and D. McInroy (LANL) from J.P. Bearzi (NMED-HWB), Santa Fe, New Mexico. (NMED 2007, 099257)

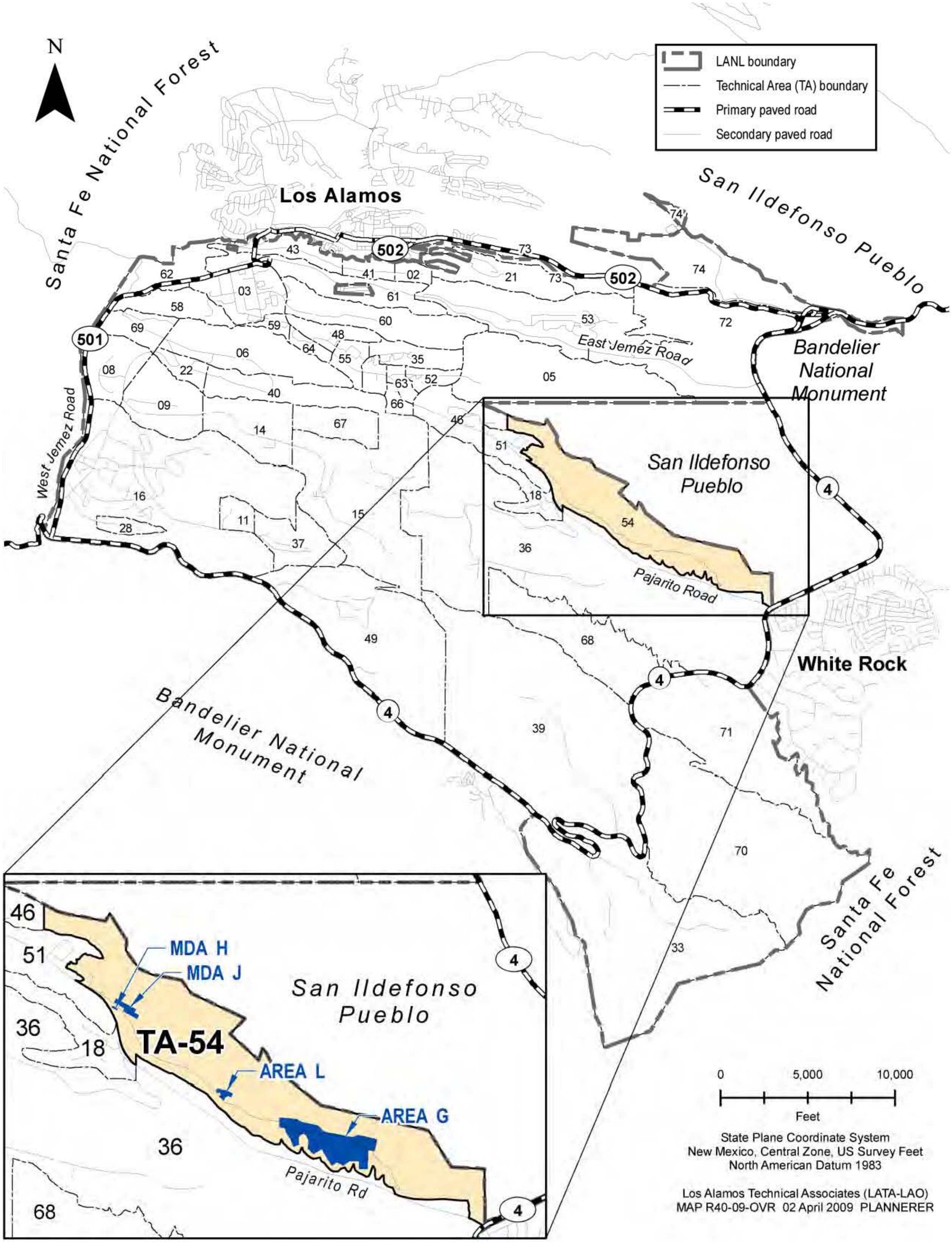


Figure 1.0-1 Area G in TA-54 with respect to Laboratory technical areas and surrounding land holdings

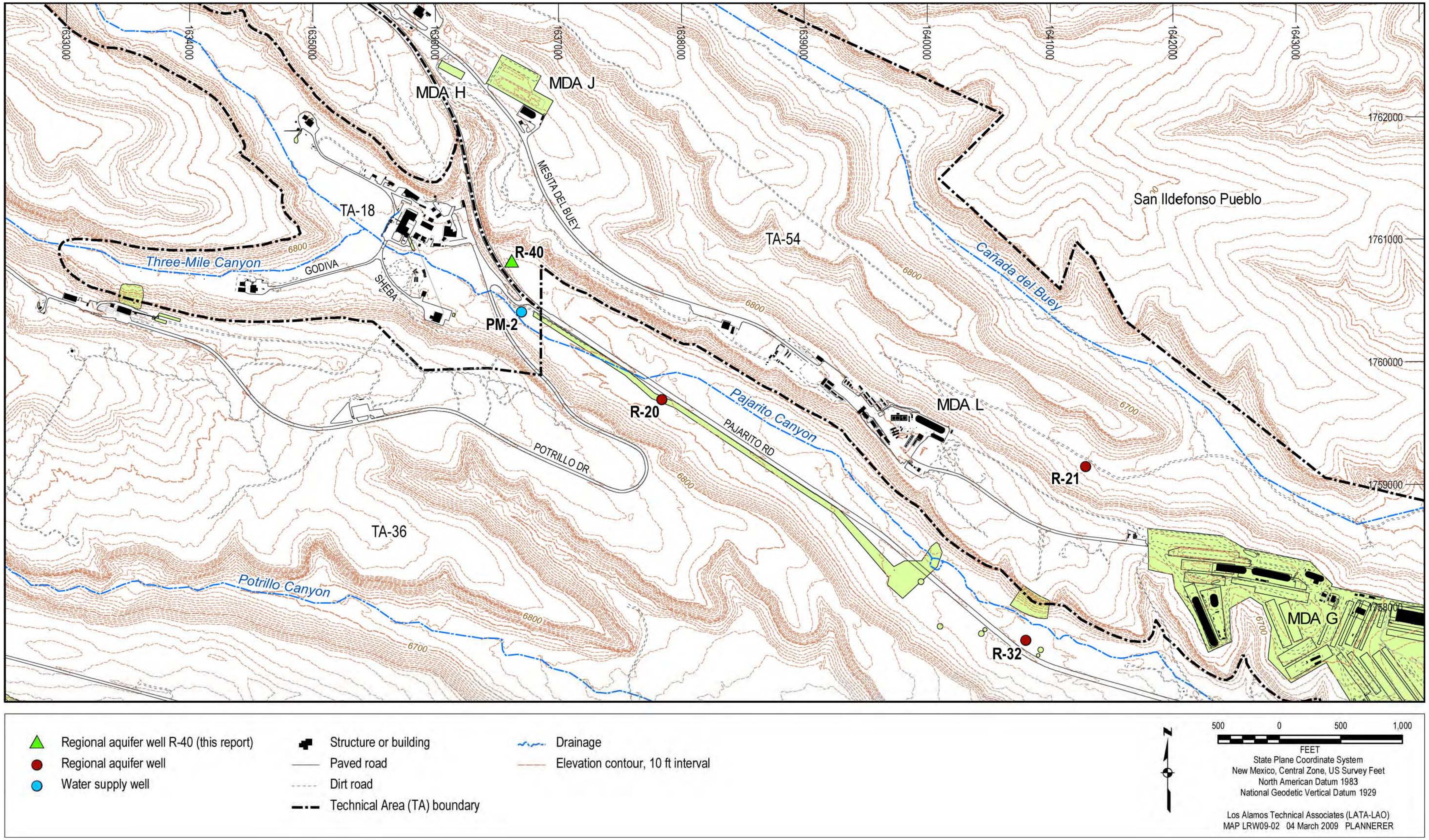
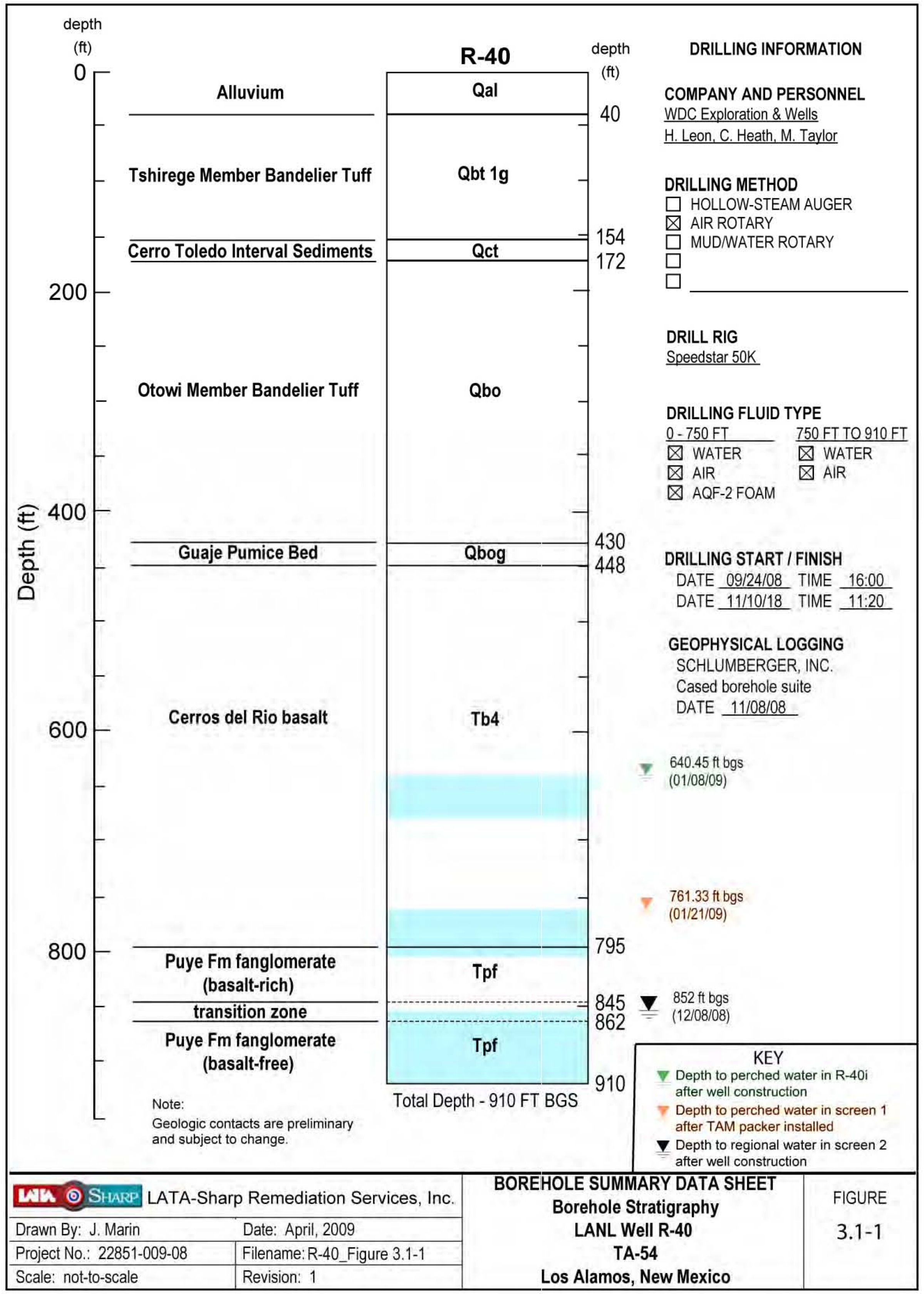


Figure 1.0-2 Regional aquifer well R-40



Note:
Geologic contacts are preliminary and subject to change.

DRILLING INFORMATION

COMPANY AND PERSONNEL
WDC Exploration & Wells
H. Leon, C. Heath, M. Taylor

DRILLING METHOD
☐ HOLLOW-STEAM AUGER
☒ AIR ROTARY
☐ MUD/WATER ROTARY
☐
☐ ____________

DRILL RIG
Speedstar 50K

DRILLING FLUID TYPE

0 - 750 FT	750 FT TO 910 FT
☒ WATER	☒ WATER
☒ AIR	☒ AIR
☒ AQF-2 FOAM	

DRILLING START / FINISH
DATE 09/24/08 TIME 16:00
DATE 11/10/18 TIME 11:20

GEOPHYSICAL LOGGING
SCHLUMBERGER, INC.
Cased borehole suite
DATE 11/08/08

LATA-Sharp Remediation Services, Inc.
Drawn By: J. Marin
Date: April, 2009
Project No.: 22851-009-08
Filename: R-40_Figure 3.1-1
Scale: not-to-scale
Revision: 1

BOREHOLE SUMMARY DATA SHEET
Borehole Stratigraphy
LANL Well R-40
TA-54
Los Alamos, New Mexico

FIGURE
3.1-1

Figure 3.1-1 Borehole summary data sheet

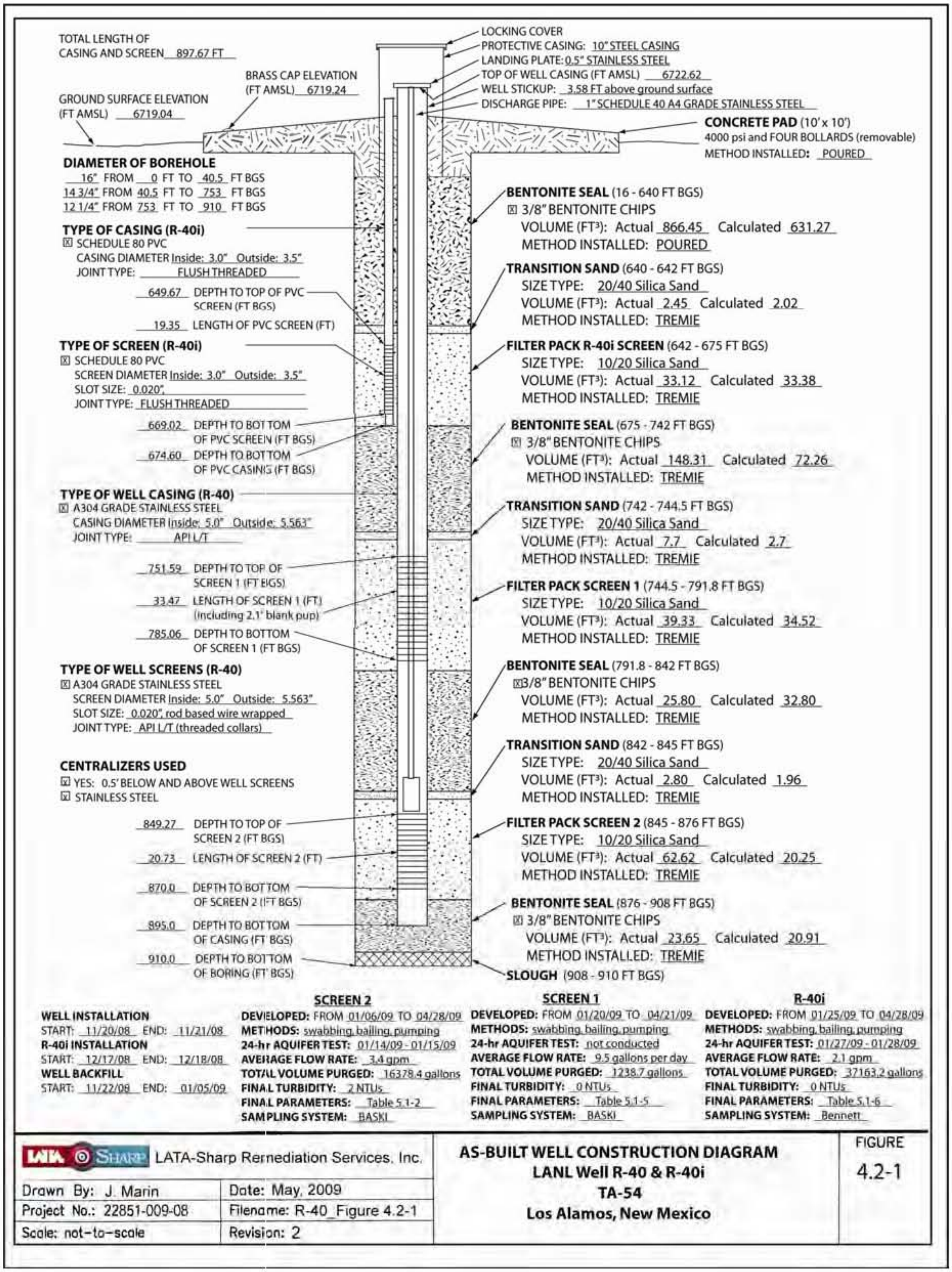


Figure 4.2-1 As-built well construction diagram

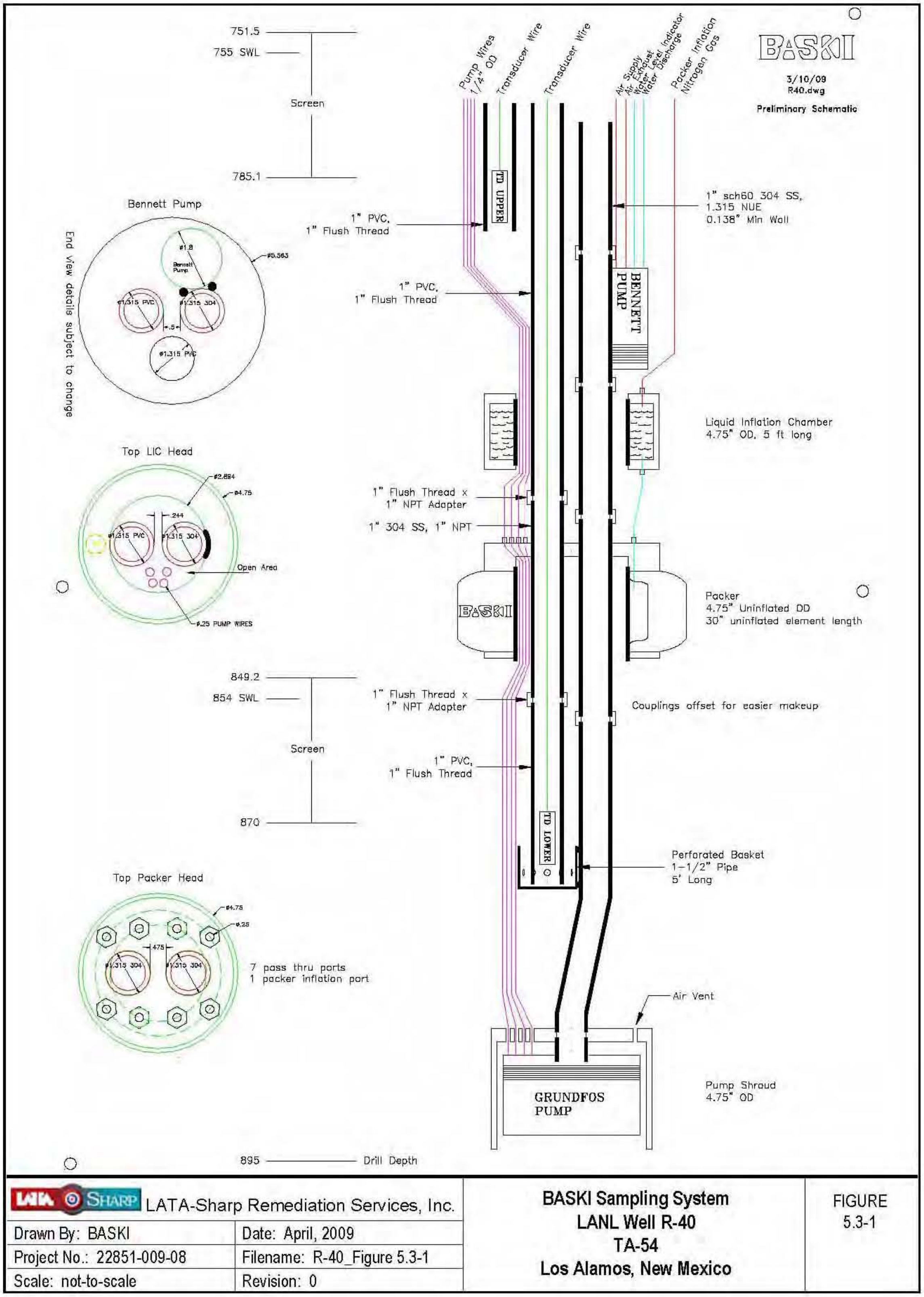


Figure 5.3-1 As-built completion schematic for regional aquifer well R-40

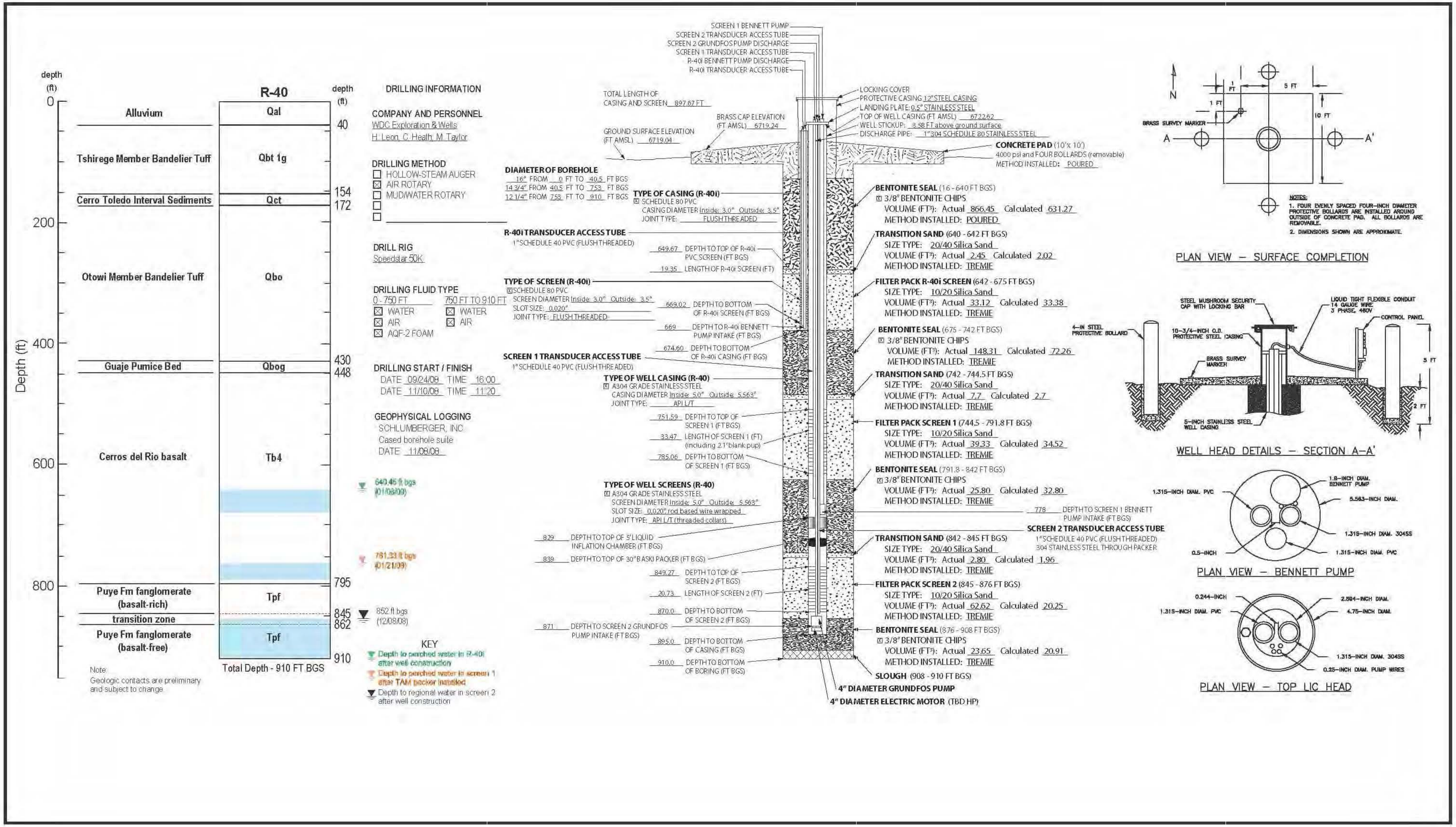


Figure 5.3-2 As-built completion schematic for regional aquifer well R-40 and intermediate well R-40i

Table 2.2-1
Municipal Water and AQF-2 Foam Used during Drilling and Well Construction at Well R-40

Date	Water (gal.)	Cumulative Water (gal.)	AQF-2 Foam (gal.)	Cumulative AQF-2 Foam (gal.)	Cumulative Returns in Pit (gal.)
Drilling					
09/24/08	0	0	0	0	0
09/25/08	0	0	0	0	0
09/26/08	175	175	2	2	125
09/27/08	800	975	3	5	680
09/28/08	850	1825	12.5	17.5	1275
09/29/08	0	1825	0	17.5	1275
09/30/08	4500	6325	62.5	80	4430
10/01/08	600	6925	20	100	4850
10/02/08	1200	8125	20	120	5685
10/07/08	1800	9925	15	135	6950
10/08/08	1500	11,425	20	155	8000
10/09/08	3000	14,425	30	185	10,100
10/10/08	1600	16,025	15	200	11,220
10/11/08	3000	19,025	25	225	13,350
10/12/08	1000	20,025	10	235	14,000
10/13/08	1000	21,025	10	245	14,750
10/14/08	1000	22,025	10	255	15,420
10/15/08	3000	25,025	20	275	17,500
10/16/08	1000	26,025	10	285	18,200
10/21/08	0	26,025	0	285	18,200
10/23/08	0	26,025	0	285	18,200
10/24/08	0	26,025	0	285	18,200
10/25/08	0	26,025	0	285	18,200
10/26/08	800	26,825	0	285	18,800
10/27/08	1000	27825	0	285	19,800
10/28/08	0	27,825	0	285	21,300
10/29/08	0	27,825	0	285	22,800
10/30/08	0	27,825	0	285	24,300
11/04/08	800	28,625	0	285	23,300
11/05/08	0	28,625	0	285	24,800
11/06/08	0	28,625	0	285	26,300
11/07/08	0	28,625	0	285	27,300
Subtotal Drilling (gal.)	**28,625**	**28,625**	**285**	**285**	**27,300**

Table 2.2-1 (continued)

Date	Water (gal.)	Cumulative Water (gal.)	AQF-2 Foam (gal.)	Cumulative AQF-2 Foam (gal.)	Cumulative Returns in Pit (gal.)
Well Construction					
11/19/08	0	0	0	0	0
11/20/08	0	0	0	0	0
11/21/08	0	0	0	0	0
11/22/08	2200	2200	0	0	0
11/23/08	1300	3500	0	0	0
11/24/08	1000	4500	0	0	0
11/25/08	250	4750	0	0	0
12/01/08	1500	6250	0	0	0
12/02/08	2000	8250	0	0	0
12/03/08	500	8750	0	0	0
12/04/08	1200	9950	0	0	0
12/05/08	0	9950	0	0	0
12/06/08	0	9950	0	0	0
12/07/08	750	10,700	0	0	0
12/08/08	0	10,700	0	0	0
12/09/08	0	10,700	0	0	0
12/10/08	0	10,700	0	0	0
12/11/08	0	10,700	0	0	0
12/12/08	0	10,700	0	0	0
12/17/08	0	10,700	0	0	0
12/18/08	500	11,200	0	0	0
12/19/08	1500	12,700	0	0	0
12/20/08	0	12,700	0	0	0
12/21/08	1000	13,700	0	0	0
12/22/08	0	13,700	0	0	0
01/05/09	0	13,700	0	0	0
Subtotal Well Construction (gal.)	**13,700**	**13,700**	**0**	**0**	**0**
Total Volume (gal.)	**42,325**	**42,325**	**285**	**285**	**27,300**

Table 2.3-1
Summary of Groundwater-Screening Samples Collected during Drilling, Well Development, and Aquifer Testing of Well R-40

Location ID	Sample ID	Date Collected	Collection Depth (ft bgs)	Sample Type
Drilling				
R-40 (first borehole)	GW40-08-14400	07/30/08	608.2	Screening
R-40 (second borehole)	GW40-08-14402	10/28/08	784	Screening
R-40 (second borehole)	GW40-08-14404	10/29/08	809	Screening
R-40 (second borehole)	GW40-08-14405	10/29/08	827	Screening
R-40 (second borehole)	GW40-08-14401	10/30/08	847	Screening
R-40 (second borehole)	RC54-09-1031	11/04/08	867	Screening
R-40 (second borehole)	RC54-09-1033	11/05/08	872	Screening
R-40 (second borehole)	RC54-09-1032	11/05/08	887	Screening
R-40 (second borehole)	RC54-09-1034	11/07/08	910	Screening
R-40 Screen 2				
Prewell Development				
R-40 screen 2	RC54-09-1037	01/06/09	853	Screening
Well Development				
R-40 screen 2	GW40-09-1615	01/09/09	867.4	TOC
R-40 screen 2	GW40-09-1616	01/10/09	867.4	TOC
Aquifer Test				
R-40 screen 2	GW40-09-1617	01/15/09	871.8	TOC
R-40 screen 2	CAPA-09-1888	01/15/09	858.78	Full Suite
R-40 screen 2	GW40-09-8323	04/23/09	867.14	TOC, metals
R-40 screen 2	GW40-09-8324	04/24/09	867.14	TOC, metals
R-40 screen 2	GW40-09-8325	04/24/09	867.14	TOC, metals
R-40 screen 2	GW40-09-8328	04/27/09	867.14	TOC, metals
R-40 screen 2	GW40-09-8331	04/27/09	867.14	TOC, metals
R-40 screen 2	GW40-09-8333	04/28/09	867.14	TOC, metals
R-40 Screen 1				
Well Development				
R-40 screen 1	GW40-09-1621	03/03/09	829.93	TOC
R-40 screen 1	GW40-09-1622	03/03/09	829.93	TOC
R-40 screen 1	GW40-09-1626	03/06/09	834.89	TOC
R-40 screen 1	GW40-09-1630	03/12/09	834.89	TOC
R-40 screen 1	GW40-09-1631	03/12/09	834.89	TOC
R-40 screen 1	GW40-09-5867	03/17/09	834.89	TOC
R-40 screen 1	GW40-09-5868	03/17/09	834.89	TOC
R-40 screen 1	GW40-09-5868	03/24/09	834.89	TOC
R-40 screen 1	GW40-09-5868	03/24/09	834.89	TOC
R-40 screen 1	GW40-09-6937	04/03/09	834.89	TOC, metals

Table 2.3-1 (continued)

Location ID	Sample ID	Date Collected	Collection Depth (ft bgs)	Sample Type
R-40 Screen 1 (continued)				
R-40 screen 1	GW40-09-6938	04/03/09	834.89	TOC, metals
R-40 screen 1	GW40-09-6949	04/10/09	834.89	TOC, metals
R-40 screen 1	GW40-09-6950	04/10/09	834.89	TOC, metals
R-40 screen 1	CAPA-09-8346	04/21/09	834.89	Full Suite
R-40i				
Prewell Development				
R-40i	RC54-09-1038	01/12/09	641.7	Screening
Well Development				
R-40i	GW40-09-1618	01/26/09	656.6	TOC
R-40i	GW40-09-1619	01/26/09	656.6	TOC
Aquifer Test				
R-40i	GW40-09-1620	01/28/09	656.6	TOC
R-40i	CAPA-09-2797	01/28/09	656.6	Full Suite
Continued Well Development				
R-40i	GW40-09-1623	03/05/09	668.11	TOC
R-40i	GW40-09-1624	03/06/09	668.11	TOC
R-40i	GW40-09-1625	03/06/09	668.11	TOC
R-40i	GW40-09-1627	03/09/09	668.11	TOC
R-40i	GW40-09-1628	03/10/09	668.11	TOC
R-40i	GW40-09-1629	03/11/09	668.11	TOC
R-40i	GW40-09-1632	03/12/09	668.11	TOC
R-40i	GW40-09-1633	03/13/09	668.11	TOC
R-40i	GW40-09-1634	03/16/09	668.11	TOC
R-40i	GW40-09-1635	03/16/09	668.11	TOC
R-40i	GW40-09-5868	03/17/09	668.11	TOC
R-40i	GW40-09-5869	03/17/09	668.11	TOC
R-40i	GW40-09-5870	03/18/09	668.11	TOC
R-40i	GW40-09-5871	03/19/09	668.11	TOC
R-40i	GW40-09-5872	03/20/09	668.11	TOC
R-40i	GW40-09-5873	03/23/09	668.11	TOC
R-40i	GW40-09-5876	03/24/09	668.11	TOC
R-40i	GW40-09-5877	03/25/09	668.11	TOC
R-40i	GW40-09-5878	03/26/09	668.11	TOC
R-40i	GW40-09-6939	04/03/09	668.11	TOC, metals
R-40i	GW40-09-6940	04/03/09	668.11	TOC, metals
R-40i	GW40-09-6941	04/06/09	668.11	TOC, metals
R-40i	GW40-09-6942	04/06/09	668.11	TOC, metals

Table 2.3-1 (continued)

Location ID	Sample ID	Date Collected	Collection Depth (ft bgs)	Sample Type
R-40i (continued)				
R-40i	GW40-09-6943	04/07/09	668.11	TOC, metals
R-40i	GW40-09-6944	04/07/09	668.11	TOC, metals
R-40i	GW40-09-6945	04/08/09	668.11	TOC, metals
R-40i	GW40-09-6946	04/08/09	668.11	TOC, metals
R-40i	GW40-09-6947	04/09/09	668.11	TOC, metals
R-40i	GW40-09-6948	04/09/09	668.11	TOC, metals
R-40i	GW40-09-6951	04/10/09	668.11	TOC, metals
R-40i	GW40-09-6952	04/10/09	668.11	TOC, metals
R-40i	GW40-09-6953	04/13/09	668.11	TOC, metals
R-40i	GW40-09-6954	04/13/09	668.11	TOC, metals
R-40i	GW40-09-6955	04/14/09	668.11	TOC, metals
R-40i	GW40-09-6956	04/14/09	668.11	TOC, metals
R-40i	GW40-09-8320	04/20/09	668.11	TOC, metals
R-40i	GW40-09-8321	04/20/09	668.11	TOC, metals
R-40i	GW40-09-8322	04/21/09	668.11	TOC, metals
R-40i	GW40-09-8326	04/24/09	668.11	TOC, metals
R-40i	GW40-09-8327	04/24/09	668.11	TOC, metals
R-40i	GW40-09-8329	04/27/09	668.11	TOC, metals
R-40i	GW40-09-8330	04/27/09	668.11	TOC, metals
R-40i	GW40-09-8332	04/28/09	668.11	TOC, metals

Table 3.1-1
Summary of Water-Level Measurements during Drilling and Well Construction at Well R-40

Date	Time	DTW (ft bgs)	Source	Type	After
Drilling					
10/28/08	0745	734	DTW Meter	Perched	Resting
10/29/08	0815	633.4	DTW Meter	Perched	Resting
10/29/08	1315	600	DTW Meter	Perched	Drilling
10/29/08	1730	337.02	DTW Meter	Perched	Drilling
10/29/08	1800	559.60	DTW Meter	Perched	Drilling
10/30/08	0740	633.8	DTW Meter	Perched	Resting
10/30/08	0815	633.8	DTW Meter	Perched	Resting
10/30/08	1311	705	DTW Meter	Perched	Drilling
10/30/08	1355	670	DTW Meter	Perched	Drilling
11/04/08	0733	636	DTW Meter	Perched	Resting
11/04/08	0803	636	DTW Meter	Perched	Resting
Drilling (past 872 ft bgs)					
11/05/08	0756	796	DTW Meter	Perched	Resting
11/05/08	0840	796	DTW Meter	Perched	Resting
11/05/08	1400	801	DTW Meter	Perched	Drilling
11/06/08	0725	811	DTW Meter	Perched	Resting
11/06/08	0800	811	DTW Meter	Perched	Resting
11/06/08	1550	840	DTW Meter	Regional	Trip out
11/07/08	0722	839	DTW Meter	Regional	Resting
11/07/08	0755	839	DTW Meter	Regional	Resting
11/07/08	1413	820	DTW Meter	Regional	Drilling
Prewell Construction					
11/10/08	1400	838	DTW Meter	Regional	Resting
11/10/08	1415	834	DTW Meter	Regional	Resting
11/12/08	0800	838	DTW Meter	Regional	Resting
11/12/08	0735	836	DTW Meter	Regional	Resting
11/19/08	0815	833	DTW Meter	Regional	Resting
Well Construction					
12/03/08	1300	791	DTW Meter	Perched?	Backfilling
12/04/08	1135	791	DTW Meter	Perched?	Backfilling
12/05/08	0735	855	DTW Meter	Regional	Resting
12/05/08	1120	854	DTW Meter	Regional	Resting
12/05/08	1505	854	DTW Meter	Regional	Resting
12/06/08	0745	854	DTW Meter	Regional	Resting
12/08/08	0755	852	DTW Meter	Regional	Resting

Table 5.1-1
Summary of Water-Level Measurements at Well R-40 Screen 2

Date	Time	DTW (ft bgs)	Source	Type	After
Prewell Development (R-40 Screen 2)					
01/06/09	1440	853.33	DTW Meter	Regional	Resting
01/07/09	0745	853.98	DTW Meter	Regional	Resting
Well Development (R-40 Screen 2)					
01/07/09	1030	856.03	DTW Meter	Regional	Bail/Swab
01/07/09	1345	853.3	DTW Meter	Regional	Set pump
01/07/09	1436	859.53	DTW Meter	Regional	Pump on
01/07/09	1455	857.73	DTW Meter	Regional	Pumping
01/08/09	0645	854.13	DTW Meter	Regional	Resting
01/08/09	0745	858.53	DTW Meter	Regional	Pumping
01/08/09	1245	860.08	DTW Meter	Regional	Pumping
01/09/09	0644	853.33	DTW Meter	Regional	Resting
04/22/09	0800	853.46	DTW Meter	Regional	Resting
Aquifer Test (R-40 Screen 2)					
01/14/09 – 01/15/09	See Appendix F				

Table 5.1-2
Well Development and Aquifer Test Volumes and Field Water-Quality Parameter Measurements at Well R-40 Screen 2

Date	Time	pH	SP[a] (µS/cm)[b]	T[c] (°C)	Turbidity (NTU)	DO[d] (mg/L)	Salinity %	TOC Result (ppm)	Comment	End-of-Day Cumulative Purge Volume –Screen 2 (gal.)
R-40 Screen 2 Well Development										
01/06/09	1502	3.95	4.43	13.3	0	5.2	0.22	—[e]	Calibrate Horiba	—
01/06/09	1510	4	4.44	12	0	5.23	0.22	—	Calibrate Horiba	—
01/06/09	1540	6.64	0.317	16.4	999	5.29	0.01	—	Turbid	110
01/07/09	1515	7.14	0.33	17.2	58	2.07	0	—	Soap	—
01/07/09	1535	7.32	0.335	16.9	34	1.43	0.01	—	Soap	—
01/07/09	1550	7.34	0.332	16.7	19	4.95	0.01	—	Soap	—
01/07/09	1605	7.28	0.004	18.2	16	1.85	0.01	—	Soap	—
01/07/09	1700	7.28	0.333	15.3	13	4.06	0	—	Soap	490
01/08/09	0800	7.53	0.306	15.2	9	1.7	0.01	—	Soap	—
01/08/09	0935	7.23	0.29	17.2	14	1.86	0.01	—	Soap	—
01/08/09	1000	7.38	0.289	19.4	14	1.87	0	—	Soap	—
01/08/09	1100	7.41	0.279	19.4	11	2.25	0	—	Soap	—
01/08/09	1145	7.33	0.268	19.7	10	4.39	0	—	Soap	—
01/08/09	1245	7.34	0.267	19.1	12	4.25	0	—	Soap	—
01/08/09	1310	7.29	0.265	19.5	12	4.32	0	—	—	—
01/08/09	1342	7.33	0.257	19.6	76	4.64	0	—	—	—
01/08/09	1423	7.35	0.262	14.4	7	4.52	0.01	—	—	—
01/08/09	1511	7.33	0.258	17.4	10	2.03	0.01	—	—	—
01/08/09	1545	7.3	0.255	17.2	10	1.98	0	—	—	—
01/08/09	1613	7.17	0.256	15.6	10	2.28	0	—	—	—
01/08/09	1655	7.22	0.251	15.8	10	2.02	0	—	—	—
01/08/09	1657	—	—	—	—	—	—	—	Pump off	2352
01/09/09	0755	7.47	0.256	19.2	12	4.32	0	—	—	—
01/09/09	0824	7.36	0.25	15.8	21	1.35	0	—	—	—

Table 5.1-2 (continued)

Date	Time	pH	SP[a] (µS/cm)[b]	T[c] (°C)	Turbidity (NTU)	DO[d] (mg/L)	Salinity %	TOC Result (ppm)	Comment	End-of-Day Cumulative Purge Volume –Screen 2 (gal.)
R-40 Screen 2 Well Development (continued)										
01/09/09	0958	6.66	0.25	15.8	18	—	0	—	—	—
01/09/09	1130	7.68	0.247	16.6	13	1.68	0	—	—	—
01/09/09	1342	7.49	0.243	18.4	12	1.82	0	—	—	—
01/09/09	1438	7.38	0.235	19.2	14	1.49	0	—	—	—
01/09/09	1515	3.97	4.48	16.2	0	6.1	0.22	—	Calibrate Horiba	—
01/09/09	1520	—	—	—	10	—	—	—	—	—
01/09/09	1526	6.8	0.216	17.6	6	5.06	0	—	—	—
01/09/09	1615	6.97	0.214	18.2	7	2.52	0	—	—	—
01/09/09	1641	7.24	0.21	17.6	6	2.69	0	—	—	—
01/09/09	1700	7.21	0.207	18	6	2.19	0	1.9/1.6	—	—
01/09/09	1701	—	—	—	—	—	—	—	Pump off	4521
01/10/09	0700	7.04	0.21	15.6	12	1.83	0	—	—	—
01/10/09	0900	6.74	0.214	18.2	10	2.24	0	—	—	—
01/10/09	1045	7.02	0.208	17.2	18	2.41	0	—	—	—
01/10/09	1117	6.89	0.208	17.7	15	2.29	0	—	—	—
01/10/09	1150	7.14	0.206	16.5	13	2.16	0	—	—	—
01/10/09	1243	7.08	0.206	18.8	13	4.12	0	—	—	—
01/10/09	1516	—	0.201	18.3	12	—	0	—	—	—
01/10/09	1522	3.98	4.58	15.2	0	0.23	0.22	—	Calibrate Horiba	—
01/10/09	1552	6.78	0.2	16.4	11	—	0	—	—	—
01/10/09	1603	3.98	4.45	14	0	6.39	0.22	—	Calibrate Horiba	—
01/10/09	1640	6.37	0.223	18.4	4	2.56	0	—	—	7145
01/10/09	1700	6.44	0.206	17.6	3	2.71	0	4.4/3.8	—	—
01/13/09	0855	7.33	0.205	20	10	1.69	0	—	—	—
01/13/09	1232	3.98	4.52	12.9	0	4.73	0.23	—	Calibrate Horiba	—
01/13/09	1255	6.92	0.227	19.2	24	1.57	0	—	—	8032

Table 5.1-2 (continued)

Date	Time	pH	SP[a] (µS/cm)[b]	T[c] (°C)	Turbidity (NTU)	DO[d] (mg/L)	Salinity %	TOC Result (ppm)	Comment	End-of-Day Cumulative Purge Volume –Screen 2 (gal.)
R-40 Screen 2 Aquifer Test (24 h)										
01/14/09	0800	—	—	—	—	—	—	—	Pump on	—
01/14/09	0806	7.21	0.225	15	25	0.51	0	—	—	—
01/14/09	1056	7.04	0.209	19.1	22	—	0	—	—	—
01/14/09	1124	3.93	4.48	12.4	0	—	0.22	—	Calibrate Horiba	—
01/14/09	1130	6.21	0.209	19.2	20	0.99	0	—	—	—
01/14/09	1345	6.72	0.197	19.6	15	1	0	—	—	—
01/14/09	1645	7.09	0.194	18.1	13	1.4	0	—	—	—
01/14/09	1730	7.03	0.192	18.2	12	0.9	0	—	—	—
01/14/09	1752	6.97	0.192	14.2	12	0.88	0	—	—	—
01/14/09	1900	6.66	0.197	17.3	12	2.17	0	—	—	—
01/14/09	2000	7.1	0.19	17.9	12	1.14	0	—	—	—
01/14/09	2100	7.38	0.189	20.2	12	1.79	0	—	—	—
01/14/09	2200	7.38	0.186	19.9	11	0.91	0	—	—	—
01/14/09	2300	7.32	0.187	19.6	10	0.93	0	—	—	—
01/14/09	2400	—	—	—	—	—	—	—	—	11296
01/15/09	0000	7.29	0.184	19	10	0.93	0	—	—	—
01/15/09	0100	7.24	0.186	21	9	0.73	0	—	—	—
01/15/09	0200	7.22	0.182	19.3	9	1.23	0	—	—	—
01/15/09	0300	7.09	0.181	19.2	9	1.23	0	—	—	—
01/15/09	0400	7.26	0.181	18.9	10	1	0	—	—	—
01/15/09	0500	7.28	0.181	20.8	8	1.33	0	—	—	—
01/15/09	0600	7.34	0.181	19	8	1.44	0	—	—	—
01/15/09	0700	7.39	0.179	20	8	0.81	0	—	—	—
01/15/09	0745	7.29	0.18	19.8	8	0.81	0	1.41/1.47	—	—
01/15/09	0800	—	—	—	—	—	—	—	Pump off	12987

Table 5.1-2 (continued)

Date	Time	pH	SP[a] (µS/cm)[b]	T[c] (°C)	Turbidity (NTU)	DO[d] (mg/L)	Salinity %	TOC Result (ppm)	Comment	End-of-Day Cumulative Purge Volume –Screen 2 (gal.)
R-40 Screen 2 Aquifer Test (24 h) (continued)										
04/21/09	1101	3.99	4.99	21.9	0	1.13	0.23	—	Calibrate Horiba	—
04/21/09	1104	4	4.48	22.4	0	9.02 FTC	0.23	—	Calibrate Horiba	—
04/23/09	1530	—	—	—	—	—	—	—	Pump on	—
04/23/09	1605	5.15	0.208	21.5	63	8.33	0	—	DO FTC	—
04/23/09	1615	5.58	0.176	19.1	32	8.57	0	—	DO FTC	—
04/23/09	1630	6.18	0.177	20	24	7.37	0	—	DO FTC	—
04/23/09	1645	6.54	0.176	20.1	7	8.39	0	0.7	DO FTC	—
04/23/09	1700	—	—	—	—	—	—	—	Pump off	13314.9
04/24/09	0705	6.61	0.221	15.2	13	8.47	0	—	Pump on	—
04/24/09	0740	—	—	—	—	—	—	0.6	—	—
04/24/09	0800	6.93	0.182	17.3	0	8.32	0	—		—
04/24/09	0900	7.01	0.18	19.1	0	7.85	0	—	DO FTC	—
04/24/09	1000	7.13	0.18	19.7	0	8.15	0	—	DO FTC	—
04/24/09	1100	7.57	0.205	21.9	0	8.63	0	—	DO FTC	—
04/24/09	1200	7.45	0.187	24.8	0	8.43	0	—	DO FTC	—
04/24/09	1300	7.51	0.187	25.3	0	8.51	0	—	DO FTC	—
04/24/09	1400	7.46	0.19	26.8	0	9.23	0	—	DO FTC	—
04/24/09	1500	7.77	0.166	22.6	0	8.92	0	—	DO FTC	—
04/24/09	1600	7.7	0.163	21.6	1	7.95	0	0.5	Pump off	14544.9
04/27/09	700	7.54	0.203	19.1	6	4.15	0	0.6	Pump on	—
04/27/09	800	7.61	0.173	19.8	5	4.23	0	—	DO FTC	—
04/27/09	900	7.69	0.166	20.7	3	4.35	0	—	DO FTC	—
04/27/09	1000	7.68	0.175	19.9	2	4.42	0	—	DO FTC	—
04/27/09	1100	7.79	0.176	20.5	2	4.49	0	—	DO FTC	—
04/27/09	1200	7.39	0.163	22.2	2	4.86	0	—	DO FTC	—
04/27/09	1300	7.56	0.157	20.5	3	4.36	0	—	DO FTC	—

Table 5.1-2 (continued)

Date	Time	pH	SP[a] (µS/cm)[b]	T[c] (°C)	Turbidity (NTU)	DO[d] (mg/L)	Salinity %	TOC Result (ppm)	Comment	End-of-Day Cumulative Purge Volume –Screen 2 (gal.)
R-40 Screen 2 Aquifer Test (24 h) (continued)										
04/27/09	1400	7.63	0.155	23.3	2	4.45	0	—	DO FTC	—
04/27/09	1500	7.65	0.158	23.4	3	4.41	0	—	DO FTC	—
04/27/09	1600	7.62	0.154	23.5	3	4.4	0	0.4	Pump off	16378.4
04/28/09	700	7.68	0.155	20.3	4	4.48	0	0.5	Pump on	—
04/28/09	800	7.48	0.155	21.2	3	4.33	0	—	DO FTC	—
04/28/09	900	7.63	0.156	21.6	2	4.25	0	—	Pump off	16750.9

[a] SP = Specific conductance.

[b] µm/cm = Micrometer per centimeter.

[c] T = Temperature.

[d] DO = Dissolved oxygen.

[e] — = Analysis not conducted. DO FLC = Dissolved oxygen measured by the Horiba instrument in a flow-through cell.

Table 5.1-3
Summary of Water-Level Measurements at Well R-40 Screen 1

Date	Time	DTW (ft bgs)	Column above TAM packer (845 ft bgs)	Source	Type	After
Prewell Development (R-40 screen 1)						
01/21/09	1500	761.33	83.67	DTW Meter	Perched	TAM packer installed
Well Development (R-40 screen 1)						
01/21/09	1715	781.33	63.67	DTW Meter	Perched	Injecting & Bailing
01/22/09	0710	742.63	102.37	DTW Meter	Perched	Injecting Bailing & Resting
01/23/09	0755	779.74	65.26	DTW Meter	Perched	Injecting Bailing & Resting
01/24/09	0745	802.48	42.52	DTW Meter	Perched	Injecting Bailing & Resting
01/25/09	1215	776.13	68.87	DTW Meter	Perched	Bailing
01/26/09	0715	755.38	89.62	DTW Meter	Perched	Resting
03/03/09	0950	762.83	82.17	DTW Meter	Perched	Resting
03/03/09 Pump 74 gal. (R-40 Screen 1)						
03/04/09	1140	807.32	37.68	DTW Meter	Perched	Pumping & Resting
03/05/09	1110	797.23	47.77	DTW Meter	Perched	Resting
03/05/09	1500	795.83	49.17	DTW Meter	Perched	Resting
03/06/09	1455	785.01	59.99	DTW Meter	Perched	Resting
03/06/09 Pump 40.2 gal. (R-40 Screen 1)						
03/09/09	1700	804.9	40.10	DTW Meter	Perched	Pumping & Resting
03/10/09	1717	794.54	50.48	DTW Meter	Perched	Resting
03/11/09	1658	784.98	60.02	DTW Meter	Perched	Resting
03/12/09	0930	782.2	62.8	DTW Meter	Perched	Resting
03/12/09 Pump 44.5 gal. (R-40 Screen 1)						
03/16/09	1530	783.33	61.67	DTW Meter	Perched	Resting
03/17/09	0705	780.14	64.86	DTW Meter	Perched	Resting

Table 5.1-3 (continued)

Date	Time	DTW (ft bgs)	Column above TAM packer (845 ft bgs)	Source	Type	After
03/17/09 Pump 46.4 gal. (R-40 Screen 1)						
03/17/09	1740	833.13	11.87	DTW Meter	Perched	Pumping
03/18/09	1740	821.48	23.52	DTW Meter	Perched	Resting
03/19/09	0702	816.28	28.72	DTW Meter	Perched	Resting
03/19/09	1800	812.01	32.99	DTW Meter	Perched	Resting
03/20/09	0705	806.75	38.25	DTW Meter	Perched	Resting
03/20/09	1305	803.48	41.52	DTW Meter	Perched	Resting
03/23/09	0710	781.45	63.55	DTW Meter	Perched	Resting
03/23/09	1735	780.68	64.32	DTW Meter	Perched	Resting
03/24/09	0710	778.63	66.37	DTW Meter	Perched	Resting
03/24/09 Pump 63.4 gal. (R-40 Screen 1)						
04/03/09 Pump 80.4 gal. (R-40 Screen 1)						
04/10/09 Pump 61.3 gal. (R-40 Screen 1)						
04/21/09	0845	769.33	75.67	DTW Meter	Perched	Resting
04/21/09 Pump 82.2 gal. (R-40 Screen 1)						

Table 5.1-4
Summary of Water-Level Measurements at Well R-40i

Date	Time	DTW (ft bgs)	Source	Type	After
Prewell Development (R-40i)					
01/08/09	0730	640.45	DTW Meter	Perched	Resting
01/12/09	0840	640.15	DTW Meter	Perched	Resting
Well Development (R-40i)					
01/12/09	1115	674.6	DTW Meter	Perched	Bailing
01/21/09	0730	640.04	DTW Meter	Perched	Resting
01/21/09	0750	640.25	DTW Meter	Perched	Resting
03/04/09	1140	639.38	DTW Meter	Perched	Resting
Aquifer Test (R-40i)					
01/27/09 – 01/28/09	See Appendix F				

Table 5.2-1
Well Development Volumes and Field Water-Quality Parameter Measurements at Well R-40 Screen 1

Date	Time	pH	SP[a] (µS/cm)[b]	T[c] (°C)	Turbidity (NTU)	DO[d] (mg/L)	Salinity %	TOC Result (mg/L)	Comment	End-of-Day Cumulative Purge Volume Screen 1 (gal.)
Well Development										
01/21/09	1605	7.57	0.246	16.6	999	2.89	0	—[e]	Bail	100
01/25/09	1100	7.05	0.229	19.2	18	2.95	0	—	Bail	—
01/25/09	1125	5.59	0.279	18.7	24	2.88	0.01	—	Bail	—
01/25/09	1215	—	—	—	—	—	—	—	—	640
02/03/09	1615	—	—	—	—	—	—	—	Bail	747
03/03/09	1356	4	4.55	19.1	0	1.85	0.23	—	Calibrate Horiba	—
03/03/09	1435	6.28	0.313	15.2	25	0.009	0	12.4	Pump on	—
03/03/09	1442	6.56	0.26	17	2	0.21	0.01	—	—	—
03/03/09	1449	6.8	0.258	17.6	1	1.41	0.01	—	—	—
03/03/09	1456	7.06	0.256	16.5	1	0.31	0	—	—	—
03/03/09	1501	7.13	0.257	16.7	2	0.21	0.01	—	—	—
03/03/09	1504	7.16	0.259	17.8	3	1.33	0.01	—	—	—
03/03/09	1509	7.21	0.259	17.3	3	0.32	0.01	—	—	—
03/03/09	1515	7.25	0.263	17.5	3	0.28	0	4.9	Pump off	821
03/06/09	1515	7.39	0.27	12.2	2	0.37	0	—	Pump on	—
03/06/09	1530	7.38	0.267	14.2	4	0.21	0.01	7.7	—	—
03/06/09	1545	—	—	—	—	—	—	—	Pump off	861.2
03/12/09	0950	8.01	0.274	10.8	9	-0.14	01	—	Pump on	—
03/12/09	1000	7.78	0.256	12.8	15	-0.25	0	—	—	—
03/12/09	1007	7.73	0.243	15.2	1	-0.05	0	—	—	—
03/12/09	1012	7.69	0.235	15.4	1	0.18	0	—	—	—
03/12/09	1013	7.65	0.235	16.1	1	0.25	0	5.1	—	—
03/12/09	1017	7.63	0.235	16.1	1	0.26	0	5.1	—	—
03/12/09	1018	—	—	—	—	—	—	—	Pump off	905.7
03/17/09	0859	—	—	—	—	—	—	—	Pump on	—

Table 5.2-1 (continued)

Date	Time	pH	SP[a] (µS/cm)[b]	T[c] (°C)	Turbidity (NTU)	DO[d] (mg/L)	Salinity %	TOC Result (mg/L)	Comment	End-of-Day Cumulative Purge Volume Screen 1 (gal.)
Well Development (continued)										
03/17/09	0902	7.95	0.25	10.2	1	-0.61	0	—	—	—
03/17/09	0906	7.81	0.249	12.3	25	0.73	0	—	—	—
03/17/09	0908	7.89	0.244	13.5	11	-0.08	0	—	—	—
03/17/09	0912	7.81	0.248	12.7	7	-0.15	0	—	—	—
03/17/09	0917	7.72	0.235	15.5	3	0.16	0	—	—	—
03/17/09	0920	7.7	0.233	14.2	2	0.24	0	4.2	—	—
03/17/09	09 22	7.68	0.232	16.1	1	0.39	0	—	—	—
03/17/09	924	7.67	0.233	14.7	2	0.28	0	4.2	Pump off	952.1
03/24/09	1508	7.98	0.236	17.4	14	-0.45	0	—	Pump on	—
03/24/09	1515	8.13	0.222	14.8	22	-0.55	0	—	—	—
03/24/09	1520	8.06	0.241	14.5	11	-0.33	0	—	—	—
03/24/09	1523	7.87	0.246	14.8	2	-0.38	0	—	—	—
03/24/09	1525	7.79	0.225	15.2	1	-0.17	0	3.4	—	—
03/24/09	1529	7.7	0.224	16.6	1	-0.18	0	—	—	—
03/24/09	1530	7.67	0.224	14.7	0	-0.14	0	3.2	—	—
03/24/09	1533	7.71	0.226	15.8	0	-0.17	0	—	—	—
03/24/09	1538	7.68	0.225	17	0	-0.12	0	—	Pump off	1014.8
04/03/09	1058	8.14	0.232	8.8	14	-0.68	0	—	Pump on	—
04/03/09	1101	7.97	0.221	12.3	43	-0.67	0	—	—	—
04/03/09	1104	7.7	0.24	12.8	15	-0.4	0	—	—	—
04/03/09	1107	7.68	0.24	11.9	12	-0.47	0	—	—	—
04/03/09	1108	7.66	0.238	11.7	11	-0.48	0	—	—	—
04/03/09	1111	7.64	0.238	11.5	8	-0.1	0	—	—	—
04/03/09	1113	7.54	0.226	15.2	1	-0.31	0	—	—	—
04/03/09	1115	7.5	0.223	15.1	1	-0.3	0	2.1	—	—
04/03/09	1117	7.47	0.223	16.1	0	-0.3	0	—	—	—
04/03/09	1119	7.48	0.223	15.9	0	-0.35	0	—	—	—

Table 5.2-1 (continued)

Date	Time	pH	SP[a] (µS/cm)[b]	T[c] (°C)	Turbidity (NTU)	DO[d] (mg/L)	Salinity %	TOC Result (mg/L)	Comment	End-of-Day Cumulative Purge Volume Screen 1 (gal.)
Well Development (continued)										
04/03/09	1121	7.43	0.222	16.4	0	-0.31	0	—	—	—
04/03/09	1123	7.41	0.224	16	0	-0.33	0	—	—	—
04/03/09	1125	7.43	0.223	15.7	0	-0.3	0	—	—	—
04/03/09	1127	7.43	0.223	16.3	0	-0.37	0	—	—	—
04/03/09	1129	7.43	0.222	16.5	0	-0.33	0	—	—	—
04/03/09	1131	7.44	0.222	17.1	0	-*0.32	0	—	—	—
04/03/09	1133	7.45	0.223	17.3	0	-0.3	0	—	—	—
04/03/09	1135	7.47	0.222	14.1	0	-0.34	0	—	—	—
04/03/09	1137	7.49	0.223	16.4	0	-0.35	0	2.3	—	—
04/03/09	1138	7.52	0.223	16.4	0	-0.4	0	—	—	—
04/03/09	1140	—	—	—	—	—	—	—	Pump off	1095.2
04/10/09	0736	8.15	0.269	11.1	22	-0.32	0	—	Pump on	—
04/10/09	0740	8.03	0.242	11.7	1	-0.67	0	—	—	—
04/10/09	0745	7.94	0.245	13.1	2	-0.78	0	—	—	—
04/10/09	0750	7.88	0.249	13.3	3	-0.76	0	1.9	—	—
04/10/09	0755	7.81	0.237	14.9	1	-0.66	0	—	—	—
04/10/09	0800	7.69	0.217	15.7	0	-0.63	0	—	—	—
04/10/09	0805	7.65	0.218	16.3	0	-0.52	0	—	—	—
04/10/09	0807	7.62	0.218	17	0	-0.13	0	—	—	—
04/10/09	0808	—	—	—	—	—	—	1.8	Pump off	1156.5
04/21/09	0857	—	—	—	—	—	—	—	Pump on	
04/21/09	0940	—	—	—	—	—	—	—	Pump off	1238.7

[a] SP = Specific conductance.

[b] µm/cm = Micrometer per centimeter.

[c] T = Temperature.

[d] DO = Dissolved oxygen.

[e] — = Analysis not conducted. DO FLC = Dissolved oxygen measured by the Horiba instrument in a flow-through cell.

Table 5.2-2
Well Development and Aquifer Test Volumes and Field Water-Quality Parameter Measurements at Well R-40i

Date	Time	pH	SP[a] (µS/cm)[b]	T[c] (°C)	Turbidity (NTU)	DO[d] (mg/L)	Salinity %	TOC Result (mg/L)	Comment	End-of-Day Cumulative Purge Volume R-40i (gal.)
R-40i Well Development										
01/12/09	1015	7.54	0.383	14.6	60	4.2	0	—[e]	Bailed	100
01/25/09	1725	6.37	0.421	19.4	23	0.3	0.01	—	Pumped	100
R-40i Preaquifer Test (24 h)										
01/26/09	0806	7.15	0.365	12.4	20	1.09	0.01	—	very (v) Foamy	—
01/26/09	0840	7.12	0.311	17.5	2	1.09	0.01	—	v. Foamy	—
01/26/09	1000	7.32	0.237	17.7	2	1.13	0	10/9.7	Foamy	—
01/26/09	1040	7.38	0.227	17.2	1	1.27	0	—	Foamy	—
01/26/09	1100	7.41	0.224	18.2	1	1.21	0	8.75/8.4	Foamy	660.5
R-40i Aquifer Test (24 h)										
01/27/09	0800	—	—	—	—	—	—	—	Pump on	—
01/27/09	0810	7.97	0.225	8.4	1	0.19	0	—	Foamy	—
01/27/09	1046	7.66	0.225	17	1	0.12	0	—	Foamy	—
01/27/09	1115	7.71	0.219	17.9	1	0.59	0	—	Foamy	—
01/27/09	1200	7.74	0.222	17.4	1	0.71	0	—	Foamy	—
01/27/09	1620	7.77	0.226	17.6	1	0.41	0	—	Less Foam	—
01/27/09	1720	7.74	0.226	16.4	1	0.45	0	—	—	—
01/27/09	1805	7.59	0.228	16.6	1	0.44	0	—	—	—
01/27/09	1905	7.66	0.228	16.9	1	1.71	0	—	—	—
01/27/09	2000	7.77	0.229	17.3	1	0.03	0	—	—	—
01/27/09	2100	7.71	0.227	17	1	0.36	0	—	—	—
01/27/09	2200	7.83	0.23	18.1	1	1.41	0	—	—	—
01/27/09	2300	7.92	.0228	17.2	1	0.45	0	—	—	—
01/27/09	2400	—	—	—	—	—	—	—	—	2708.4

Table 5.2-2 (continued)

Date	Time	pH	SP[a] (µS/cm)[b]	T[c] (°C)	Turbidity (NTU)	DO[d] (mg/L)	Salinity %	TOC Result (mg/L)	Comment	End-of-Day Cumulative Purge Volume R-40i (gal.)
R-40i Aquifer Test (24 h) (continued)										
01/28/09	0000	7.92	0.23	17.5	1	0.43	0	—	—	—
01/28/09	0100	8	0.23	17.4	1	0.58	0	—	—	—
01/28/09	0200	7.96	0.202	17.2	1	0.47	0	—	—	—
01/28/09	0300	8.17	0.23	16.9	1	1.39	0	—	—	—
01/28/09	0400	8.04	0.229	17.4	1	0.39	0	—	—	—
01/28/09	0503	8.02	0.232	17.2	1	1.47	0	—	—	—
01/28/09	0605	7.95	0.231	17.3	1	0.42	0	—	—	—
01/28/09	0721	7.8	0.231	11	1	0.51	0	11.22	—	—
01/28/09	0800	—	—	—	—	—	—	—	Pump off	3784.6
03/05/09	1032	4	4.87	10.7	0	1.61	0.23	—	Calibrate Horiba	—
03/05/09	1045	7.19	0.32	17.1	9	0.08	0.01	—	—	—
03/05/09	1127	7.39	0.253	18.2	3	0.26	0	—	—	03/05/09
03/05/09	1150	7.46	0.246	19.2	2	0.12	0	—	—	03/05/09
03/05/09	1300	7.25	0.225	19.7	1	0.46	0	—	—	03/05/09
03/05/09	1419	7.22	0.218	18	1	0.05	0	—	—	03/05/09
03/05/09	1517	7.45	0.218	17.8	1	1.55	0	—	—	—
03/05/09	1640	7.46	0.217	17.4	0	0.01	0	—	—	—
03/05/09	1700	7.59	0.218	17.1	1	0.35	0	9	Pump off	4577.9
03/06/09	0700	—	—	—	—	—	—	—	Pump on	—
03/06/09	0716	7.27	0.226	13.8	2	0.84	0	14	—	—
03/06/09	0805	7.5	0.215	15.9	2	0.59	0	—	—	—
03/06/09	0903	7.6	0.212	17.7	2	0.5	0	—	—	—
03/06/09	1003	7.67	0.219	18.1	2	0.26	0	—	—	—
03/06/09	1108	7.66	0.215	18.1	0	0.26	0	—	—	—
03/06/09	1203	7.72	0.218	19.8	1	0.65	0	—	—	—
03/06/09	1305	7.68	0.219	19.1	1	0.64	0	—	—	—

Table 5.2-2 (continued)

Date	Time	pH	SP[a] (µS/cm)[b]	T[c] (°C)	Turbidity (NTU)	DO[d] (mg/L)	Salinity %	TOC Result (mg/L)	Comment	End-of-Day Cumulative Purge Volume R-40i (gal.)
R-40i Aquifer Test (24 h) (continued)										
03/06/09	1402	7.71	0.218	18.7	1	0.58	0	—	—	—
03/06/09	1500	7.38	0.22	18	1	0.22	0	10	Pump off	5569.4
03/09/09	0740	—	—	—	—	—	—	—	Pump on	—
03/09/09	0808	7.75	0.246	16	1	0.97	0	—	—	—
03/09/09	0923	7.48	0.215	18.2	0	0.9	0	—	—	—
03/09/09	1615	7.44	0.214	19.4	0	0.42	0	—	—	—
03/09/09	1730	7.61	0.213	19.4	0	0.67	0	—	—	—
03/09/09	1745	7.55	0.214	17.9	0	0.3	0	6.6	Pump off	6701.7
03/10/09	0700	—	—	—	—	—	—	—	Pump on	—
03/10/09	0800	7.71	0.214	16.5	1	0.19	0	—	—	—
03/10/09	0900	7.73	0.212	17.4	1	0.22	0	—	—	—
03/10/09	1000	7.82	0.213	17.5	0	1.02	0	—	—	—
03/10/09	1100	8.02	0.213	19.3	0	1.36	0	—	—	—
03/10/09	1200	7.98	0.214	19.5	1	0.98	0	—	—	—
03/10/09	1300	7.95	0.215	20	1	0.37	0	—	—	—
03/10/09	1400	7.91	0.215	20	0	0.39	0	—	—	—
03/10/09	1500	7.81	0.215	20	0	0.38	0	—	—	—
03/10/09	1600	7.77	0.215	19.4	0	0.49	0	—	—	—
03/10/09	1700	7.7	0.218	19.3	0	0.53	0	—	—	—
03/10/09	1730	7.68	0.217	19.2	0	0.46	0	5	—	—
03/10/09	1745	7.76	0.218	19.3	0	0.47	0	—	Pump off	7797.7
03/11/09	0705	—	—	—	—	—	—	—	Pump on	—
03/11/09	0812	7.48	0.217	16.5	1	0.09	0	—	—	—
03/11/09	0900	7.46	0.217	16.5	0	0.19	0	—	—	—
03/11/09	1000	7.77	0.212	18.2	0	0.21	0	—	—	—
03/11/09	1100	7.78	0.212	18.6	0	0.41	0	—	—	—

Table 5.2-2 (continued)

Date	Time	pH	SP[a] (µS/cm)[b]	T[c] (°C)	Turbidity (NTU)	DO[d] (mg/L)	Salinity %	TOC Result (mg/L)	Comment	End-of-Day Cumulative Purge Volume R-40i (gal.)
R-40i Aquifer Test (24 h) (continued)										
03/11/09	1200	7.78	0.219	19.1	0	0.94	0	—	—	—
03/11/09	1300	7.81	0.215	19.6	0	0.81	0	—	—	—
03/11/09	1400	7.83	0.214	19.9	0	0.46	0	—	—	—
03/11/09	1500	7.83	0.214	19.9	0	0.96	0	—	—	—
03/11/09	16:00	7.73	0.214	19.9	0	0.43	0	—	—	—
03/11/09	1700	7.74	0.215	18.6	0	0.45	0	—	—	—
03/11/09	1800	7.75	0.215	18.4	0	0.2	0	6.9	Pump off	8737.2
03/12/09	1020	—	—	—	—	—	—	—	Pump on	—
03/12/09	10:30	7.75	0.226	16.6	1	0.42	0	—	—	—
03/12/09	1130	7.75	0.224	17.2	0	0.33	0	—	—	—
03/12/09	1230	7.7	0.21	18.6	0	0.18	0	—	—	—
03/12/09	1330	7.7	0.214	19	0	0.08	0	—	—	—
03/12/09	1430	7.72	0.213	19.6	0	0.01	0	—	—	—
03/12/09	1550	7.74	0.217	19.9	0	0.01	0	—	—	—
03/12/09	1650	7.67	0.215	19.4	0	-0.02	0	6	Pump off	9603.2
03/13/09	0700	7.75	0.214	17.6	0	-0.04	0	—	Pump on	—
03/13/09	0800	7.75	0.21	—	—	-0.01	0	—	—	—
03/13/09	0900	7.76	1.209	18.9	1	0.01	0	—	—	—
03/13/09	1000	7.78	0.209	18.9	0	0.08	0	—	—	—
03/13/09	1100	7.92	0.207	18.8	0	0.25	0	—	—	—
03/13/09	1300	7.9	0.209	18.8	0	0.21	0	—	—	—
03/13/09	1400	7.86	0.213	19.2	0	-0.06	0	—	—	—
03/13/09	1500	7.86	0.213	19	0	0.02	0	—	—	—
03/13/09	1600	7.88	0.216	18.7	0	0.03	0	—	—	—
03/13/09	1630	7.88	0.214	17.9	0	0.05	0	5	Pump off	10606.95
03/16/09	0700	7.73	0.24	14.7	1	0.3	0	—	—	—

Table 5.2-2 (continued)

Date	Time	pH	SP[a] (µS/cm)[b]	T[c] (°C)	Turbidity (NTU)	DO[d] (mg/L)	Salinity %	TOC Result (mg/L)	Comment	End-of-Day Cumulative Purge Volume R-40i (gal.)
R-40i Aquifer Test (24 h) (continued)										
03/16/09	0800	.767	0.213	18.2	0	0.38	0	—	—	—
03/16/09	0900	7.78	0.21	18.7	0	0.23	0	—	—	—
03/16/09	1000	7.8	0.205	19.3	0	0.012	0	—	—	—
03/16/09	1100	7.88	0.205	19.4	0	0.18	0	—	—	—
03/16/09	1200	7.9	0.206	19.4	0	0.3	0	—	—	—
03/16/09	1300	7.9	0.207	20	0	0.19	0	—	—	—
03/16/09	1400	7.92	0.207	20.2	0	0.17	0	—	—	—
03/16/09	1500	7.84	0.211	19.2	0	-0.04	0	—	—	—
03/16/09	1600	7.94	0.216	20.2	0	-0.06	0	4.4	direct	—
03/16/09	1601	—	—	—	—	—	—	6	beaker	—
03/16/09	1700	7.95	0.214	20.5	0	0.15	0	—	—	—
03/16/09	1800	7.85	0.214	17	0	0.18	0	—	Pump off	11755.2
03/17/09	0700	7.92	0.218	11.4	0	0.04	0	—	Pump on	—
03/17/09	0800	7.85	0.208	18.1	0	0.08	0	—	—	—
03/17/09	0850	—	—	—	—	—	—	—	Pump off	—
03/17/09	0932	—	—	—	—	—	—	—	Pump on	—
03/17/09	1030	7.87	0.204	17.4	0	-0.61	0	—	—	—
03/17/09	1200	7.94	0.209	19.1	0	0.25	0	—	—	—
03/17/09	1300	7.94	0.211	19.2	0	0.25	0	—	—	—
03/17/09	1400	7.96	0.212	20.5	0	0.24	0	—	—	—
03/17/09	1500	7.85	0.212	20.5	0	0.18	0	—	—	—
03/17/09	1600	7.88	0.216	20.7	0	-0.13	0	—	—	—
03/17/09	1720	7.8	0.216	20.4	0	0.24	0	—	—	—
03/17/09	1800	7.65	0.217	19.5	0	-0.05	0	5.4	Pump off	12976.8
03/18/09	0700	—	—	—	—	—	—	—	Pump on	—
03/18/09	0800	7.72	0.211	17	0	0.08	0	—	—	—

Table 5.2-2 (continued)

Date	Time	pH	SP[a] (µS/cm)[b]	T[c] (°C)	Turbidity (NTU)	DO[d] (mg/L)	Salinity %	TOC Result (mg/L)	Comment	End-of-Day Cumulative Purge Volume R-40i (gal.)
R-40i Aquifer Test (24 h) (continued)										
03/18/09	0900	7.76	0.211	17.1	0	0.02	0	—	—	—
03/18/09	1000	7.82	0.205	17.8	0	0.07	0	—	—	—
03/18/09	1100	7.99	0.212	18.7	0	0.13	0	—	—	—
03/18/09	1200	7.99	0.215	—	0	0.07	0	—	—	—
03/18/09	1300	7.98	0.219	19.3	0	-0.02	0	—	—	—
03/18/09	1400	7.99	0.219	19.6	0	-0.03	0	—	—	—
03/18/09	1500	8.04	0.0218	19.7	0	-0.08	0	—	—	—
03/18/09	1600	7.96	0.219	20.1	0	.018	0	—	—	—
03/18/09	1745	8.02	0.022	20.1	0	0.12	0	6.1	Pump off	14666.8
03/19/09	0702	7.98	0.224	9.1	1	0.62	0	—	Pump on	—
03/19/09	0802	7.96	0.221	9.9	0	0.51	0	—	—	—
03/19/09	1000	7.87	0.213	16.3	0	0.19	0	—	—	—
03/19/09	1100	7.87	0.215	17.3	0	0.05	0	—	—	—
03/19/09	1200	7.89	0.218	18.2	0	-0.04	0	—	—	—
03/19/09	1300	7.89	0.218	18.8	0	-0.04	0	—	—	—
03/19/09	1400	7.96	0.216	19.7	0	0.14	0	—	—	—
03/19/09	1500	7.94	0.221	20.1	1	-0.2	0	—	—	—
03/19/09	1600	7.86	0.218	19.9	1	-0.36	0	—	—	—
03/19/09	1645	7.83	0.222	19.8	0	-0.05	0	—	—	—
03/19/09	1730	7.69	0.22	18.4	0	0.8	0	—	—	—
03/19/09	1800	7.79	0.218	17.9	0	-0.06	0	4.4	Pump off	14666.8
03/20/09	0700	7.88	0.225	11.1	1	-0.15	0	—	Pump on	—
03/20/09	0800	7.84	0.221	15.4	0	-0.12	0	—	—	—
03/20/09	0900	7.76	0.209	18.2	0	-0.08	0	—	—	—
03/20/09	1002	7.81	0.216	18.7	0	-0.25	0	—	—	—
03/20/09	1100	7.87	0.218	19.1	0	-0.46	0	—	—	—

Table 5.2-2 (continued)

Date	Time	pH	SP[a] (µS/cm)[b]	T[c] (°C)	Turbidity (NTU)	DO[d] (mg/L)	Salinity %	TOC Result (mg/L)	Comment	End-of-Day Cumulative Purge Volume R-40i (gal.)
R-40i Aquifer Test (24 h) (continued)										
03/20/09	1200	7.95	0.218	19.1	0	-0.35	0	—	—	—
03/20/09	1300	7.87	0.221	19.2	0	-0.28	0	—	—	—
03/20/09	1400	7.92	0.221	19.4	0	-0.28	0	—	—	—
03/20/09	1500	7.95	0.219	20.1	0	-0.22	0	—	—	—
03/20/09	1545	7.95	0.219	20.3	0	0.01	0	4.1	Pump off	17205.65
03/23/09	0700	7.99	0.214	16	0	-0.37	0	—	—	—
03/23/09	0800	8	0.212	—	0	-.037	0	—	—	—
03/23/09	0900	8.02	0.208	19.9	0	-.032	0	—	—	—
03/23/09	1000	7.99	0.21	19.1	0	-0.38	0	—	—	—
03/23/09	1100	7.96	0.213	18.6	0	-0.45	0	—	—	—
03/23/09	1200	7.98	0.213	18.7	0	-0.44	0	—	—	—
03/23/09	1300	7.99	0.211	18.7	0	-0.41	0	—	—	—
03/23/09	1400	7.92	0.213	18.8	0	0.42	0	—	—	—
03/23/09	1500	7.8	—	—	0	0.36	0	—	—	—
03/23/09	1730	7.89	0.219	19	0	-0.33	0	—	—	—
03/23/09	1800	7.83	0.216	17.7	0	-0.22	0	4.98	Pump off	18990.9
03/24/09	0700	7.71	0.227	14.3	1	-0.17	0	—	—	—
03/24/09	0800	7.89	0.218	16.3	0	-0.21	0	—	—	—
03/24/09	0900	7.94	0.0214	17	0	-0.26	0	—	—	—
03/24/09	1000	7.96	0.215	17.6	0	-0.19	0	—	—	—
03/24/09	1100	7.83	0.0215	18.3	0	-0.23	0	—	—	—
03/24/09	1200	7.83	0.0218	17.4	0	-.024	0	—	—	—
03/24/09	1300	7.84	0.22	18.9	0	-.021	0	—	—	—
03/24/09	1400	7.92	0.0218	19.2	0	-0.21	0	—	—	—
03/24/09	1500	7.8	0.222	19.4	0	-0.29	0	—	—	—
03/24/09	1600	7.96	0.216	18.1	0	-0.08	0	—	—	—

Table 5.2-2 (continued)

Date	Time	pH	SP[a] (µS/cm)[b]	T[c] (°C)	Turbidity (NTU)	DO[d] (mg/L)	Salinity %	TOC Result (mg/L)	Comment	End-of-Day Cumulative Purge Volume R-40i (gal.)
R-40i Aquifer Test (24 h) (continued)										
03/24/09	1700	7.88	0.215	18.9	0	-0.23	0	—	—	—
03/24/09	1740	7.85	0.217	18.4	0	0.43	0	5.8	Pump off	20726.8
03/25/09	0730	7.69	0.218	13.2	1	-0.3	0	—	—	—
03/25/09	0840	7.87	0.207	16.8	0	-0.18	0	—	—	—
03/25/09	1000	7.82	0.213	15.9	0	-0.33	0	—	—	—
03/25/09	1115	7.87	0.213	15.7	0	-0.4	0	—	—	—
03/25/09	1330	7.95	0.21	15.4	0	-0.64	0	—	—	—
03/25/09	1430	8.09	0.207	18.3	0	-0.17	0	—	—	—
03/25/09	1530	7.96	0.213	18.9	0	-0.42	0	—	—	—
03/25/09	1640	7.95	0.214	18.4	0	-0.24	0	3.9	Pump off	21843.5
03/26/09	1030	7.53	0.235	16.1	0	-0.01	0	—	—	—
03/26/09	1200	7.84	0.204	18.1	0	-0.18	0	—	—	—
03/26/09	1300	8.14	0.206	16.8	0	-0.2	0	—	—	—
03/26/09	1430	7.93	0.208	15.7	0	-0.31	0	—	—	—
03/26/09	1600	8.04	0.213	17.4	0	-0.19	0	3.8	Pump off	22768.9
04/03/09	1144	—	—	—	—	—	—	—	Pump on	—
04/03/09	1202	8.19	0.212	13.6	3	-0.34	0	—	—	—
04/03/09	1205	—	—	—	—	—	—	18.7	—	—
04/03/09	1300	8.34	0.203	15	0	-0.02	0	—	—	—
04/03/09	1400	8.2	0.202	16.1	0	-0.11	0	—	—	—
04/03/09	1500	7.99	0.204	18.5	0	-0.22	0	—	—	—
04/03/09	1600	—	—	—	—	—	—	3.1	—	—
04/03/09	1601	7.95	0.201	19.1	0	0.2	0	—	Pump off	23348.3
04/06/09	0815	7.97	0.227	13.9	0	-0.65	0	—	Pump on	—
04/06/09	0850	—	—	—	—	—	—	3.8	—	—
04/06/09	0930	8.02	0.203	17.2	0	-0.44	0	—	—	—

Table 5.2-2 (continued)

Date	Time	pH	SP[a] (µS/cm)[b]	T[c] (°C)	Turbidity (NTU)	DO[d] (mg/L)	Salinity %	TOC Result (mg/L)	Comment	End-of-Day Cumulative Purge Volume R-40i (gal.)
R-40i Aquifer Test (24 h) (continued)										
04/06/09	1030	7.99	0.202	17.1	0	-0.24	0	—	—	—
04/06/09	1130	8.05	0.203	18.6	0	-0.35	0	—	—	—
04/06/09	1230	7.03	0.203	19.1	0	-0.32	0	—	—	—
04/06/09	1330	8.01	0.203	19.9	0	-0.47	0	—	—	—
04/06/09	1430	8.02	0.204	19.9	0	-0.47	0	—	—	—
04/06/09	1600	7.93	0.207	19.8	0	-0.42	0	—	—	—
04/06/09	1700	7.95	0.208	18.3	0	-0.03	0	3.8	Pump off	25045.3
04/07/09	0753	—	—	—	—	—	—	—	Pump on	—
04/07/09	0830	7.91	0.208	12.8	1	-0.3	0	4	—	—
04/07/09	1000	7.99	0.206	18	0	-0.4	0	—	—	—
04/07/09	1100	7.9	0.206	19	0	-0.38	0	—	—	—
04/07/09	1230	7.89	0.205	17.9	0	-0.37	0	—	—	—
04/07/09	1300	7.96	0.204	18.3	0	-0.43	0	—	—	—
04/07/09	1400	7.95	0.208	18.9	0	-0.38	0	—	—	—
04/07/09	1500	7.91	0.209	19.9	0	-0.39	0	—	—	—
04/07/09	1600	7.89	0.209	20.1	0	-0.44	0	—	—	—
04/07/09	1630	7.89	0.209	20.6	0	-0.46	0	4	—	—
04/07/09	1700	7.9	0.212	21.4	0	-0.34	0	—	Pump off	26213.1
04/08/09	0710	—	—	—	—	—	—	—	Pump on	—
04/08/09	0730	7.78	0.217	17.6	0	-0.62	0	6.5	—	—
04/08/09	0830	7.82	0.213	17.6	0	-0.35	0	—	—	—
04/08/09	0930	7.94	0.201	17.9	0	-0.12	0	—	—	—
04/08/09	1030	8.2	0.205	19	0	-0.16	0	—	—	—
04/08/09	1130	8.22	0.207	19.8	0	-0.05	0	—	—	—
04/08/09	1230	8.03	0.209	20.2	0	-0.48	0	—	—	—
04/08/09	1330	8.1	0.211	20.3	0	-0.46	0	—	—	—

Table 5.2-2 (continued)

Date	Time	pH	SP[a] (µS/cm)[b]	T[c] (°C)	Turbidity (NTU)	DO[d] (mg/L)	Salinity %	TOC Result (mg/L)	Comment	End-of-Day Cumulative Purge Volume R-40i (gal.)
R-40i Aquifer Test (24 h) (continued)										
04/08/09	1430	8.16	0.211	20.8	0	-0.07	0	—	—	—
04/08/09	1530	8.03	0.213	20.5	0	-0.48	0	—	—	—
04/08/09	1630	8.02	0.212	20.2	0	-0.14	0	—	—	—
04/08/09	1700	8.09	0.212	19.9	0	0.68	0	3.9	Pump off	28093.1
04/09/09	0700	7.95	0.222	16.7	0	-0.56	0	—	Pump on	—
04/09/09	0730	7.88	0.213	16.9	0	-0.29	0	6.3	—	—
04/09/09	0800	7.9	0.202	16.1	0	-0.32	0	—	—	—
04/09/09	0900	7.93	0.204	17.2	0	-0.51	0	—	—	—
04/09/09	1000	8.02	0.205	17.7	0	-0.37	0	—	—	—
04/09/09	1100	8.06	0.206	18.2	0	0.01	0	—	—	—
04/09/09	1200	7.97	0.21	18.6	0	-0.6	0	—	—	—
04/09/09	1300	7.95	0.21	18.8	0	-0.48	0	—	—	—
04/09/09	1400	7.86	0.211	19.2	1	-0.49	0	—	—	—
04/09/09	1500	8.03	0.212	19.3	0	-0.3	0	—	—	—
04/09/09	1600	8.01	0.0212	19.2	0	-0.41	0	—	—	—
04/09/09	1700	8.02	0.213	19.2	0	-0.25	0	4.1	Pump off	30003.3
04/10/09	0817	—	—	—	—	—	—	—	Pump on	—
04/10/09	0833	8	0.226	12.4	0	-0.31	0	7.1	—	—
04/10/09	0930	7.97	0.203	15.2	0	-0.03	0	—	—	—
04/10/09	1030	8.02	0.206	18	0	-0.21	0	—	—	—
04/10/09	1130	7.89	0.206	19	0	-0.43	0	—	—	—
04/10/09	1200	7.82	0.206	19.3	0	-0.56	0	3.2	Pump off	30781.8
04/13/09	0730	7.96	0.223	16.2	0	-0.7	0	—	Pump on	—
04/13/09	0830	7.97	0.223	16.5	0	-0.72	0	6.6	—	—
04/13/09	0930	8.06	0.202	17.8	0	-0.55	0	—	—	—
04/13/09	1030	7.93	0.199	16	0	-0.77	0	—	—	—

Table 5.2-2 (continued)

Date	Time	pH	SP[a] (µS/cm)[b]	T[c] (°C)	Turbidity (NTU)	DO[d] (mg/L)	Salinity %	TOC Result (mg/L)	Comment	End-of-Day Cumulative Purge Volume R-40i (gal.)
R-40i Aquifer Test (24 h) (continued)										
04/13/09	1130	7.91	0.198	18.2	0	-0.62	0	—	—	—
04/13/09	1230	7.82	0.201	19.1	0	-0.32	0	—	—	—
04/13/09	1330	8.04	0.204	20.4	0	-0.47	0	—	—	—
04/13/09	1430	8.06	0.203	19.7	0	-0.45	0	—	—	—
04/13/09	1530	7.98	0.206	19.7	0	-0.56	0	—	—	—
04/13/09	1630	7.93	0.207	20.1	0	-0.57	0	2.8	—	—
04/13/09	1648	—	—	—	—	—	—	—	Pump off	32441.8
04/14/09	0710	—	—	—	—	—	—	—	Pump on	—
04/14/09	0730	8.09	0.207	16.8	1	-0.28	0	3.8	—	—
04/14/09	0830	8.01	0.207	17.4	0	-0.33	0	—	—	—
04/14/09	0930	8.01	0.206	17.6	1	-0.44	0	—	—	—
04/14/09	1030	8.06	0.206	18.1	1	-0.37	0	—	—	—
04/14/09	1130	8.12	2.207	17.3	0	-0.43	0	—	—	—
04/14/09	1230	7.97	0.201	19.3	0	-0.53	0	—	—	—
04/14/09	1330	7.86	0.203	20	0	-0.54	0	—	—	—
04/14/09	1430	7.92	0.203	20.1	0	-0.06	0	2.1	Pump off	33247.0
04/20/09	0835	—	—	—	—	—	—	—	Pump on	—
04/20/09	0908	6.4	0.255	16.4	0	7.29	0	—	DO FLC	—
04/20/09	0914	4	4.48	14.5	0	0.31	0.22	—	Calibrate Horiba	—
04/20/09	0925	6.28	0.211	17.2	0	7.84	0	1.9	DO FLC	—
04/20/09	1000	7.05	0.201	17.5	0	7.18	0	—	DO FLC	—
04/20/09	1030	7.35	0.199	18.7	0	7.2	0	—	DO FLC	—
04/20/09	1100	7.43	0.203	20	0	7.35	0	—	DO FLC	—
04/20/09	1130	7.6	0.202	19.5	0	7.75	0	—	DO FLC	—
04/20/09	1300	7.76	0.199	17.7	0	8.4	0	—	DO FLC	—
04/20/09	1330	7.91	0.197	20.6	0	8.36	0	—	DO FLC	—

Table 5.2-2 (continued)

Date	Time	pH	SP^a (µS/cm)^b	T^c (^{o}C)	Turbidity (NTU)	DO^d (mg/L)	Salinity %	TOC Result (mg/L)	Comment	End-of-Day Cumulative Purge Volume R-40i (gal.)
R-40i Aquifer Test (24 h) (continued)										
04/20/09	1400	7.84	0.202	20.2	0	8.26	0	—	DO FLC	—
04/20/09	1430	7.92	0.199	19.6	0	8.22	0	—	DO FLC	—
04/20/09	1515	7.83	0.2	20.8	0	8.12	0	—	DO FLC	—
04/20/09	1600	7.88	0.202	18.8	0	8.07	0	—	DO FLC	—
04/20/09	1630	7.76	0.203	20.4	0	7.82	0	—	DO FLC	—
04/20/09	1645	7.85	0.206	19.7	0	7.71	0	1.7	Pump off	34541.8
04/21/09	0700	—	—	—	—	—	—	—	Pump on	—
04/21/09	0730	—	—	—	—	—	—	3.5	—	—
04/21/09	0845	—	—	—	—	—	—	—	Pump off	34791.8
04/21/09	1101	3.99	4.99	21.9	0	1.13	0.23	—	Calibrate Horiba	—
04/21/09	1104	4	4.48	22.4	0	9.02	0.23	—	Calibrate Horiba	—
04/24/09	1445	—	—	—	—	—	—	—	Pump on	—
04/24/09	1500	7.81	0.203	21.1	0	-0.18	0	1.7	—	—
04/24/09	1600	—	—	—	—	—	—	—	Pump off	35002.2
04/27/09	0745	—	—	—	—	—	—	—	Pump on	—
04/27/09	0800	7.44	0.196	18.6	0	0.22	0	1.4	—	—
04/27/09	0900	7.44	0.195	19.1	0	0.37	0	—	—	—
04/27/09	1000	7.49	0.196	19.2	0	-0.34	0	—	—	—
04/27/09	1100	7.57	0.198	19.6	0	-0.28	0	—	—	—
04/27/09	1200	7.43	0.198	19.6	0	0.01	0	—	—	—
04/27/09	1300	7.57	0.201	19.6	0	0.15	0	—	—	—
04/27/09	1400	7.41	0.202	18.5	0	0.28	0	—	—	—
04/27/09	1500	7.46	0.201	20	0	0.19	0	—	—	—
04/27/09	1600	7.39	0.201	21.2	0	0.21	0	—	—	—
04/27/09	1700	7.42	0.203	19.6	0	0.15	0	2.4	Pump off	36804.0

Table 5.2-2 (continued)

Date	Time	pH	SP[a] (µS/cm)[b]	T[c] (°C)	Turbidity (NTU)	DO[d] (mg/L)	Salinity %	TOC Result (mg/L)	Comment	End-of-Day Cumulative Purge Volume R-40i (gal.)
R-40i Aquifer Test (24 h) (continued)										
04/28/09	0700	7.45	0.196	17.9	0	0.25	0	—	Pump on	—
04/28/09	0730	7.45	0.196	17.9	0	0.25	0	2.7	DO FLC	—
04/28/09	0830	7.48	0.198	18.6	0	0.18	0	—	DO FLC	—
04/28/09	0900	7.53	0.201	19.2	0	0.22	0	—	Pump off	37163.2

[a] SP = Specific conductance.

[b] µS/cm = microsiemens per centimeter.

[c] T = Temperature.

[d] DO = Dissolved oxygen.

[e] — = Analysis not conducted. DO FLC = Dissolved oxygen measured by the Horiba instrument in a flow-through cell.

Table 5.5-1
R-40 Survey Coordinates

Northing	Easting	Elevation	Identification
1760801.14	1636628.23	6719.24	R-40 brass monument in cement pad
1760802.14	1636628.23	6719.04	R-40 ground surface adjacent to pad
1760795.42	1636628.21	6722.62	R-40 top of 10-in protective casing
1760795.49	1636628.14	6722.10	R-40 top of stainless steel well casing
1760795.43	1636628.43	6720.01	R-40i top of PVC well casing

Note: All coordinates are expressed as New Mexico State Plane Coordinate System Central Zone (NAD 83); elevation is expressed in feet above mean sea level using the National Geodetic Vertical Datum of 1929.

Table 5.6-1
Summary of Waste Samples Collected during Drilling and Development of R-40

Location ID	Sample ID	Date Collected	Description	Container	Sample Type
R-40	GW40-08-14315	07/28/2008	Dry drill cuttings	Rolloff	Solid
R-40	GW40-08-14316	07/28/2008	Dry drill cuttings	Rolloff	Solid
R-40	GW40-08-14317	07/30/2008	Dry drill cuttings	Rolloff	Solid
R-40	GW40-08-14807	08/07/2008	Hydraulic-oil gravel	Drum	NMSW
R-40	GW37-08-15265	09/18/2008	Dry drill cuttings	Rolloff	Solid
R-40	GW37-08-15267	10/16/2008	Dry drill cuttings	Rolloff	Solid
R-40	GW40-09-516	11/20/2008	Drilling water	1st tank	Liquid
R-40	GW40-09-1609	12/21/2008	Drilling water	Containment pit	Liquid
R-40	GW37-09-1545	12/22/2008	Wet drill cuttings	Containment pit	Solid
R-40	GW40-09-1610	01/29/2009	Development water	2nd tank	Liquid
R-40	GW37-09-6294	03/26/2009	Development water	3rd tank	Liquid
R-40	GW37-09-6305	03/26/2009	Development water	1st tank, resample	Liquid
R-40	GW37-09-6307	03/29/2009	Development water	2nd tank, resample	Liquid
R-40	GW37-09-6304	03/30/2009	Drilling water, resample	Containment pit resample	Liquid
R-40	GW37-09-6296	04/29/2009	Development water	4th tank	Liquid
R-40	GW37-09-6297	04/29/2009	Development water	Poly tanks (2)	Liquid

Appendix A

Acronyms and Abbreviations, Metric Conversion Table, and Data Qualifier Definitions

A-1.0 ACRONYMS AND ABBREVIATIONS

µS/cm	microsiemens per centimeter
amsl	above mean sea level
APS	Accelerator Porosity Sonde
ASTM	American Society for Testing and Materials
bgs	below ground surface
Consent Order	Compliance Order on Consent
cu	capture unit
DO	dissolved oxygen
DTW	depth to water
ECS	Elemental Capture Spectroscopy
EES-14	Earth and Environmental Science Group
ENV-MAQ	Environmental Division–Meteorology and Air Quality
FLC	flow-through cell
gAPI	American Petroleum Institute gamma ray
GR	gamma ray
HE	high explosives
HNGS	Hostile Natural Gamma Spectroscopy
IC	ion chromatography
ICPMS	inductively coupled (argon) plasma mass spectrometry
ICPOES	inductively coupled (argon) plasma optical emission spectroscopy (I
I.D.	inside diameter
LANL	Los Alamos National Laboratory
lbf	pound force
LWSP	LANL Water Stewardship Program
MDA	material disposal area
NMED	New Mexico Environment Department
NMSW	New Mexico special waste
NOI	notice of intent
NTU	nephelometric turbidity unit
O.D.	outside diameter
PVC	polyvinyl chloride
RCRA	Resource Conservation and Recovery Act

RPF	Records Processing Facility
SP	specific conductance
T	temperature
TA	technical area
TD	total depth
TLD	Triple Detector Litho-Density
TOC	total organic carbon
VOC	volatile organic compounds
WDC	WDC Exploration & Wells

A-2.0 METRIC CONVERSION TABLE

Multiply SI (Metric) Unit	by	To Obtain U.S. Customary Unit
kilometers (km)	0.622	miles (mi)
kilometers (km)	3281	feet (ft)
meters (m)	3.281	feet (ft)
meters (m)	39.37	inches (in.)
centimeters (cm)	0.03281	feet (ft)
centimeters (cm)	0.394	inches (in.)
millimeters (mm)	0.0394	inches (in.)
micrometers or microns (µm)	0.0000394	inches (in.)
square kilometers (km^2)	0.3861	square miles (mi^2)
hectares (ha)	2.5	acres
square meters (m^2)	10.764	square feet (ft^2)
cubic meters (m^3)	35.31	cubic feet (ft^3)
kilograms (kg)	2.2046	pounds (lb)
grams (g)	0.0353	ounces (oz)
grams per cubic centimeter (g/cm^3)	62.422	pounds per cubic foot (lb/ft^3)
milligrams per kilogram (mg/kg)	1	parts per million (ppm)
micrograms per gram (µg/g)	1	parts per million (ppm)
liters (L)	0.26	gallons (gal.)
milligrams per liter (mg/L)	1	parts per million (ppm)
degrees Celsius (°C)	9/5 + 32	degrees Fahrenheit (°F)

A-3.0 DATA QUALIFIER DEFINITIONS

Data Qualifier	Definition
U	The analyte was analyzed for but not detected.
J	The analyte was positively identified, and the associated numerical value is estimated to be more uncertain than would normally be expected for that analysis.
J+	The analyte was positively identified, and the result is likely to be biased high.
J-	The analyte was positively identified, and the result is likely to be biased low.
UJ	The analyte was not positively identified in the sample, and the associated value is an estimate of the sample-specific detection or quantitation limit.
R	The data are rejected as a result of major problems with quality assurance/quality control (QA/QC) parameters.

Appendix B

Well R-40 Lithologic Log

LATA-Sharp Remediation Services, Inc.
Borehole Log

Project: LWSP Regional Aquifer Wells **Page 1 of 8**

Borehole Location ID: R-40

TA- 54

AOC/SWMU: NA

Drilling Company: WDC Exploration and Wells

Drilling Equipment: Speedstar 50K

Geologist: Jon Marin

Sampling Equipment: Airlift, bail, and pump

Date: September 9 to November 7, 2008

Attitude: Vertical

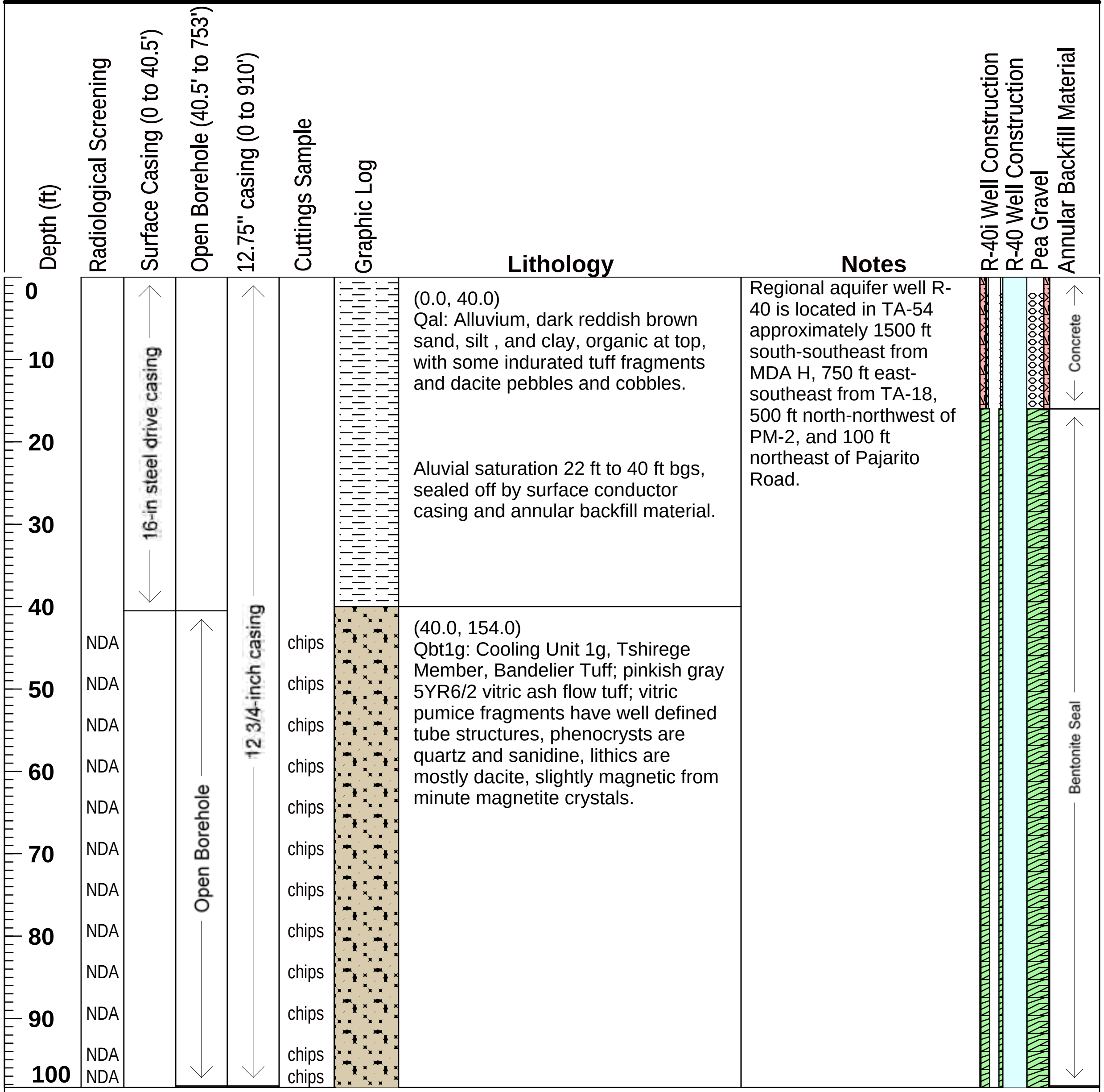
Drill Operator: Hector Leon

DTW R-40i Perched (ft): 640.45 ft

DTW R-40 Screen 1 Perched (ft): 761.33 ft

DTW R-40 Screen 2 Regional (ft): 852.0 ft

Total Depth (ft): 910 ft



Lithology

(0.0, 40.0)
Qal: Alluvium, dark reddish brown sand, silt , and clay, organic at top, with some indurated tuff fragments and dacite pebbles and cobbles.

Aluvial saturation 22 ft to 40 ft bgs, sealed off by surface conductor casing and annular backfill material.

(40.0, 154.0)
Qbt1g: Cooling Unit 1g, Tshirege Member, Bandelier Tuff; pinkish gray 5YR6/2 vitric ash flow tuff; vitric pumice fragments have well defined tube structures, phenocrysts are quartz and sanidine, lithics are mostly dacite, slightly magnetic from minute magnetite crystals.

Notes

Regional aquifer well R-40 is located in TA-54 approximately 1500 ft south-southeast from MDA H, 750 ft east-southeast from TA-18, 500 ft north-northwest of PM-2, and 100 ft northeast of Pajarito Road.

bgs = below ground surface; DTW = Depth to Water (ft bgs); NA = not applicable or not encountered; NDA = No Detectable Activity > 2 X daily- and location-specific radiological background value; Radiological Screening peformed on cuttings for curation; SAA = same as above; SS = A304 stainless steel; TA = Technical Area; TD = Total Depth; WDC = Water Development Corporation.

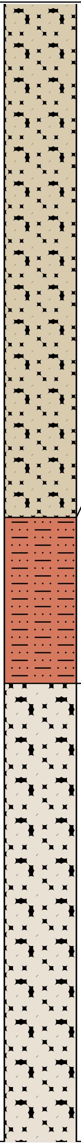
LATA-Sharp Remediation Services, Inc.
Borehole Log

LWSP Regional Aquifer Wells

Well Location ID: R-40

Page 2 of 8

Depth (ft)	Radiological Screening	Surface Casing (0 to 40.5')	Open Borehole (40.5' to 753')	12.75" casing (0 to 910')	Cuttings Sample
100					
	NDA				chips
110	NDA				chips
	NDA				chips
120	NDA				chips
	NDA				chips
130	NDA				chips
	NDA				chips
140	NDA				chips
	NDA				chips
150	NDA				chips
	NDA				chips
160	NDA		Open Borehole	12 3/4-inch casing	chips
	NDA				chips
170	NDA				chips
	NDA				chips
180	NDA				chips
	NDA				chips
190	NDA				chips
	NDA				chips
200	NDA				chips
	NDA				chips
210	NDA				chips
	NDA				chips
220	NDA				chips



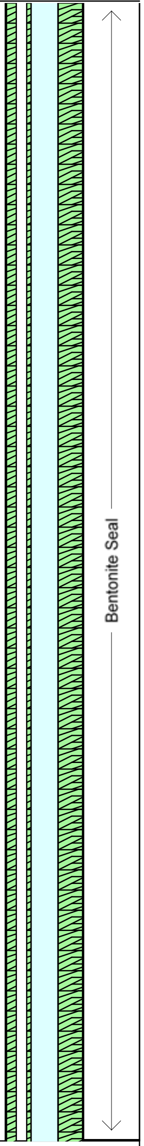
Lithology

Qbt1g: Cooling Unit 1g, Tshirege Member, Bandelier Tuff continued; pinkish gray 5YR6/2 vitric ash flow tuff.

(154.0, 172.0)
Qct: Tephras and volcaniclastic sediments of the Cerro Toledo interval; mostly reworked Otowi Formation tuff and pumice deposits, some sand and gravel lenses, few dacite cobbles and boulders.

(172.0, 430.0)
Qbo: Otowi Member; pinkish gray 5YR7/2 vitric ash flow tuff; vitric pumice fragments, phenocrysts are quartz and sanidine, lithics are mostly dacite, slightly magnetic from minute magnetite crystals.

Notes



bgs = below ground surface; DTW = Depth to Water (ft bgs); NA = not applicable or not encountered; NDA = No Detectable Activity > 2 X daily- and location-specific radiological background value; Radiological Screening peformed on cuttings for curation; SAA = same as above; SS = A304 stainless steel; TA = Technical Area; TD = Total Depth; WDC = Water Development Corporation.

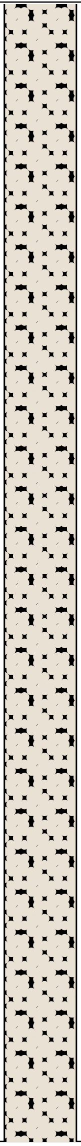
LATA-Sharp Remediation Services, Inc.
Borehole Log

LWSP Regional Aquifer Wells

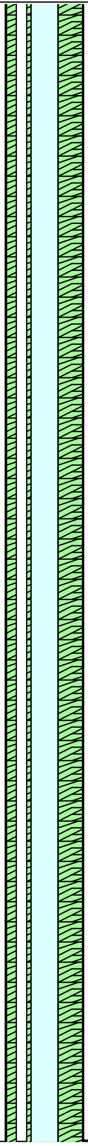
Well Location ID: R-40

Depth (ft)	Radiological Screening	Surface Casing (0 to 40.5')	Open Borehole (40.5' to 753')	12.75" casing (0 to 910')	Cuttings Sample	Lithology	Notes	Annular Backfill Material
	NDA		Open Borehole	12 3/4-inch casing	chips	Qbo: Otowi Member continued; pinkish gray 5YR7/2 vitric ash flow tuff; vitric pumice fragments, phenocrysts are quartz and sanidine, lithics are mostly dacite, slightly magnetic from minute magnetite crystals.		Bentonite Seal
230	NDA				chips			
	NDA				chips			
240	NDA				chips			
	NDA				chips			
250	NDA				chips			
	NDA				chips			
260	NDA				chips			
	NDA				chips			
270	NDA				chips			
	NDA				chips			
280	NDA				chips			
	NDA				chips			
290	NDA				chips			
	NDA				chips			
300	NDA				chips			
	NDA				chips			
310	NDA							
	NDA				chips			
320	NDA				chips			
	NDA				chips			
330	NDA				chips			
	NDA				chips			
340	NDA				chips			
	NDA				chips			

Graphic Log



R-40i Well Construction
R-40 Well Construction



bgs = below ground surface; DTW = Depth to Water (ft bgs); NA = not applicable or not encountered; NDA = No Detectable Activity > 2 X daily- and location-specific radiological background value; Radiological Screening peformed on cuttings for curation; SAA = same as above; SS = A304 stainless steel; TA = Technical Area; TD = Total Depth; WDC = Water Development Corporation.

LATA-Sharp Remediation Services, Inc.
Borehole Log

LWSP Regional Aquifer Wells

Well Location ID: R-40

Page 4 of 8

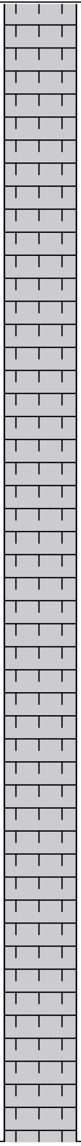
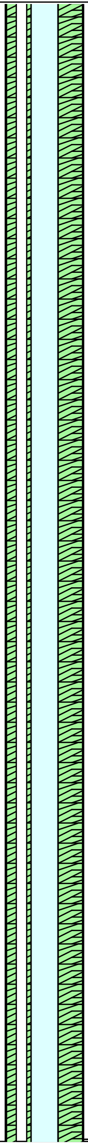
Depth (ft)	Radiological Screening	Surface Casing (0 to 40.5')	Open Borehole (40.5' to 753')	12.75" casing (0 to 910')	Cuttings Sample	Graphic Log	Lithology	Notes	R-40i Well Construction	R-40 Well Construction	Annular Backfill Material
350	NDA				chips		Qbo: Otowi Member continued; pinkish gray 5YR7/2 vitric ash flow tuff; vitric pumice fragments, phenocrysts are quartz and sanidine, lithics are mostly dacite, slightly magnetic from minute magnetite crystals.				
	NDA				chips						
360	NDA				chips						
	NDA				chips						
370	NDA				chips						
	NDA				chips						
380	NDA				chips						
	NDA				chips						
390	NDA				chips						
	NDA				chips						
400	NDA		Open Borehole	12 3/4-inch casing	chips						Bentonite Seal
	NDA				chips						
410	NDA				chips						
	NDA				chips						
420	NDA				chips						
	NDA				chips						
430	NDA				chips		(430.0, 448.0) Qbog: Guaje Pumice Bed consisting mostly of whitish gray, vitric pumice lapilli, ash, and lithics.				
	NDA				chips						
440	NDA				chips						
	NDA				chips						
450	NDA				chips		(448.0, 795.0) Tb4: Cerros del Rio basalt; dark gray N4/, massive, slightly magnetic, few small (< 1mm) vesicles.				
	NDA				chips						
460	NDA				chips						
	NDA				chips						

bgs = below ground surface; DTW = Depth to Water (ft bgs); NA = not applicable or not encountered; NDA = No Detectable Activity > 2 X daily- and location-specific radiological background value; Radiological Screening peformed on cuttings for curation; SAA = same as above; SS = A304 stainless steel; TA = Technical Area; TD = Total Depth; WDC = Water Development Corporation.

LATA-Sharp Remediation Services, Inc.
Borehole Log

LWSP Regional Aquifer Wells

Well Location ID: R-40

Depth (ft)	Radiological Screening	Surface Casing (0 to 40.5')	Open Borehole (40.5' to 753')	12.75" casing (0 to 910')	Cuttings Sample	Graphic Log	Lithology	Notes	R-40i Well Construction R-40 Well Construction	Annular Backfill Material
470	NDA		Open Borehole	12 3/4-inch casing	chips					Bentonite Seal
	NDA				chips					
480	NDA				chips		At 480 ft, same as above (SAA) basalt except light gray N7/0.			
	NDA				chips					
490	NDA				chips		At 490 ft, SAA basalt except reddish gray 2.5 YR 6/1.			
	NDA				chips					
500	NDA				chips		At 500 ft, slightly vesicular basalt, reddish gray 2.5 YR 6/1.			
	NDA				chips					
510	NDA				chips					
	NDA				chips					
520	NDA				chips					
	NDA				chips					
530	NDA				chips					
	NDA				chips					
540	NDA				chips					
	NDA				chips					
550	NDA				chips					
	NDA				chips					
560	NDA				chips					
	NDA				chips					
570	NDA				chips					
	NDA				chips					
580	NDA				chips					
	NDA				chips					
590	NDA				chips		At 590 ft, moderately vesicular basalt.			

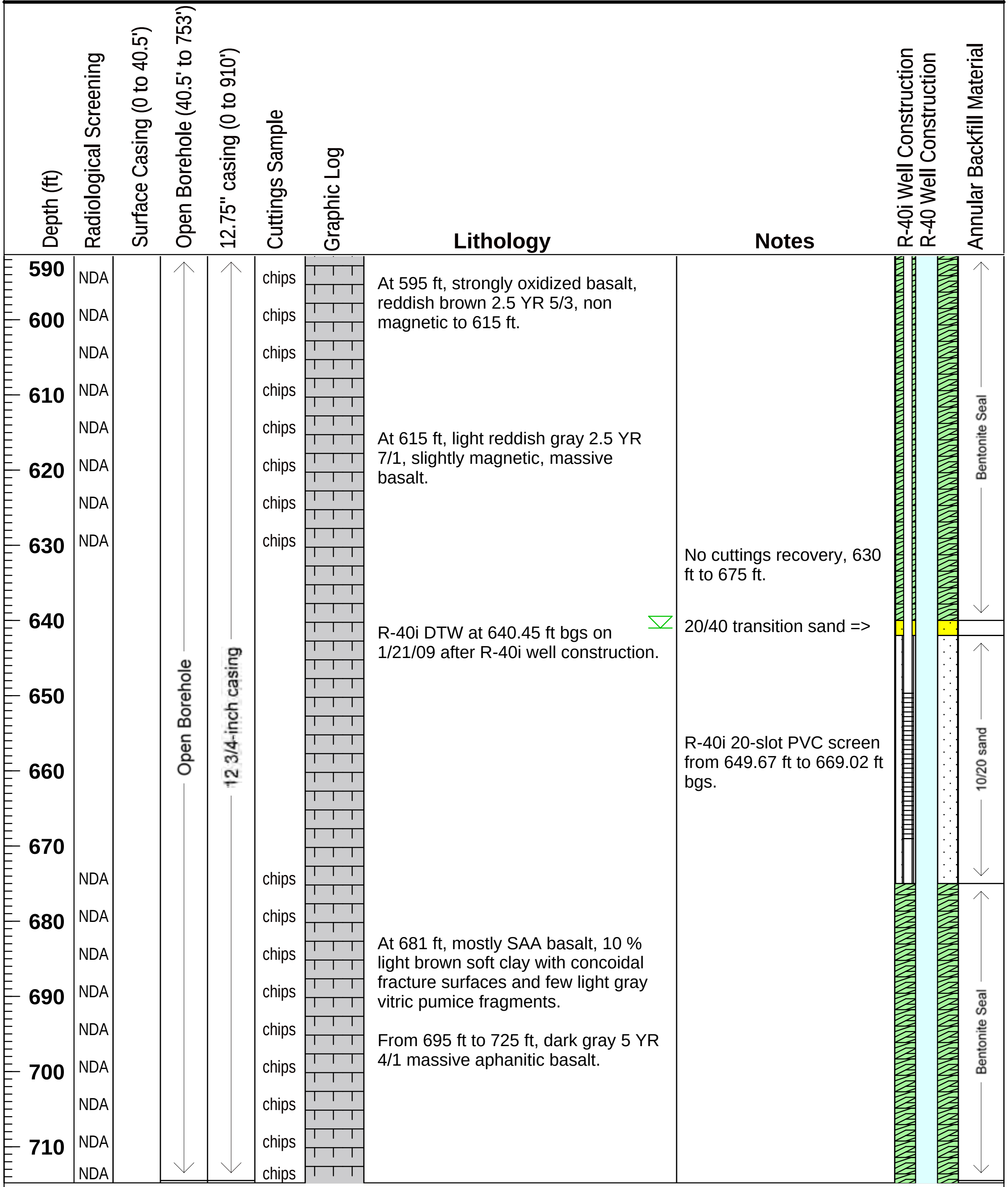
bgs = below ground surface; DTW = Depth to Water (ft bgs); NA = not applicable or not encountered; NDA = No Detectable Activity > 2 X daily- and location-specific radiological background value; Radiological Screening peformed on cuttings for curation; SAA = same as above; SS = A304 stainless steel; TA = Technical Area; TD = Total Depth; WDC = Water Development Corporation.

LATA-Sharp Remediation Services, Inc.
Borehole Log

LWSP Regional Aquifer Wells

Well Location ID: R-40

Page 6 of 8



At 595 ft, strongly oxidized basalt, reddish brown 2.5 YR 5/3, non magnetic to 615 ft.

At 615 ft, light reddish gray 2.5 YR 7/1, slightly magnetic, massive basalt.

R-40i DTW at 640.45 ft bgs on 1/21/09 after R-40i well construction.

At 681 ft, mostly SAA basalt, 10 % light brown soft clay with concoidal fracture surfaces and few light gray vitric pumice fragments.

From 695 ft to 725 ft, dark gray 5 YR 4/1 massive aphanitic basalt.

No cuttings recovery, 630 ft to 675 ft.

20/40 transition sand =>

R-40i 20-slot PVC screen from 649.67 ft to 669.02 ft bgs.

bgs = below ground surface; DTW = Depth to Water (ft bgs); NA = not applicable or not encountered; NDA = No Detectable Activity > 2 X daily- and location-specific radiological background value; Radiological Screening peformed on cuttings for curation; SAA = same as above; SS = A304 stainless steel; TA = Technical Area; TD = Total Depth; WDC = Water Development Corporation.

LATA-Sharp Remediation Services, Inc.
Borehole Log

LWSP Regional Aquifer Wells

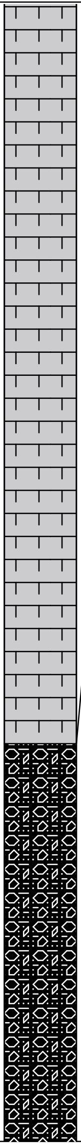
Well Location ID: R-40

Depth (ft)	Radiological Screening	Surface Casing (0 to 40.5')	Open Borehole (40.5' to 753')	12.75" casing (0 to 910')	Cuttings Sample
720	NDA				chips
	NDA				chips
730	NDA				chips
	NDA				chips
740	NDA				chips
	NDA				chips
750	NDA				chips
	NDA				chips
760	NDA				chips
	NDA				chips
770	NDA				chips
	NDA				chips
780	NDA				chips
	NDA				chips
790	NDA				chips
	NDA				chips
800	NDA				chips
	NDA				chips
810	NDA				chips
	NDA				chips
820	NDA				chips
	NDA				chips
830	NDA				chips
	NDA				chips
	NDA				chips

Open Borehole

12 3/4-inch casing

Graphic Log



Lithology

At 725 ft, drilling rate increased slightly. Mostly SAA basalt with some well oxidized mafic-rich sandstone, clay, pumice, glassy highly vesicular basalt.

At 752 ft, drilling rate slowed considerably in massive basalt and led to change from open-borehole drilling to casing advance.

At 753 ft, gray 7.5 YR 5/1, massive ▽ aphanitic basalt

(795.0, 845.0)
Tpf basalt-rich: Puye Formation sedimentary deposits consisting mostly of dark reddish gray 5 YR 4/2, massive to moderately vesicular, rounded to well rounded, basalt sand, gravel, pebbles, and cobbles.

At 807 ft, mostly strongly oxidized highly vesicular to frothy rounded basalt pebbles.

At 812 ft, SAA basalt sediments with 2% quartzite (not introduced quartz sand) and 10% porphyritic dacite clasts.

At 817 ft, highly vesicular, ellipsoidal basalt pumice up to 0.5" x 1" x 1.5".

Notes

20/40 transition sand =>

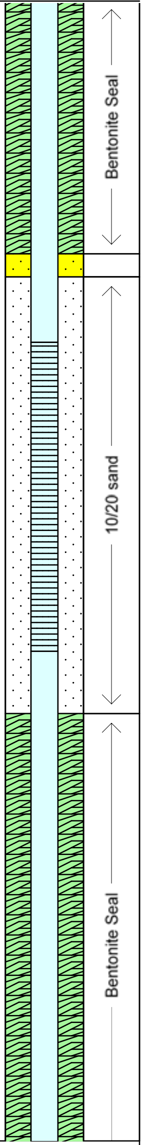
R-40 Screen 1 DTW at 761.33 ft bgs on 1/21/09 after TAM packer installed in well.

R-40 Screen 1: 20-slot wire-wrapped SS from 751.59 ft to 785.06 ft bgs.

From 755 ft to 850 ft, clean poorly sorted quartz sand in cuttings is introduced and was installed to hold 12.75-in casing weight from 400 ft to 753 ft bgs.

At 815 ft, contact metamorphism indicated by quartzite sand imbedded in light green glassy matrix on basalt surface.

R-40i Well Construction / R-40 Well Construction / Annular Backfill Material



bgs = below ground surface; DTW = Depth to Water (ft bgs); NA = not applicable or not encountered; NDA = No Detectable Activity > 2 X daily- and location-specific radiological background value; Radiological Screening peformed on cuttings for curation; SAA = same as above; SS = A304 stainless steel; TA = Technical Area; TD = Total Depth; WDC = Water Development Corporation.

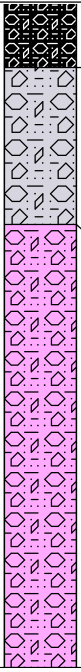
LATA-Sharp Remediation Services, Inc.
Borehole Log

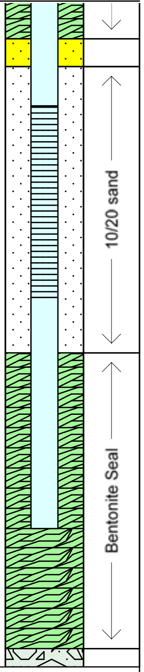
LWSP Regional Aquifer Wells

Well Location ID: R-40

Page 8 of 8

Depth (ft)	Radiological Screening	Surface Casing (0 to 40.5')	Open Borehole (40.5' to 753')	12.75" casing (0 to 910')	Cuttings Sample	Lithology	Notes
840						At 840 ft, drilling rate increased.	
	NDA				chips		20/40 transition sand =>
850	NDA				chips	(845.0, 862.0) Tpf transition zone: Basalt and dacite sediments.	
	NDA				chips		R-40 Screen 2: 20-slot wire-wrapped SS from 849.27 ft to 870.0 ft bgs.
860	NDA				chips	Regional Aquifer DTW at 852 ft bgs on 12/8/09 after well construction.	
	NDA				chips	(862.0, 910.0) Tpf gravel/sand: Puye Formation fanglomerate deposits consisting mostly of poorly sorted porphyritic dacite sand, gravel, pebbles, cobbles, and boulders.	
870	NDA			12 3/4-inch casing	chips		
	NDA				chips		
880	NDA				chips		
	NDA				chips		
890	NDA				chips		
	NDA				chips		
900	NDA				chips		
	NDA				chips		
910	NDA				chips	TD = 910 ft bgs	Borehole Slough =>





bgs = below ground surface; DTW = Depth to Water (ft bgs); NA = not applicable or not encountered; NDA = No Detectable Activity > 2 X daily- and location-specific radiological background value; Radiological Screening peformed on cuttings for curation; SAA = same as above; SS = A304 stainless steel; TA = Technical Area; TD = Total Depth; WDC = Water Development Corporation.

Appendix C

Groundwater Analytical Results

C-1.0 SAMPLING AND ANALYSIS OF GROUNDWATER AT WELLS R-40 AND R-40I

A total of 28 groundwater-screening samples were collected and analyzed for inorganic chemicals during drilling (9 samples) and well development (19 samples) at the vadose zone well R-40i and regional aquifer well R-40 screens 1 and 2. Fifteen and 13 groundwater-screening samples were collected from wells R-40i and R-40, respectively, during development. Well R-40i is completed within the Cerros del Rio basalt, and groundwater-screening samples were collected between a depth interval ranging from 649.7 and 674.6 ft below ground surface (bgs). A total of 34,792 gal. of groundwater was pumped from well R-40i during development. Four groundwater-screening samples were collected from R-40 screen 1 during development between a depth interval ranging from 751.6 to 785.1 ft bgs. Two groundwater-screening samples were collected from R-40 screen 2 between a depth interval ranging from 849.3 and 870.0 ft bgs. Well R-40, screens 1 and 2, are completed within the Cerros del Rio basalt and Puye Formation, respectively. The filtered samples were analyzed for cations, anions, perchlorate, and metals. A total of 18,009 gal. of groundwater was pumped from well R-40 during development.

C-1.1 Field Preparation and Analytical Techniques

Chemical analyses of groundwater-screening samples collected from wells R-40i and R-40 were performed at Los Alamos National Laboratory's (LANL's, or the Laboratory's) Earth and Environmental Sciences Group 14 (EES-14). Groundwater-screening samples were filtered (0.45-µm membranes) before preservation and chemical analyses. Samples were acidified at the EES-14 wet chemistry laboratory with analytical grade nitric acid to a pH of 2.0 or less for metal and major cation analyses.

Groundwater samples were analyzed using techniques specified in the U.S. Environmental Protection Agency SW-846 manual. Ion chromatography (IC) was the analytical method for bromide, chloride, fluoride, nitrate, nitrite, oxalate, perchlorate, phosphate, and sulfate. The instrument detection limits for perchlorate were 0.002 and 0.005 ppm, depending on sample matrix (borehole samples) with interfering anions and presence of residual drilling fluid (AQF-2). Analytical results for perchlorate for groundwater-screening samples collected during well development and aquifer testing at R-40i and R-40 are pending. Inductively coupled (argon) plasma optical emission spectroscopy (ICPOES) was used for analyses of dissolved aluminum, barium, boron, calcium, total chromium, iron, lithium, magnesium, manganese, potassium, silica, sodium, strontium, titanium, and zinc. Dissolved aluminum, antimony, arsenic, barium, beryllium, boron, cadmium, cesium, chromium, cobalt, copper, iron, lead, lithium, manganese, mercury, molybdenum, nickel, rubidium, selenium, silver, thallium, thorium, tin, vanadium, uranium, and zinc were analyzed by inductively coupled (argon) plasma mass spectrometry (ICPMS). The precision limits (analytical error) for major ions and trace elements were generally less than ±7% using ICPOES and ICPMS. Concentrations of total organic carbon (TOC) in nonfiltered groundwater-screening samples collected during well development and aquifer testing were determined by using an organic carbon analyzer. Charge balance errors for total cations and anions were generally less than ±10% for complete analyses of the above inorganic chemicals. The negative cation-anion charge balance values indicate excess anions for the filtered samples. Total carbonate alkalinity was measured using standard titration techniques.

C-1.2 Field Parameters

C-1.2.1 Well Development

Results of field parameters, consisting of pH, temperature, dissolved oxygen (DO), specific conductance, and turbidity measured during development and aquifer testing at well R-40 and R-40i are provided in Table C-1.2-1. Some of the groundwater used for measuring field parameters was bailed from well R-40, which provided aeration that influences pH, DO, and turbidity. Negative DO measurements are considered to be unreliable and are not included in any discussions regarding this field parameter.

Improper calibration of the DO instrument is the suspected cause of the erroneous measurements or readings. Measurements of pH and temperature varied from 5.59 to 8.13 and from 10.2°C to 19.2°C, respectively, in groundwater pumped from well R-40 screen 1 during development and aquifer testing. Groundwater pumped from well R-40 was exposed to the atmosphere, resulting in notable variations in temperature. Reliable concentrations of DO range from 0.16 to 2.95 mg/L, which suggest the presence of residual drilling fluid (AQF-2) and possible microbial degradation of AQF-2, resulting in decreasing DO concentrations. Specific conductance ranged from 222 to 313 microsiemens per centimeter (μS/cm), and turbidity ranged from 0 to 999 nephelometric turbidity units (NTUs) during development of well R-40 screen 1 (Table C-1.2-1), with the initial bailed sample having the highest turbidity. Twenty-four of the 36 turbidity measurements had values less than 5 NTUs during development of well R-40 screen 1. Turbidity values generally decreased during development of well R-40 screen 1.

Measurements of pH and temperature varied from 6.37 to 7.53 and from 14°C to 20°C, respectively, in groundwater pumped from well R-40 screen 2 during development (Table C-1.2-1). Concentrations of DO varied from 1.35 to 5.29 mg/L, which is slightly more oxic than groundwater pumped from R-40 screen 1. Specific conductance ranged from 200 to 335 μS/cm in groundwater pumped from well R-40 screen 2 during development, and turbidity varied from 0 to 999 NTUs. Two of the 40 measurements had turbidity less than 5 NTUs during development of well R-40 screen 2.

Two measurements of pH decreased from 7.54 to 6.37, and temperature increased from 14.6°C to 19.4°C, respectively, in groundwater extracted from the vadose zone well R-40i during development (Table C-1.2-1). Concentrations of DO decreased from 4.2 to 0.3 mg/L, whereas specific conductance increased from 383 to 421 μS/cm, and turbidity decreased from 60 to 23 NTUs during development at well R-40i.

C-1.2.2 Aquifer Performance Testing

Aquifer performance testing was not conducted on well R-40 screen 1 due to a low hydraulic conductivity or permeability of the Cerros del Rio basalt within the screen interval. During aquifer performance testing of well R-40 screen 2, 21 measurements of pH and temperature varied from 6.21 to 7.39 and from 12.4°C to 20.8°C, respectively (Table C-1.2-1). Concentrations of DO varied from 0.51 to 2.17 mg/L during aquifer performance testing of R-40 screen 2. Specific conductance and turbidity decreased from 225 to 179 μS/cm and from 25 to 8 NTUs, respectively, for groundwater pumped from well R-40 screen 2 during development.

Five measurements of pH and temperature generally increased from 7.12 to 7.41 and from 12.4°C to 18.2°C, respectively, during preaquifer performance testing conducted at vadose zone well R-40i (Table C-1.2-1). Concentrations of DO slightly varied from 1.09 to 1.27 mg/L. Specific conductance decreased from 365 to 224 μS/cm, and turbidity decreased from 20 to 1 NTUs for the R-40i groundwater-screening samples taken during preaquifer performance testing.

During aquifer performance testing conducted at well R-40i, 171 measurements of pH and temperature varied from 7.19 to 8.14 and from 8.4°C to 20.3°C, respectively (Table C-1.2-1). Reliable (positive) concentrations of DO ranged from 0.01 to 1.71 mg/L. Specific conductance significantly varied from 202 to 1209 μS/cm, and turbidity varied from 0 to 9 NTU for the R-40i groundwater-screening samples taken during aquifer performance testing. Most of the specific conductance values measured on the groundwater-screening samples, however, were between 202 and 230 μS/cm. Only one turbidity measurement exceeded 5 NTUs during this phase of testing at well R-40i.

C-1.3 Analytical Results for Well R-40i Groundwater-Screening Samples

Analytical results for groundwater-screening samples collected at wells R-40i and R-40 during drilling, well development, and aquifer testing are provided in Table C-1.3-1. Thirty-one groundwater-screening samples were collected and analyzed only for TOC to determine the presence of residual drilling fluid (AQF-2) within the Cerros del Rio basalt and Puye Formation during development at wells R-40i and R-40. Other groundwater-screening samples were collected and analyzed for TOC and inorganic solutes during development at wells R-40i and R-40. Calcium and sodium are the dominant cations in perched intermediate-depth groundwater pumped from well R-40i. During development, dissolved concentrations of calcium and sodium ranged from 15.49 to 17.68 ppm (15.49 to 17.68 mg/L) and from 13.96 to 20.54 ppm, respectively. Dissolved concentrations of chloride and fluoride varied from 3.02 to 4.26 ppm and from 0.34 to 0.52 ppm, respectively, during development at well R-40i (Table C-1.3-1). Dissolved concentrations of nitrate(N) and sulfate ranged from 0.003 to 0.408 ppm and from 6.15 to 7.99 ppm, respectively, at well R-40i. Dissolved concentrations of chloride, nitrate(N), and sulfate do not exceeded Laboratory background within perched intermediate-depth groundwater at well R-40i (LANL 2007, 095817). Maximum background concentrations for dissolved chloride, nitrate plus nitrite(N), and sulfate for perched intermediate-depth groundwater are 6.43 mg/L, 1.78 mg/L, and 34.8 mg/L, respectively (LANL 2007, 095817). Concentrations of TOC generally decreased from 13.9 to 1.4 mgC/L during development at well R-40i (Table C-1.3-1). The background concentration of TOC is 0.45 mgC/L (one sample) for perched intermediate-depth groundwater (LANL 2007, 095817). Concentrations of perchlorate were less than analytical detection (<0.002 and <0.005 ppm, IC method) during drilling at well R-40i (Table C-1.3-1). The combination of low concentrations of nitrate(N) and elevated above-background concentrations of TOC suggest the presence of residual drilling fluid (AQF-2) during early stages of development at well R-40i.

Dissolved concentrations of iron ranged from 0.011 to 0.084 ppm (from 11 to 84 μg/L, or from 11 to 84 ppb) using ICPOES at well R-40i. Dissolved concentrations of manganese ranged from 0.054 to 0.165 ppm (Table C.1-3-1), which exceeded the maximum background value of 3.63 μg/L for perched intermediate-depth groundwater (LANL 2007, 095817). The measured concentrations of dissolved iron and manganese most likely result from using a carbon-steel discharge pipe for sample collection at well R-40i during development. Dissolved concentrations of boron ranged from 0.016 to 0.064 ppm (Table C-1.3-1) at well R-40i, for which most of the groundwater-screening samples have concentrations of this trace element above the maximum background value of 18.0 μg/L for perched intermediate-depth groundwater (LANL 2007, 095817). Dissolved concentrations of nickel ranged from 0.001 to 0.116 ppm (Table C-1.3-1) at well R-40i, which only one groundwater-screening sample exceeded the maximum background value of 29.0 μg/L for perched intermediate-depth groundwater (LANL 2007, 095817). Background mean and median concentrations of nickel in filtered samples, however, are 3.04 and 0.50 μg/L, respectively, for perched intermediate-depth groundwater (LANL 2007, 095817). Dissolved concentrations of zinc ranged from 0.280 to 1.510 ppm in groundwater-screening samples collected from well R-40i (Table C.1-3-1). Background mean, median, and maximum dissolved concentrations of zinc are 3.21 μg/L, 0.75 μg/L, and 19.0 μg/L, respectively, for perched intermediate-depth groundwater (LANL 2007, 095817). Total dissolved concentrations of chromium ranged from 0.001 to 0.006 ppm (1 to 6 μg/L) at well R-40i (Table C-1.3-1). Background mean, median, and maximum concentrations of total dissolved chromium are 0.86 μg/L, 0.50 μg/L, and 2.40 μg/L, respectively, for perched intermediate-depth groundwater (LANL 2007, 095817). Dissolved concentrations of molybdenum ranged from 0.004 to 0.011 ppm (Table C-1.3-1) at well R-40i. Most of the groundwater-screening samples collected from R-40i exceeded the maximum background value of 4.3 μg/L for perched intermediate-depth groundwater (LANL 2007, 095817). Background mean and median concentrations of molybdenum in filtered samples, however, are 1.09 and 0.50 μg/L, respectively, for perched intermediate-depth groundwater (LANL 2007, 095817).

C-1.4 Analytical Results for Well R-40 Groundwater-Screening Samples

Analytical results for groundwater-screening samples collected at well R-40 during drilling, development, and aquifer testing are provided in Table C-1.3-1. Calcium and sodium are the dominant cations in regional aquifer groundwater pumped from well R-40 screens 1 and 2. During well development and aquifer testing of R-40 screen 1, dissolved concentrations of calcium and sodium varied slightly from 20.93 to 21.04 ppm and from 13.58 to 14.89 ppm, respectively (Table C-1.3-1). Dissolved concentrations of chloride and fluoride varied slightly from 2.97 to 3.02 ppm and from 0.38 to 0.53 ppm, respectively, during development and aquifer testing of this screen (Table C-1.3-1). Dissolved concentrations of nitrate(N) were less than analytical detection (0.002 mg/L) in groundwater-screening samples collected from well R-40 screen 1 during development and aquifer testing. It is very likely that nitrate(N) has been reduced by the degradation (oxidation) of residual drilling fluid (AQF-2) in the groundwater-screening samples. Dissolved concentrations of sulfate ranged from 4.80 to 5.19 ppm in the R-40 screen 1 samples. Dissolved concentrations of chloride and sulfate at well R-40 screen 1 do not exceed Laboratory background for the regional aquifer (LANL 2007, 095817). Maximum background concentrations for dissolved chloride and sulfate in the regional aquifer are 5.95 mg/L and 8.63 mg/L, respectively (LANL 2007, 095817). Concentrations of TOC generally decreased from 12.5 to 1.8 mgC/L during development and aquifer testing of well R-40 screen 1 (Table C-1.3-1). The maximum background concentration of TOC is 1.37 mgC/L for the regional aquifer (LANL 2007, 095817).

During development and aquifer testing of well R-40 screen 1, dissolved concentrations of iron and manganese decreased from 0.348 to 0.116 ppm and from 0.101 to 0.069 ppm, respectively (Table C-1.3-1). The measured dissolved concentrations of iron and manganese most likely result from using a corroded carbon-steel discharge pipe for sample collection at well R-40 screen 1 during development and aquifer performance testing. Dissolved concentrations of iron in three of the four groundwater-screening samples exceeded the maximum background value of 147 μg/L for the regional aquifer; however, dissolved concentrations of manganese did not exceed the maximum background value of 124 μg/L (LANL 2007, 095817). Dissolved concentrations of boron ranged from 0.019 to 0.036 ppm (Table C-1.3-1) at well R-40 screen 1, which is below the maximum background value of 51.6 μg/L for the regional aquifer (LANL 2007, 095817). Dissolved concentrations of nickel ranged from 0.003 to 0.009 ppm in groundwater samples collected during both development and aquifer performance testing at well R-40 screen 1. Background mean and median concentrations of nickel in filtered samples are 2.14 and 0.50 μg/L, respectively, for regional aquifer groundwater (LANL 2007, 095817). Dissolved concentrations of zinc ranged from 0.934 to 1.316 ppm in groundwater-screening samples collected at well R-40 screen 1 during development (Table C-1.3-1). The measured concentrations of dissolved zinc most likely result from using a carbon-steel discharge pipe for sample collection at well R-40 during development and aquifer performance testing. Background mean, median, and maximum concentrations of zinc in filtered samples are 3.08 μg/L, 1.45 μg/L, and 32.0 μg/L, respectively, for the regional aquifer (LANL 2007, 095817). The detectable concentration of total dissolved chromium was 0.002 ppm (2 μg/L) in two samples collected from well R-40 screen 1 during aquifer testing (Table C-1.3-1). Background mean, median, and maximum concentrations of total dissolved chromium are 3.07 μg/L, 3.05 μg/L, and 7.20 μg/L, respectively, for the regional aquifer (LANL 2007, 095817). Adsorption of chromium (III, VI) onto the corroded carbon-steel pipe may have taken place during development and aquifer testing of R-40 screen 1. Dissolved concentrations of molybdenum ranged from 0.005 to 0.008 ppm (Table C-1.3-1) at well R-40 screen 1, which all four groundwater-screening samples exceeded the maximum background value of 4.4 μg/L for this trace metal in regional aquifer groundwater (LANL 2007, 095817). Background mean and median concentrations of molybdenum in filtered samples are 1.53 and 1.11 μg/L, respectively, for regional aquifer groundwater (LANL 2007, 095817).

During development of well R-40 screen 2, dissolved concentrations of calcium and sodium varied from 10.90 to 11.89 ppm and from 14.17 to 24.80 ppm, respectively (Table C-1.3-1). Dissolved concentrations of chloride and fluoride varied slightly from 3.48 to 3.74 ppm and from 0.26 to 0.29 ppm, respectively, during development of this screen (Table C-1.3-1). Dissolved concentrations of nitrate(N) increased from 0.103 to 0.316 mg/L in groundwater-screening samples collected from well R-40 screen 2 during development. Dissolved concentrations of sulfate decreased from 16.42 to 6.13 ppm in the R-40 screen 2 samples. Dissolved concentrations of chloride and nitrate(N) at well R-40 screen 1 do not exceed Laboratory background for the regional aquifer (LANL 2007, 095817). Maximum background concentrations for dissolved chloride and nitrate plus nitrite(N) in the regional aquifer are 5.95 mg/L and 1.05 mg/L, respectively (LANL 2007, 095817). Concentrations of dissolved sulfate in several groundwater-screening samples collected from well R-40 screen 2, however, exceed the maximum dissolved concentration for this anion (8.63 mg/L) in the regional aquifer (LANL 2007, 095817). Concentrations of TOC generally decreased from 1.43 to 0.4 mgC/L during development and aquifer testing of well R-40 screen 2 (Table C.1-3-1). The maximum background concentration of TOC is 1.37 mgC/L for the regional aquifer (LANL 2007, 095817).

During development of well R-40 screen 2, dissolved concentrations of iron and manganese varied from 0.010 to 0.012 ppm and from 0.055 to 0.235 ppm, respectively (Table C-1.3-1). The measured dissolved concentrations of manganese most likely result from using a corroded carbon-steel discharge pipe for sample collection at R-40 screen 2 during well development. The low dissolved concentrations of iron, however, are typical of oxidizing conditions prevalent in the regional aquifer (LANL 2007, 095817), and additional iron produced from the corroded carbon-steel discharge pipe is unlikely during this phase of testing at well R-40 screen 2. Dissolved concentrations of boron decreased from 0.042 to 0.015 ppm (Table C-1.3-1) at well R-40 screen 2, which is below the maximum background value of 51.6 μg/L for the regional aquifer (LANL 2007, 095817). Dissolved concentrations of nickel ranged from 0.001 to 0.038 ppm in groundwater samples collected during development at well R-40 screen 2. Background mean and median concentrations of nickel in filtered samples are 2.14 and 0.50 μg/L, respectively, for regional aquifer groundwater (LANL 2007, 095817). There is no obvious explanation of why the concentration of dissolved nickel was elevated in one groundwater-screening sample (GW40-09-8333) collected from well R-40 screen 2 with an analytical error (±0.000 ppm) being acceptable using ICPMS. Dissolved concentrations of zinc ranged from 0.350 to 2.883 ppm in groundwater-screening samples collected at well R-40 screen 2 during development (Table C-1.3-1). The measured concentrations of dissolved zinc most likely result from using a corroded carbon-steel discharge pipe for sample collection at R-40 screen 2 during well development. Background mean, median, and maximum concentrations of zinc in filtered samples are 3.08 μg/L, 1.45 μg/L, and 32.0 μg/L, respectively, for the regional aquifer (LANL 2007, 095817). Concentrations of total dissolved chromium ranged from 0.003 to 0.005 ppm (3 to 5 μg/L) in groundwater-screening samples collected from well R-40 screen 2 (Table C-1.3-1). Background mean, median, and maximum concentrations of total dissolved chromium are 3.07 μg/L, 3.05 μg/L, and 7.20 μg/L, respectively, for the regional aquifer (LANL 2007, 095817). Dissolved concentrations of molybdenum ranged from 0.005 to 0.014 ppm (Table C-1.3-1) at well R-40 screen 2, which all six groundwater-screening samples exceeded the maximum background value of 4.4 μg/L for this trace metal in regional aquifer groundwater (LANL 2007, 095817). Background mean and median concentrations of molybdenum in filtered samples are 1.53 and 1.11 μg/L, respectively, for regional aquifer groundwater (LANL 2007, 095817).

C-2.0 REFERENCES

The following list includes all documents cited in this appendix. Parenthetical information following each reference provides the author(s), publication date, and ER ID. This information is also included in text citations. ER IDs are assigned by the Environmental Programs Directorate's Records Processing Facility (RPF) and are used to locate the document at the RPF and, where applicable, in the master reference set.

Copies of the master reference set are maintained at the NMED Hazardous Waste Bureau and the Directorate. The set was developed to ensure that the administrative authority has all material needed to review this document, and it is updated with every document submitted to the administrative authority. Documents previously submitted to the administrative authority are not included.

LANL (Los Alamos National Laboratory), May 2007. "Groundwater Background Investigation Report, Revision 3," Los Alamos National Laboratory document LA-UR-07-2853, Los Alamos, New Mexico. (LANL 2007, 095817)

Table C-1.2-1
Well Development and Aquifer Test Volumes and Field Water-Quality Parameter Measurements at Wells R-40 and R-40

Date	Time	pH	SP[a] (µS/cm)	T (^oC)	Turbidity (NTU)	DO (mg/L)	End-of-Day Cumulative Purge Volume Screen 2 (gal.)
R-40 Screen 2 Well Development							
01/06/09	15:40	6.64	317	16.4	999	5.29	110
01/07/09	15:15	7.14	330	17.2	58	2.07	—[b]
01/07/09	15:35	7.32	335	16.9	34	1.43	—
01/07/09	15:50	7.34	332	16.7	19	4.95	—
01/07/09	16:05	7.28	4[c]	18.2	16	1.85	—
01/07/09	17:00	7.28	333	15.3	13	4.06	490
01/08/09	8:00	7.53	306	15.2	9	1.7	—
01/08/09	9:35	7.23	290	17.2	14	1.86	—
01/08/09	10:00	7.38	289	19.4	14	1.87	—
01/08/09	11:00	7.41	279	19.4	11	2.25	—
01/08/09	11:45	7.33	268	19.7	10	4.39	—
01/08/09	12:45	7.34	267	19.1	12	4.25	—
01/08/09	13:10	7.29	265	19.5	12	4.32	—
01/08/09	13:42	7.33	257	19.6	76	4.64	—
01/08/09	14:23	7.35	262	14.4	7	4.52	—
01/08/09	15:11	7.33	258	17.4	10	2.03	—
01/08/09	15:45	7.3	255	17.2	10	1.98	—
01/08/09	16:13	7.17	256	15.6	10	2.28	—
01/08/09	16:55	7.22	251	15.8	10	2.02	—
01/08/09	16:57	—	—	—	—	—	2352
01/09/09	7:55	7.47	256	19.2	12	4.32	—
01/09/09	8.24	7.36	250	15.8	21	1.35	—
01/09/09	9:58	6.66	25	15.8	18	—	—
01/09/09	11:30	7.68	247	16.6	13	1.68	—
01/09/09	13:42	7.49	243	18.4	12	1.82	—
01/09/09	14:38	7.38	235	19.2	14	1.49	—
01/09/09	15:20	—	—	—	10	—	—
01/09/09	15:26	6.8	216	17.6	6	5.06	—
01/09/09	16:15	6.97	214	18.2	7	2.52	—
01/09/09	16:41	7.24	210	17.6	6	2.69	—
01/09/09	17:00	7.21	207	18	6	2.19	—
01/09/09	17:01	—	—	—	—	—	4521
01/10/09	7:00	7.04	210	15.6	12	1.83	—
01/10/09	9:00	6.74	214	18.2	10	2.24	—
01/10/09	10:45	7.02	208	17.2	18	2.41	—

Table C-1.2-1 (continued)

Date	Time	pH	SP[a] (µS/cm)	T (°C)	Turbidity (NTU)	DO (mg/L)	End-of-Day Cumulative Purge Volume Screen 2 (gal.)
R-40 Screen 2 Well Development (continued)							
01/10/09	11:17	6.89	208	17.7	15	2.29	—
01/10/09	11:50	7.14	206	16.5	13	2.16	—
01/10/09	12:43	7.08	206	18.8	13	4.12	—
01/10/09	15:16	—	201	18.3	12	—	—
01/10/09	15:52	6.78	200	16.4	11	—	—
01/10/09	16:40	6.37	223	18.4	4	2.56	7145
01/10/09	17:00	6.44	206	17.6	3	2.71	—
01/13/09	8:55	7.33	205	20	10	1.69	—
01/13/09	12:55	6.92	227	19.2	24	1.57	8032
R-40 Screen 2 Aquifer Test (24 h)							
01/14/09	8:00	—	—	—	—	—	—
01/14/09	8:06	7.21	225	15	25	0.51	—
01/14/09	10:56	7.04	209	19.1	22	—	—
01/14/09	11:30	6.21	209	19.2	20	0.99	—
01/14/09	13:45	6.72	197	19.6	15	1	—
01/14/09	16:45	7.09	194	18.1	13	1.4	—
01/14/09	17:30	7.03	192	18.2	12	0.9	—
01/14/09	17:52	6.97	192	14.2	12	0.88	—
01/14/09	19:00	6.66	197	17.3	12	2.17	—
01/14/09	20:00	7.1	190	17.9	12	1.14	—
01/14/09	21:00	7.38	189	20.2	12	1.79	—
01/14/09	22:00	7.38	186	19.9	11	0.91	—
01/14/09	23:00	7.32	187	19.6	10	0.93	—
01/14/09	24:00	—	—	—	—	—	11296
01/15/09	0:00	7.29	184	19	10	0.93	—
01/15/09	1:00	7.24	186	21	9	0.73	—
01/15/09	2:00	7.22	182	19.3	9	1.23	—
01/15/09	3:00	7.09	181	19.2	9	1.23	—
01/15/09	4:00	7.26	181	18.9	10	1	—
01/15/09	5:00	7.28	181	20.8	8	1.33	—
01/15/09	6:00	7.34	181	19	8	1.44	—
01/15/09	7:00	7.39	179	20	8	0.81	—
01/15/09	7:45	7.29	180	19.8	8	0.81	—
01/15/09	8:00	—	—	—	—	—	12987
R-40i Well Development							
01/12/09	10:15	7.54	383	14.6	60	4.2	
01/25/09	17:25	6.37	421	19.4	23	0.3	100

Table C-1.2-1 (continued)

Date	Time	pH	SP[a] (µS/cm)	T (°C)	Turbidity (NTU)	DO (mg/L)	End-of-Day Cumulative Purge Volume Screen 2 (gal.)
R-40i Preaquifer Test (24 h)							
01/26/09	8:06	7.15	365	12.4	20	1.09	—
01/26/09	8:40	7.12	311	17.5	2	1.09	—
01/26/09	10:00	7.32	237	17.7	2	1.13	—
01/26/09	10:40	7.38	227	17.2	1	1.27	—
01/26/09	11:00	7.41	224	18.2	1	1.21	660.5
R-40i Aquifer Test (24 h)							
01/27/09	8:00	—	—	—	—	—	—
01/27/09	8:10	7.97	225	8.4	1	0.19	—
01/27/09	10:46	7.66	225	17	1	0.12	—
01/27/09	11:15	7.71	219	17.9	1	0.59	—
01/27/09	12:00	7.74	222	17.4	1	0.71	—
01/27/09	16:20	7.77	226	17.6	1	0.41	—
01/27/09	17:20	7.74	226	16.4	1	0.45	—
01/27/09	18:05	7.59	228	16.6	1	0.44	—
01/27/09	19:05	7.66	228	16.9	1	1.71	—
01/27/09	20:00	7.77	229	17.3	1	0.03	—
01/27/09	21:00	7.71	227	17	1	0.36	—
01/27/09	22:00	7.83	230	18.1	1	1.41	—
01/27/09	23:00	7.92	228	17.2	1	0.45	—
01/27/09	24:00	—	—	—	—	—	2708.4
01/28/09	0:00	7.92	230	17.5	1	0.43	—
01/28/09	1:00	8	230	17.4	1	0.58	—
01/28/09	2:00	7.96	202	17.2	1	0.47	—
01/28/09	3:00	8.17	230	16.9	1	1.39	—
01/28/09	4:00	8.04	229	17.4	1	0.39	—
01/28/09	5:03	8.02	232	17.2	1	1.47	—
01/28/09	6:05	7.95	231	17.3	1	0.42	—
01/28/09	7:21	7.8	231	11	1	0.51	—
01/28/09	8:00	—	—	—	—	—	3784.6

Table C-1.2-1 (continued)

Date	Time	pH	SP[a] (µS/cm)	T (°C)	Turbidity (NTU)	DO (mg/L)	End-of-Day Cumulative Purge Volume Screen 2 (gal.)
R-40i Continued Well Development							
03/05/09	10:45	7.19	320	17.1	9	0.08	—
03/05/09	11:27	7.39	253	18.2	3	0.26	—
03/05/09	11:50	7.46	246	19.2	2	0.12	—
03/05/09	13:00	7.25	225	19.7	1	0.46	—
03/05/09	14:19	7.22	218	18	1	0.05	—
03/05/09	15:17	7.45	218	17.8	1	1.55	—
03/05/09	16:40	7.46	217	17.4	0	0.01	—
03/05/09	17:00	7.59	218	17.1	1	0.35	4577.9
03/06/09	7:00	—	—	—	—	—	—
03/06/09	7:16	7.27	226	13.8	2	0.84	—
03/06/09	8:05	7.5	215	15.9	2	0.59	—
03/06/09	9:03	7.6	212	17.7	2	0.5	—
03/06/09	10:03	7.67	219	18.1	2	0.26	—
03/06/09	11:08	7.66	215	18.1	0	0.26	—
03/06/09	12:03	7.72	218	19.8	1	0.65	—
03/06/09	13:05	7.68	219	19.1	1	0.64	—
03/06/09	14:02	7.71	218	18.7	1	0.58	—
03/06/09	15:00	7.38	220	18	1	0.22	5569.4
03/09/09	7:40	—	—	—	—	—	—
03/09/09	8:08	7.75	246	16	1	0.97	—
03/09/09	9:23	7.48	215	18.2	0	0.9	—
03/09/09	16:15	7.44	214	19.4	0	0.42	—
03/09/09	17:30	7.61	213	19.4	0	0.67	—
03/09/09	17:45	7.55	214	17.9	0	0.3	6701.7
03/10/09	7:00	—	—	—	—	—	—
03/10/09	8:00	7.71	214	16.5	1	0.19	—
03/10/09	9:00	7.73	212	17.4	1	0.22	—
03/10/09	10:00	7.82	213	17.5	0	1.02	—
03/10/09	11:00	8.02	213	19.3	0	1.36	—
03/10/09	12:00	7.98	214	19.5	1	0.98	—
03/10/09	10:00	7.82	213	17.5	0	1.02	—
03/10/09	13:00	7.95	215	20	1	0.37	—
03/10/09	14:00	7.91	215	20	0	0.39	—
03/10/09	15:00	7.81	215	20	0	0.38	—
03/10/09	16:00	7.77	215	19.4	0	0.49	—
03/10/09	17:00	7.7	218	19.3	0	0.53	—
03/10/09	17:30	7.68	217	19.2	0	0.46	—

Table C-1.2-1 (continued)

Date	Time	pH	SP[a] (μS/cm)	T (^{o}C)	Turbidity (NTU)	DO (mg/L)	End-of-Day Cumulative Purge Volume Screen 2 (gal.)
R-40i Continued Well Development (continued)							
03/10/09	17:45	7.76	218	19.3	0	0.47	7797.7
03/11/09	7:05	—	—	—	—	—	—
03/11/09	8:12	7.48	217	16.5	1	0.09	—
03/11/09	9:00	7.46	217	16.5	0	0.19	—
03/11/09	10:00	7.77	212	18.2	0	0.21	—
03/11/09	11:00	7.78	212	18.6	0	0.41	—
03/11/09	12:00	7.78	219	19.1	0	0.94	—
03/11/09	13:00	7.81	215	19.6	0	0.81	—
03/11/09	14:00	7.83	214	19.9	0	0.46	—
03/11/09	15:00	7.83	214	19.9	0	0.96	—
03/11/09	16:00	7.73	214	19.9	0	0.43	—
03/11/09	17:00	7.74	215	18.6	0	0.45	—
03/11/09	18:00	7.75	215	18.4	0	0.2	8737.2
03/12/09	10:20	—	—	—	—	—	—
03/12/09	10:30	7.75	226	16.6	1	0.42	—
03/12/09	11:30	7.75	224	17.2	0	0.33	—
03/12/09	12:30	7.7	210	18.6	0	0.18	—
03/12/09	13:30	7.7	214	19	0	0.08	—
03/12/09	14:30	7.72	213	19.6	0	0.01	—
03/12/09	15:50	7.74	217	19.9	0	0.01	—
03/12/09	16:50	7.67	215	19.4	0	-0.02	9603.2
03/13/09	7:00	7.75	214	17.6	0	-0.04	—
03/13/09	8:00	7.75	210	—	—	-0.01	—
03/13/09	9:00	7.76	1209	18.9	1	0.01	—
03/13/09	10:00	7.78	209	18.9	0	0.08	—
03/13/09	11:00	7.92	207	18.8	0	0.25	—
03/13/09	13:00	7.9	209	18.8	0	0.21	—
03/13/09	14:00	7.86	213	19.2	0	-0.06	—
03/13/09	15:00	7.86	213	19	0	0.02	—
03/13/09	16:00	7.88	216	18.7	0	0.03	—
03/13/09	16:30	7.88	214	17.9	0	0.05	10606.95
03/16/09	7:00	7.73	240	14.7	1	0.3	—
03/16/09	8:00	.767	213	18.2	0	0.38	—
03/16/09	9:00	7.78	210	18.7	0	0.23	—
03/16/09	10:00	7.8	205	19.3	0	0.012	—
03/16/09	11:00	7.88	205	19.4	0	0.18	—
03/16/09	12:00	7.9	206	19.4	0	0.3	—

Table C-1.2-1 (continued)

Date	Time	pH	SP[a] (µS/cm)	T (°C)	Turbidity (NTU)	DO (mg/L)	End-of-Day Cumulative Purge Volume Screen 2 (gal.)
R-40i Continued Well Development (continued)							
03/16/09	13:00	7.9	207	20	0	0.19	—
03/16/09	14:00	7.92	207	20.2	0	0.17	—
03/16/09	15:00	7.84	211	19.2	0	-0.04	—
03/16/09	16:00	7.94	216	20.2	0	-0.06	—
03/16/09	16:01	—	—	—	—	—	—
03/16/09	17:00	7.95	214	20.5	0	0.15	—
03/16/09	18:00	7.85	214	17	0	0.18	11755.2
03/17/09	7:00	7.92	218	11.4	0	0.04	—
03/17/09	8:00	7.85	208	18.1	0	0.08	—
03/17/09	8:50	—	—	—	—	—	—
03/17/09	9:32	—	—	—	—	—	—
03/17/09	10:30	7.87	204	17.4	0	-0.61	—
03/17/09	12:00	7.94	209	19.1	0	0.25	—
03/17/09	13:00	7.94	211	19.2	0	0.25	—
03/17/09	14:00	7.96	212	20.5	0	0.24	—
03/17/09	15:00	7.85	212	20.5	0	0.18	—
03/17/09	16:00	7.88	216	20.7	0	-0.13	—
03/17/09	17:20	7.8	216	20.4	0	0.24	—
03/17/09	18:00	7.65	217	19.5	0	-0.05	12976.8
03/18/09	7:00	—	—	—	—	—	—
03/18/09	8:00	7.72	211	17	0	0.08	—
03/18/09	9:00	7.76	211	17.1	0	0.02	—
03/18/09	10:00	7.82	205	17.8	0	0.07	—
03/18/09	11:00	7.99	212	18.7	0	0.13	—
03/18/09	12:00	7.99	215	—	0	0.07	—
03/18/09	13:00	7.98	219	19.3	0	-0.02	—
03/18/09	14:00	7.99	219	19.6	0	-0.03	—
03/18/09	15:00	8.04	218	19.7	0	-0.08	—
03/18/09	16:00	7.96	219	20.1	0	.018	—
03/18/09	17:45	8.02	220	20.1	0	0.12	14666.8
03/19/09	7:02	7.98	224	9.1	1	0.62	—
03/19/09	8:02	7.96	221	9.9	0	0.51	—
03/19/09	10:00	7.87	213	16.3	0	0.19	—
03/19/09	11:00	7.87	215	17.3	0	0.05	—
03/19/09	12:00	7.89	218	18.2	0	-0.04	—
03/19/09	13:00	7.89	218	18.8	0	-0.04	—
03/19/09	14:00	7.96	216	19.7	0	0.14	—

Table C-1.2-1 (continued)

Date	Time	pH	SP[a] (µS/cm)	T (°C)	Turbidity (NTU)	DO (mg/L)	End-of-Day Cumulative Purge Volume Screen 2 (gal.)
R-40i Continued Well Development (continued)							
03/19/09	15:00	7.94	221	20.1	1	-0.2	—
03/19/09	16:00	7.86	218	19.9	1	-0.36	—
03/19/09	16:45	7.83	222	19.8	0	-0.05	—
03/19/09	17:30	7.69	220	18.4	0	0.8	—
03/19/09	18:00	7.79	218	17.9	0	-0.06	14666.8
03/20/09	7:00	7.88	225	11.1	1	-0.15	—
03/20/09	8:00	7.84	221	15.4	0	-0.12	—
03/20/09	9:00	7.76	209	18.2	0	-0.08	—
03/20/09	10:02	7.81	216	18.7	0	-0.25	—
03/20/09	11:00	7.87	218	19.1	0	-0.46	—
03/20/09	12:00	7.95	218	19.1	0	-0.35	—
03/20/09	13:00	7.87	221	19.2	0	-0.28	—
03/20/09	14:00	7.92	221	19.4	0	-0.28	—
03/20/09	15:00	7.95	219	20.1	0	-0.22	—
03/20/09	15:45	7.95	219	20.3	0	0.01	17205.65
03/23/09	7:00	7.99	214	16	0	-0.37	—
03/23/09	8:00	8	212	—	0	-0.037	—
03/23/09	9:00	8.02	208	19.9	0	-.032	—
03/23/09	10:00	7.99	210	19.1	0	-.38	—
03/23/09	11:00	7.96	213	18.6	0	-0.45	—
03/23/09	12:00	7.98	213	18.7	0	-0.44	—
03/23/09	13:00	7.99	211	18.7	0	-0.41	—
03/23/09	14:00	7.92	213	18.8	0	0.42	—
03/23/09	15:00	7.8	—	—	0	0.36	—
03/23/09	17:30	7.89	219	19	0	-0.33	—
03/23/09	18:00	7.83	216	17.7	0	-0.22	18990.9
03/24/09	7:00	7.71	227	14.3	1	-0.17	—
03/24/09	8:00	7.89	218	16.3	0	-0.21	—
03/24/09	9:00	7.94	214	17	0	-0.26	—
03/24/09	10:00	7.96	215	17.6	0	-0.19	—
03/24/09	11:00	7.83	215	18.3	0	-0.23	—
03/24/09	12:00	7.83	218	17.4	0	-.024	—
03/24/09	13:00	7.84	220	18.9	0	-.021	—
03/24/09	14:00	7.92	218	19.2	0	-0.21	—
03/24/09	15:00	7.8	222	19.4	0	-0.29	—
03/24/09	16:00	7.96	216	18.1	0	-0.08	—
03/24/09	17:00	7.88	215	18.9	0	-0.23	—

Table C-1.2-1 (continued)

Date	Time	pH	SP[a] (µS/cm)	T (°C)	Turbidity (NTU)	DO (mg/L)	End-of-Day Cumulative Purge Volume Screen 2 (gal.)
R-40i Continued Well Development (continued)							
03/24/09	17:40	7.85	217	18.4	0	0.43	20726.8
03/25/09	7:30	7.69	218	13.2	1	-0.3	—
03/25/09	8:40	7.87	207	16.8	0	-0.18	—
03/25/09	10:00	7.82	213	15.9	0	-0.33	—
03/25/09	11:15	7.87	213	15.7	0	-0.4	—
03/25/09	13:30	7.95	210	15.4	0	-0.64	—
03/25/09	14:30	8.09	207	18.3	0	-0.17	—
03/25/09	15:30	7.96	213	18.9	0	-0.42	—
03/25/09	16:40	7.95	214	18.4	0	-0.24	21843.5
03/26/09	10:30	7.53	235	16.1	0	-0.01	—
03/26/09	12:00	7.84	204	18.1	0	-0.18	—
03/26/09	13:00	8.14	206	16.8	0	-0.2	—
03/26/09	14:30	7.93	208	15.7	0	-0.31	—
03/26/09	16:00	8.04	213	17.4	0	-0.19	22763.5
R-40 Screen 1 Well Development							
01/21/09	16:05	7.57	246	16.6	999	Bail	100
01/25/09	11:00	7.05	229	19.2	18	2.95	—
01/25/09	11:25	5.59	279	18.7	24	Bail	—
01/25/09	12:15	—	—	—	—	—	640
02/03/09	16:15	—	—	—	—	Bail	747
03/03/09	14:35	6.28	313	15.2	25	Pump on	—
03/03/09	14:42	6.56	26	17	2	—	—
03/03/09	14:49	6.8	258	17.6	1	—	—
03/03/09	14:56	7.06	256	16.5	1	—	—
03/03/09	15:01	7.13	257	16.7	2	—	—
03/03/09	15:04	7.16	259	17.8	3	—	—
03/03/09	15:09	7.21	259	17.3	3	—	—
03/03/09	15:15	7.25	263	17.5	3	Pump off	821
03/06/09	15:15	7.39	270	12.2	2	Pump on	—
03/06/09	15:30	7.38	267	14.2	4	—	—
03/06/09	15:45	—	—	—	—	Pump off	861.2
03/12/09	9:50	8.01	274	10.8	9	Pump on	—
03/12/09	10:00	7.78	256	12.8	15	—	—
03/12/09	10:07	7.73	243	15.2	1	—	—
03/12/09	10:12	7.69	235	15.4	1	—	—
03/12/09	10:13	7.65	235	16.1	1	—	—
03/12/09	10:17	7.63	235	16.1	1	—	—

Table C-1.2-1 (continued)

Date	Time	pH	SP[a] (µS/cm)	T (°C)	Turbidity (NTU)	DO (mg/L)	End-of-Day Cumulative Purge Volume Screen 2 (gal.)
R-40 Screen 1 Well Development (continued)							
03/12/09	10:18	—	—	—	—	Pump off	905.7
03/17/09	8:59	—	—	—	—	Pump on	—
03/17/09	9:02	7.95	250	10.2	1	—	—
03/17/09	9:06	7.81	249	12.3	25	—	—
03/17/09	9:08	7.89	244	13.5	11	—	—
03/17/09	9:12	7.81	248	12.7	7	—	—
03/17/09	9:17	7.72	235	15.5	3	—	—
03/17/09	9:20	7.7	233	14.2	2	—	—
03/17/09	9:22	7.68	232	16.1	1	—	—
03/17/09	9:24	7.67	233	14.7	2	Pump off	952.1
03/24/09	15:08	7.98	236	17.4	14	—	—
03/24/09	15:15	8.13	222	14.8	22	—	—
03/24/09	15:20	8.06	241	14.5	11	—	—
03/24/09	15:23	7.87	246	14.8	2	—	—
03/24/09	15:25	7.79	225	15.2	1	—	—
03/24/09	15:29	7.7	224	16.6	1	—	—
03/24/09	15:30	7.67	224	14.7	0	—	—
03/24/09	15:33	7.71	226	15.8	0	—	—
03/24/09	15:38	7.68	225	17	0	Pump off	1014.8

[a] SP = Specific conductivity.

[b] — = Analysis not conducted.

[c] Suspect value.

Table C-1.3-1
Analytical Results for Groundwater-Screening Samples Collected from R-40i and R-40 screens 1 and 2, Pajarito Canyon

Sample ID	Date Received	ER/RRES-WQH	Depth (feet)	Well/Borehole	Activity-Phase	Ag rslt (ppm)	stdev (Ag)	Al rslt (ppm)	stdev (Al)	As rslt (ppm)	stdev (As)	B rslt (ppm)	stdev (B)
RC54-09-1031	11/10/2008	09-246	867	Borehole	Drilling	0.001	U	0.743	0.002	0.0005	0.0000	0.152	0.002
RC54-09-1032	11/10/2008	09-246	887	Borehole	Drilling	0.001	U	0.531	0.003	0.0003	0.0000	0.128	0.001
RC54-09-1033	11/10/2008	09-246	872	Borehole	Drilling	0.001	U	0.273	0.001	0.0002	U	0.107	0.002
RC54-09-1034	11/12/2008	09-278	910	Borehole	Drilling	0.001	U	0.086	0.001	0.0005	0.0000	0.083	0.001
RC54-09-1037	1/8/2009	09-591	853	R-40, screen 1	Pre-well development	0.001	U	0.003	0.000	0.0012	0.0000	0.030	0.000
RC54-09-1038	1/13/2009	09-615	641.7	R-40i	Pre-well development	0.001	U	0.015	0.000	0.0029	0.0001	0.043	0.000
GW40-08-14400	7/31/2008	08-1598	608.2	Borehole	Drilling	0.001	U	0.268	0.002	0.0005	0.0000	0.051	0.001
GW40-08-14401	10/31/2008	09-196	847	Borehole	Drilling	0.001	U	0.137	0.001	0.0002	0.0000	0.025	0.001
GW40-08-14402	10/29/2008	09-186	784	Borehole	Drilling	0.001	U	0.043	0.001	0.0003	0.0000	0.037	0.000
GW40-08-14404	10/30/2008	09-194	809	Borehole	Drilling	0.001	U	0.343	0.002	0.0002	0.0000	0.044	0.001
GW40-08-14405	10/30/2008	09-194	827	Borehole	Drilling	0.001	U	0.376	0.001	0.0003	0.0000	0.037	0.000
GW40-09-1617	1/21/2009	09-696	867.4	R-40, screen 2	Aquifer testing	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1618	1/26/2009	09-734	656.6	R-40i	Development	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1619	1/26/2009	09-734	656.6	R-40i	Development	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1620	2/5/2009	09-781	656.6	R-40i	Aquifer testing	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1621	3/5/2009	09-1086	829.93	R-40, screen 1	Development	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1622	3/5/2009	09-1086	829.93	R-40, screen 1	Development	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1623	3/10/2009	09-1117	668.11	R-40i	Development	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1624	3/10/2009	09-1117	668.11	R-40i	Development	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1625	3/10/2009	09-1143	668.11	R-40i	Development	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1626	3/9/2009	09-1138	834.89	R-40, screen 1	Development	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1627	3/10/2009	09-1157	668.11	R-40i	Development	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1628	3/11/2009	09-1163	668.11	R-40i	Development	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1629	3/12/2009	09-1198	668.11	R-40i	Development	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1630	3/12/2009	09-1198	834.89	R-40, screen 1	Development	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1631	3/12/2009	09-1198	834.89	R-40, screen 1	Development	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1632	3/13/2009	09-1200	668.11	R-40i	Development	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1633	3/16/2009	09-1217	668.11	R-40i	Development	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1634	3/17/2009	09-1232	668.11	R-40i	Development	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1635	3/17/2009	09-1232	668.11	R-40i	Development	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5867	3/18/2009	09-1236	834.89	R-40, screen 1	Development	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5868	3/18/2009	09-1236	834.89	R-40, screen 1	Development	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5869	3/18/2009	09-1247	668.11	R-40i	Development	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5870	3/23/2009	09-1249	668.11	R-40i	Development	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5871	3/23/2009	09-1255	668.11	R-40i	Development	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5872	3/24/2009	09-1269	668.11	R-40i	Development	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5873	3/24/2009	09-1269	668.11	R-40i	Development	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5874	3/25/2009	09-1295	834.89	R-40, screen 1	Development	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5875	3/25/2009	09-1295	834.89	R-40, screen 1	Development	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5876	3/25/2009	09-1295	668.11	R-40i	Development	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5877	3/26/2009	09-1309	668.11	R-40i	Development	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5878	3/30/2009	09-1313	668.11	R-40i	Development	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-6937	4/7/2009	09-1393	834.99	R-40, screen 1	Aquifer testing	0.001	U	0.002	0.000	0.0005	0.0000	0.036	0.001
GW40-09-6938	4/7/2009	09-1393	834.99	R-40, screen 1	Aquifer testing	0.001	U	0.002	0.000	0.0005	0.0001	0.028	0.000
GW40-09-6939	4/7/2009	09-1393	668.11	R-40i	Development	0.001	U	0.002	0.000	0.0015	0.0000	0.026	0.000
GW40-09-6940	4/7/2009	09-1393	668.11	R-40i	Development	0.001	U	0.006	0.000	0.0009	0.0000	0.022	0.000
GW40-09-6941	4/7/2009	09-1393	668.11	R-40i	Development	0.001	U	0.007	0.000	0.0010	0.0000	0.021	0.000
GW40-09-6942	4/8/2009	09-1401	668.11	R-40i	Development	0.001	U	0.007	0.000	0.0010	0.0001	0.018	0.001
GW40-09-6943	4/8/2009	09-1404	668.11	R-40i	Development	0.001	U	0.006	0.000	0.0010	0.0000	0.018	0.000
GW40-09-6944	4/9/2009	09-1424	668.11	R-40i	Development	0.001	U	0.008	0.000	0.0009	0.0000	0.032	0.001
GW40-09-6945	4/9/2009	09-1424	668.11	R-40i	Development	0.001	U	0.009	0.002	0.0015	0.0000	0.026	0.001
GW40-09-6946	4/13/2009	09-1451	668.11	R-40i	Development	0.001	U	0.006	0.000	0.0009	0.0000	0.023	0.000

Table C-1.3-1
Analytical Results for Groundwater-Screening Samples Collected from R-40i and R-40 screens 1 and 2, Pajarito Canyon

Sample ID	Date Received	ER/RRES-WQH	Depth (feet)	Well/Borehole	Activity-Phase	Ag rslt (ppm)	stdev (Ag)	Al rslt (ppm)	stdev (Al)	As rslt (ppm)	stdev (As)	B rslt (ppm)	stdev (B)
GW40-09-6947	4/13/2009	09-1451	668.11	R-40i	Development	0.001	U	0.006	0.001	0.0013	0.0000	0.022	0.000
GW40-09-6948	4/13/2009	09-1451	668.11	R-40i	Development	0.001	U	0.007	0.002	0.0009	0.0000	0.019	0.000
GW40-09-6949	4/13/2009	09-1451	834.99	R-40, screen 1	Development	0.001	U	0.004	0.000	0.0004	0.0000	0.019	0.000
GW40-09-6950	4/13/2009	09-1451	834.99	R-40, screen 1	Development	0.001	U	0.002	0.001	0.0005	0.0000	0.019	0.000
GW40-09-6951	4/13/2009	09-1451	668.11	R-40i	Development	0.001	U	0.011	0.000	0.0013	0.0000	0.018	0.000
GW40-09-6952	4/13/2009	09-1449	668.11	R-40i	Development	0.001	U	0.006	0.000	0.0008	0.0000	0.017	0.000
GW40-09-6953	4/13/2009	09-1449	668.11	R-40i	Development	0.001	U	0.051	0.000	0.0014	0.0000	0.051	0.001
GW40-09-6954	4/20/2009	09-1496	668.11	R-40i	Development	0.001	U	0.003	0.000	0.0009	0.0000	0.064	0.001
GW40-09-6955	4/20/2009	09-1496	668.11	R-40i	Development	0.001	U	0.004	0.000	0.0010	0.0000	0.038	0.001
GW40-09-6956	4/20/2009	09-1496	668.11	R-40i	Development	0.001	U	0.003	0.000	0.0009	0.0000	0.028	0.000
GW40-09-8320	4/23/2009	09-1549	668.11	R-40i	Development	0.001	U	0.004	0.000	0.0009	0.0000	0.022	0.000
GW40-09-8321	4/23/2009	09-1549	668.11	R-40i	Development	0.001	U	0.003	0.000	0.0008	0.0000	0.022	0.001
GW40-09-8322	4/23/2009	09-1549	668.11	R-40i	Development	0.001	U	0.006	0.000	0.0012	0.0000	0.019	0.000
GW40-09-8323	4/27/2009	09-1595	867.4	R-40 screen 2	Development	0.001	U	0.002	0.000	0.0009	0.0000	0.034	0.002
GW40-09-8324	4/27/2009	09-1595	867.4	R-40 screen 2	Development	0.001	U	0.003	0.000	0.0008	0.0000	0.042	0.001
GW40-09-8325	4/27/2009	09-1615	867.4	R-40 screen 2	Development	0.001	U	0.002	0.000	0.0012	0.0000	0.027	0.000
GW40-09-8326	4/27/2009	09-1615	668.11	R-40i	Development	0.001	U	0.003	0.000	0.0010	0.0000	0.025	0.000
GW40-09-8327	4/27/2009	09-1615	668.11	R-40i	Development	0.001	U	0.002	0.000	0.0009	0.0000	0.022	0.000
GW40-09-8328	4/27/2009	09-1615	867.4	R-40 screen 2	Development	0.001	U	0.002	0.000	0.0010	0.0000	0.020	0.000
GW40-09-8329	4/27/2009	09-1615	668.11	R-40i	Development	0.001	U	0.005	0.000	0.0008	0.0000	0.020	0.000
GW40-09-8330	4/30/2009	09-1647	668.11	R-40i	Development	0.001	U	0.003	0.000	0.0008	0.0000	0.018	0.000
GW40-09-8331	4/30/2009	09-1647	867.4	R-40 screen 2	Development	0.001	U	0.003	0.000	0.0009	0.0000	0.017	0.000
GW40-09-8332	4/30/2009	09-1647	668.11	R-40i	Development	0.001	U	0.005	0.000	0.0009	0.0000	0.016	0.001
GW40-09-8333	4/30/2009	09-1647	867.4	R-40 screen 2	Development	0.001	U	0.001	U	0.0008	0.0000	0.015	0.000

Note: During development at well R-40 and R-40i, only TOC was analyzed in some groundwater-screening samples to evaluate the presence of residual drilling fluid (AQF-2).

Table C-1.3-1
Analytical Results for Groundwater-Screening Samples Collected from R-40i and R-40 screens 1 and 2, Pajarito Canyon

Sample ID	Date Received	ER/RRES-WQH	Ba rslt (ppm)	stdev (Ba)	Be rslt (ppm)	stdev (Be)	Br(-) ppm	TOC rslt (ppm)	Ca rslt (ppm)	stdev (Ca)	Cd rslt (ppm)	stdev (Cd)	Cl(-) ppm	ClO4(-) ppm
RC54-09-1031	11/10/2008	09-246	0.388	0.001	0.001	U	0.06	Not applicable	13.69	0.1	0.001	U	4.77	0.005
RC54-09-1032	11/10/2008	09-246	0.464	0.002	0.001	U	0.05	Not applicable	13.66	0.0	0.001	U	7.18	0.005
RC54-09-1033	11/10/2008	09-246	0.283	0.002	0.001	U	0.07	Not applicable	15.35	0.1	0.001	U	4.71	0.005
RC54-09-1034	11/12/2008	09-278	0.298	0.001	0.001	U	0.03	Not applicable	10.22	0.1	0.001	U	2.91	0.002
RC54-09-1037	1/8/2009	09-591	0.034	0.000	0.001	U	0.09	Not applicable	13.21	0.1	0.001	U	3.93	0.005
RC54-09-1038	1/13/2009	09-615	0.031	0.001	0.001	U	0.13	Not applicable	13.36	0.2	0.001	U	8.56	0.005
GW40-08-14400	7/31/2008	08-1598	0.015	0.000	0.001	U	0.02	Not applicable	10.17	0.1	0.001	U	9.15	0.005
GW40-08-14401	10/31/2008	09-196	0.017	0.000	0.001	U	0.10	Not applicable	15.05	0.1	0.001	U	5.32	0.005
GW40-08-14402	10/29/2008	09-186	0.007	0.000	0.001	U	0.11	Not applicable	6.99	0.0	0.001	U	8.23	0.005
GW40-08-14404	10/30/2008	09-194	0.015	0.000	0.001	U	0.08	Not applicable	14.49	0.0	0.001	U	5.93	0.005
GW40-08-14405	10/30/2008	09-194	0.014	0.000	0.001	U	0.06	Not applicable	14.54	0.1	0.001	U	5.33	0.005
GW40-09-1617	1/21/2009	09-696	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	1.43	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1618	1/26/2009	09-734	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	9.49	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1619	1/26/2009	09-734	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	8.51	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1620	2/5/2009	09-781	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	11.2	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1621	3/5/2009	09-1086	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	12.5	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1622	3/5/2009	09-1086	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	4.9	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1623	3/10/2009	09-1117	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	9.2	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1624	3/10/2009	09-1117	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	13.9	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1625	3/10/2009	09-1143	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	10.0	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1626	3/9/2009	09-1138	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	7.7	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1627	3/10/2009	09-1157	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	6.6	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1628	3/11/2009	09-1163	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	5.1	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1629	3/12/2009	09-1198	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	6.9	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1630	3/12/2009	09-1198	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	5.1	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1631	3/12/2009	09-1198	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	5.1	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1632	3/13/2009	09-1200	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	5.9	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1633	3/16/2009	09-1217	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	5.0	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1634	3/17/2009	09-1232	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	4.4	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1635	3/17/2009	09-1232	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	6.0	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5867	3/18/2009	09-1236	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	4.3	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5868	3/18/2009	09-1236	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	4.3	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5869	3/18/2009	09-1247	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	5.4	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5870	3/23/2009	09-1249	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	6.1	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5871	3/23/2009	09-1255	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	4.4	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5872	3/24/2009	09-1269	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	4.1	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5873	3/24/2009	09-1269	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	5.0	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5874	3/25/2009	09-1295	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	3.4	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5875	3/25/2009	09-1295	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	3.2	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5876	3/25/2009	09-1295	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	5.8	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5877	3/26/2009	09-1309	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	3.9	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5878	3/30/2009	09-1313	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	3.8	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-6937	4/7/2009	09-1393	0.039	0.000	0.001	U	0.05	2.2	20.82	0.06	0.001	U	3.02	Pending
GW40-09-6938	4/7/2009	09-1393	0.036	0.001	0.001	U	0.05	2.3	20.93	0.05	0.001	U	2.97	Pending
GW40-09-6939	4/7/2009	09-1393	0.020	0.000	0.001	U	0.05	17.9	21.05	0.09	0.001	U	3.74	Pending
GW40-09-6940	4/7/2009	09-1393	0.016	0.000	0.001	U	0.05	2.9	15.65	0.10	0.001	U	3.71	Pending
GW40-09-6941	4/7/2009	09-1393	0.016	0.000	0.001	U	0.04	3.7	15.51	0.14	0.001	U	3.71	Pending
GW40-09-6942	4/8/2009	09-1401	0.016	0.000	0.001	U	0.05	3.8	16.21	0.04	0.001	U	3.62	Pending
GW40-09-6943	4/8/2009	09-1404	0.016	0.000	0.001	U	0.05	4.0	16.00	0.06	0.001	U	3.67	Pending
GW40-09-6944	4/9/2009	09-1424	0.017	0.001	0.001	U	0.05	4.0	16.96	0.04	0.001	U	3.63	Pending
GW40-09-6945	4/9/2009	09-1424	0.019	0.000	0.001	U	0.05	6.4	17.68	0.10	0.001	U	3.42	Pending
GW40-09-6946	4/13/2009	09-1451	0.018	0.000	0.001	U	0.05	3.9	17.22	0.11	0.001	U	3.52	Pending

Table C-1.3-1
Analytical Results for Groundwater-Screening Samples Collected from R-40i and R-40 screens 1 and 2, Pajarito Canyon

Sample ID	Date Received	ER/RRES-WQH	Ba rslt (ppm)	stdev (Ba)	Be rslt (ppm)	stdev (Be)	Br(-) ppm	TOC rslt (ppm)	Ca rslt (ppm)	stdev (Ca)	Cd rslt (ppm)	stdev (Cd)	Cl(-) ppm	ClO4(-) ppm
GW40-09-6947	4/13/2009	09-1451	0.019	0.000	0.001	U	0.06	6.3	17.76	0.07	0.001	U	3.44	Pending
GW40-09-6948	4/13/2009	09-1451	0.018	0.000	0.001	U	0.05	4.1	17.28	0.04	0.001	U	3.52	Pending
GW40-09-6949	4/13/2009	09-1451	0.039	0.000	0.001	U	0.05	1.9	21.03	0.11	0.001	U	3.02	Pending
GW40-09-6950	4/13/2009	09-1451	0.038	0.001	0.001	U	0.05	1.8	21.04	0.05	0.001	U	3.16	Pending
GW40-09-6951	4/13/2009	09-1451	0.019	0.001	0.001	U	0.07	7.1	17.88	0.14	0.001	U	3.46	Pending
GW40-09-6952	4/13/2009	09-1449	0.017	0.000	0.001	U	0.05	3.2	16.81	0.03	0.001	U	3.59	Pending
GW40-09-6953	4/13/2009	09-1449	0.019	0.000	0.001	U	0.09	6.6	17.36	0.13	0.001	U	3.56	Pending
GW40-09-6954	4/20/2009	09-1496	0.019	0.000	0.001	U	0.10	2.8	15.96	0.09	0.001	U	3.78	Pending
GW40-09-6955	4/20/2009	09-1496	0.019	0.000	0.001	U	0.10	3.8	16.06	0.12	0.001	U	3.82	Pending
GW40-09-6956	4/20/2009	09-1496	0.018	0.000	0.001	U	0.10	2.1	15.90	0.09	0.001	U	3.79	Pending
GW40-09-8320	4/23/2009	09-1549	0.016	0.001	0.001	U	0.08	1.9	15.56	0.10	0.001	U	3.99	Pending
GW40-09-8321	4/23/2009	09-1549	0.017	0.001	0.001	U	0.06	1.7	15.93	0.08	0.001	U	3.95	Pending
GW40-09-8322	4/23/2009	09-1549	0.020	0.000	0.001	U	0.07	3.5	16.22	0.15	0.001	U	3.90	Pending
GW40-09-8323	4/27/2009	09-1595	0.018	0.001	0.001	U	0.08	0.7	11.89	0.03	0.001	U	3.69	Pending
GW40-09-8324	4/27/2009	09-1595	0.020	0.000	0.001	U	0.09	0.6	11.63	0.01	0.001	U	3.74	Pending
GW40-09-8325	4/27/2009	09-1615	0.026	0.001	0.001	U	0.08	0.5	11.44	0.11	0.001	U	3.50	Pending
GW40-09-8326	4/27/2009	09-1615	0.020	0.002	0.001	U	0.10	1.7	15.49	0.08	0.001	U	4.00	Pending
GW40-09-8327	4/27/2009	09-1615	0.018	0.001	0.001	U	0.10	1.4	15.79	0.06	0.001	U	4.02	Pending
GW40-09-8328	4/27/2009	09-1615	0.022	0.000	0.001	U	0.08	0.6	11.05	0.03	0.001	U	3.48	Pending
GW40-09-8329	4/27/2009	09-1615	0.017	0.000	0.001	U	0.09	1.8	15.66	0.08	0.001	U	4.10	Pending
GW40-09-8330	4/30/2009	09-1647	0.018	0.000	0.001	U	0.05	2.4	16.70	0.07	0.001	U	4.15	Pending
GW40-09-8331	4/30/2009	09-1647	0.023	0.000	0.001	U	0.04	0.4	11.38	0.06	0.001	U	3.64	Pending
GW40-09-8332	4/30/2009	09-1647	0.018	0.000	0.001	U	0.06	2.7	16.78	0.10	0.001	U	4.26	Pending
GW40-09-8333	4/30/2009	09-1647	0.021	0.000	0.001	U	0.04	0.5	10.90	0.02	0.001	U	3.64	Pending

Note: During development at well R-40 and R-40i, only TOC was analyzed in some groundwater-screening samples to evaluate the presence of residual drilling fluid (AQF-2).

Table C-1.3-1
Analytical Results for Groundwater-Screening Samples Collected from R-40i and R-40 screens 1 and 2, Pajarito Canyon

Sample ID	Date Received	ER/RRES-WQH	ClO4(-) (U)	Co rslt (ppm)	stdev (Co)	Alk-CO3 rslt (ppı	ALK-CO3 (U)	Cr rslt (ppm)	stdev (Cr)	Cs rslt (ppm)	stdev (Cs)	Cu rslt (ppm)	stdev (Cu)	F(-) ppm
RC54-09-1031	11/10/2008	09-246	U	0.001	U	0.8	U	0.008	0.000	0.001	U	0.001	0.000	0.63
RC54-09-1032	11/10/2008	09-246	U	0.001	U	0.8	U	0.007	0.000	0.001	U	0.001	0.000	1.01
RC54-09-1033	11/10/2008	09-246	U	0.001	U	0.8	U	0.007	0.000	0.001	U	0.001	U	0.58
RC54-09-1034	11/12/2008	09-278	U	0.001	U	0.8	U	0.005	0.000	0.001	U	0.001	U	0.63
RC54-09-1037	1/8/2009	09-591	U	0.001	U	0.8	U	0.001	0.000	0.001	U	0.001	0.000	0.37
RC54-09-1038	1/13/2009	09-615	U	0.001	U	0.8	U	0.001	0.000	0.001	U	0.004	0.000	0.60
GW40-08-14400	7/31/2008	08-1598	U	0.001	U	8.19		0.006	0.000	0.001	U	0.002	0.000	0.78
GW40-08-14401	10/31/2008	09-196	U	0.001	U	0.8	U	0.001	U	0.001	U	0.002	0.000	0.59
GW40-08-14402	10/29/2008	09-186	U	0.001	U	0.8	U	0.001	0.000	0.001	U	0.001	0.000	0.48
GW40-08-14404	10/30/2008	09-194	U	0.001	U	0.8	U	0.001	0.000	0.001	U	0.001	0.000	0.44
GW40-08-14405	10/30/2008	09-194	U	0.001	U	0.8	U	0.001	0.000	0.001	U	0.002	0.000	0.43
GW40-09-1617	1/21/2009	09-696	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1618	1/26/2009	09-734	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1619	1/26/2009	09-734	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1620	2/5/2009	09-781	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1621	3/5/2009	09-1086	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1622	3/5/2009	09-1086	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1623	3/10/2009	09-1117	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1624	3/10/2009	09-1117	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1625	3/10/2009	09-1143	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1626	3/9/2009	09-1138	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1627	3/10/2009	09-1157	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1628	3/11/2009	09-1163	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1629	3/12/2009	09-1198	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1630	3/12/2009	09-1198	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1631	3/12/2009	09-1198	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1632	3/13/2009	09-1200	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1633	3/16/2009	09-1217	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1634	3/17/2009	09-1232	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1635	3/17/2009	09-1232	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5867	3/18/2009	09-1236	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5868	3/18/2009	09-1236	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5869	3/18/2009	09-1247	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5870	3/23/2009	09-1249	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5871	3/23/2009	09-1255	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5872	3/24/2009	09-1269	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5873	3/24/2009	09-1269	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5874	3/25/2009	09-1295	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5875	3/25/2009	09-1295	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5876	3/25/2009	09-1295	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5877	3/26/2009	09-1309	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5878	3/30/2009	09-1313	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-6937	4/7/2009	09-1393		0.001	U	0.8	U	0.002	0.000	0.001	U	0.002	0.000	0.47
GW40-09-6938	4/7/2009	09-1393		0.001	U	0.8	U	0.002	0.000	0.001	U	0.002	0.000	0.53
GW40-09-6939	4/7/2009	09-1393		0.001	U	0.8	U	0.004	0.000	0.001	U	0.001	0.000	0.52
GW40-09-6940	4/7/2009	09-1393		0.001	U	0.8	U	0.003	0.000	0.001	U	0.001	U	0.43
GW40-09-6941	4/7/2009	09-1393		0.001	U	0.8	U	0.002	0.000	0.001	U	0.001	U	0.50
GW40-09-6942	4/8/2009	09-1401		0.001	U	0.8	U	0.003	0.000	0.001	U	0.001	U	0.39
GW40-09-6943	4/8/2009	09-1404		0.001	U	0.8	U	0.002	0.000	0.001	U	0.001	U	0.39
GW40-09-6944	4/9/2009	09-1424		0.001	U	0.8	U	0.001	U	0.001	U	0.001	U	0.40
GW40-09-6945	4/9/2009	09-1424		0.001	U	0.8	U	0.001	U	0.001	U	0.001	U	0.36
GW40-09-6946	4/13/2009	09-1451		0.001	U	0.8	U	0.001	U	0.001	U	0.001	U	0.38

Table C-1.3-1
Analytical Results for Groundwater-Screening Samples Collected from R-40i and R-40 screens 1 and 2, Pajarito Canyon

Sample ID	Date Received	ER/RRES-WQH	ClO4(-) (U)	Co rslt (ppm)	stdev (Co)	Alk-CO3 rslt (ppr	ALK-CO3 (U)	Cr rslt (ppm)	stdev (Cr)	Cs rslt (ppm)	stdev (Cs)	Cu rslt (ppm)	stdev (Cu)	F(-) ppm
GW40-09-6947	4/13/2009	09-1451		0.001	U	0.8	U	0.001	U	0.001	U	0.001	U	0.38
GW40-09-6948	4/13/2009	09-1451		0.001	U	0.8	U	0.001	U	0.001	U	0.001	U	0.38
GW40-09-6949	4/13/2009	09-1451		0.001	U	0.8	U	0.001	U	0.001	U	0.001	0.000	0.38
GW40-09-6950	4/13/2009	09-1451		0.001	U	0.8	U	0.001	U	0.001	U	0.002	0.000	0.38
GW40-09-6951	4/13/2009	09-1451		0.001	U	0.8	U	0.001	U	0.001	U	0.001	0.000	0.37
GW40-09-6952	4/13/2009	09-1449		0.001	U	0.8	U	0.001	U	0.001	U	0.001	U	0.39
GW40-09-6953	4/13/2009	09-1449		0.001	U	0.8	U	0.001	U	0.001	U	0.001	U	0.46
GW40-09-6954	4/20/2009	09-1496		0.001	U	0.8	U	0.001	U	0.001	U	0.001	U	0.35
GW40-09-6955	4/20/2009	09-1496		0.001	U	0.8	U	0.002	0.000	0.001	U	0.001	0.000	0.34
GW40-09-6956	4/20/2009	09-1496		0.001	U	0.8	U	0.001	0.000	0.001	U	0.001	U	0.35
GW40-09-8320	4/23/2009	09-1549		0.001	U	0.8	U	0.004	0.000	0.001	U	0.001	U	0.36
GW40-09-8321	4/23/2009	09-1549		0.001	U	0.8	U	0.003	0.000	0.001	U	0.001	U	0.37
GW40-09-8322	4/23/2009	09-1549		0.001	U	0.8	U	0.004	0.000	0.001	U	0.001	0.000	0.37
GW40-09-8323	4/27/2009	09-1595		0.001	U	0.8	U	0.005	0.000	0.001	U	0.003	0.000	0.27
GW40-09-8324	4/27/2009	09-1595		0.001	U	0.8	U	0.004	0.000	0.001	U	0.002	0.000	0.29
GW40-09-8325	4/27/2009	09-1615		0.001	U	0.8	U	0.005	0.001	0.001	U	0.001	U	0.27
GW40-09-8326	4/27/2009	09-1615		0.001	U	0.8	U	0.006	0.001	0.001	U	0.001	U	0.37
GW40-09-8327	4/27/2009	09-1615		0.001	U	0.8	U	0.005	0.000	0.001	U	0.001	U	0.38
GW40-09-8328	4/27/2009	09-1615		0.001	U	0.8	U	0.004	0.000	0.001	U	0.001	0.000	0.26
GW40-09-8329	4/27/2009	09-1615		0.001	U	0.8	U	0.003	0.000	0.001	U	0.001	U	0.39
GW40-09-8330	4/30/2009	09-1647		0.001	U	0.8	U	0.003	0.000	0.001	U	0.001	U	0.37
GW40-09-8331	4/30/2009	09-1647		0.001	U	0.8	U	0.003	0.000	0.001	U	0.001	U	0.27
GW40-09-8332	4/30/2009	09-1647		0.001	U	0.8	U	0.003	0.000	0.001	U	0.001	U	0.40
GW40-09-8333	4/30/2009	09-1647		0.001	U	0.8	U	0.003	0.000	0.001	U	0.001	U	0.27

Note: During development at well R-40 and R-40i, only TOC was analyzed in some groundwater-screening samples to evaluate the presence of residual drilling fluid (AQF-2).

Table C-1.3-1
Analytical Results for Groundwater-Screening Samples Collected from R-40i and R-40 screens 1 and 2, Pajarito Canyon

Sample ID	Date Received	ER/RRES-WQH	Fe rslt (ppm)	stdev (Fe)	Alk-CO3+HCO3	Hg rslt (ppm)	stdev (Hg)	K rslt (ppm)	stdev (K)	Li rslt (ppm)	stdev (Li)	Mg rslt (ppm)	stdev (Mg)	Mn rslt (ppm)
RC54-09-1031	11/10/2008	09-246	0.483	0.003	106	0.00013	0.00001	2.49	0.01	0.021	0.000	4.95	0.03	0.078
RC54-09-1032	11/10/2008	09-246	0.346	0.000	111	0.00007	0.00000	3.87	0.00	0.044	0.001	4.59	0.01	0.196
RC54-09-1033	11/10/2008	09-246	0.243	0.001	115	0.00005	U	2.68	0.01	0.021	0.000	5.43	0.01	0.177
RC54-09-1034	11/12/2008	09-278	0.262	0.001	77	0.00006	0.00000	1.52	0.00	0.027	0.000	2.88	0.03	0.192
RC54-09-1037	1/8/2009	09-591	0.010	U	170	0.00005	U	2.18	0.02	0.029	0.000	3.84	0.02	0.304
RC54-09-1038	1/13/2009	09-615	0.013	0.000	171	0.00006	0.00001	2.22	0.01	0.047	0.000	3.33	0.01	0.396
GW40-08-14400	7/31/2008	08-1598	0.121	0.002	109	0.00005	U	2.97	0.03	0.014	0.000	5.34	0.06	0.023
GW40-08-14401	10/31/2008	09-196	0.261	0.001	114	0.00006	0.00000	2.35	0.01	0.016	0.000	6.44	0.07	0.101
GW40-08-14402	10/29/2008	09-186	0.010	U	89.2	0.00005	U	2.91	0.02	0.018	0.000	2.86	0.01	0.147
GW40-08-14404	10/30/2008	09-194	0.258	0.002	117	0.00014	0.00001	2.53	0.01	0.015	0.000	6.26	0.01	0.127
GW40-08-14405	10/30/2008	09-194	0.351	0.004	113	0.00011	0.00000	2.43	0.01	0.014	0.000	6.14	0.03	0.110
GW40-09-1617	1/21/2009	09-696	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1618	1/26/2009	09-734	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1619	1/26/2009	09-734	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1620	2/5/2009	09-781	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1621	3/5/2009	09-1086	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1622	3/5/2009	09-1086	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1623	3/10/2009	09-1117	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1624	3/10/2009	09-1117	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1625	3/10/2009	09-1143	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1626	3/9/2009	09-1138	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1627	3/10/2009	09-1157	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1628	3/11/2009	09-1163	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1629	3/12/2009	09-1198	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1630	3/12/2009	09-1198	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1631	3/12/2009	09-1198	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1632	3/13/2009	09-1200	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1633	3/16/2009	09-1217	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1634	3/17/2009	09-1232	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1635	3/17/2009	09-1232	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5867	3/18/2009	09-1236	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5868	3/18/2009	09-1236	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5869	3/18/2009	09-1247	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5870	3/23/2009	09-1249	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5871	3/23/2009	09-1255	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5872	3/24/2009	09-1269	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5873	3/24/2009	09-1269	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5874	3/25/2009	09-1295	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5875	3/25/2009	09-1295	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5876	3/25/2009	09-1295	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5877	3/26/2009	09-1309	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5878	3/30/2009	09-1313	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-6937	4/7/2009	09-1393	0.348	0.002	132	0.00005	U	1.78	0.01	0.03	0.00	6.35	0	0.101
GW40-09-6938	4/7/2009	09-1393	0.195	0.001	130	0.00005	U	1.70	0.01	0.03	0.00	6.23	0	0.081
GW40-09-6939	4/7/2009	09-1393	0.030	0.000	166	0.00005	U	3.63	0.02	0.02	0.00	8.98	0	0.165
GW40-09-6940	4/7/2009	09-1393	0.011	0.000	108	0.00005	U	2.13	0.00	0.01	0.00	6.56	0	0.054
GW40-09-6941	4/7/2009	09-1393	0.016	0.000	112	0.00005	U	1.90	0.01	0.01	0.00	6.33	0	0.100
GW40-09-6942	4/8/2009	09-1401	0.012	0.000	112	0.00020	0.00000	2.14	0.01	0.01	0.00	6.71	0	0.059
GW40-09-6943	4/8/2009	09-1404	0.013	0.000	112	0.00014	0.00001	2.05	0.01	0.01	0.00	6.51	0	0.076
GW40-09-6944	4/9/2009	09-1424	0.010	U	120	0.00007	0.00000	2.12	0.01	0.02	0.00	6.67	0	0.060
GW40-09-6945	4/9/2009	09-1424	0.019	0.000	123	0.00008	0.00001	2.18	0.03	0.02	0.00	6.88	0	0.088
GW40-09-6946	4/13/2009	09-1451	0.010	U	115	0.00006	0.00000	2.13	0.00	0.02	0.00	6.90	0	0.069

Table C-1.3-1
Analytical Results for Groundwater-Screening Samples Collected from R-40i and R-40 screens 1 and 2, Pajarito Canyon

Sample ID	Date Received	ER/RRES-WQH	Fe rslt (ppm)	stdev (Fe)	Alk-CO3+HCO3	Hg rslt (ppm)	stdev (Hg)	K rslt (ppm)	stdev (K)	Li rslt (ppm)	stdev (Li)	Mg rslt (ppm)	stdev (Mg)	Mn rslt (ppm)
GW40-09-6947	4/13/2009	09-1451	0.011	0.000	124	0.00005	U	2.16	0.01	0.02	0.00	6.99	0	0.095
GW40-09-6948	4/13/2009	09-1451	0.010	U	115	0.00005	U	2.13	0.01	0.02	0.00	6.96	0	0.071
GW40-09-6949	4/13/2009	09-1451	0.174	0.000	125	0.00008	0.00000	1.62	0.01	0.03	0.00	5.96	0	0.079
GW40-09-6950	4/13/2009	09-1451	0.116	0.001	125	0.00000	U	1.67	0.01	0.03	0.00	6.10	0	0.069
GW40-09-6951	4/13/2009	09-1451	0.018	0.000	126	0.00008	0.00001	2.32	0.01	0.02	0.00	7.15	0	0.093
GW40-09-6952	4/13/2009	09-1449	0.010	U	112	0.00005	U	2.07	0.01	0.02	0.00	6.67	0	0.061
GW40-09-6953	4/13/2009	09-1449	0.084	0.001	125	0.00005	U	2.35	0.02	0.02	0.00	6.94	0	0.100
GW40-09-6954	4/20/2009	09-1496	0.010	U	112	0.00005	U	2.17	0.01	0.02	0.00	6.65	0	0.057
GW40-09-6955	4/20/2009	09-1496	0.010	U	116	0.00005	U	2.16	0.02	0.02	0.00	6.70	0	0.076
GW40-09-6956	4/20/2009	09-1496	0.010	U	110	0.00005	U	2.14	0.01	0.02	0.00	6.59	0	0.051
GW40-09-8320	4/23/2009	09-1549	0.010	U	119	0.00005	U	3.32	0.03	0.02	0.00	6.32	0	0.108
GW40-09-8321	4/23/2009	09-1549	0.010	U	111	0.00005	U	2.19	0.04	0.02	0.00	6.89	0	0.058
GW40-09-8322	4/23/2009	09-1549	0.011	0.000	118	0.00005	U	2.07	0.02	0.02	0.00	6.40	0	0.075
GW40-09-8323	4/27/2009	09-1595	0.010	U	93	0.00005	U	2.32	0.02	0.03	0.00	3.34	0	0.065
GW40-09-8324	4/27/2009	09-1595	0.010	U	98	0.00005	U	2.43	0.01	0.03	0.00	3.55	0	0.135
GW40-09-8325	4/27/2009	09-1615	0.010	U	86	0.00005	U	1.73	0.01	0.03	0.00	3.08	0	0.071
GW40-09-8326	4/27/2009	09-1615	0.010	U	113	0.00005	U	1.90	0.01	0.02	0.00	6.45	0	0.121
GW40-09-8327	4/27/2009	09-1615	0.010	U	108	0.00005	U	2.01	0.01	0.02	0.00	6.42	0	0.078
GW40-09-8328	4/27/2009	09-1615	0.012	0.001	86	0.00005	U	1.68	0.01	0.03	0.00	3.01	0	0.056
GW40-09-8329	4/27/2009	09-1615	0.068	0.001	108	0.00005	U	1.97	0.01	0.02	0.00	6.24	0	0.072
GW40-09-8330	4/30/2009	09-1647	0.010	U	116	0.00005	U	2.07	0.00	0.01	0.00	6.63	0	0.057
GW40-09-8331	4/30/2009	09-1647	0.010	0.001	83	0.00005	U	1.56	0.00	0.02	0.00	3.00	0	0.058
GW40-09-8332	4/30/2009	09-1647	0.010	0.000	112	0.00005	U	1.99	0.01	0.01	0.00	6.52	0	0.079
GW40-09-8333	4/30/2009	09-1647	0.010	U	89	0.00005	U	1.49	0.01	0.02	0.00	2.85	0	0.055

Note: During development at well R-40 and R-40i, only TOC was analyzed in some groundwater-screening samples to evaluate the presence of residual drilling fluid (AQF-2).

Table C-1.3-1
Analytical Results for Groundwater-Screening Samples Collected from R-40i and R-40 screens 1 and 2, Pajarito Canyon

Sample ID	Date Received	ER/RRES-WQH	stdev (Mn)	Mo rslt (ppm)	stdev (Mo)	Na rslt (ppm)	stdev (Na)	Ni rslt (ppm)	stdev (Ni)	NO2(ppm)	NO2-N rslt	NO3 ppm	NO3-N rslt	C2O4 rslt (ppm	Pb rslt (ppm)
RC54-09-1031	11/10/2008	09-246	0.001	0.067	0.001	19.06	0.08	0.002	0.000	0.01	0.003, U	0.01	0.002, U	0.01, U	0.0005
RC54-09-1032	11/10/2008	09-246	0.001	0.164	0.001	21.01	0.12	0.003	0.000	0.01	0.003, U	0.01	0.002, U	0.37	0.0004
RC54-09-1033	11/10/2008	09-246	0.001	0.043	0.000	18.58	0.15	0.003	0.000	0.01	0.003, U	0.01	0.002, U	0.04	0.0002
RC54-09-1034	11/12/2008	09-278	0.000	0.016	0.000	11.72	0.01	0.002	0.000	0.01	0.003, U	0.85	0.191	0.05	0.0002
RC54-09-1037	1/8/2009	09-591	0.001	0.049	0.000	37.86	0.44	0.003	0.000	0.01	0.003, U	0.01	0.002, U	0.01, U	0.0002
RC54-09-1038	1/13/2009	09-615	0.004	0.052	0.001	59.73	0.47	0.004	0.000	0.01	0.003, U	0.01	0.002, U	0.01, U	0.0002
GW40-08-14400	7/31/2008	08-1598	0.000	0.032	0.000	23.21	0.22	0.003	0.000	1.13	0.344	2.67	0.604	0.23	0.0002
GW40-08-14401	10/31/2008	09-196	0.001	0.021	0.000	18.27	0.09	0.001	U	0.01	0.003, U	0.01	0.002, U	0.05	0.0002
GW40-08-14402	10/29/2008	09-186	0.005	0.060	0.000	27.03	0.11	0.001	0.000	0.01	0.003, U	0.16	0.036	0.16	0.0002
GW40-08-14404	10/30/2008	09-194	0.001	0.026	0.000	21.13	0.02	0.001	U	0.01	0.003, U	0.23	0.053	0.03	0.0002
GW40-08-14405	10/30/2008	09-194	0.001	0.022	0.000	20.07	0.23	0.001	U	0.01	0.003, U	0.20	0.045	0.03	0.0002
GW40-09-1617	1/21/2009	09-696	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1618	1/26/2009	09-734	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1619	1/26/2009	09-734	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1620	2/5/2009	09-781	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1621	3/5/2009	09-1086	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1622	3/5/2009	09-1086	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1623	3/10/2009	09-1117	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1624	3/10/2009	09-1117	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1625	3/10/2009	09-1143	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1626	3/9/2009	09-1138	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1627	3/10/2009	09-1157	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1628	3/11/2009	09-1163	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1629	3/12/2009	09-1198	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1630	3/12/2009	09-1198	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1631	3/12/2009	09-1198	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1632	3/13/2009	09-1200	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1633	3/16/2009	09-1217	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1634	3/17/2009	09-1232	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1635	3/17/2009	09-1232	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5867	3/18/2009	09-1236	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5868	3/18/2009	09-1236	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5869	3/18/2009	09-1247	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5870	3/23/2009	09-1249	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5871	3/23/2009	09-1255	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5872	3/24/2009	09-1269	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5873	3/24/2009	09-1269	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5874	3/25/2009	09-1295	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5875	3/25/2009	09-1295	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5876	3/25/2009	09-1295	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5877	3/26/2009	09-1309	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5878	3/30/2009	09-1313	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-6937	4/7/2009	09-1393	0.007	0.007	0.000	14.89	0.10	0.007	0.000	0.01	0.003, U	0.01	0.002, U	0.05	0.0012
GW40-09-6938	4/7/2009	09-1393	0.001	0.007	0.000	14.33	0.07	0.008	0.000	0.01	0.003, U	0.01	0.002, U	0.04	0.0013
GW40-09-6939	4/7/2009	09-1393	0.001	0.011	0.000	20.54	0.09	0.005	0.000	0.01	0.003, U	0.01	0.003	0.01, U	0.0002
GW40-09-6940	4/7/2009	09-1393	0.000	0.005	0.000	14.90	0.05	0.004	0.000	0.01	0.003, U	1.81	0.408	0.01, U	0.0002
GW40-09-6941	4/7/2009	09-1393	0.001	0.006	0.000	16.35	0.13	0.003	0.000	0.13	0.038	0.83	0.187	0.01, U	0.0002
GW40-09-6942	4/8/2009	09-1401	0.000	0.006	0.000	15.43	0.11	0.012	0.000	0.03	0.008	1.37	0.309	0.01, U	0.0002
GW40-09-6943	4/8/2009	09-1404	0.001	0.009	0.000	15.34	0.08	0.005	0.000	0.10	0.030	1.49	0.337	0.01, U	0.0002
GW40-09-6944	4/9/2009	09-1424	0.001	0.006	0.000	15.39	0.11	0.003	0.000	0.01	0.003, U	1.05	0.237	0.01, U	0.0002
GW40-09-6945	4/9/2009	09-1424	0.000	0.008	0.000	17.06	0.13	0.008	0.000	0.01	0.003, U	0.01	0.002, U	0.01, U	0.0002
GW40-09-6946	4/13/2009	09-1451	0.001	0.006	0.000	15.90	0.06	0.005	0.000	0.01	0.003, U	0.69	0.156	0.01, U	0.0002

Table C-1.3-1
Analytical Results for Groundwater-Screening Samples Collected from R-40i and R-40 screens 1 and 2, Pajarito Canyon

Sample ID	Date Received	ER/RRES-WQH	stdev (Mn)	Mo rslt (ppm)	stdev (Mo)	Na rslt (ppm)	stdev (Na)	Ni rslt (ppm)	stdev (Ni)	NO2(ppm)	NO2-N rslt	NO3 ppm	NO3-N rslt	C2O4 rslt (ppm	Pb rslt (ppm)
GW40-09-6947	4/13/2009	09-1451	0.000	0.007	0.000	17.34	0.03	0.005	0.000	0.01	0.003, U	0.01	0.002, U	0.01, U	0.0002
GW40-09-6948	4/13/2009	09-1451	0.000	0.007	0.000	15.86	0.03	0.002	0.000	0.01	0.003, U	1.02	0.231	0.01, U	0.0002
GW40-09-6949	4/13/2009	09-1451	0.001	0.008	0.000	13.58	0.09	0.003	0.000	0.01	0.003, U	0.01	0.002, U	0.03	0.0004
GW40-09-6950	4/13/2009	09-1451	0.000	0.005	0.000	13.76	0.03	0.009	0.000	0.01	0.003, U	0.01	0.002, U	0.03	0.0004
GW40-09-6951	4/13/2009	09-1451	0.002	0.009	0.000	17.81	0.04	0.002	0.000	0.01	0.003, U	0.01	0.002, U	0.01, U	0.0002
GW40-09-6952	4/13/2009	09-1449	0.001	0.005	0.000	15.19	0.03	0.003	0.000	0.01	0.003, U	1.38	0.311	0.01, U	0.0002
GW40-09-6953	4/13/2009	09-1449	0.002	0.006	0.000	18.69	0.09	0.116	0.001	0.01	0.003, U	0.01	0.002, U	0.01, U	0.0002
GW40-09-6954	4/20/2009	09-1496	0.001	0.005	0.000	15.77	0.05	0.006	0.000	0.01	0.003, U	1.21	0.274	0.01, U	0.0002
GW40-09-6955	4/20/2009	09-1496	0.000	0.006	0.000	16.59	0.08	0.024	0.000	0.06	0.018	0.43	0.096	0.01, U	0.0002
GW40-09-6956	4/20/2009	09-1496	0.000	0.005	0.000	15.27	0.10	0.006	0.000	0.01	0.003, U	1.65	0.373	0.01, U	0.0002
GW40-09-8320	4/23/2009	09-1549	0.002	0.005	0.000	15.68	0.05	0.002	0.000	0.01	0.003, U	0.01	0.002, U	0.01, U	0.0002
GW40-09-8321	4/23/2009	09-1549	0.000	0.005	0.000	15.49	0.20	0.003	0.000	0.01	0.003, U	0.99	0.224	0.01, U	0.0002
GW40-09-8322	4/23/2009	09-1549	0.002	0.006	0.000	15.47	0.04	0.015	0.000	0.01	0.003, U	0.19	0.044	0.01, U	0.0002
GW40-09-8323	4/27/2009	09-1595	0.001	0.010	0.000	19.10	0.19	0.003	0.000	0.01	0.003, U	0.90	0.202	0.01, U	0.0002
GW40-09-8324	4/27/2009	09-1595	0.001	0.014	0.000	24.80	0.29	0.003	0.000	0.01	0.003, U	0.46	0.103	0.01, U	0.0002
GW40-09-8325	4/27/2009	09-1615	0.007	0.007	0.000	16.14	0.13	0.002	0.000	0.01	0.003, U	1.01	0.229	0.01, U	0.0002
GW40-09-8326	4/27/2009	09-1615	0.009	0.005	0.000	16.03	0.09	0.001	0.000	0.20	0.06	0.34	0.076	0.01, U	0.0002
GW40-09-8327	4/27/2009	09-1615	0.002	0.004	0.000	14.67	0.15	0.001	0.000	0.13	0.040	1.07	0.241	0.01, U	0.0002
GW40-09-8328	4/27/2009	09-1615	0.000	0.006	0.000	16.05	0.13	0.001	0.000	0.01	0.003, U	1.08	0.243	0.01, U	0.0002
GW40-09-8329	4/27/2009	09-1615	0.001	0.004	0.000	13.96	0.04	0.001	0.000	0.16	0.049	1.75	0.395	0.01, U	0.0002
GW40-09-8330	4/30/2009	09-1647	0.000	0.005	0.000	14.35	0.16	0.002	0.000	0.01	0.003, U	1.01	0.227	0.01, U	0.0002
GW40-09-8331	4/30/2009	09-1647	0.000	0.005	0.000	14.17	0.03	0.007	0.000	0.01	0.003, U	1.40	0.316	0.01, U	0.0002
GW40-09-8332	4/30/2009	09-1647	0.001	0.005	0.000	14.33	0.04	0.004	0.000	0.01	0.003, U	0.88	0.198	0.01, U	0.0002
GW40-09-8333	4/30/2009	09-1647	0.000	0.005	0.000	14.21	0.12	0.038	0.000	0.01	0.003, U	1.25	0.282	0.01, U	0.0002

Note: During development at well R-40 and R-40i, only TOC was analyzed in some groundwater-screening samples to evaluate the presence of residual drilling fluid (AQF-2).

Table C-1.3-1
Analytical Results for Groundwater-Screening Samples Collected from R-40i and R-40 screens 1 and 2, Pajarito Canyon

Sample ID	Date Received	ER/RRES-WQH	stdev (Pb)	Lab pH	PO4(-3) rslt (pp	Rb rslt (ppm)	stdev (Rb)	Sb rslt (ppm)	stdev (Sb)	Se rslt (ppm)	stdev (Se)	Si rslt (ppm)	stdev (Si)	SiO2 rslt (ppm)
RC54-09-1031	11/10/2008	09-246	0.0000	7.88	0.12	0.003	0.000	0.001	U	0.001	U	20.6	0.2	44.1
RC54-09-1032	11/10/2008	09-246	0.0000	7.83	0.08	0.003	0.000	0.001	U	0.001	U	21.6	0.2	46.2
RC54-09-1033	11/10/2008	09-246	0.0000	7.81	0.07	0.002	0.000	0.001	U	0.001	U	22.6	0.1	48.3
RC54-09-1034	11/12/2008	09-278	U	7.84	0.09	0.001	U	0.001	U	0.001	U	33.4	0.2	71.4
RC54-09-1037	1/8/2009	09-591	U	7.10	0.01, U	0.004	0.000	0.001	U	0.001	U	15.5	0.1	33.1
RC54-09-1038	1/13/2009	09-615	U	8.00	0.11	0.002	0.000	0.001	U	0.001	U	15.9	0.1	34.0
GW40-08-14400	7/31/2008	08-1598	U	8.65	0.22	0.007	0.000	0.001	U	0.001	U	12.3	0.1	26.3
GW40-08-14401	10/31/2008	09-196	U	7.76	0.02	0.004	0.000	0.001	U	0.001	U	21.7	0.1	46.4
GW40-08-14402	10/29/2008	09-186	U	7.52	0.01, U	0.006	0.000	0.001	U	0.001	U	2.7	0.0	5.7
GW40-08-14404	10/30/2008	09-194	U	7.81	0.01, U	0.006	0.000	0.001	U	0.001	U	22.9	0.2	48.9
GW40-08-14405	10/30/2008	09-194	U	7.68	0.01, U	0.006	0.000	0.001	U	0.001	U	22.8	0.0	48.9
GW40-09-1617	1/21/2009	09-696	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1618	1/26/2009	09-734	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1619	1/26/2009	09-734	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1620	2/5/2009	09-781	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1621	3/5/2009	09-1086	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1622	3/5/2009	09-1086	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1623	3/10/2009	09-1117	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1624	3/10/2009	09-1117	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1625	3/10/2009	09-1143	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1626	3/9/2009	09-1138	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1627	3/10/2009	09-1157	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1628	3/11/2009	09-1163	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1629	3/12/2009	09-1198	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1630	3/12/2009	09-1198	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1631	3/12/2009	09-1198	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1632	3/13/2009	09-1200	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1633	3/16/2009	09-1217	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1634	3/17/2009	09-1232	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1635	3/17/2009	09-1232	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5867	3/18/2009	09-1236	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5868	3/18/2009	09-1236	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5869	3/18/2009	09-1247	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5870	3/23/2009	09-1249	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5871	3/23/2009	09-1255	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5872	3/24/2009	09-1269	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5873	3/24/2009	09-1269	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5874	3/25/2009	09-1295	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5875	3/25/2009	09-1295	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5876	3/25/2009	09-1295	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5877	3/26/2009	09-1309	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5878	3/30/2009	09-1313	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-6937	4/7/2009	09-1393	0.0000	7.46	0.01, U	0.002	0.000	0.001	U	0.001	U	30	0	63
GW40-09-6938	4/7/2009	09-1393	0.0000	7.27	0.01, U	0.002	0.000	0.001	U	0.001	U	29	0	62
GW40-09-6939	4/7/2009	09-1393	U	6.99	0.05	0.009	0.000	0.001	U	0.001	U	32	0	68
GW40-09-6940	4/7/2009	09-1393	U	7.24	0.02	0.003	0.000	0.001	U	0.001	U	31	0	66
GW40-09-6941	4/7/2009	09-1393	U	7.27	0.02	0.003	0.000	0.001	U	0.001	U	30	0	63
GW40-09-6942	4/8/2009	09-1401	U	7.22	0.06	0.003	0.000	0.001	U	0.001	U	30	0	65
GW40-09-6943	4/8/2009	09-1404	U	7.27	0.08	0.003	0.000	0.001	U	0.001	U	30	0	64
GW40-09-6944	4/9/2009	09-1424	U	7.40	0.01, U	0.003	0.000	0.001	U	0.001	U	29	0	63
GW40-09-6945	4/9/2009	09-1424	U	7.08	0.14	0.004	0.000	0.001	U	0.001	U	29	0	63
GW40-09-6946	4/13/2009	09-1451	U	6.97	0.01, U	0.003	0.000	0.001	U	0.001	U	30	0	65

Table C-1.3-1
Analytical Results for Groundwater-Screening Samples Collected from R-40i and R-40 screens 1 and 2, Pajarito Canyon

Sample ID	Date Received	ER/RRES-WQH	stdev (Pb)	Lab pH	PO4(-3) rslt (pp	Rb rslt (ppm)	stdev (Rb)	Sb rslt (ppm)	stdev (Sb)	Se rslt (ppm)	stdev (Se)	Si rslt (ppm)	stdev (Si)	SiO2 rslt (ppm)
GW40-09-6947	4/13/2009	09-1451	U	7.05	0.11	0.004	0.000	0.001	U	0.001	U	30	0	63
GW40-09-6948	4/13/2009	09-1451	U	6.90	0.01, U	0.003	0.000	0.001	U	0.001	U	30	0	65
GW40-09-6949	4/13/2009	09-1451	0.0000	6.95	0.01, U	0.002	0.000	0.001	U	0.001	U	28	0	60
GW40-09-6950	4/13/2009	09-1451	0.0000	7.06	0.01, U	0.002	0.000	0.001	U	0.001	U	28	0	61
GW40-09-6951	4/13/2009	09-1451	U	7.08	0.13	0.004	0.000	0.001	U	0.001	U	30	0	64
GW40-09-6952	4/13/2009	09-1449	U	6.89	0.01, U	0.003	0.000	0.001	U	0.001	U	30	0	64
GW40-09-6953	4/13/2009	09-1449	0.0000	6.96	0.07	0.005	0.000	0.001	U	0.001	U	30	0	64
GW40-09-6954	4/20/2009	09-1496	U	6.98	0.01, U	0.003	0.000	0.001	U	0.001	U	30	0	64
GW40-09-6955	4/20/2009	09-1496	U	6.97	0.01, U	0.004	0.000	0.001	U	0.001	U	30	0	64
GW40-09-6956	4/20/2009	09-1496	U	7.07	0.01, U	0.003	0.000	0.001	U	0.001	U	30	0	64
GW40-09-8320	4/23/2009	09-1549	U	7.19	0.01, U	0.004	0.000	0.001	U	0.001	U	30	0	64
GW40-09-8321	4/23/2009	09-1549	U	7.03	0.01, U	0.004	0.000	0.001	U	0.001	U	32	0	69
GW40-09-8322	4/23/2009	09-1549	U	7.18	0.01	0.004	0.000	0.001	U	0.001	U	29	0	62
GW40-09-8323	4/27/2009	09-1595	U	7.37	0.01	0.004	0.000	0.001	U	0.001	U	32	0	69
GW40-09-8324	4/27/2009	09-1595	U	7.08	0.01, U	0.004	0.000	0.001	U	0.001	U	32	0	68
GW40-09-8325	4/27/2009	09-1615	U	7.21	0.01	0.003	0.000	0.001	U	0.001	U	32	0	68
GW40-09-8326	4/27/2009	09-1615	U	7.11	0.01, U	0.004	0.000	0.001	U	0.001	U	29	0	62
GW40-09-8327	4/27/2009	09-1615	U	7.12	0.01, U	0.003	0.000	0.001	U	0.001	U	30	0	64
GW40-09-8328	4/27/2009	09-1615	U	7.34	0.01	0.003	0.000	0.001	U	0.001	U	32	0	68
GW40-09-8329	4/27/2009	09-1615	U	7.23	0.01	0.003	0.000	0.001	U	0.001	U	29	0	62
GW40-09-8330	4/30/2009	09-1647	U	7.35	0.01, U	0.005	0.000	0.001	U	0.001	U	30	0	64
GW40-09-8331	4/30/2009	09-1647	U	7.17	0.01	0.004	0.000	0.001	U	0.001	U	32	0	68
GW40-09-8332	4/30/2009	09-1647	U	7.08	0.01	0.005	0.000	0.001	U	0.001	U	29	0	62
GW40-09-8333	4/30/2009	09-1647	U	7.17	0.01	0.004	0.000	0.001	U	0.001	U	31	0	65

Note: During development at well R-40 and R-40i, only TOC was analyzed in some groundwater-screening samples to evaluate the presence of residual drilling fluid (AQF-2).

Table C-1.3-1
Analytical Results for Groundwater-Screening Samples Collected from R-40i and R-40 screens 1 and 2, Pajarito Canyon

Sample ID	Date Received	ER/RRES-WQH	stdev (SiO2)	Sn rslt (ppm)	stdev (Sn)	SO4(-2) rslt (ppn	Sr rslt (ppm)	stdev (Sr)	Th rslt (ppm)	stdev (Th)	Ti rslt (ppm)	stdev (Ti)	Tl rslt (ppm)	stdev (Tl)
RC54-09-1031	11/10/2008	09-246	0.4	0.001	U	6.59	0.074	0.000	0.001	U	0.058	0.001	0.001	U
RC54-09-1032	11/10/2008	09-246	0.3	0.001	U	5.45	0.068	0.001	0.001	U	0.045	0.000	0.001	U
RC54-09-1033	11/10/2008	09-246	0.2	0.001	U	6.17	0.081	0.002	0.001	U	0.027	0.000	0.001	U
RC54-09-1034	11/12/2008	09-278	0.3	0.001	U	2.34	0.044	0.001	0.001	U	0.005	0.000	0.001	U
RC54-09-1037	1/8/2009	09-591	0.3	0.001	U	10.47	0.105	0.001	0.001	U	0.002	U	0.001	U
RC54-09-1038	1/13/2009	09-615	0.1	0.001	U	42.64	0.118	0.004	0.001	U	0.002	U	0.001	U
GW40-08-14400	7/31/2008	08-1598	0.2	0.001	U	4.65	0.059	0.001	0.001	U	0.008	0.000	0.001	U
GW40-08-14401	10/31/2008	09-196	0.3	0.001	U	0.13	0.065	0.001	0.001	U	0.005	0.000	0.001	U
GW40-08-14402	10/29/2008	09-186	0.0	0.001	U	8.77	0.041	0.000	0.001	U	0.002	U	0.001	U
GW40-08-14404	10/30/2008	09-194	0.4	0.001	U	9.57	0.069	0.001	0.001	U	0.016	0.000	0.001	U
GW40-08-14405	10/30/2008	09-194	0.1	0.001	U	9.05	0.066	0.001	0.001	U	0.012	0.000	0.001	U
GW40-09-1617	1/21/2009	09-696	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1618	1/26/2009	09-734	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1619	1/26/2009	09-734	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1620	2/5/2009	09-781	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1621	3/5/2009	09-1086	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1622	3/5/2009	09-1086	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1623	3/10/2009	09-1117	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1624	3/10/2009	09-1117	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1625	3/10/2009	09-1143	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1626	3/9/2009	09-1138	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1627	3/10/2009	09-1157	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1628	3/11/2009	09-1163	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1629	3/12/2009	09-1198	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1630	3/12/2009	09-1198	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1631	3/12/2009	09-1198	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1632	3/13/2009	09-1200	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1633	3/16/2009	09-1217	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1634	3/17/2009	09-1232	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-1635	3/17/2009	09-1232	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5867	3/18/2009	09-1236	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5868	3/18/2009	09-1236	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5869	3/18/2009	09-1247	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5870	3/23/2009	09-1249	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5871	3/23/2009	09-1255	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5872	3/24/2009	09-1269	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5873	3/24/2009	09-1269	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5874	3/25/2009	09-1295	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5875	3/25/2009	09-1295	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5876	3/25/2009	09-1295	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5877	3/26/2009	09-1309	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-5878	3/30/2009	09-1313	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed
GW40-09-6937	4/7/2009	09-1393	1	0.001	U	4.84	0.102	0.001	0.001	U	0.002	U	0.001	U
GW40-09-6938	4/7/2009	09-1393	0	0.001	U	4.80	0.102	0.001	0.001	U	0.002	U	0.001	U
GW40-09-6939	4/7/2009	09-1393	0	0.001	U	1.20	0.107	0.000	0.001	U	0.002	U	0.001	U
GW40-09-6940	4/7/2009	09-1393	0	0.001	U	6.99	0.081	0.001	0.001	U	0.002	U	0.001	U
GW40-09-6941	4/7/2009	09-1393	0	0.001	U	6.52	0.080	0.000	0.001	U	0.002	U	0.001	U
GW40-09-6942	4/8/2009	09-1401	0	0.001	U	7.20	0.081	0.001	0.001	U	0.002	U	0.001	U
GW40-09-6943	4/8/2009	09-1404	0	0.001	U	6.88	0.079	0.000	0.001	U	0.002	U	0.001	U
GW40-09-6944	4/9/2009	09-1424	0	0.001	U	7.71	0.081	0.000	0.001	U	0.002	U	0.001	U
GW40-09-6945	4/9/2009	09-1424	1	0.001	U	7.64	0.085	0.000	0.001	U	0.002	U	0.001	U
GW40-09-6946	4/13/2009	09-1451	0	0.001	U	7.99	0.079	0.001	0.001	U	0.002	U	0.001	U

Table C-1.3-1
Analytical Results for Groundwater-Screening Samples Collected from R-40i and R-40 screens 1 and 2, Pajarito Canyon

Sample ID	Date Received	ER/RRES-WQH	stdev (SiO2)	Sn rslt (ppm)	stdev (Sn)	SO4(-2) rslt (ppn	Sr rslt (ppm)	stdev (Sr)	Th rslt (ppm)	stdev (Th)	Ti rslt (ppm)	stdev (Ti)	Tl rslt (ppm)	stdev (Tl)
GW40-09-6947	4/13/2009	09-1451	0	0.001	U	7.84	0.081	0.001	0.001	U	0.002	U	0.001	U
GW40-09-6948	4/13/2009	09-1451	0	0.001	U	7.82	0.079	0.000	0.001	U	0.002	U	0.001	U
GW40-09-6949	4/13/2009	09-1451	1	0.001	U	5.15	0.088	0.000	0.001	U	0.002	U	0.001	U
GW40-09-6950	4/13/2009	09-1451	1	0.001	U	5.19	0.087	0.002	0.001	U	0.002	U	0.001	U
GW40-09-6951	4/13/2009	09-1451	0	0.001	U	7.96	0.078	0.001	0.001	U	0.002	U	0.001	U
GW40-09-6952	4/13/2009	09-1449	1	0.001	U	7.72	0.073	0.000	0.001	U	0.002	U	0.001	U
GW40-09-6953	4/13/2009	09-1449	0	0.001	U	7.67	0.076	0.001	0.001	U	0.002	U	0.001	U
GW40-09-6954	4/20/2009	09-1496	1	0.001	U	6.78	0.077	0.000	0.001	U	0.002	U	0.001	U
GW40-09-6955	4/20/2009	09-1496	0	0.001	U	6.93	0.073	0.000	0.001	U	0.002	U	0.001	U
GW40-09-6956	4/20/2009	09-1496	1	0.001	U	6.60	0.072	0.000	0.001	U	0.002	U	0.001	U
GW40-09-8320	4/23/2009	09-1549	1	0.001	U	6.39	0.079	0.001	0.001	U	0.002	U	0.001	U
GW40-09-8321	4/23/2009	09-1549	1	0.001	U	7.11	0.079	0.001	0.001	U	0.002	U	0.001	U
GW40-09-8322	4/23/2009	09-1549	1	0.001	U	6.82	0.075	0.001	0.001	U	0.002	U	0.001	U
GW40-09-8323	4/27/2009	09-1595	1	0.001	U	10.08	0.045	0.002	0.001	U	0.002	U	0.001	U
GW40-09-8324	4/27/2009	09-1595	1	0.001	U	16.42	0.044	0.001	0.001	U	0.002	U	0.001	U
GW40-09-8325	4/27/2009	09-1615	0	0.001	U	7.72	0.045	0.003	0.001	U	0.002	U	0.001	U
GW40-09-8326	4/27/2009	09-1615	0	0.001	U	6.68	0.068	0.006	0.001	U	0.002	U	0.001	U
GW40-09-8327	4/27/2009	09-1615	0	0.001	U	6.44	0.064	0.001	0.001	U	0.002	U	0.001	U
GW40-09-8328	4/27/2009	09-1615	0	0.001	U	6.86	0.040	0.000	0.001	U	0.002	U	0.001	U
GW40-09-8329	4/27/2009	09-1615	0	0.001	U	6.15	0.060	0.001	0.001	U	0.002	U	0.001	U
GW40-09-8330	4/30/2009	09-1647	0	0.001	U	7.55	0.092	0.001	0.001	U	0.002	U	0.001	U
GW40-09-8331	4/30/2009	09-1647	1	0.001	U	6.18	0.068	0.000	0.001	U	0.002	U	0.001	U
GW40-09-8332	4/30/2009	09-1647	0	0.001	U	7.54	0.091	0.000	0.001	U	0.002	U	0.001	U
GW40-09-8333	4/30/2009	09-1647	0	0.001	U	6.13	0.066	0.001	0.001	U	0.002	U	0.001	U

Note: During development at well R-40 and R-40i, only TOC was analyzed in some groundwater-screening samples to evaluate the presence of residual drilling fluid (AQF-2).

Table C-1.3-1
Analytical Results for Groundwater-Screening Samples Collected from R-40i and R-40 screens 1 and 2, Pajarito Canyon

Sample ID	Date Received	ER/RRES-WQH	U rslt (ppm)	stdev (U)	V rslt (ppm)	stdev (V)	Zn rslt (ppm)	stdev (Zn)	TDS (ppm)	Cations	Anions	Balance
RC54-09-1031	11/10/2008	09-246	0.0007	0.0000	0.003	0.000	0.114	0.001	206	2.00	2.09	-0.02
RC54-09-1032	11/10/2008	09-246	0.0009	0.0000	0.003	0.000	0.101	0.001	217	2.10	2.23	-0.03
RC54-09-1033	11/10/2008	09-246	0.0007	0.0000	0.002	0.000	0.111	0.001	219	2.11	2.22	-0.02
RC54-09-1034	11/12/2008	09-278	0.0002	U	0.003	0.000	0.072	0.000	183	1.31	1.47	-0.06
RC54-09-1037	1/8/2009	09-591	0.0011	0.0000	0.002	0.000	0.008	0.000	276	2.70	3.16	-0.08
RC54-09-1038	1/13/2009	09-615	0.0008	0.0000	0.003	0.000	0.012	0.003	337	3.62	4.00	-0.05
GW40-08-14400	7/31/2008	08-1598	0.0017	0.0001	0.009	0.000	0.011	0.001	204	2.04	2.53	-0.11
GW40-08-14401	10/31/2008	09-196	0.0007	0.0000	0.001	0.000	0.022	0.001	210	2.14	2.08	0.02
GW40-08-14402	10/29/2008	09-186	0.0002	U	0.002	0.000	0.004	0.000	154	1.84	1.94	-0.02
GW40-08-14404	10/30/2008	09-194	0.0008	0.0001	0.002	0.000	0.001	U	228	2.23	2.35	-0.03
GW40-08-14405	10/30/2008	09-194	0.0008	0.0000	0.002	0.000	0.001	0.000	222	2.17	2.25	-0.02
GW40-09-1617	1/21/2009	09-696	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not applicable	Not applicable	Not applicable
GW40-09-1618	1/26/2009	09-734	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not applicable	Not applicable	Not applicable
GW40-09-1619	1/26/2009	09-734	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not applicable	Not applicable	Not applicable
GW40-09-1620	2/5/2009	09-781	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not applicable	Not applicable	Not applicable
GW40-09-1621	3/5/2009	09-1086	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not applicable	Not applicable	Not applicable
GW40-09-1622	3/5/2009	09-1086	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not applicable	Not applicable	Not applicable
GW40-09-1623	3/10/2009	09-1117	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not applicable	Not applicable	Not applicable
GW40-09-1624	3/10/2009	09-1117	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not applicable	Not applicable	Not applicable
GW40-09-1625	3/10/2009	09-1143	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not applicable	Not applicable	Not applicable
GW40-09-1626	3/9/2009	09-1138	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not applicable	Not applicable	Not applicable
GW40-09-1627	3/10/2009	09-1157	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not applicable	Not applicable	Not applicable
GW40-09-1628	3/11/2009	09-1163	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not applicable	Not applicable	Not applicable
GW40-09-1629	3/12/2009	09-1198	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not applicable	Not applicable	Not applicable
GW40-09-1630	3/12/2009	09-1198	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not applicable	Not applicable	Not applicable
GW40-09-1631	3/12/2009	09-1198	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not applicable	Not applicable	Not applicable
GW40-09-1632	3/13/2009	09-1200	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not applicable	Not applicable	Not applicable
GW40-09-1633	3/16/2009	09-1217	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not applicable	Not applicable	Not applicable
GW40-09-1634	3/17/2009	09-1232	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not applicable	Not applicable	Not applicable
GW40-09-1635	3/17/2009	09-1232	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not applicable	Not applicable	Not applicable
GW40-09-5867	3/18/2009	09-1236	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not applicable	Not applicable	Not applicable
GW40-09-5868	3/18/2009	09-1236	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not applicable	Not applicable	Not applicable
GW40-09-5869	3/18/2009	09-1247	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not applicable	Not applicable	Not applicable
GW40-09-5870	3/23/2009	09-1249	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not applicable	Not applicable	Not applicable
GW40-09-5871	3/23/2009	09-1255	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not applicable	Not applicable	Not applicable
GW40-09-5872	3/24/2009	09-1269	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not applicable	Not applicable	Not applicable
GW40-09-5873	3/24/2009	09-1269	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not applicable	Not applicable	Not applicable
GW40-09-5874	3/25/2009	09-1295	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not applicable	Not applicable	Not applicable
GW40-09-5875	3/25/2009	09-1295	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not applicable	Not applicable	Not applicable
GW40-09-5876	3/25/2009	09-1295	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not applicable	Not applicable	Not applicable
GW40-09-5877	3/26/2009	09-1309	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not applicable	Not applicable	Not applicable
GW40-09-5878	3/30/2009	09-1313	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not applicable	Not applicable	Not applicable
GW40-09-6937	4/7/2009	09-1393	0.0006	0.0000	0.001	0.000	1.316	0.004	250	2.3	2.4	-0.02
GW40-09-6938	4/7/2009	09-1393	0.0006	0.0000	0.001	0.000	0.934	0.001	246	2.3	2.4	-0.02
GW40-09-6939	4/7/2009	09-1393	0.0002	0.0000	0.001	0.000	1.514	0.005	296	2.8	2.9	-0.01
GW40-09-6940	4/7/2009	09-1393	0.0005	0.0000	0.002	0.000	0.421	0.002	228	2.0	2.1	-0.02
GW40-09-6941	4/7/2009	09-1393	0.0005	0.0000	0.001	0.000	0.524	0.006	229	2.1	2.2	-0.02
GW40-09-6942	4/8/2009	09-1401	0.0006	0.0000	0.002	0.000	0.331	0.003	232	2.1	2.2	-0.01
GW40-09-6943	4/8/2009	09-1404	0.0005	0.0000	0.001	0.000	0.427	0.001	230	2.1	2.2	-0.02
GW40-09-6944	4/9/2009	09-1424	0.0007	0.0000	0.002	0.000	0.276	0.002	238	2.1	2.3	-0.04
GW40-09-6945	4/9/2009	09-1424	0.0009	0.0000	0.002	0.000	0.715	0.009	243	2.3	2.3	-0.01
GW40-09-6946	4/13/2009	09-1451	0.0007	0.0000	0.003	0.000	0.277	0.001	236	2.2	2.2	-0.01

Table C-1.3-1
Analytical Results for Groundwater-Screening Samples Collected from R-40i and R-40 screens 1 and 2, Pajarito Canyon

Sample ID	Date Received	ER/RRES-WQH	U rslt (ppm)	stdev (U)	V rslt (ppm)	stdev (V)	Zn rslt (ppm)	stdev (Zn)	TDS (ppm)	Cations	Anions	Balance
GW40-09-6947	4/13/2009	09-1451	0.0008	0.0000	0.002	0.000	0.732	0.003	245	2.3	2.3	-0.01
GW40-09-6948	4/13/2009	09-1451	0.0007	0.0000	0.003	0.000	0.300	0.000	236	2.2	2.2	0.00
GW40-09-6949	4/13/2009	09-1451	0.0008	0.0000	0.002	0.000	1.179	0.004	238	2.2	2.3	-0.02
GW40-09-6950	4/13/2009	09-1451	0.0008	0.0000	0.002	0.000	1.026	0.005	240	2.2	2.3	-0.01
GW40-09-6951	4/13/2009	09-1451	0.0009	0.0000	0.002	0.000	0.815	0.003	249	2.3	2.4	-0.01
GW40-09-6952	4/13/2009	09-1449	0.0007	0.0000	0.003	0.000	0.297	0.002	231	2.1	2.2	-0.01
GW40-09-6953	4/13/2009	09-1449	0.0007	0.0000	0.001	0.000	0.865	0.009	248	2.3	2.4	0.00
GW40-09-6954	4/20/2009	09-1496	0.0007	0.0000	0.002	0.000	0.294	0.000	231	2.1	2.2	-0.01
GW40-09-6955	4/20/2009	09-1496	0.0007	0.0000	0.001	0.000	0.747	0.003	235	2.2	2.2	-0.01
GW40-09-6956	4/20/2009	09-1496	0.0006	0.0000	0.002	0.000	0.302	0.001	228	2.1	2.1	-0.01
GW40-09-8320	4/23/2009	09-1549	0.0006	0.0000	0.001	0.000	0.603	0.004	236	2.1	2.2	-0.04
GW40-09-8321	4/23/2009	09-1549	0.0006	0.0000	0.003	0.000	0.423	0.010	234	2.1	2.1	-0.01
GW40-09-8322	4/23/2009	09-1549	0.0006	0.0000	0.002	0.000	1.297	0.004	234	2.1	2.2	-0.03
GW40-09-8323	4/27/2009	09-1595	0.0003	0.0000	0.005	0.000	0.603	0.006	215	1.8	1.9	-0.03
GW40-09-8324	4/27/2009	09-1595	0.0003	0.0000	0.003	0.000	1.255	0.017	231	2.1	2.1	-0.01
GW40-09-8325	4/27/2009	09-1615	0.0004	0.0000	0.005	0.001	0.350	0.002	200	1.6	1.7	-0.04
GW40-09-8326	4/27/2009	09-1615	0.0006	0.0000	0.002	0.000	0.606	0.004	229	2.1	2.2	-0.02
GW40-09-8327	4/27/2009	09-1615	0.0006	0.0000	0.002	0.000	0.490	0.003	225	2.0	2.1	-0.01
GW40-09-8328	4/27/2009	09-1615	0.0003	0.0000	0.004	0.000	0.397	0.002	198	1.6	1.7	-0.04
GW40-09-8329	4/27/2009	09-1615	0.0006	0.0000	0.001	0.000	0.483	0.001	222	2.0	2.1	-0.03
GW40-09-8330	4/30/2009	09-1647	0.0006	0.0000	0.003	0.000	0.328	0.000	234	2.1	2.2	-0.04
GW40-09-8331	4/30/2009	09-1647	0.0003	0.0000	0.003	0.000	0.615	0.001	195	1.5	1.7	-0.05
GW40-09-8332	4/30/2009	09-1647	0.0006	0.0000	0.002	0.000	0.594	0.002	228	2.1	2.2	-0.02
GW40-09-8333	4/30/2009	09-1647	0.0003	0.0000	0.003	0.000	2.883	0.001	199	1.5	1.8	-0.07

Note: During development at well R-40 and R-40i, only TOC was analyzed in some groundwater-screening samples to evaluate the presence of residual drilling fluid (AQF-2).

Appendix D

Borehole Video Logging
(on DVD included with this document)

Appendix E

Schlumberger Geophysical Logging Report
(on CD included with this document)

Appendix F

Aquifer Testing Report

F-1.0 INTRODUCTION

This appendix describes the hydraulic analysis of pumping tests at wells R-40 and R-40i, screens 1 and 2, located in Pajarito Canyon downstream of Technical Area 18 (TA-18). The tests were conducted in January and February 2009 to quantify the properties of the formations screened by the wells. A secondary objective was to look for cross-connection among the three screened intervals as well as between nearby R-20 and the pumped wells.

R-40 is a three-screen completion well finished with a deep 5-in. inside diameter (I.D.) stainless-steel casing that includes screens 1 and 2, as well as a shallow 3-in. polyvinyl chloride (PVC) casing in the annular space outside the 5-in. stainless-steel casing that includes screen R-40i. Screen R-40i is completed with slotted Schedule 80 PVC pipe.

Testing of R-40 screen 2 and R-40i consisted primarily of constant-rate pumping tests. R-40 screen 1, however, was too low-yielding to support pumping. Therefore, it was tested using two methods: (1) bailing it dry and observing the refill rate and (2) packer injection and recovery tests. During the tests on each screen, water levels were monitored in the nonpumped screen zones as well as R-20. No interference effects were observed in any of the tests among the tested wells and R-20. As a result, the R-20 data are not included in this report.

F-1.1 Conceptual Hydrogeology

R-40 is a dual screen well completed in both the Cerros del Rio basalt and the underlying Puye Formation. Screen 1 is 33.5 ft long and lies in a perched zone within the basalt from approximately 751.6 to 785.1 ft below ground surface (bgs). The static water level falls within the well screen and was estimated to be roughly 761 ft bgs. As described below, the recovery rate in screen 1 was too slow to equilibrate to the actual static level during the testing period. The saturated perched zone thickness was interpreted as the distance from the static water level to the bottom of the well screen, about 24.1 ft. The land-surface elevation at R-40 was estimated at 6718 ft above mean sea level (amsl), making the water table elevation in screen 1 approximately 5957 ft amsl.

Screen 2 lies within the Puye Formation. It has a length of 20.8 ft, running from about 849.2 to 870 ft bgs. The top of the screen lies within a transition zone separating overlying basalt-rich and underlying basalt-free sediments, with the bottom of the screen extending into the basalt-free sediments. The static water level for screen 2 at the time of testing fell within the screened interval at 853.9 ft bgs, making the water-table elevation 5864.1 ft amsl, about 93 ft deeper than the water level in screen 1. The saturated screen length was 16.1 ft.

Screen R-40i is set in an upper-perched zone within the Cerros del Rio basalt and comprises 19.3 ft of 3-in. slotted PVC pipe set between the depths of 649.7 and 669 ft bgs. At the time of testing, the static water level for screen R-40i was 9.4 ft above the top of the screen at 640.3 ft bgs, or elevation 6077.7 ft amsl, nearly 121 ft above the water level in R-40 screen 1.

Based on the differing completion intervals and the regional and perched water levels in screens 1, 2, and R-40i, it was expected that the three screened intervals were hydraulically distinct and not in communication with one another. Indeed, none of the pumping tests showed discernible effects in the nonpumped intervals. (Note: Subsequent to preparing this report, extensive pumping of screen R-40i over a period of weeks was observed to diminish the recharge rate into screen 1, thus implying that the screen R-40i interval recharges the screen 1 interval under equilibrium conditions.)

In R-40, the water levels in both screens 1 and 2 fell within the screens. In each case, this made it impossible to use an inflatable packer to eliminate the effects of casing storage on the test data. In screen 1, flood injection tests were conducted using an inflatable packer. This eliminated the storage component associated with the casing itself. However, it was likely that during the tests air was trapped in the filter pack behind the blank casing just above the screen, causing a storagelike effect. Packers were used effectively to separate screens 1 and 2 during testing but not to eliminate storage effects.

Likewise, storage effects were not eliminated from the 3-in. PVC well because the tests were run without an inflatable packer. Implementing an inflatable packer was avoided as a safety measure to minimize the risk of damaging the plastic casing.

F-1.2 R-40 Screen 1 Testing

R-40 screen 1 was tested using two methods. One method involved emptying the screen, filter pack, and a portion of the casing beneath the screen, and observing the refill rate as perched groundwater from screen 1 slowly refilled the casing beneath the screen.

The other method used water injection to stress the screened interval. To apply the procedure, potable water was added to the screen 1 interval, causing injection of groundwater into the formation. Then a packer just above the screen was inflated to halt the flow of water and allow measurement of recovery data.

The first refill test occurred during the testing of screen 2. An inflatable packer was set between screens 1 and 2 to separate the zones for the screen 2 testing. When this was done, screen 1 water slowly filled the blank casing beneath screen 1 just above the packer. The refill rate data from this event were recorded from January 12 to 14, 2009. Subsequently, similar tests were conducted by bailing the screen, filter pack, and sump dry and observing the refill rate. These tests were conducted on January 23 to 24 and February 3 to 4, following episodes of swab-and-bail development on screen 1.

Injection testing and monitoring of recovery were performed on January 24. The injection test procedures flooded the entire well screen interval and therefore the observed response reflected properties of both the saturated zone and the unsaturated zone at the top of the well screen.

F-1.3 R-40 Screen 2 Testing

R-40 screen 2 was tested from January 13 to January 16 using conventional constant-rate pumping methods. Testing consisted of brief trial pumping on January 13, a 24-h constant-rate pumping test that was begun on January 14, and background data collection.

Trial 1 was conducted for 60 min from 8:00 to 9:00 a.m. and was followed by 60 min of recovery until 10:00 a.m. Trial 2 was conducted for 60 min from 10:00 to 11:00 a.m., also followed by 60 min of recovery until 12:00 p.m. Trial 3 was conducted for 60 min from 12:00 to 1:00 p.m. Following shutdown, recovery was monitored for 1140 min until 8:00 a.m. on January 14.

At 8:00 a.m. on January 14, the 24-h pumping test was begun at a rate of 3.44 gpm. Pumping continued until 8:00 a.m. on January 15. Following shutdown, recovery/background measurements were recorded for 7167 min until 7:27 a.m. on January 20.

F-1.4 R-40i Testing

Screen R-40i was tested from January 25 to February 3 using conventional constant-rate pumping methods. Testing consisted of brief trial pumping on January 26, a 24-h constant-rate pumping test that was begun on January 27, and background data collection.

Trial 1 was conducted for 180 min from 8:00 to 11:00 a.m. and was followed by 180 min of recovery until 2:00 p.m. Trial 2 was conducted for 60 min from 2:00 to 3:00 p.m. Following shutdown, recovery was monitored for 1020 min until 8:00 a.m. on January 27.

At 8:00 a.m. on January 27, the 24-h pumping test was begun at a rate of 2.22 gpm. Pumping continued until 8:00 a.m. on January 28. Following shutdown, recovery/background measurements were recorded for 8656 min until 8:16 a.m. on February 3.

During testing of screen R-40i, the pumped water was significantly aerated, with substantial residual foam left over from the drilling operation, appearing in the discharge water stream. The presence of the foam in the pumped water had two deleterious effects on the testing effort. First, it affected the pump operation by reducing the discharge rates initially. Running aerated or foamy water through a submersible pump causes cavitation, reducing the pump efficiency in a chaotic way. This, in turn, causes the discharge rate to vary. Thus, it was not possible to maintain constant rates during any of the tests. This placed a greater reliance than usual on the recovery data for assessing formation properties. The second and more prominent effect was that the foam interfered with operation of the flow meter. Early in each test, the meter reading was significantly less than the actual well output. As pumping continued, the contribution of foam may have diminished because the meter reflected the actual discharge rates more accurately.

F-2.0 BACKGROUND DATA

The background water-level data collected in conjunction with running the pumping tests allow the analyst to see what water-level fluctuations occur naturally in the aquifer and help distinguish between water-level changes caused by conducting the pumping test and changes associated with other causes.

Background water-level fluctuations have several causes, among them barometric pressure changes, operation of other wells in the aquifer, Earth tides, and long-term trends related to weather patterns. The background data hydrographs from the monitored wells were compared with barometric pressure data from the area to determine if a correlation existed.

Previous pumping tests on the plateau have demonstrated a barometric efficiency for most wells between 90% and 100%. Barometric efficiency is defined as the ratio of water-level change divided by barometric pressure change, expressed as a percentage. In the initial pumping tests conducted on the early R-wells, downhole pressure was monitored using a *vented* pressure transducer. This equipment measures the *difference* between the total pressure applied to the transducer and the barometric pressure, this difference being the true height of water above the transducer.

Subsequent pumping tests, including R-40, have used *nonvented* transducers. These devices simply record the total pressure on the transducer, that is, the sum of the water height plus the barometric pressure. This results in an attenuated “apparent” hydrograph in a barometrically efficient well. Take as an example a 90% barometrically efficient well. When monitored using a vented transducer, an *increase* in barometric pressure of 1 unit causes a *decrease* in recorded downhole pressure of 0.9 unit because the water level is forced downward 0.9 unit by the barometric pressure change. However, using a nonvented transducer, the total measured pressure *increases* by 0.1 unit (the combination of the barometric pressure increase and the water-level decrease). Thus, the resulting apparent hydrograph changes by a factor of 100 minus the barometric efficiency and in the same direction as the barometric pressure change, rather than in the opposite direction.

Barometric pressure data were obtained from the TA-54 tower site from the Environmental Division-Meteorology and Air Quality (ENV-MAQ). The TA-54 measurement location is at an elevation of 6548 ft amsl, whereas the wellhead elevation is approximately 6718 ft amsl. The static water levels in R-40 screens 1, 2, and R-40i were about 761, 854, and 640 ft below land surface, making the water-table elevations roughly 5957, 5864, and 6078 ft amsl, respectively. Therefore, the measured barometric pressure data from TA-54 had to be adjusted to reflect the pressure at these elevations.

The following formula was used to adjust the measured barometric pressure data:

$$P_{WT} = P_{TA54} \exp\left[-\frac{g}{3.281R}\left(\frac{E_{R40} - E_{TA54}}{T_{TA54}} + \frac{E_{WT} - E_{R40}}{T_{WELL}}\right)\right] \qquad \textbf{Equation F-1}$$

where, P_{WT} = barometric pressure at the water table in a given screen in R-40

P_{TA54} = barometric pressure measured at TA-54

g = acceleration of gravity, in m/sec^2 (9.80665 m/sec^2)

R = gas constant, in J/Kg/degree Kelvin (287.04 J/Kg/degree Kelvin)

E_{R40} = land surface elevation at R-40 site, in feet (6718 ft estimated)

E_{TA54} = elevation of barometric pressure measuring point at TA-54, in feet (6548 ft)

E_{WT} = elevation of the water levels in R-40, in feet (approximately 5864, 5957, and 6078 ft for screens 2, 1 and R-40i, respectively)

T_{TA54} = air temperature near TA-54, in degrees Kelvin (assigned a value of 29.4 degrees Fahrenheit, or 271.7 degrees Kelvin)

T_{WELL} = air temperature inside R-40, in degrees Kelvin (assigned a value of 62.3 degrees Fahrenheit, or 290.0 degrees Kelvin)

This formula is an adaptation of an equation ENV-MAQ provided. It can be derived from the ideal gas law and standard physics principles. An inherent assumption in the derivation of the equation is that the air temperature between TA-54 and the well is temporally and spatially constant and that the temperature of the air column in the well is similarly constant.

The corrected barometric pressure data reflecting pressure conditions at the water table were compared with the water-level hydrographs to discern the correlation between the two.

F-2.1 Importance of Early Data

When pumping or recovery first begins, the vertical extent of the cone of depression is limited to approximately the well screen length, the filter pack length, or the aquifer thickness in relatively thin permeable strata. For many pumping tests on the plateau, the early pumping period is the only time that the effective height of the cone of depression is known with certainty. Thus, the early data often offer the best opportunity to obtain hydraulic conductivity information because conductivity would equal the earliest-time transmissivity divided by the well screen length.

Unfortunately, in many pumping tests, casing-storage effects dominate the early-time data, hindering the effort to determine the transmissivity of the screened interval. The duration of casing-storage effects can be estimated using the following equation (Schafer 1978, 098240).

$$t_c = \frac{0.6\left(D^2 - d^2\right)}{\frac{Q}{s}}$$

Equation F-2

where, t_c = duration of casing-storage effect, in minutes

D = inside diameter of well casing, in inches

d = outside diameter of column pipe, in inches

Q = discharge rate, in gallons per minute

s = drawdown observed in pumped well at time t_c, in feet

For wells screened across the water table, such as R-40, there is additional storage contribution from the filter pack around the screen. Therefore, the casing-storage duration must be increased to account for the additional volume of water that drains and refills the filter pack, as follows:

$$t_c = \frac{0.6\left[\left(D^2 - d^2\right) + S_y\left(D_B^2 - D_C^2\right)\right]}{\frac{Q}{s}}$$

Equation F-3

where, S_y = short-term specific yield of filter media (typically around 0.2)

D_B = diameter of borehole, in inches

D_C = outside diameter of well casing, in inches

In some instances, it is possible to eliminate casing-storage effects by setting an inflatable packer above the tested screen interval before conducting the test. Therefore, this approach has been implemented for the R-well testing program. However, as explained above, it was not possible to eliminate casing-storage effects in R-40 in this manner.

F-2.2 Time-Drawdown Methods

Time-drawdown data can be analyzed using a variety of methods. Among them is the Theis method (1934-1935, 098241). The Theis equation describes drawdown around a well as follows:

$$s = \frac{114.6Q}{T} W\left(u\right)$$

Equation F-4

where,

$$W(u)=\int_{u}^{\infty}\frac{e^{-x}}{x}dx$$ **Equation F-5**

and

$$u=\frac{1.87r^{2}S}{Tt}$$ **Equation F-6**

and where, *s* = drawdown, in feet

Q = discharge rate, in gallons per minute

T = transmissivity, in gallons per day per foot

S = storage coefficient (dimensionless)

t = pumping time, in days

r = distance from center of pumpage, in feet

To use the Theis method of analysis, the time-drawdown data are plotted on log-log graph paper. Then, Theis curve matching is performed using the Theis type curve, a plot of the Theis well function *W*(*u*) versus *1*/*u*. Curve matching is accomplished by overlaying the type curve on the data plot and, while keeping the coordinate axes of the two plots parallel, shifting the data plot to align with the type curve, effecting a match position. An arbitrary point, referred to as the match point, is selected from the overlapping parts of the plots. Match-point coordinates are recorded from the two graphs, yielding four values: *W*(*u*), *1*/*u*, *s*, and *t*. Using these match-point values, transmissivity and storage coefficient are computed as follows:

$$T=\frac{114.6Q}{s}W(u)$$ **Equation F-7**

$$S=\frac{Tut}{2693r^{2}}$$ **Equation F-8**

where, *T* = transmissivity, in gallons per day per foot

S = storage coefficient

Q = discharge rate, in gallons per minute

W(*u*) = match-point value

s = match-point value, in feet

u = match-point value

t = match-point value, in minutes

An alternative solution method applicable to time-drawdown data is the Cooper–Jacob method (1946, 098236), a simplification of the Theis equation that is mathematically equivalent to the Theis equation for most pumped well data. The Cooper–Jacob equation describes drawdown around a pumping well as follows:

$$s = \frac{264Q}{T} \log \frac{0.3Tt}{r^2 S}$$ **Equation F-9**

The Cooper–Jacob equation is a simplified approximation of the Theis equation and is valid whenever the *u* value is less than about 0.05. For small radius values (e.g., corresponding to borehole radii), *u* is less than 0.05 at very early pumping times and therefore is less than 0.05 for most or all measured drawdown values. Thus, for the pumped well, the Cooper–Jacob equation usually can be considered a valid approximation of the Theis equation.

According to the Cooper–Jacob method, the time-drawdown data are plotted on a semilog graph, with time plotted on the logarithmic scale. Then a straight line of best fit is constructed through the data points and transmissivity is calculated using

$$T = \frac{264Q}{\Delta s}$$ **Equation F-10**

where, T = transmissivity, in gallons per day per foot

Q = discharge rate, in gallons per minute

Δs = change in head over one log cycle of the graph, in feet

F-2.3 Recovery Methods

Recovery data were analyzed using the Theis recovery method. This is a semilog analysis method similar to the Cooper–Jacob procedure.

In this method, residual drawdown is plotted on a semilog graph versus the ratio *t/t'*, where *t* is the time since pumping began and *t'* is the time since pumping stopped. A straight line of best fit is constructed through the data points and *T* is calculated from the slope of the line as follows:

$$T = \frac{264Q}{\Delta s}$$ **Equation F-11**

The recovery data are particularly useful compared with time-drawdown data. Because the pump is not running, spurious data responses associated with dynamic discharge rate fluctuations are eliminated. The result is that the data set is generally “smoother” and easier to analyze.

F-2.4 Specific Capacity Method

The specific capacity of the pumped well can be used to obtain a lower-bound value of hydraulic conductivity. The hydraulic conductivity is computed using formulas that are based on the assumption that the pumped well is 100% efficient. The resulting hydraulic conductivity is the value required to sustain the observed specific capacity. If the actual well is less than 100% efficient, it follows that the actual hydraulic conductivity would have to be greater than calculated to compensate for well inefficiency. Thus, because the efficiency is unknown, the computed hydraulic conductivity value represents a lower bound. The actual conductivity is known to be greater than or equal to the computed value.

For fully penetrating wells, the Cooper–Jacob equation can be iterated to solve for the lower-bound hydraulic conductivity. However, the Cooper–Jacob equation (assuming full penetration) ignores the contribution to well yield from permeable sediments above and below the screened interval. To account for this contribution, it is necessary to use a computation algorithm that includes the effects of partial penetration. One such approach was introduced by Brons and Marting (1961, 098235) and augmented by Bradbury and Rothchild (1985, 098234).

Brons and Marting introduced a dimensionless drawdown correction factor, s_P, approximated by Bradbury and Rothschild as follows:

$$s_P = \frac{1-\frac{L}{b}}{\frac{L}{b}}\left[\ln\frac{b}{r_w} - 2.948 + 7.363\frac{L}{b} - 11.447\left(\frac{L}{b}\right)^2 + 4.675\left(\frac{L}{b}\right)^3\right] \qquad \textbf{Equation F-12}$$

In this equation, *L* is the well screen length, in feet. Incorporating the dimensionless drawdown parameter, the conductivity is obtained by iterating the following formula:

$$K = \frac{264Q}{sb}\left(\log\frac{0.3Tt}{r_w^2 S} + \frac{2s_P}{\ln 10}\right) \qquad \textbf{Equation F-13}$$

To apply this procedure, a storage coefficient value must be assigned. Unconfined conditions were assumed for the tested screens in R-40. Storage coefficient values for unconfined conditions can be expected to range from about 0.01 to 0.25 for unconsolidated sediments (Driscoll 1986, 104226). For fractured basalt, however, a much smaller porosity and storage coefficient are expected. The calculation result is not particularly sensitive to the choice of storage coefficient value, so a rough estimate of the storage coefficient is generally adequate to support the calculations. A value of 0.05 was used in the calculations for R-40 screen 2 within the Puye sediments, while an arbitrarily assigned value of 0.001 was used for R-40 screens 1 and R-40i in the basalt.

The analysis also requires assigning a value for the saturated aquifer thickness, *b*. For calculation purposes, the screen 1 and R-40i perched zones were assumed to extend from the water table to the bottom of the well screen. This resulted in assigned aquifer thickness values of 28.7 and 24.1 ft, respectively. For R-40 screen 2, which partially penetrates the top of the Puye sediments, an arbitrary thickness of 100 ft was assigned in the calculations.

Computing the lower-bound estimate of hydraulic conductivity can provide a useful frame of reference for evaluating the other pumping test calculations.

F-3.0 R-40 SCREEN 1 DATA ANALYSIS

This section presents the data obtained from the R-40 screen 1 pumping tests and the results of the analytical interpretations. Data are presented for refill tests as wells as injection and recovery tests. Some refill data were obtained from screen 1 during testing of screen 2, which occurred earlier. Additional refill data and injection/recovery data were obtained subsequently during focused testing of screen 1.

F-3.1 R-40 Screen 1 Refill Tests

The first opportunity to observe the sluggish refill rate in screen 1 occurred in mid-January during the testing of screen 2. On January 12, a packer was set between screens 1 and 2 to isolate screen 2 for testing. A transducer was installed above the packer to monitor water levels in screen 1. Figure F-3.1-1 shows the observed water-level response in screen 1 over the next 8 d. The pumping times for the screen two tests are shown for reference. Clearly, pumping screen 2 had no discernible effect on screen 1 water levels.

For the first 2 d of recovery, the screen 1 water levels remained in the 5-in. well casing beneath the well screen. Note that there was a subtle transient slope change (flattening) midday on January 13, after which the initial recovery slope was resumed. The brief flattening was a barometric pressure effect corresponding to a rapid atmospheric pressure drop of about 0.2 ft.

Once the water level rose into the well screen at 785.1 ft bgs, there was an abrupt reduction in the slope of the recovery graph because a greater volume of water was required to fill both the well screen and filter packed annulus.

The filling of the 5-in. casing represented a pumping event with respect to screen 1. The change in observed water level in the casing over time was used to compute the effective discharge rate. Figure F-3.1-2 shows the resulting computed flow rates.

The erratic results shown in the graph were a function of a combination of transducer noise and barometric pressure changes. The overall average refill rate determined from the data was 7.8 gpd. Note that data analysis was limited to the refill of the 5-in. casing beneath screen 1 and was not applied to refill of the screen and filter pack. This was because the actual borehole diameter of a drilled well generally is not known with certainty and neither is the short-term drainable porosity (short-term specific yield) of the filter pack. The volume of the casing, however, is known exactly.

This effective pumping rate was used to establish a specific capacity for screen 1 to support estimating a lower-bound transmissivity value using the Cooper–Jacob equation. The actual drawdown during the refill event was 24.1 ft. However, because the well screen was dewatered, it was necessary to correct the drawdown for dewatering effects before performing the calculations. The following equation can be used to correct observed drawdown for the effects of dewatering:

$$s_c = s_a - \frac{s_a^2}{2b}$$ **Equation F-14**

where, s_c = corrected drawdown

s_a = actual drawdown

b = original saturated thickness

Assumptions required for validity of Equation F-14 are (1) homogeneous hydraulic conductivity, (2) full penetration of the producing zone by the well screen, and (3) no head loss associated with vertical flow. This last assumption is satisfied by one of two extremes: either zero permeability in the vertical direction so that there is no flow (and therefore no head loss) vertically or infinite vertical permeability. Failure to meet any of these three assumptions leads to modest errors in application of the drawdown correction equation.

Applying this correction to the observed drawdown cut it in half to 12.05 ft because the drawdown was equal to the saturated thickness. Other inputs used in the lower-bound transmissivity calculation included a borehole radius of 0.51 ft, a storage coefficient of 0.001, and a pumping time of 42 d. This latter parameter was the elapsed time between pulling the advance casing back to expose the screen 1 perched zone during well construction (December 2, 2008) and the midpoint of the flow observation period from Figure F-3.1-2. It was determined that perched water from screen 1 would have flowed downward to the regional aquifer during this entire 42-d period.

Iterating the Cooper–Jacob equation using these inputs produced a lower-bound transmissivity of 0.52 gpd/ft and a hydraulic conductivity of 0.022 gpd/ft^2, or 0.0029 ft/d.

Attempts were made to increase the yield of screen 1 by swabbing and bailing on January 21 and 22. To accomplish this, water was added to the well to saturate screen 1, swabbing was performed, and bailing was used to remove dirty water from the screen and filter packer. These procedures were repeated several times. The water bailed from the well following episodes of swabbing contained large amounts of sand, silt and clay.

After swabbing and bailing, water-level recovery in screen 1 was measured overnight. Figure F-3.1-3 shows the resulting water-level response. The portion of the graph in Figure F-3.1-3 corresponding to refilling the casing beneath screen 1 was plotted on the expanded-scale graph shown in Figure F-3.1-4.

As indicated in the graph, the casing refill rate was 167 gpd. This was substantially greater than shown in Figures F-3.1-1 and F-3.1-2, giving the impression that the yield of the well had been increased. However, it was suspected that the majority of the contribution may have come from slow drainage of the filter pack as well as the vadose zone that had been saturated temporarily during the development procedures.

To check this possibility, swabbing and bailing was repeated on January 23 followed by water-level monitoring overnight. This time, however, bailing time was extended in an attempt to exhaust filter pack and vadose zone water contribution before monitoring refill rates. The water bailed from the well continued to exhibit significant, though somewhat reduced, solids. Figure F-3.1-5 shows the results of water-level monitoring following this development effort.

The late refill rate shown in the graph was 12.5 gpd, greater than the initial refill rate of 7.8 gpd observed during the testing of screen 2. The effective pumping time since bailing screen 2 dry was 15 h for the data shown in Figure F-3.1-5. Applying the Cooper–Jacob equation to these parameters yielded a lower-bound transmissivity of 0.48 gpd/ft and a hydraulic conductivity of 0.020 gpd/ft^2, or 0.0027 ft/d. These values were consistent with those determined from the initial refill event, indicating that the greater refill rate of 12.5 gpd was a function of the shorter effective pumping time and not an indication of increased yield due to development.

A final bail down and recovery test was performed in screen 1 on February 2 and 3, following the test pumping of screen R-40i. No swabbing was performed before the bailing operation. Water bailed from the well was dirty but contained fewer solids than observed in the preceding development efforts. Figure F-3.1-6 shows the water-level recovery data recorded during this test with an effective pumping time of 22 h since bailing screen 1 dry.

As indicated in Figure F-3.1-6, after 22 h of flow from screen 1, the effective recharge rate was 12.2 gpd. The parameters calculated from this information included a lower-bound transmissivity of 0.50 gpd/ft and a hydraulic conductivity of 0.021 gpd/ft^2, or 0.0028 ft/d. These results agreed with those obtained from the previous refill tests.

F-3.2 R-40 Screen 1 Static Water Level

The water-level response rate in screen 1 was too sluggish to allow equilibration to the static level during the bail down and recovery tests described above. To estimate this parameter, screen 1 water levels were monitored for several days during the testing of screen R-40i. Before installing the pressure transducer in the screen 1 sump, the water level was bailed to a position that was suspected to be near the true static level.

Figure F-3.2-1 shows the water-level data measured over an 8-d period from January 26 to February 3. Throughout the observation period, the water level continued to drop but did not stabilize. Near the end of the monitoring period, however, the rate of descent became quite small, suggesting that the measured level was nearing the true static level. The lowest level measured was 760 ft bgs. It was assumed that a reasonable estimate of the true static water level was slightly deeper, at 761 ft. This estimate was used in subsequent analysis of R-40 screen 1 data. (Long-term monitoring performed after the test analyses in this report were completed confirmed an estimated static water depth between 761 and 762 ft bgs.)

F-3.3 R-40 Screen 1 Injection/Recovery Tests

On January 24, additional testing of screen 1 was performed using injection and recovery. This was accomplished by adding water to the well to cause injection into the screen zone and then inflating a packer just above the screen to halt the injection and allow measurement of recovery. During these procedures, it was believed that suction beneath the inflatable packer would suspend water within the casing at the level of the bottom of the packer, preventing the casing from draining, thereby eliminating casing-storage effects during recovery. It was likely, however, that adding water to the well trapped air in the filter pack outside the blank casing just above the well screen. Contraction and expansion of this trapped air during injection and recovery was expected to cause a storagelike effect on the data.

Because the entire screen 1 interval was saturated during these tests, the results reflected response of both the saturated portion of screen 1 as well as the vadose zone above the water level.

Figure F-3.3-1 shows water-level data measured during the injection/recovery tests. As indicated in the graph, two episodes of injection and recovery were monitored.

In the first test, adding water to the well raised levels initially about 120 ft. When addition of water ceased, the water level began to drop slowly as water flowed into the screen 1 perched zone and vadose zone. The effective flow rate at any point in time was calculated from the reduction in the standing water level in the casing and the known volume between the 5-in. well casing and 1-in. pipe used to suspend the inflatable packer.

After about 10 min of injection, the packer was inflated to block further flow of water into screen 1. When this occurred, there was an abrupt drop in pressure (recovery) beneath the packer as shown by the steep portion of the curve. Over time, the water level recovered to a level about 754 ft bgs, 7 ft above the estimated screen 1 static water level of 761 ft. This may have been an indication that the primary permeability (perhaps a fracture) within the vadose zone was located near and above 754 ft, with very low permeability below that point.

As shown on the right side of Figure F-3.3-1, after 165 min of recovery, the packer was deflated, allowing resumption of flow of water from the well casing downward into screen 1. The water level in the casing dropped at a moderate rate, reflecting the rate of flow into screen 1. Then after 20 min of flow, the packer was inflated again, halting further flow and allowing recovery. Again, the water level equilibrated near a depth of 754 ft.

Figure F-3.3-2 shows an expanded-scale graph of the water levels for injection test 1. Also shown in the graph are the computed flow rates and corresponding specific capacities during injection. The final injection rate measured at the end of the injection period was 1.86 gpm, while the average flow rate over the bulk of the injection period was 2.0 gpm.

Formation parameters were determined using two methods based on the injection data. First, a conventional Theis recovery plot of the data was used to compute transmissivity. Second, the specific capacity information was used to compute a lower-bound transmissivity.

Figure F-3.3-3 shows a semilog plot of the recovery data collected following the injection ("pumping") period. The concave-upward form of the graph was consistent with both storage effects (such as trapped air in the filter pack) and fracture flow. Either of these phenomena can cause the appearance seen in the figure. Storage effects were expected because of the likelihood of trapping air in the filter pack during injection. Also, fracture flow was a reasonable expectation because screen 1 lies within the basalt.

With either storage effects or fracture flow, determination of formation parameters using the Theis recovery method must be restricted to the late data. The line of fit selected in Figure F-3.3-3 yielded a formation transmissivity of 7.0 gpd/ft. This result was more than an order of magnitude greater than lower-bound transmissivity estimates for the saturated zone in screen 1 (about 0.5 gpd/ft) discussed previously. This suggested that the vadose zone at the top of screen 1 contributed most of the transmissivity and that it could be roughly an order of magnitude more transmissive than the saturated interval.

The specific capacity data were used also to estimate a lower-bound transmissivity for the combined screen 1 saturated and vadose zones. As shown in Figure F-3.3-2, after 10 min of continuous injection at the maximum rate, the specific capacity was 0.025 gpm/ft. The Cooper–Jacob equation was iterated using this specific capacity value to estimate the lower-bound transmissivity. Other inputs used in the calculation included a borehole radius of 0.51 ft and a storage coefficient of 0.001.

The resulting calculated lower-bound transmissivity value was 13.1 gpd/ft. This result was *greater than* the result from the Theis recovery analysis shown in Figure F-3.3-3, ostensibly a contradiction. However, this may simply have been an indication of fracture flow. The lower-bound transmissivity estimate was based on the Cooper–Jacob equation, which, in turn, is based on flow through porous media. In fractured media of a given transmissivity, the specific capacity of the pumped well is generally greater than that of a well in sediments having homogeneous transmissivity. This is because the well typically penetrates a fracture that has the effect of increasing the effective hydraulic diameter of the well. The greater specific capacity associated with fracture flow yields a greater transmissivity when the porous media equation is used for the calculation.

Applying a fractured media formula to the specific capacity data to estimate a lower-bound value for transmissivity would yield a lower value than what was obtained from the Cooper–Jacob equation. Such computations were not performed because they require imposing artificial assumptions regarding the detailed nature of the fractured media, such as fracture patterns, orientation, and length. These properties can vary tremendously and thus any arbitrary assignment of parameters and values would have negated the value of the calculations. It was sufficient to know that the assumption of fracture flow would essentially eliminate the apparent contradiction above, where the lower-bound transmissivity exceeded the value obtained from the Theis recovery analysis.

Figure F-3.3-4 shows an expanded-scale graph of the water levels for injection test 2. Also shown in the graph are the computed flow rates and corresponding specific capacities during injection. The final injection rate measured at the end of the injection period was 0.65 gpm, while the average flow rate over the entire injection period was 0.94 gpm.

As with the first injection test, formation parameters were determined using two methods. As before, a conventional Theis recovery plot of the data was used to compute transmissivity. Second, the specific capacity information was used to compute a lower-bound transmissivity.

Figure F-3.3-5 shows a semilog plot of the recovery data collected following the second injection period. As before, the concave-upward form of the graph was consistent with both storage effects and fracture flow, either of which could have caused the appearance seen in the figure.

The line of fit selected in Figure F-3.3-5 yielded a transmissivity value of 7.3 gpd/ft, consistent with the results from the first injection and recovery test.

The very late data on the left side of the graph showed a reversal in the water-level recovery trend. Because the water level had been declining during recovery, this reversal meant that the level actually rose toward the end of the monitoring period. The magnitude of the water-level rise was about 0.3 ft. During the same period, the change in barometric pressure was only about 0.1 ft, so it was unlikely that this could have caused the observed response. Also, the inflation pressure on the packer had not declined, so leakage of water past the packer was not likely. There was no obvious explanation for the unusual water-level reversal.

As was done in test 1, the specific capacity data were used to estimate a lower-bound transmissivity for the combined screen 1 saturated and vadose zones. As shown in Figure F-3.3-4, after 20 min of continuous injection, the specific capacity was 0.019 gpm/ft. The Cooper–Jacob equation was iterated using this specific capacity value to estimate the lower-bound transmissivity. Other inputs used in the calculation included a borehole radius of 0.51 ft and a storage coefficient of 0.001.

The resulting calculated lower-bound transmissivity value was 11.5 gpd/ft. This result was greater than the result from the Theis recovery analysis shown in Figure F-3.3-5, again lending credibility to the idea that fracture flow dominated the flow regime near the well.

F-4.0 R-40 SCREEN 2 DATA ANALYSIS

R-40 screen 2 was tested from January 13 to January 16 using conventional constant-rate pumping methods. Testing consisted of brief trial pumping on January 13, a 24-h constant-rate pumping test that was begun on January 14, and background data collection.

Trial 1 was conducted for 60 min from 8:00 to 9:00 a.m. and was followed by 60 min of recovery until 10:00 a.m. Trial 2 was conducted for 60 min from 10:00 to 11:00 a.m., also followed by 60 min of recovery until 12:00 p.m. Trial 3 was conducted for 60 min from 12:00 to 1:00 p.m. Following shutdown, recovery was monitored for 1140 min until 8:00 a.m. on January 14.

At 8:00 a.m. on January 14, the 24-h pumping test was begun at a rate of 3.44 gpm. Pumping continued until 8:00 a.m. on January 15. Following shutdown, recovery/background measurements were recorded for 7167 min until 7:27 a.m. on January 20.

Because the static water level fell within screen 2, pumping caused dewatering of a portion of the saturated thickness. The multiple trial tests, combined with the 24-h test, afforded the opportunity to pump screen 2 at several different rates so that the mathematical correction required for dewatering could be evaluated.

The early data from all of the screen 2 tests were affected by casing and filter pack storage. Using Equation F-3, the estimated storage duration for the various tests ranged from about 60 to 70 min. EquationsF-2 and F-3 tend to be conservative, so commonly it can be assumed that significant storage effects persist for only about half of the theoretically calculated pumping time. This still put the effective storage duration at just over a half hour—a significant hindrance to interpreting the test data. As described below, in each screen 2 test, the induced cone of depression expanded vertically throughout the pumping period. Thus, multiple transmissivity values could be obtained from the data plots and there was no way to know what effective sediment thickness corresponded to a given transmissivity value.

F-4.1 R-40 Screen 2 Background Data

Background aquifer pressure data collected during the R-40 screen 2 testing were plotted along with barometric pressure to determine the barometric effect on water levels.

Figure F-4.1-1 shows aquifer pressure data from R-40 screen 2 (screened in the Puye Formation) along with barometric pressure data from TA-54 that have been corrected to equivalent barometric pressure at the water table in feet of water. The screen 2 data are referred to in the figure as the “apparent hydrograph” because the measurements reflect the sum of water pressure and barometric pressure, having been recorded using a nonvented pressure transducer. The times of the pumping periods for the screen 2 pumping tests are included in the figure for reference.

The apparent hydrograph showed deflections that were roughly coincident with those in the barometric pressure signal but muted. The barometric pressure data were adjusted for barometric efficiency and re-plotted. Then the barometric efficiency was adjusted to obtain a reasonable match between the two curves.

Figure F-4.1-2 shows the resulting comparison for an assumed immediate barometric efficiency of 75%. The curve match was not perfect but implied that most of the observed water-level fluctuations were caused by barometric pressure changes.

Figure F-4.1-3 shows a comparison of the adjusted barometric pressure and the apparent hydrograph from screen R-40i (screened in the Cerros del Rio basalt) during the same monitoring period. The peaks on the apparent hydrograph were similar to those on the barometric pressure curve but were smoothed, attenuated, and delayed.

The barometric pressure data from Figure F-4.1-3 were adjusted for time delay and barometric efficiency. In addition, smoothing was accomplished by taking a rolling average of the data. An optimum match between the two plots was obtained for a barometric efficiency of 33% and a 10-h rolling average of the data with an average 5-h lag time. Figure F-4.1-4 shows the resulting data plot. As with R-40 screen 2, the curve match in Figure F-4.1-4 implied that most of the fluctuations in groundwater level were caused by barometric pressure changes.

F-4.2 R-40 Screen 2 Trial 1

Trial 1 consisted of pumping screen 2 for 60 minutes followed by 60 minutes of recovery.

Figure F-4.2-1 shows the time-drawdown graph from the pumping event. The initial discharge rate was 2.91 gpm, adjusted subsequently to 2.2 gpm for most of the pumping period.

The key casing-storage times are shown in the graph for reference. Note that the theoretical casing-storage time, t_c, computed from Equation F-3 exceeded the duration of the pumping test. This meant that in theory, none of the test data could be analyzed. As discussed previously, in practice, many times data recorded after t_c/2 can support a valid analysis. In this case, however, the data after t_c/2 were erratic because of subtle discharge rate fluctuations and were not used to support calculation of aquifer parameters.

Figure F-4.2-2 shows recovery data recorded following pump shutdown. Most or all of the data were storage affected. The transmissivity value computed from data recorded between recovery times t_c /2 and t_c was 390 gpd/ft. The height of the cone of depression corresponding to these data was not known, although it likely would have been in excess of the saturated screen length of 16.1 ft.

F-4.3 R-40 Screen 2 Trial 2

Trial 2 consisted of pumping screen 2 for 60 min followed by 60 min of recovery.

Figure F-4.3-1 shows the time-drawdown graph from the pumping period. The initial discharge rate was 2.28 gpm, adjusted subsequently to 2.84 gpm for most of the pumping period.

The key casing-storage times are shown in the graph for reference. Again the theoretical casing-storage time, t_c, computed from Equation F-3 exceeded the duration of the pumping test. Analysis of the data was performed for the data recorded between times t_c/2 and t_c. The computed transmissivity value from this portion of the curve was 340 gpd/ft.

Because significant dewatering occurred during the pumping test, the drawdown included a bias that increased with increasing drawdown magnitude. Therefore, the drawdown data were corrected for the effects of dewatering and replotted for analysis. The dewatering correction was based on Equation F-14 to adjust the observed drawdown values to theoretical equivalents that compensated for the effects of dewatering a portion of the saturated screen length.

The correction applied to the data was based on the assumption of a saturated aquifer thickness equal to the well screen length of 16.1 ft. In practice, it was likely that permeable sediments (and the cone of depression) extended to a depth beneath the bottom of the screen incorporating partial penetration effects in addition to dewatering. In this situation, the dewatering correction overcompensates for the effects of the reduction in saturated thickness.

Figure F-4.3-2 shows a plot of the drawdown data corrected for dewatering. The transmissivity value computed from the data was 650 gpd/ft. Because the correction factor may have overcompensated for the effects of dewatering, it is possible that the true transmissivity falls between the value obtained from the uncorrected data (340 gpd/ft) and this value (650 gpd/ft).

Figure F-4-3.3-3 shows recovery data recorded following the trial 2 pump shutdown. Most or all of the data were storage-affected. The transmissivity value computed from data recorded between recovery times t_c /2 and t_c was 410 gpd/ft. The height of the cone of depression corresponding to these data were not known, although it likely would have been in excess of the saturated screen length of 16.1 ft.

F-4.4 R-40 Screen 2 Trial 3

Trial 3 consisted of pumping screen 2 for 60 min followed by 1140 min of recovery. Figure F-4.4-1 shows the time-drawdown graph from the pumping period. The initial discharge rate was 3.11 gpm, adjusted subsequently to 3.99 gpm for most of the pumping period.

The key casing-storage times are shown in the graph for reference. Again the theoretical casing-storage time, t_c, computed from Equation F-3 exceeded the duration of the pumping test. Analysis of the data was performed for the data recorded between times $t_c/2$ and t_c. The computed transmissivity value from this portion of the curve was 350 gpd/ft.

Because significant dewatering occurred during pumping, the data were corrected using Equation F-14 and replotted. Figure F-4.4-2 shows the resulting graph of corrected data. The transmissivity value computed from the data was 970 gpd/ft. Because the correction factor may have overcompensated for the effects of dewatering, it is possible that the true transmissivity falls between the value obtained from the uncorrected data (350 gpd/ft) and this value (970 gpd/ft).

Figure F-4.4-3 shows recovery data recorded following the trial 3 pump shutdown. Much of the data were storage-affected. The transmissivity value computed from data recorded between recovery times t_c /2 and t_c was 415 gpd/ft. The height of the cone of depression corresponding to these data was not known, although it likely would have been in excess of the saturated screen length of 16.1 ft.

As recovery time continued, the response curve flattened further, presumably in response to continued vertical growth of the cone of impression beneath the bottom of the well. Figure F-4.4-4 shows an expanded-scale plot of the late recovery data.

The transmissivity value computed from the late recovery data in Figure F-4.4-4 was 950 gpd/ft. Again, the thickness of sediments (height of the cone of impression) corresponding to this value could not be ascertained.

F-4.5 R-40 Screen 2, 24 H Constant-Rate Test

Following trial testing, R-40 screen 2 was pumped continuously at a rate of 3.44 gpm for 24 h from 8:00 a.m. on January 14 to 8:00 a.m. on January 15. Following pump shutoff, recovery data were recorded for nearly 120 hours until 7:27 a.m. on January 20.

Figure F-4.5-1 shows the drawdown data recorded during the pumping test. As with the trial tests, the data were storage-affected for the first half hour to 1 h of pumping. After storage effects subsided, the drawdown curve continued to flatten throughout the remainder of the pumping test, presumably as the cone of depression expanded vertically through an increasing thickness of the Puye Formation.

Figure F-4.5-2 shows an expanded-scale graph of the drawdown data. A transmissivity value was computed from the data between $t_c/2$ and t_c, consistent with previous calculations from the trial tests. The calculation showed a transmissivity value of 320 gpd/ft, similar to previous early-time values.

Because significant dewatering occurred during pumping, the data were corrected using Equation F-14 and replotted. Figure F-4.5-3 shows the resulting graph of corrected data. The transmissivity value computed from the data was 670 gpd/ft. Because the correction factor may have overcompensated for the effects of dewatering, it is possible that the true transmissivity falls between the value obtained from the uncorrected data (320 gpd/ft) and this value (670 gpd/ft).

Finally, an analysis was made of the latest drawdown data as shown in Figure F-4.5-4. The late data were corrected for the effects of dewatering. Further, they were adjusted for barometric pressure effects using the relationship illustrated in Figure F-4.1-2. The transmissivity value computed from the line of fit in the graph was 5580 gpd/ft. It was not possible to know the sediment thickness (height of the cone of depression) corresponding to the transmissivity value. Also, the transmissivity value was considered uncertain because of the significant data scatter and limited change in head (0.03 ft) on which the analysis was based.

Figure F-4.5-5 shows recovery data recorded following the 24-h pumping test. As with the drawdown response, much of the data were storage-affected, followed by substantial flattening of the data trace.

Figure F-4.5-6 shows an expanded-scale plot of the recovery data. The transmissivity value computed from data recorded between recovery times t_c /2 and t_c was 840 gpd/ft. The height of the cone of impression corresponding to these data was not known.

Figure F-4.5-7 shows an expanded-scale plot of the late-recovery data from the 24-h pumping test. The transmissivity value computed from the graph was 15,100 gpd/ft. However, there was substantial scatter among the data points and barometric pressure effects were not removed.

To improve the transmissivity estimate, the late-recovery data were corrected for barometric pressure effects and plotted in Figure F-4.5-8. The late-time transmissivity value obtained from the graph was 11,800 gpd/ft. Even after applying the barometric pressure correction, substantial scatter remained in the data set. Further, the magnitude of head change on which the calculation was based was only a few hundredths of a foot. These factors cast doubt on the accuracy of the computations.

F-4.6 R-40 Screen 2 Dewatering Correction

A comparison of specific capacities observed in screen 2 at different pumping rates was made to evaluate the dewatering correction factor applied to the data. Table F-4.6-1 shows pumping rate and drawdown data recorded after 60 min of pumping during each of the four tests conducted on screen 2.

As shown in the table, the specific capacity at the lowest pumping rate of 2.2 gpm was 0.44 gpm/ft. At successively greater flow rates, the specific capacity declined, as would be expected because of the effects of increasing dewatering at the greater pumping rates.

The measured drawdown values were corrected using Equation F-14 and corrected specific capacity values were computed, as shown in Table F-4.6-1. In theory, the resulting corrected specific capacity values should be identical for laminar flow conditions. For conditions including minor turbulent flow, slight decline in specific capacity at greater pumping rates will occur because of second-order head loss.

As shown in Table F-4.6-1, however, the corrected specific capacity values *increased* at greater pumping rates. This meant that the mathematical correction was too great. This was probably an artifact of partial penetration effects in which the contribution to specific capacity from the unscreened sediments is about the same for all pumping rates, therefore not requiring correction—in other words, the standard correction overcompensated for the dewatering effects.

Inspection of the actual and corrected specific capacities in Table F-4.6-1 shows that the increase in the corrected values at greater pumping rates was similar to the decrease observed in the actual values. This implied that a more appropriate correction should have been about midway between the actual values and the corrected values. The right-hand columns in Table F-4.6-1 show the arithmetic average of the actual and corrected values of drawdown and specific capacity. This, in turn, implied that the true transmissivity from a given drawdown analysis probably fell between the values computed for uncorrected and corrected data. Note that this was applicable only to drawdown analyses, not recovery analyses.

(Note: The foregoing discussion assumes uniform flow contribution along the saturated length of well screen. If heterogeneous conditions exist [variable sediment permeability along the screened interval], the actual and corrected specific capacities can vary in a more chaotic way than described here.)

F-4.7 R-40 Screen 2 Specific Capacity Data

Specific capacity data were used along with well geometry to estimate a lower-bound conductivity value for the R-40 screen 2 zone for comparison to the pumping test values. In addition to specific capacity, other input values used in the calculations included the aquifer thickness, storage coefficient, and borehole radius. An assigned storage coefficient value of 0.05 and a borehole radius of 0.51 ft were used in the calculations. An arbitrary aquifer thickness of 100 ft was assigned. The calculations are somewhat insensitive to the magnitude of the aquifer thickness, as long as the selected value is substantially greater than the screen length. They are likewise somewhat insensitive to the selection of storage coefficient value.

The data recorded from trial 1, which was conducted at the lowest discharge rate, were used to minimize the effect of the dewatering correction algorithm. The trial 1 pumping rate was 2.2 gpm with a drawdown of 5.05 ft after 60 min of pumping. Correcting the drawdown for dewatering using Equation F-14 yielded a corrected drawdown value of 4.26 ft. Knowing that overcorrection was likely, these two values were averaged, producing an effective drawdown of 4.66 ft. It was judged that this value was a more representative estimate of theoretical drawdown than either the actual or corrected drawdown.

Applying the Brons and Marting method to these inputs yielded a lower-bound hydraulic conductivity value of 22.4 gpd/ft^2, or 3.0 ft/d. This result was used to evaluate the various pumping test analyses presented above.

F-4.8 R-40 Screen 2 Data Interpretation

Table F-4.8-1 shows a summary of the early-time transmissivity values obtained from the pumping tests conducted on R-40 screen 2.

The average values obtained from the drawdown data were 337 gpd/ft for the uncorrected data and 763 gpd/ft for the corrected data. As stated above, the true value likely lies between these extremes. Taking the average of these two values yielded 550 gpd/ft for the early-drawdown analyses.

As shown in Table F-4.8-1, the average transmissivity value obtained from the early-recovery analyses was 514 gpd/ft, similar to the average drawdown-based value.

Combining these two averages yielded an overall average early-time transmissivity of about 530 gpd/ft. At early time, the height of the cone of depression (effective thickness of sediments corresponding to the computed transmissivity) was relatively small, increasing steadily at later time.

The saturated well screen length of 16.1 ft can be used as a lower bound of the possible cone of depression height (effective sediment thickness responding to pumping), corresponding to the early-time analyses. The height of the actual cone of depression surely would have been greater than the screen length. Dividing the average early-time transmissivity of 530 gpd/ft by this lower-bound thickness value yielded an upper bound for hydraulic conductivity—32.9 gpd/ft^2, or 4.4 ft/d.

The specific capacity data presented earlier established a lower-bound hydraulic conductivity of 3.0 ft/d. Thus, the data analyses implied bounding values of 3.0 and 4.4 ft/d for the saturated sediments.

As pumping (or recovery) time increased, the cone of depression (or impression) intercepted a progressively greater, yet unknown, thickness of sediment. The late-drawdown data, corrected for both dewatering and barometric pressure effects, supported a transmissivity calculation of 5580 gpd/ft. This may have been an overestimate, having been based on corrected data with respect to dewatering, rather than the average of the corrected and uncorrected data. The recovery data, on the other hand, yielded a late-time transmissivity value of 11,800 gpd/ft. Averaging the drawdown and recovery based results yielded a transmissivity of about 8700 gpd/ft for the contiguous sediments affected by pumping. There was no way to know the sediment thickness reflected by these values. Further, these values were not considered reliable because they were based on data sets with large scatter and minimal change in magnitude.

F-5.0 R-40i DATA ANALYSIS

Screen R-40i was tested from January 25 to February 3 using conventional constant-rate pumping methods. Testing consisted of brief trial pumping on January 26, a 24-h constant-rate pumping test that was begun on January 27, and background data collection.

Trial 1 was conducted for 180 min from 8:00 to 11:00 a.m. and was followed by 180 min of recovery until 2:00 p.m. Trial 2 was conducted for 60 min from 2:00 to 3:00 p.m. Following shutdown, recovery was monitored for 1020 min until 8:00 a m on January 27.

At 8:00 am on January 27, the 24-h pumping test was begun at a rate of 2.22 gpm. Pumping continued until 8:00 a.m. on January 28. Following shutdown, recovery/background measurements were recorded for 8656 min until 8:16 a.m. on February 3.

As described earlier, during testing of screen R-40i, the pumped water was significantly aerated, with substantial residual foam, left over from the drilling operation, appearing in the discharge water stream. The presence of the foam in the pumped water had two deleterious effects on the testing effort. First, it affected the pump operation by reducing the discharge rates initially. Second, the foam interfered with operation of the flow meter. Early in each test, the meter reading was significantly less than the actual well output. As pumping continued, the contribution of foam may have diminished because the meter reflected the actual discharge rates more accurately.

F-5.1 R-40i Background Data

Background aquifer pressure data collected during the screen R-40i testing were plotted along with barometric pressure to determine the barometric effect on water levels and provide a basis for correcting observed water levels for the effects of atmospheric pressure fluctuations.

Figure F-5.1-1 shows aquifer pressure data from screen R-40i along with barometric pressure data from TA-54 that have been corrected to equivalent barometric pressure at the water table in feet of water. The times of the pumping periods for screen R-40i pumping tests are included in the figure for reference.

As observed on the earlier screen R-40i data shown in Figure F-4.1-3, the apparent hydrograph in Figure F-5.1-1 showed deflections that were similar to those in the barometric pressure signal, but smoothed, delayed, and attenuated. The barometric pressure data from Figure F-5.1-1 were adjusted for time delay and barometric efficiency using the same values as those shown in Figure F-4.1-1 previously. In addition, smoothing was accomplished by taking a rolling average of the data as was done before.

Figure F-5.1-2 shows the correlation between screen R-40i water levels and modified barometric pressure. As before, the match shown between the two plots was obtained for a barometric efficiency of 33% and a 10-h rolling average of the data with an average 5-hour lag time.

The resulting data plots showed similar shape but did not coincide. The gap between the two curves represented the drawdown induced by pumping screen R-40i. Note that the gap between the curves remained even after 6 d of recovery. This showed the presence of a negative boundary that was encountered during the testing, i.e., either a limited permeable zone around screen R-40i or a relatively permeable zone imbedded within a tighter region.

F-5.2 R-40i Trial 1

Trial 1 consisted of 180 minutes of pumping about 2.0 gpm followed by 180 minutes of recovery. Figure F-5.2-1 shows the drawdown data recorded during the test.

Indicated in the graph are the average discharge rates measured on the flow meter for selected time intervals. The actual flow meter output changed more uniformly than suggested by the rates listed in the figure. The actual readings were arbitrarily broken up into the intervals shown in the graph for ease of presentation.

It is clear from the data that the water meter did not record pumping rates accurately initially. For example, during the early pumping when the recorded discharge rate increased from 1.07 to 1.77 gpm, the drawdown remained fairly stable implying that the actual discharge rate was relatively constant during that period.

In addition to the meter errors, the actual discharge rate of the pump changed as well. An indication of this can be seen as a discontinuity in the drawdown after about 60 minutes of pumping. It was suspected that the presence of foam or air bubbles in the produced water affected the operation of both the water meter and submersible pump. The actual documented discharge rate during the latter stages of the trial test was 2.0 gpm.

Figure F-5.2-2 shows the recovery data recorded following pump shutoff. Two distinct slopes were recorded in the graph. The transmissivity computed from the early data was 26,400 gpd/ft. This likely represents the properties of the formation adjacent to the well bore.

The subsequent data, considered intermediate data, yielded a transmissivity of 4980 gpd/ft. This likely represents formation properties some distance from the well. Note that this latter value would represent a true transmissivity only if the formation properties varied in perfect circular symmetry around the well—an unlikely scenario. Thus, the value of 4980 gpd/ft represents an effective average of the properties of the more distant formation.

F-5.3 R-40i Trial 2

Trial 2 consisted of pumping at an average rate of about 2.0 gpm for 60 min followed by 1020 min of recovery. Figure F-5.3-1 shows the drawdown data recorded during the pumping period. The graph also shows average measured discharge rates for arbitrarily selected intervals.

In this test, the flow meter appeared to provide more accurate readings than in trial 1. For example, the lowest measured rate was 1.82 gpm. Also, the transition from the 1.89-gpm interval to the 1.98-gpm interval was accompanied by an abrupt drop in water level, suggesting that the rate increase was real rather than an artifact of the operation of the meter. Nevertheless, the meter still gave small errors, yielding slightly smaller readings than obtained using the “bucket and stop watch” method of measuring flow.

The transmissivity value computed from the intermediate data was 4850 gpd/ft, representing a bulk average of the formation properties some distance away from the well. The actual flow rate was probably slightly greater than 1.89 gpm, so the foregoing transmissivity value is likely understated by a minor amount.

A transmissivity was not calculated from the first few minutes of pumping because the drawdown data were erratic during that period.

Figure F-5.3-2 shows the recovery data recorded following trial 2. Two distinct slopes were evident in the early and intermediate data. The transmissivity computed from the early data was 27,300 gpd/ft. This likely represents the properties of the formation adjacent to the well bore and was in good agreement with the value obtained from trial 1. The intermediate data produced a transmissivity value of 5280, also in agreement with previous results.

The late data shown in Figure F-5.3-2 were influenced by barometric pressure changes and were not analyzed. The magnitude of any barometric pressure correction applied to the data would have been large in comparison to the observed change in water level. This, coupled with the complexity associated with running back-to-back trial tests, negated any value in correcting and analyzing the late recovery data.

F-5.4 R-40i 24-H Constant-Rate Pumping Test

Screen R-40i was pumped continuously at 2.22 gpm for 24 h beginning at 8:00 a.m. on January 27. Following pump shutoff, recovery data were recorded for 8656 min until 8:16 a.m. on February 3.

Figure F-5.4-1 shows the drawdown data recorded during the pumping test. Also shown in the graph are average discharge rates recorded using the flow meter for selected intervals throughout the test. Again, there were large errors in the meter output, similar to what occurred in trial 1. For example, during the first 20 minutes of pumping, the measured discharge rate nearly doubled even though the modest change in drawdown belied significant change in the actual flow rate.

The late data in Figure F-5.4-1 showed a great increase in the slope of the data trace. This suggested lateral limits to the permeable perched zone and/or a radical reduction in the bulk transmissivity of the formation far from the well. The late data were corrected for the effects of barometric pressure changes using the relationship shown in Figure F-5-1-2.

The transmissivity value computed from the late corrected data was 340 gpd/ft.

Figure F-5.4-2 shows a semilog plot of the recovery data recorded following shutdown of the 24-h test. The data exhibited the early flat slope, the intermediate slope, and the late steep slope including barometric pressure effects.

In addition, the very early data (first two data points) showed casing and filter pack storage effects. The positions in the graph corresponding to t_c and t_c /2 are included for reference.

The early-recovery data revealed a transmissivity of 22,500 gpd/ft, consistent with previous analyses. The intermediate data showed a reduction in transmissivity away from the well, yielding a value of 3490 gpd/ft, also consistent with previous results.

The late data showed a steep trend but also showed cyclic fluctuations, including levels above the initial static water level. These unusual responses were assumed to reflect barometric pressure changes. To remove these influences, the relationship between water level and barometric pressure shown previously in Figure F-5.1-2 was used to correct the recovery data for barometric effects.

Figure F-5.4-3 shows the resulting data plot. The corrected data trace appears more reasonable in that the sinusoidal fluctuations were absent and the plotted water levels did not rise above the initial static level. The transmissivity value computed from the late data was 470 gpd/ft, similar to the value obtained from the late drawdown data. In this case, the magnitude of the water-level corrections was comparable to the change in water level on which the transmissivity computation was based. In such circumstances, the possibility of introduced error increases.

F-5.5 R-40i Reduction in Efficiency

The efficiency of screen R-40i appeared to decline somewhat during testing. An illustration of this can be seen by examining recovery data following trial 1 and that following the 24-h test.

In trial 1, the water level rebounded from a maximum drawdown of 0.63 to 0.18 ft between 0.8 and 0.9 min following pump shutoff. Thus, the magnitude of the recovery was 0.45 ft with a pumping rate of 2.0 gpm. After the 24-h test, on the other hand, the water level rose from a maximum drawdown of 1.28 to 0.46 ft in the same time frame, for a recovery of 0.82 ft at a pumping rate of 2.22 gpm. Adjusting this recovery for a rate of 2.0 gpm yielded 0.82 × (2.0/2.22) = 0.74 ft. Theoretically, the adjusted recovery should have been equal to that observed after trial 1. The discrepancy (0.74 ft versus 0.45 ft) implied a greater well loss component in the drawdown at the end of the 24-h test as compared with trial 1.

The most likely explanation for the reduction in efficiency was the possibility of the formation of foam or air bubbles in the pore spaces around the well bore during pumping, thereby reducing the permeability of the openings. In wells drilled with air, it is not unusual for air to become dissolved in the formation during construction. Subsequently, when the head is lowered by pumping, air can come out of solution near the well bore and degrade the permeability around the well. The substantial amount of foam observed in the pumped water during testing of screen R-40i makes it likely that air-induced permeability reduction occurred during the extended pumping of the 24-h test.

F-5.6 R-40i Specific Capacity Data

Specific capacity data were used along with well geometry to estimate a lower-bound transmissivity value for the formation near the well bore at screen R-40i for comparison to the pumping test values. In addition to specific capacity, other input values used in the calculations included the estimated aquifer thickness of 28.7 ft between the static water level and the bottom of the well screen, an estimated storage coefficient of 0.001, and an effective borehole radius of 0.51 ft. The calculations are somewhat insensitive to the assigned storage coefficient, so an estimate of this value was deemed adequate. Because of the change in transmissivity with distance around the well, this analysis was restricted to the early data before the cone of depression intercepting formation material having significantly different characteristics. Also, the analysis was performed for the earliest test (trial 1) to minimize the effects of permeability and efficiency degradation. Finally, recovery, rather than pumping, data were used in the analysis because of the uncertainty regarding the early-time discharge rate measurements.

During trial 1, screen R-40i produced 2.0 gpm. Following shutdown, the water level recovered 0.475 ft in 7.2 min. Applying the Brons and Marting method to these inputs yielded a lower-bound transmissivity value for the perched interval adjacent to the well of 6120 gpd/ft. This result was about one-fourth of the average early-time transmissivity from the preceding analyses of 25,400 gpd/ft. This, in turn, implied a well efficiency on that same order of magnitude.

This result of the analyses of early recovery data from trial 1 was consistent with the average pumping test transmissivity value in that it was less than it, rather than greater (which would have been contradictory). Also, the modest efficiency that would be concluded from this result was not surprising.

The total drawdown in screen R-40i during trial 1 was only 0.63 ft. Thus, a well loss of just half a foot or so would produce an efficiency of about what can be concluded from the specific capacity examination. The screen R-40i pumping tests were conducted using a tight-fitting nominal 3-in. submersible pump inside the 2.9-in. I.D. PVC well casing. The inefficiency losses comprises head loss in the damaged zone of the formation (which may have been exacerbated by the formation of air bubbles), head loss through the filter pack, head loss through the slotted PVC pipe, axial pipeline flow losses along the slotted pipe, and convergence losses in the tight space between the pump and the inside of the pipe. That these losses might total half a foot (about three-fourths of the total drawdown in the well) was not unusual or surprising.

F-6.0 SUMMARY

Constant-rate pumping tests, bail down tests, and injection/recovery tests were conducted on R-40 screens 1, 2, and R-40i in Pajarito Canyon. The tests were conducted to gain an understanding of the hydraulic characteristics of the formations in which the screens were installed. None of the tests showed any effect on the nonpumped screen zones. Numerous observations and conclusions were drawn for the tests as summarized below:

F-6.1 General

1. The three screen zones were separate, hydraulically distinct units with 121 ft separating the water levels in the two perched zones (screens 1 and R-40i) and 93 ft separating the water levels in screens 1 and 2.
2. None of the pumping tests affected water levels in any of the nonpumped intervals or nearby monitoring well R-20.

F-6.2 R-40 Screen 1

1. Flow into screen 1 was extremely sluggish—on the order of just 12 gpd (plus or minus).
2. The low yield corresponded to a specific capacity at maximum drawdown of only 3.5×10^{-4} gpm/ft.
3. Vigorous development of screen 1 removed ample quantities of silt sand and clay but did not increase the flow rate.
4. The transmissivity of the saturated zone was estimated to have a lower bound of 0.5 gpd/ft.
5. The transmissivity of the vadose zone just above the screen 1 saturated zone was about an order of magnitude greater than that of the saturated zone.

F-6.3 R-40 Screen 2

1. Casing and filter pack storage phenomena rendered the first half hour to 1 h of pumping and recovery data nonanalyzable.
2. Because of vertical growth of the cone of depression (and impression), it was not possible to know the effective sediment thickness corresponding to a given transmissivity calculation.

3. The water-level data in screen 2 responded to atmospheric pressure changes with a barometric efficiency of 75%.

4. Drawdown data were corrected for the effects of dewatering. However, partial penetration effects rendered the correction too extreme. It was likely that true parameter values fell between those based on corrected and uncorrected data.

5. The average early-time transmissivity was 530 gpd/ft. Using the saturated screen length (16.1 ft) as a lower-bound for the effective height of the cone of depression yielded an upper-bound hydraulic conductivity value of 33 gpd/ft^2, or 4.4 ft/d.

6. The specific capacity of screen 2 after 60 min of pumping ranged from 0.39 to 0.44 gpm/ft, depending on discharge rate, and dropped to 0.32 gpm/ft after 24 h of pumping. At 2.2 gpm (a realistic future sampling rate), the specific capacity was 0.44 gpm/ft. The specific capacity of screen 2 implied a lower-bound hydraulic conductivity of about 22 gpd/ft^2, or 3.0 ft/d. This bracketed the hydraulic conductivity between 3.0 and 4.4 feet per day.

F-6.4 R-40i

1. The water levels in screen R-40i responded to atmospheric pressure changes with a barometric efficiency of 33% and an average lag time of 5 h.

2. Presence of foam in the saturated perched zone caused minor discharge rate variations and large errors in the flow meter reading during testing.

3. Possible formation of air bubbles in the saturated zone around the well reduced formation permeability and increased well loss and total drawdown.

4. The formation materials near the well showed an average transmissivity of 25,400 gpd/ft. Dividing this be the saturated thickness of 28.7 ft yielded a hydraulic conductivity value of 885 gpd/ft^2, or 118 ft/d.

5. At a greater distance around the well, the effective average transmissivity was estimated to be 4640 gpd/ft, making the effective average hydraulic conductivity 162 gpd/ft^2, or 22 ft/d.

6. Late drawdown and recovery data showed a transmissivity value averaging around 400 gpd/ft. This was an indication of boundary effect—a severe lateral limit to the permeable zone.

7. The specific capacity of screen R-40i was 4.2 gpm/ft after several minutes of pumping and dropped to 1.5 gpm/ft (factoring in barometric effects) after 24 h. The specific capacity of screen R-40i implied a lower-bound transmissivity value of 6120 gpd/ft, consistent with, but well below, the pumping test values. Because of the minimal drawdown during the test, this corresponded to a well loss of only half a foot—a reasonable value.

F-7.0 REFERENCES

The following list includes all documents cited in this appendix. Parenthetical information following each reference provides the author(s), publication date, and ER ID. This information is also included in text citations. ER IDs are assigned by the Environmental Programs Directorate's Records Processing Facility (RPF) and are used to locate the document at the RPF and, where applicable, in the master reference set.

Copies of the master reference set are maintained at the NMED Hazardous Waste Bureau and the Directorate. The set was developed to ensure that the administrative authority has all material needed to review this document, and it is updated with every document submitted to the administrative authority. Documents previously submitted to the administrative authority are not included.

Bradbury, K.R., and E.R. Rothschild, March-April 1985. “A Computerized Technique for Estimating the Hydraulic Conductivity of Aquifers from Specific Capacity Data,” *Ground Water,* Vol. 23, No. 2, pp. 240-246. (Bradbury and Rothschild 1985, 098234)

Brons, F., and V.E. Marting, 1961. “The Effect of Restricted Fluid Entry on Well Productivity,” *Journal of Petroleum Technology,* Vol. 13, No. 2, pp. 172-174. (Brons and Marting 1961, 098235)

Cooper, H.H., Jr., and C.E. Jacob, August 1946. “A Generalized Graphical Method for Evaluating Formation Constants and Summarizing Well-Field History,” *American Geophysical Union Transactions,* Vol. 27, No. 4, pp. 526-534. (Cooper and Jacob 1946, 098236)

Driscoll, F.G., 1986. Excerpted pages from *Groundwater and Wells*, 2nd Ed., Johnson Filtration Systems Inc., St. Paul, Minnesota. (Driscoll 1986, 104226)

Schafer, D.C., January-February 1978. "Casing Storage Can Affect Pumping Test Data," *The Johnson Drillers Journal,* pp. 1-6, Johnson Division, UOP, Inc., St. Paul, Minnesota. (Schafer 1978, 098240)

Theis, C.V., 1934-1935. “The Relation Between the Lowering of the Piezometric Surface and the Rate and Duration of Discharge of a Well Using Ground-Water Storage,” *American Geophysical Union Transactions,* Vol. 15-16, pp. 519-524. (Theis 1934-1935, 098241)

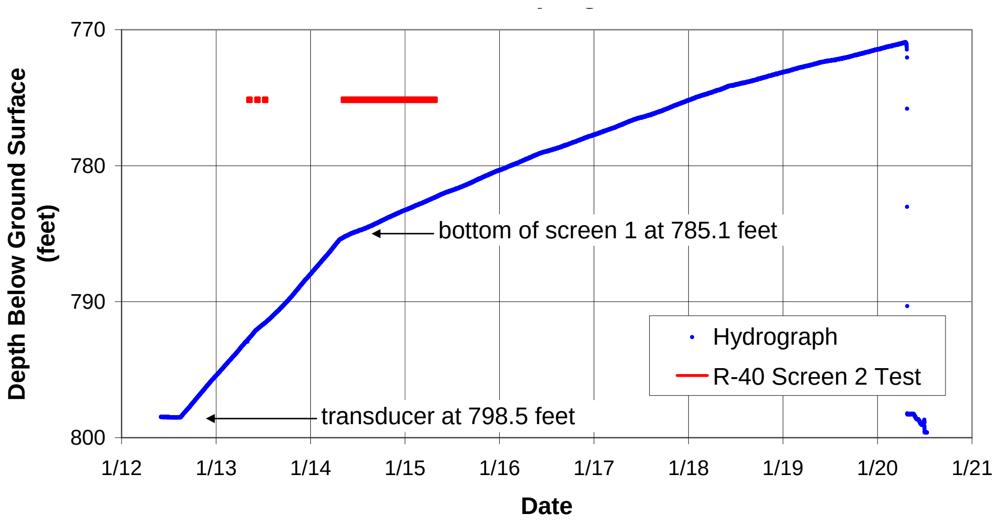


Figure 3.1-1 R-40 Screen 1 apparent hydrograph during Screen 2 pumping test

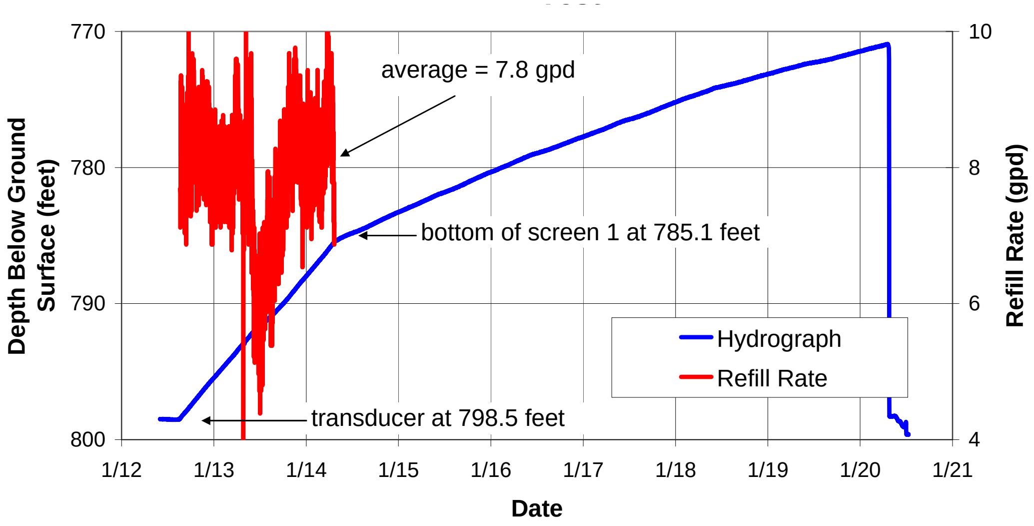


Figure 3.1-2 R-40 screen 1 refill rate during screen 2 pumping test

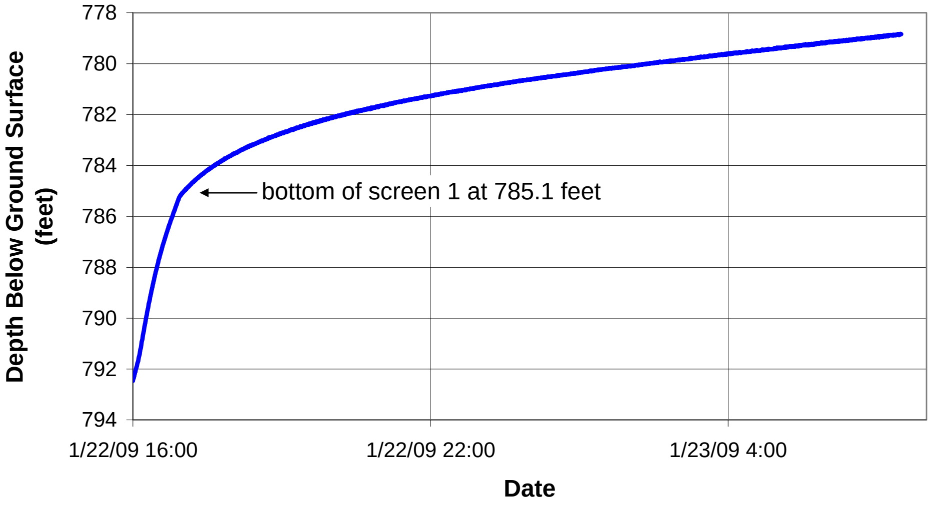


Figure F-3.1-3 R-40 screen 1 refill rate following initial development

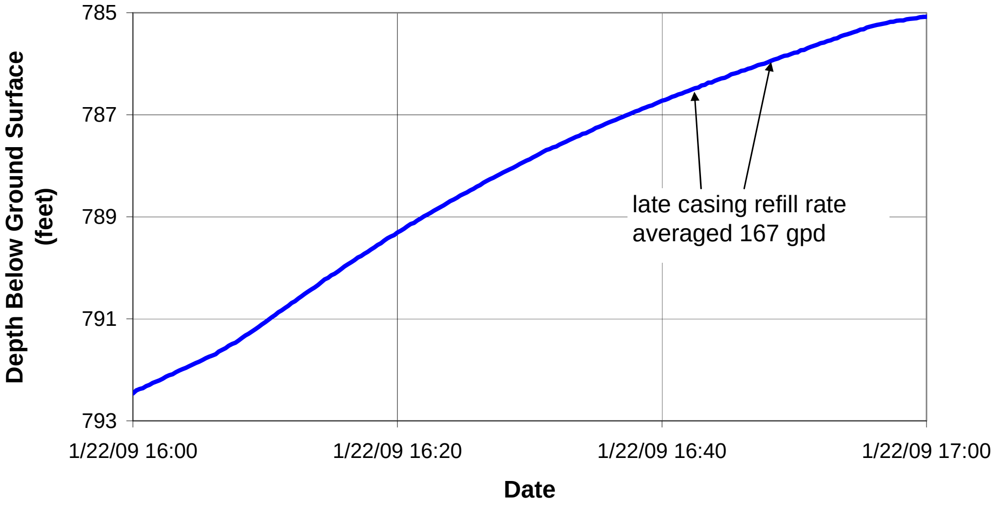


Figure F-3.1-4 R-40 screen 1 refill rate following initial development–expanded scale

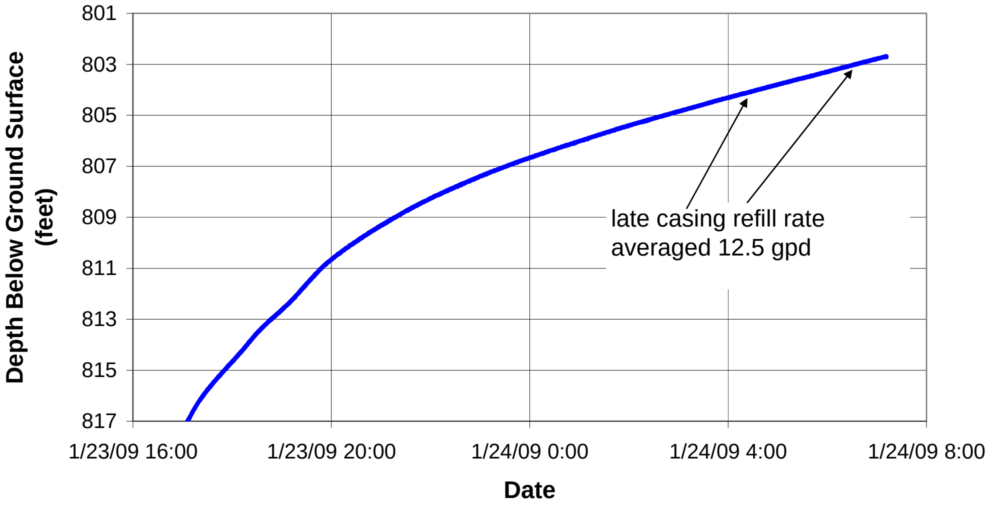


Figure F-3.1-5 R-40 screen 1 refill rate following final development

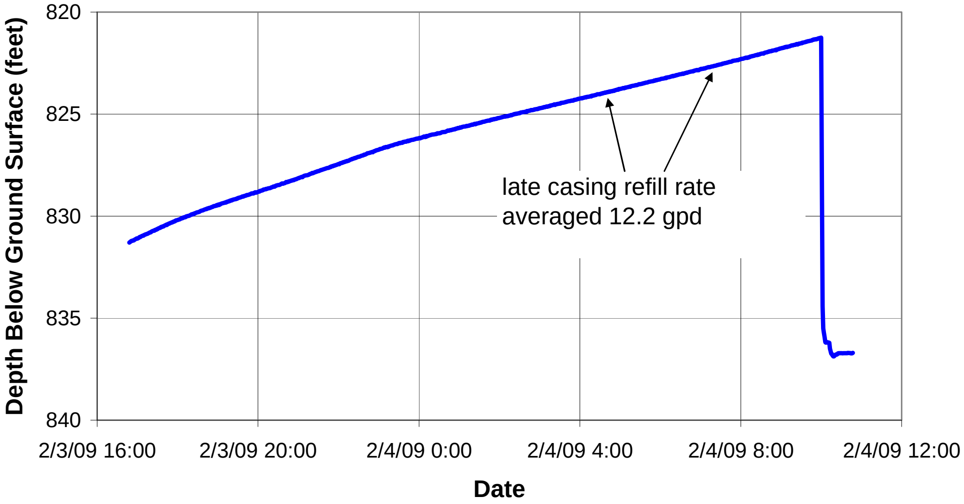


Figure F-3.1-6 R-40 screen 1 final refill rate

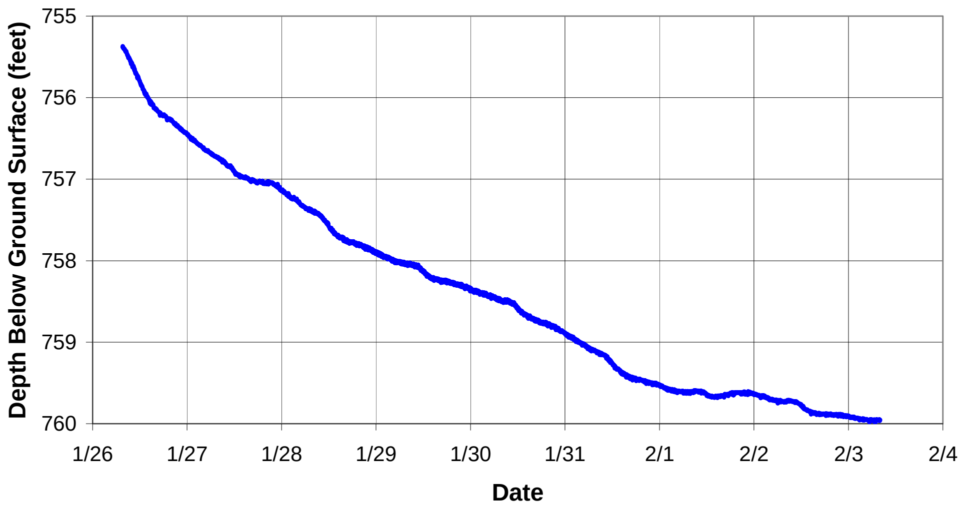


Figure F-3.2-1 R-40 screen 1 static water level determination

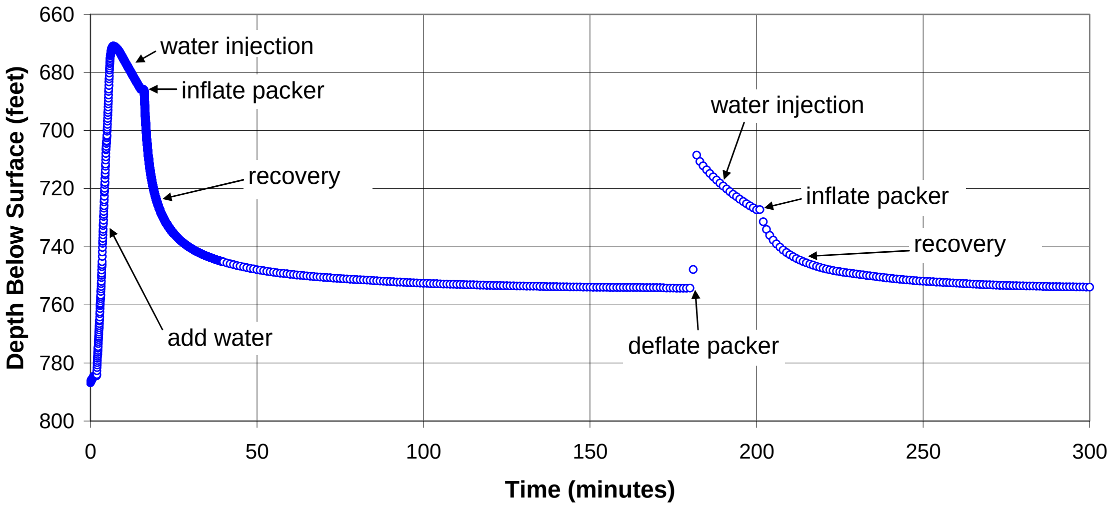


Figure F-3.3-1 R-40 screen 1 injection testing

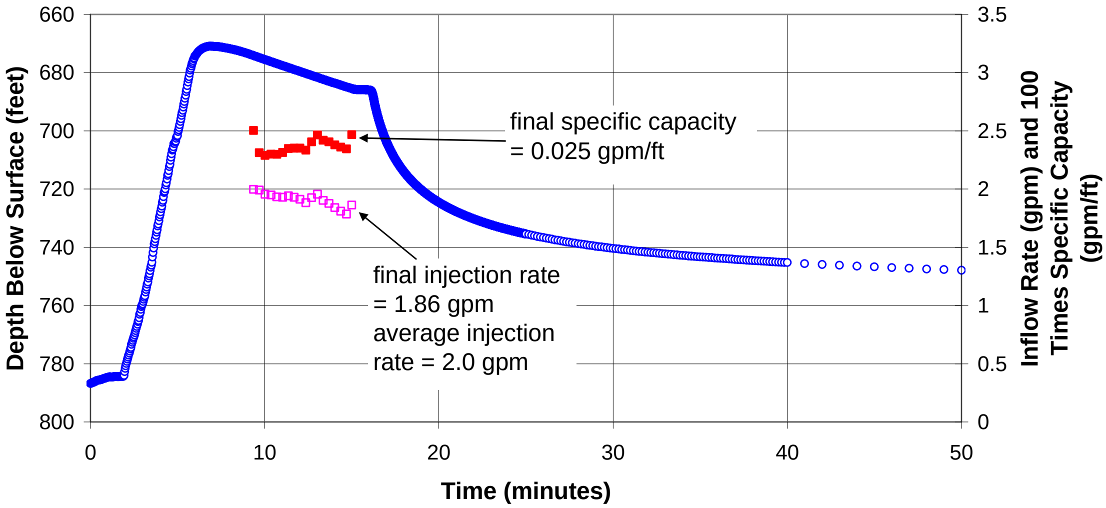


Figure F-3.3-2 R-40 screen 1 injection test 1

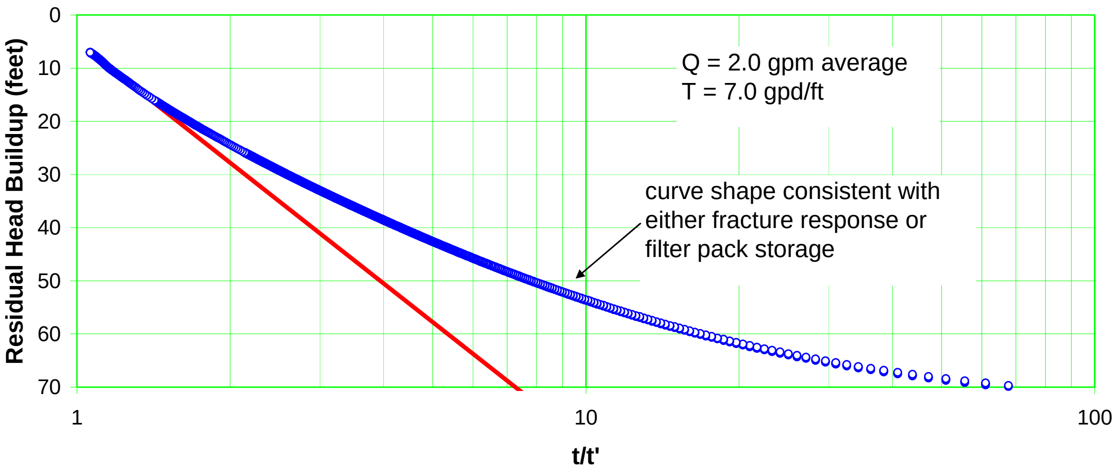


Figure F-3.3-3 Well R-40 screen 1 injection test 1 recovery

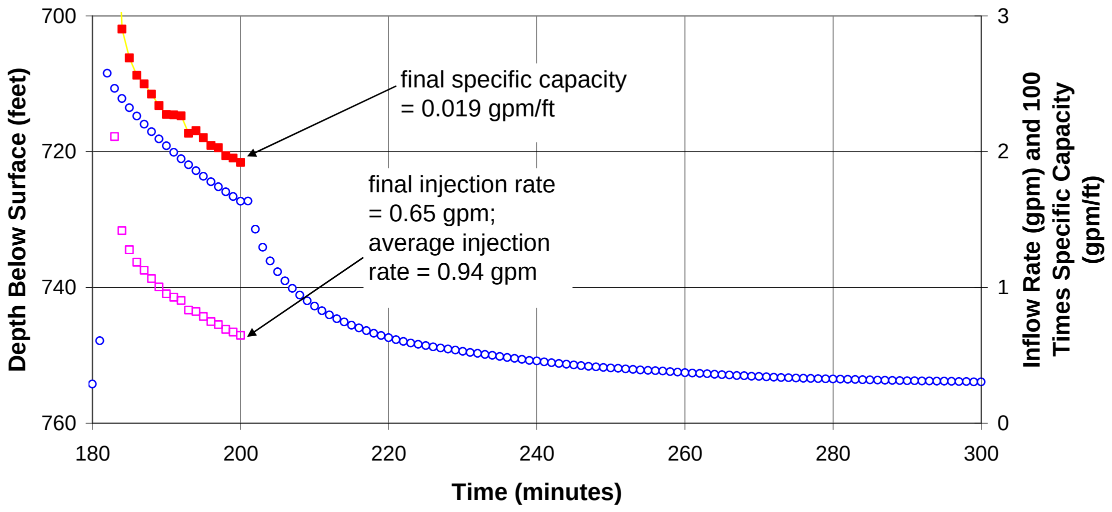


Figure F-3.3-4 R-40 screen 1 injection test 2

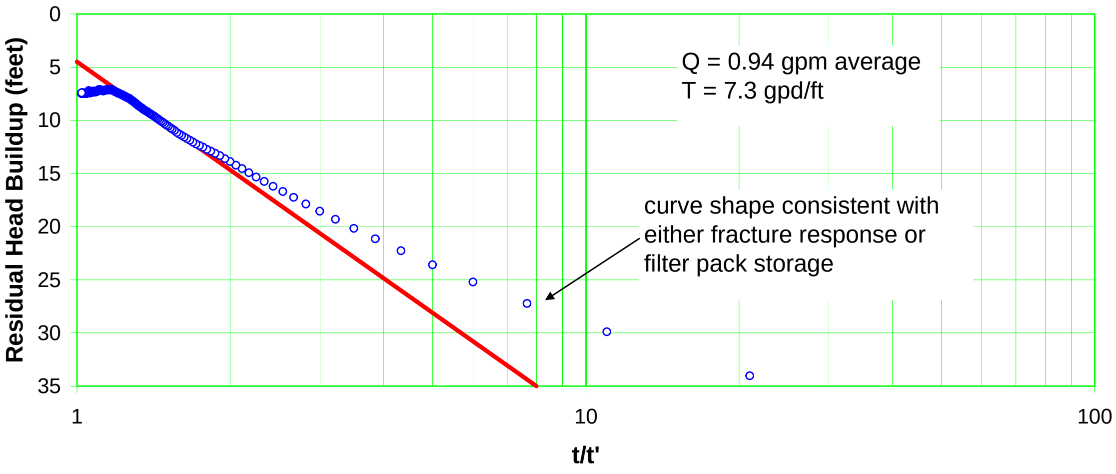


Figure F-3.3-5 Well R-40 screen 1 injection test 2 recovery

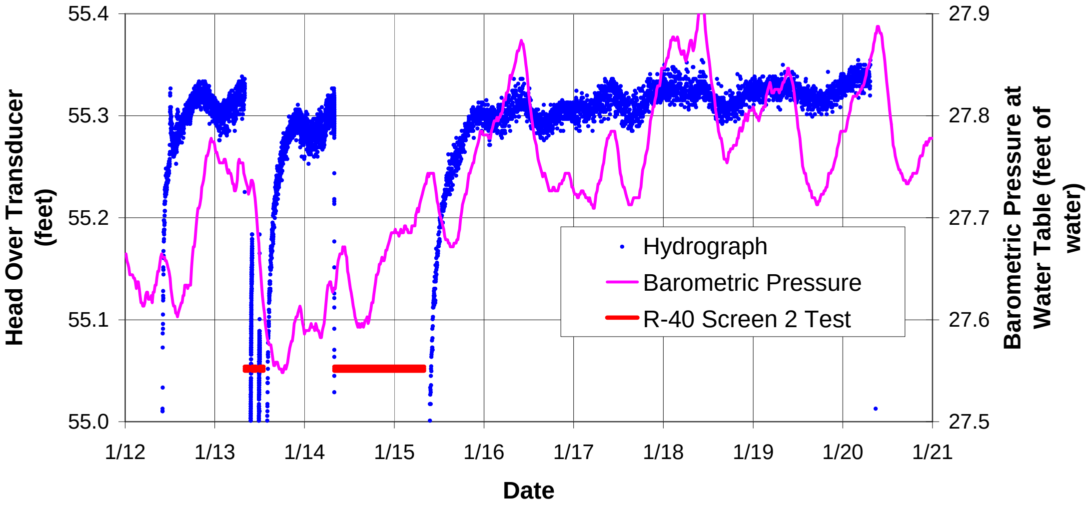


Figure F-4.1-1 **Comparison of R-40 screen 2 apparent hydrograph and adjusted TA-54 barometric pressure**

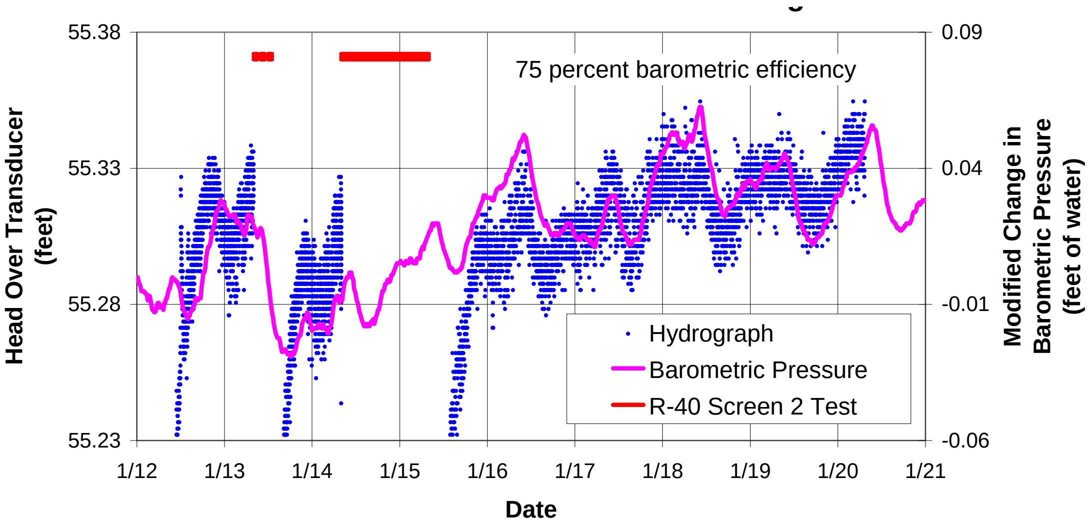


Figure F-4.1-2 **R-40 screen 2 apparent hydrograph and modified TA-54 barometric pressure change**

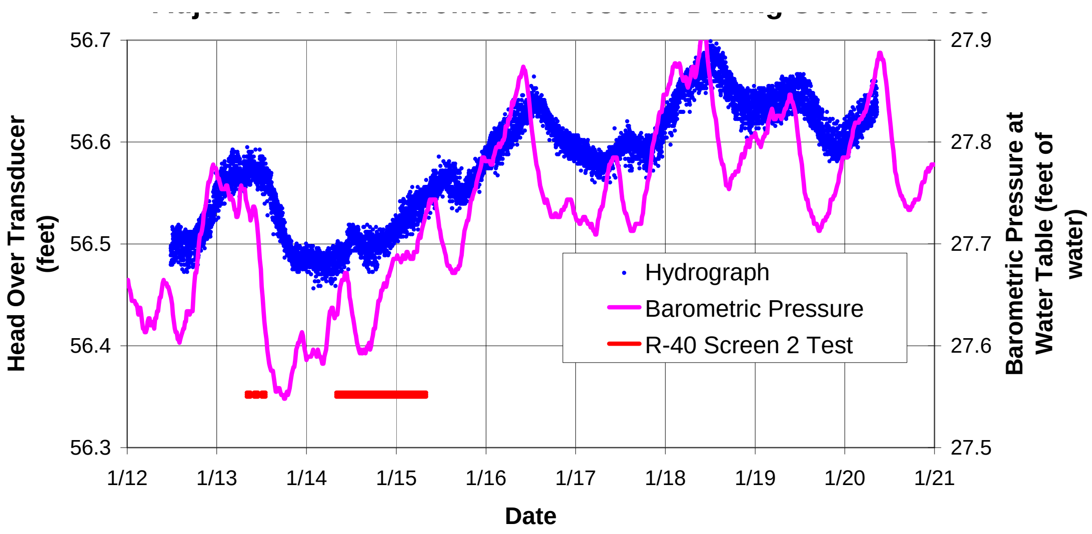


Figure F-4.1-3 Comparison of R-40i apparent hydrograph and adjusted TA-54 barometric pressure during screen 2 test

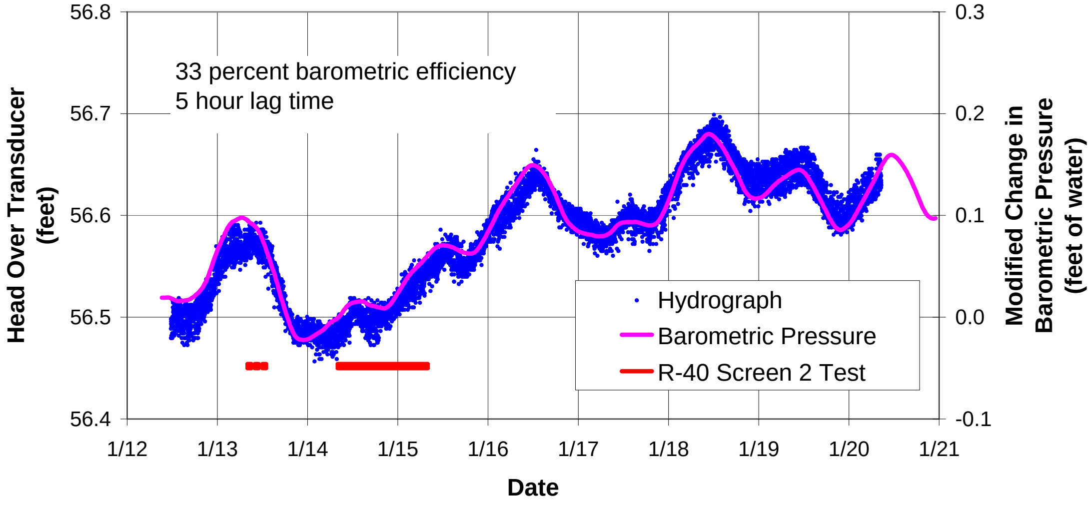


Figure F-4.1-4 R-40i background and modified TA-54 barometric pressure during screen 2 test – 10 hour rolling average

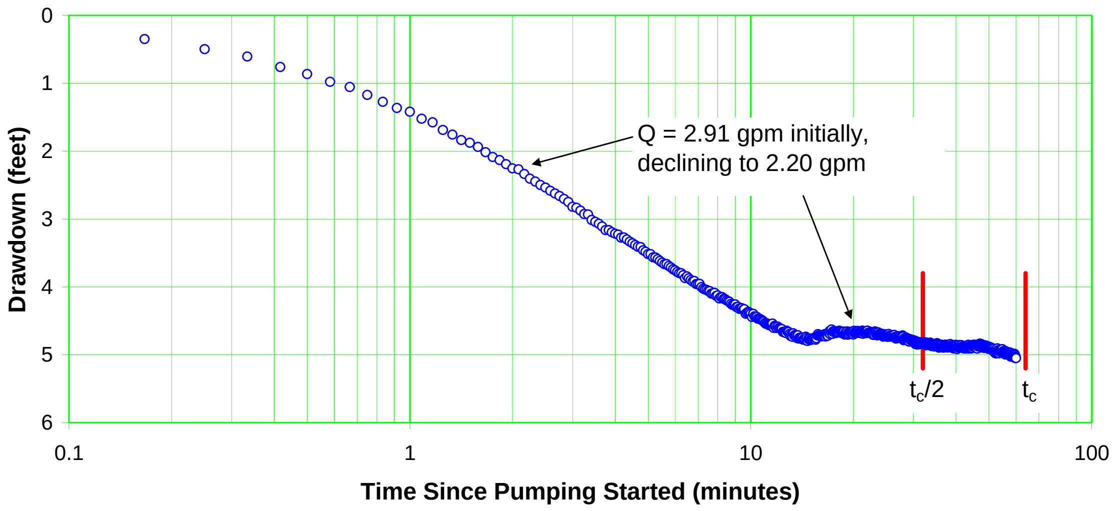


Figure F-4.2-1 Well R-40 screen 2 trial 1 drawdown

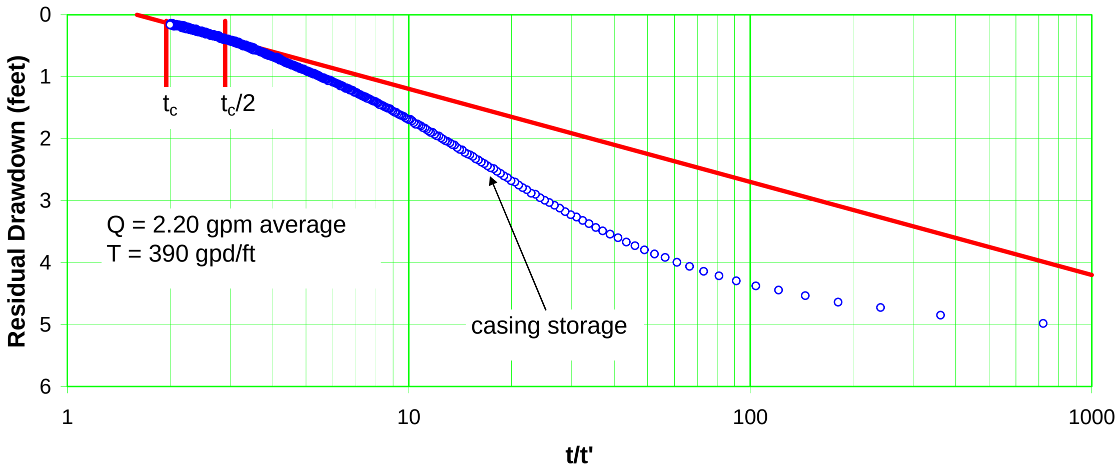


Figure F-4.2-2 Well R-40 screen 2 trial 1 recovery

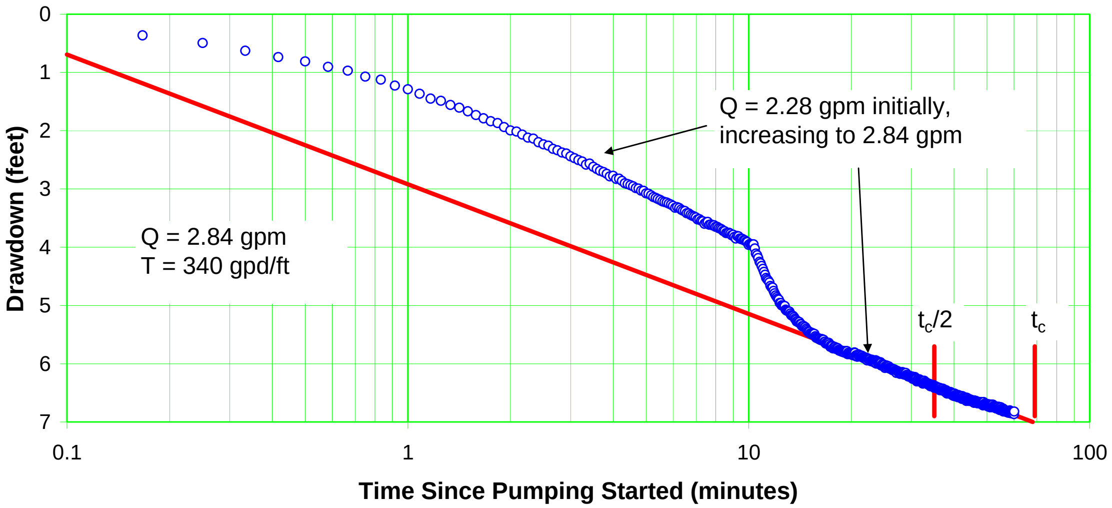


Figure F-4.3-1 Well R-40 screen 2 trail 2 drawdown

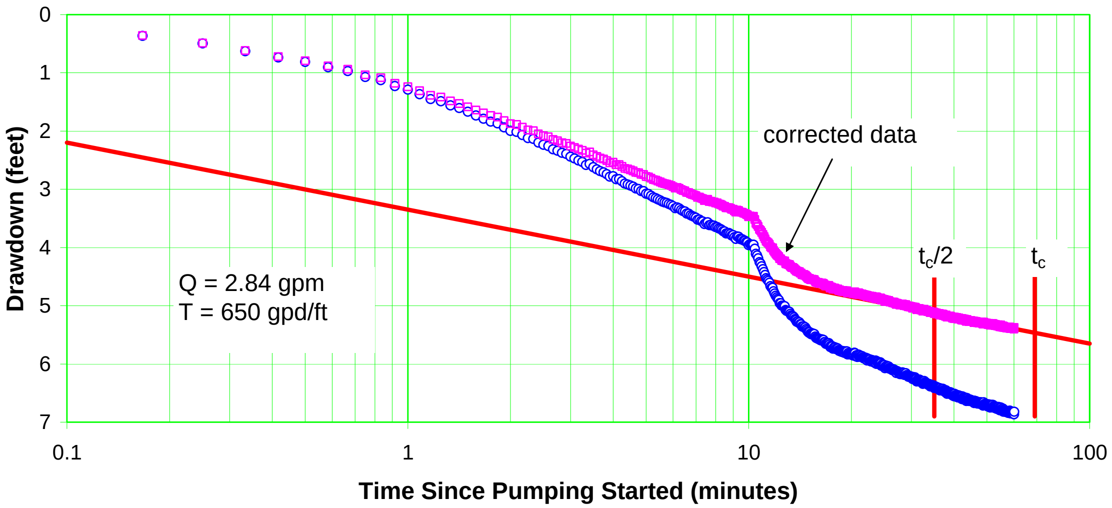


Figure F-4.3-2 Well R-40 screen 2 trail 2 corrected drawdown

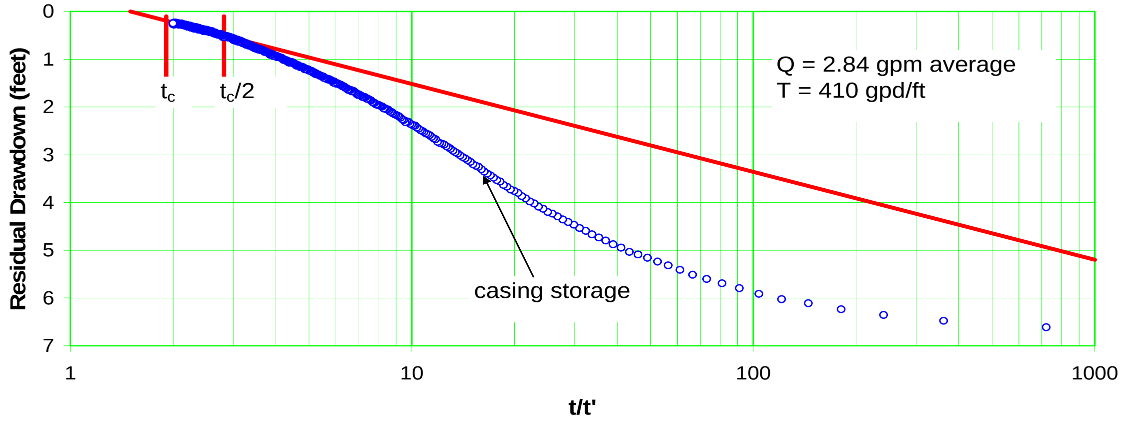


Figure F-4.3-3 Well R-40 screen 2 trail 2 recovery

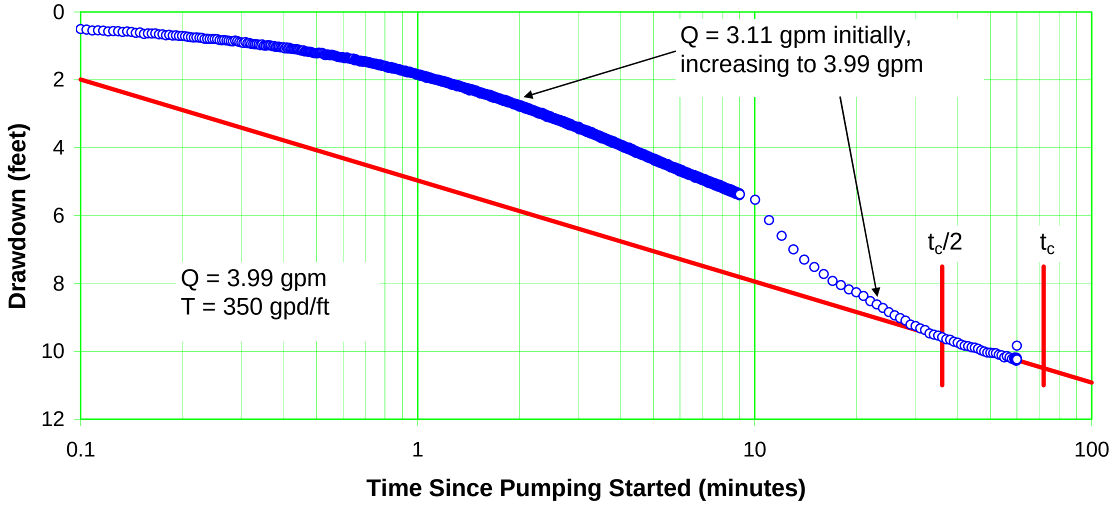


Figure F-4.4-1 Well R-40 screen 2 trail 3 drawdown

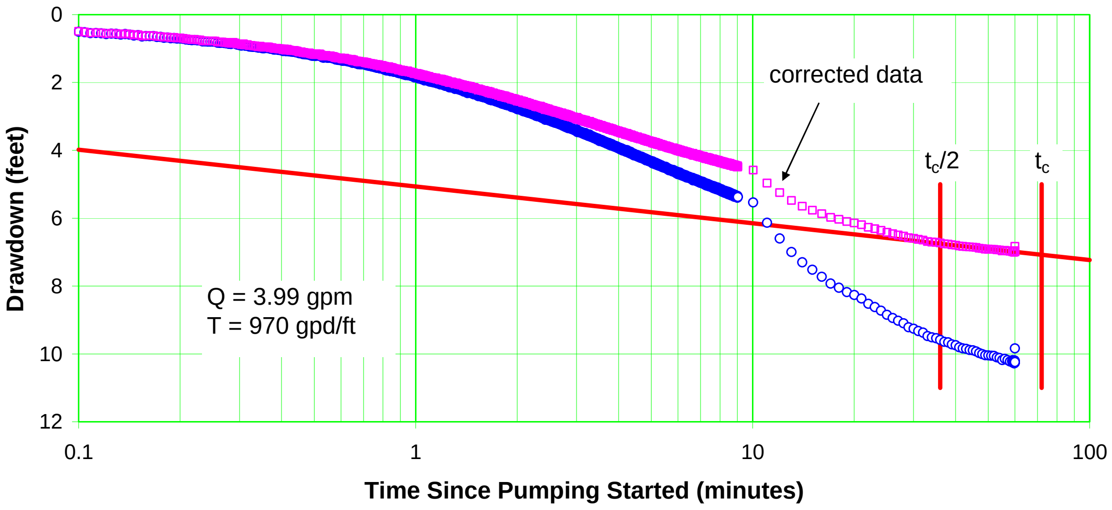


Figure F-4.4-2 Well R-40 screen 2 trail 3 corrected drawdown

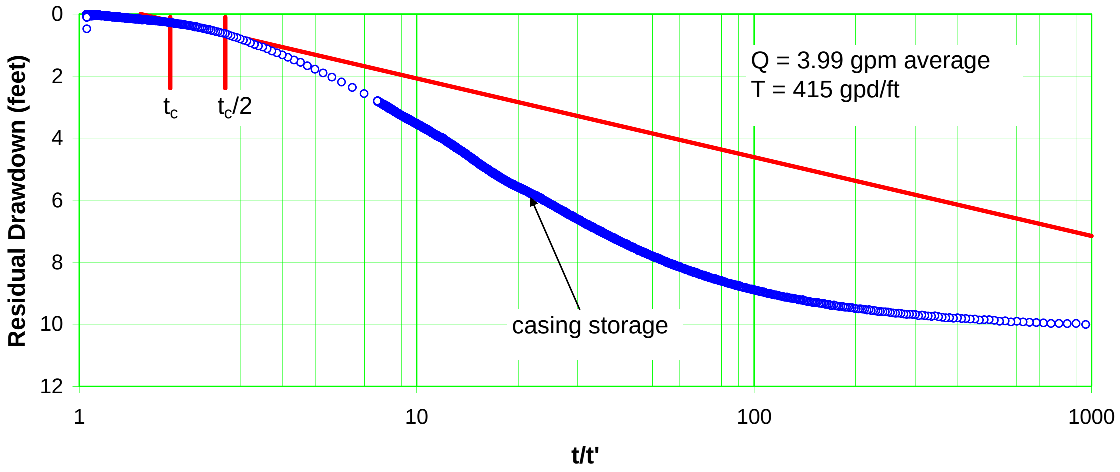


Figure F-4.4-3 Well R-40 screen 2 trail 3 recovery

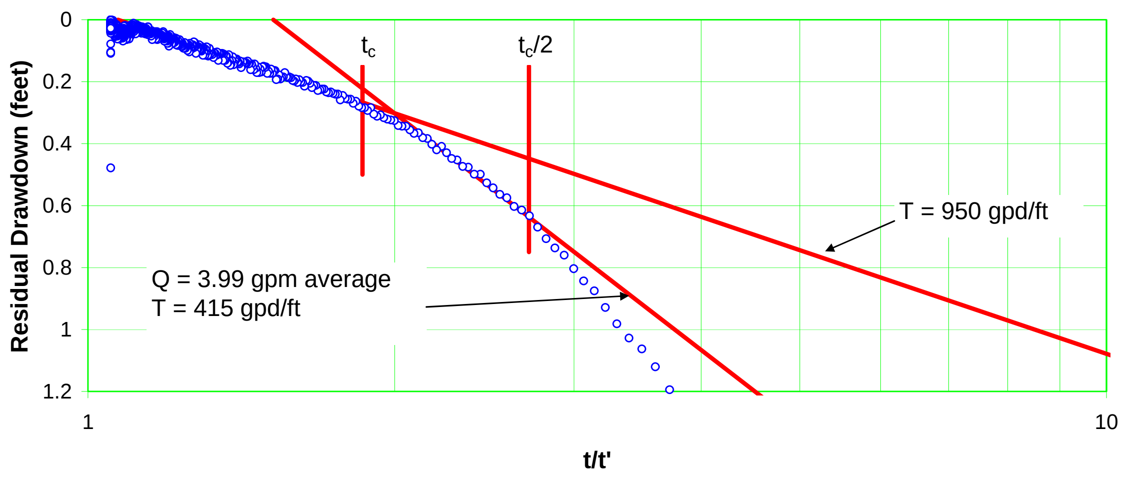


Figure F-4.4-4 Well R-40 screen 2 trail 3 recovery – expanded scale

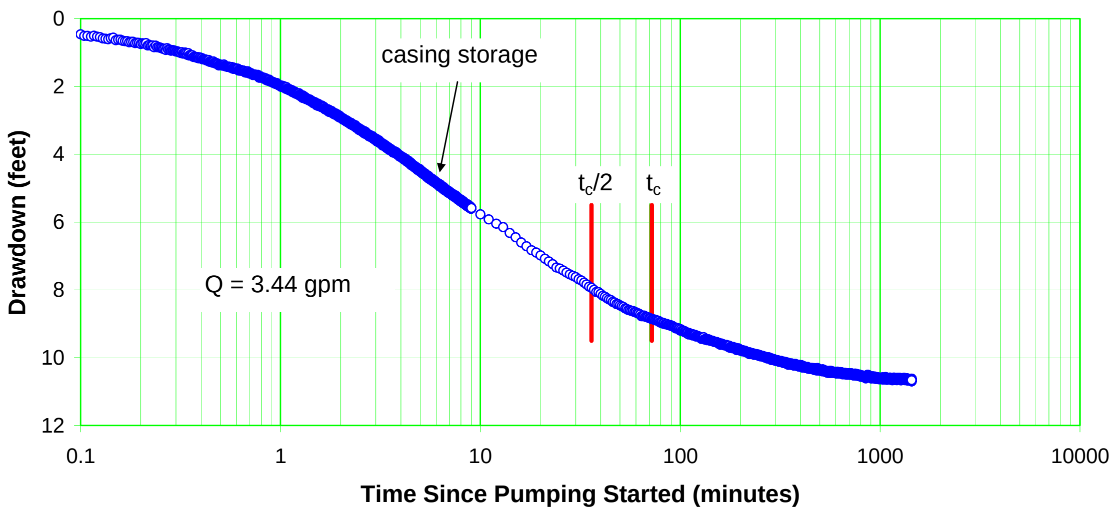


Figure F-4.5-1 Well R-40 screen 2 drawdown

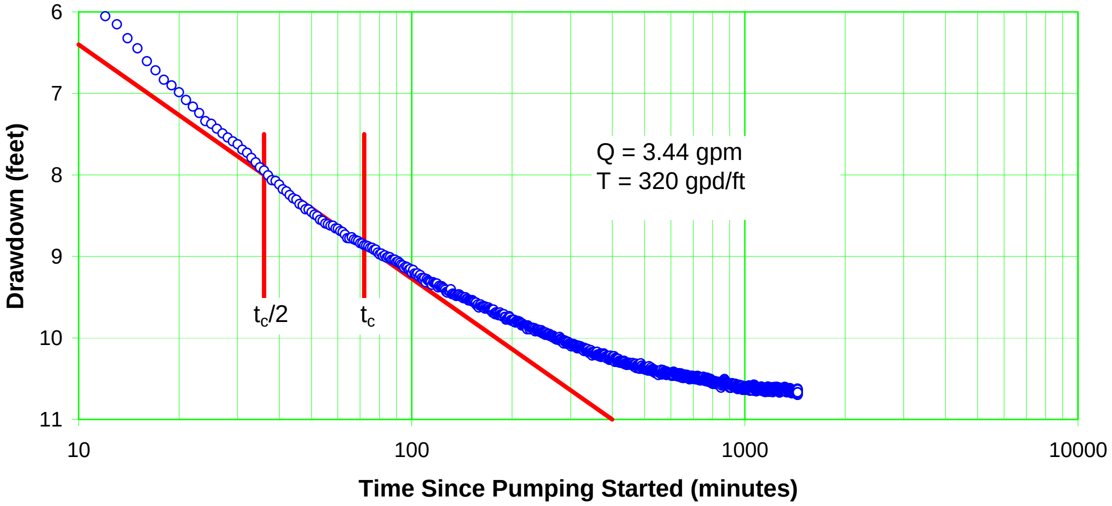


Figure F-4.5-2 Well R-40 screen 2 drawdown – expanded scale

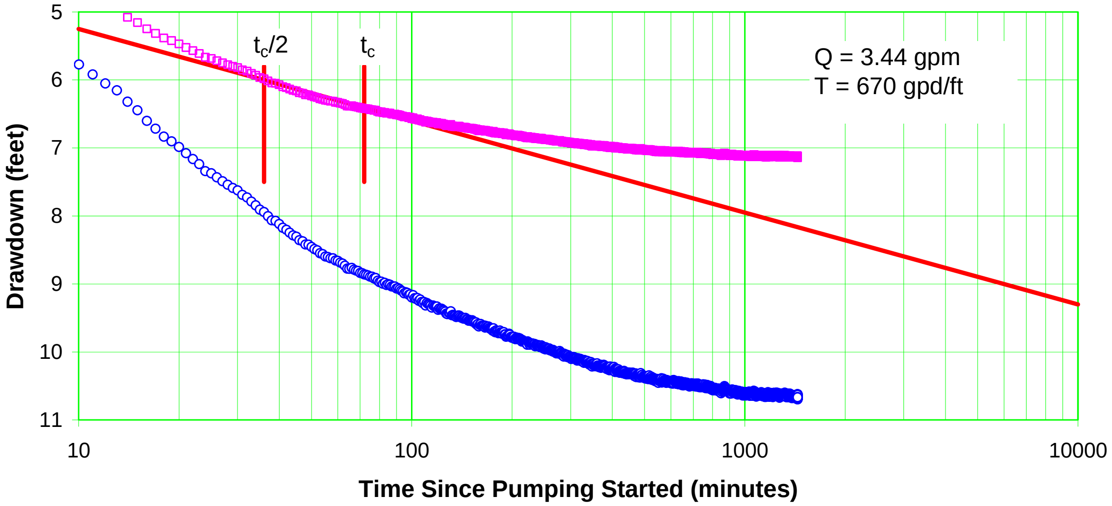


Figure F-4.5-3 Well R-40 screen 2 corrected drawdown

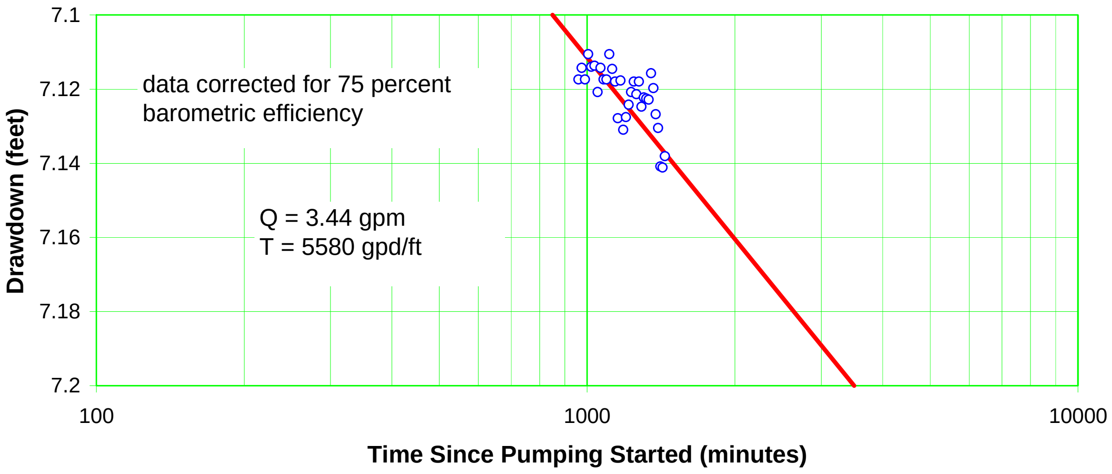


Figure F-4.5-4 Well R-40 screen 2 drawdown corrected for dewatering and barometric pressure

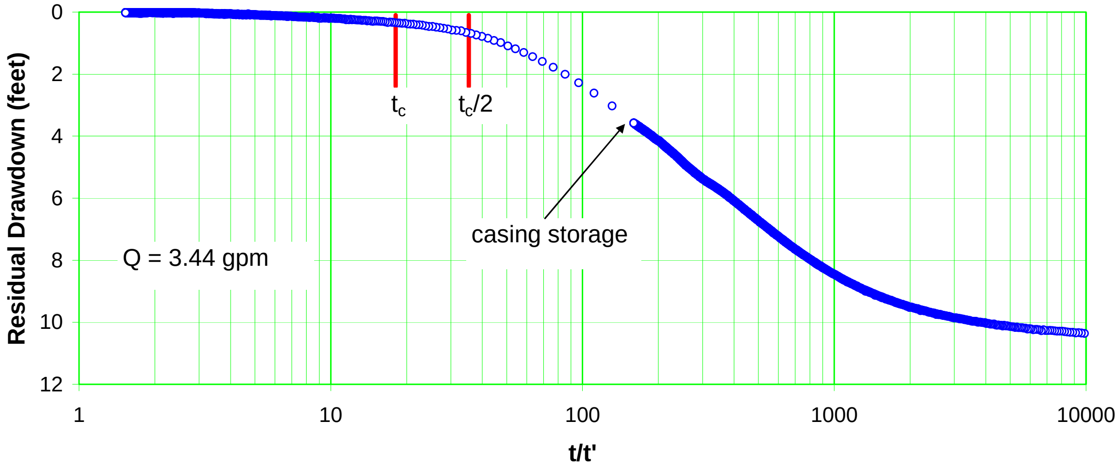


Figure F-4.5-5 Well R-40 screen 2 recovery

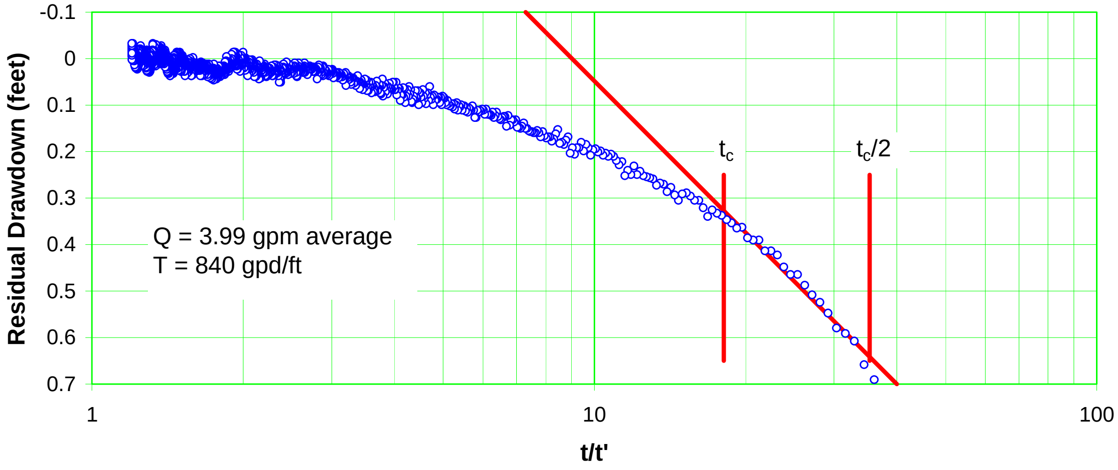


Figure F-4.5-6 **Well R-40 screen 2 recovery – expanded scale**

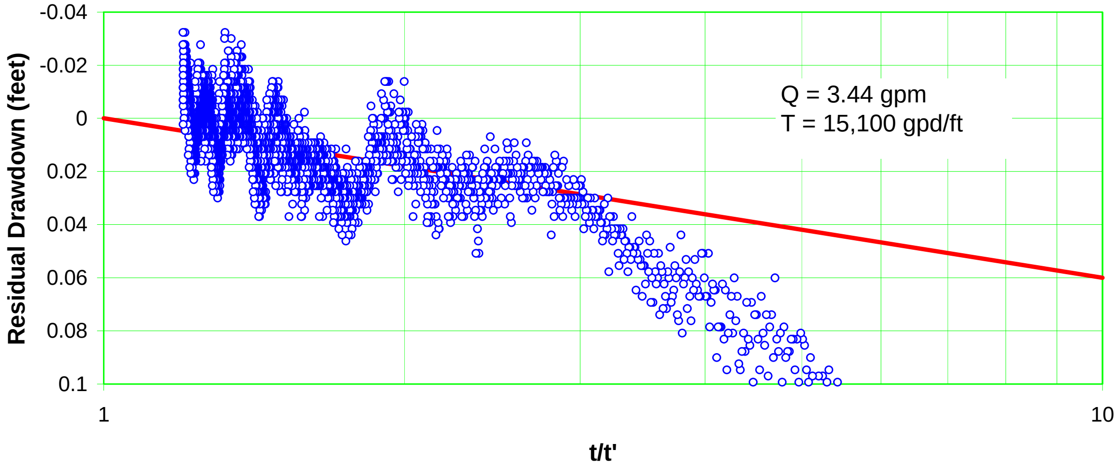


Figure F-4.5-7 **Well R-40 screen 2 recovery – late data**

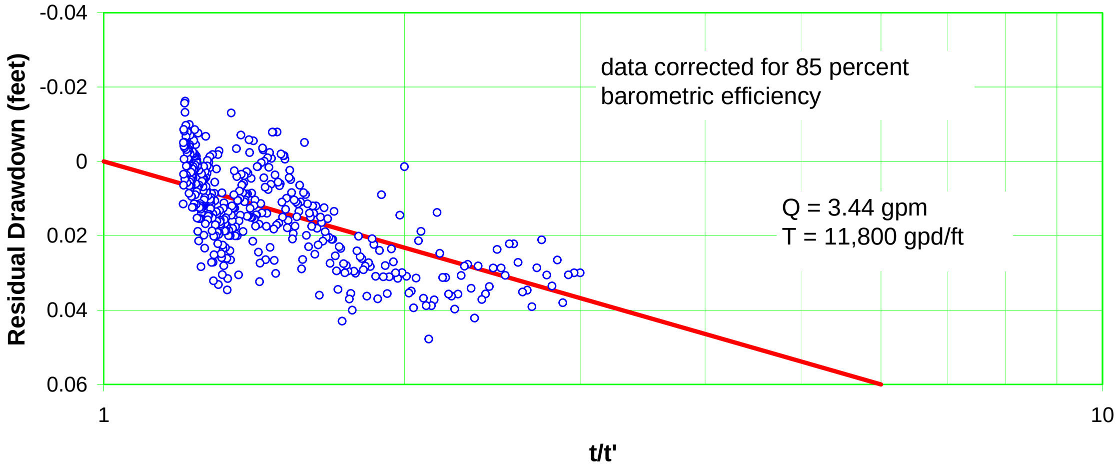


Figure F-4.5-8 Well R-40 screen 2 corrected recovery

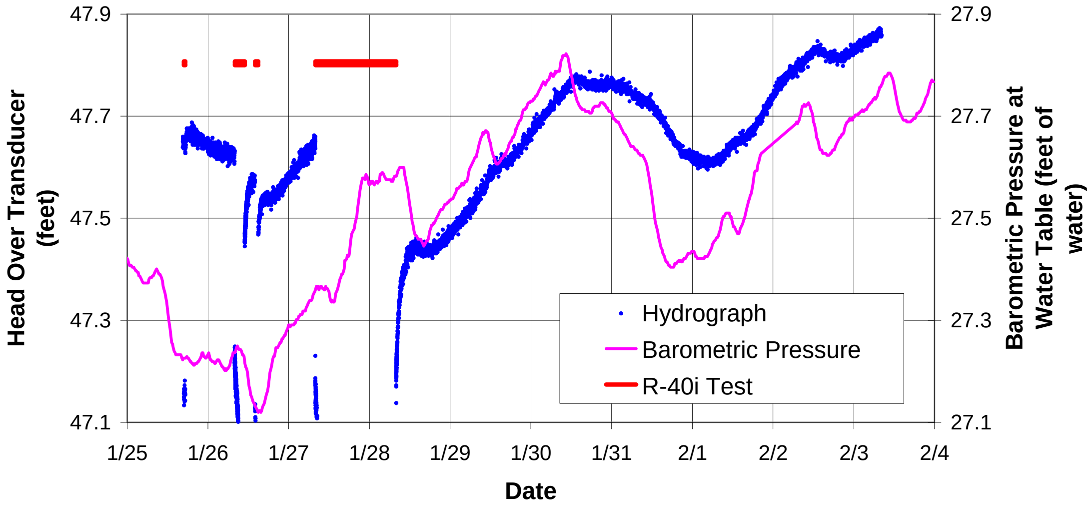


Figure F-5.1-1 Comparison of screen R-40i apparent hydrograph and adjusted TA-54 barometric pressure

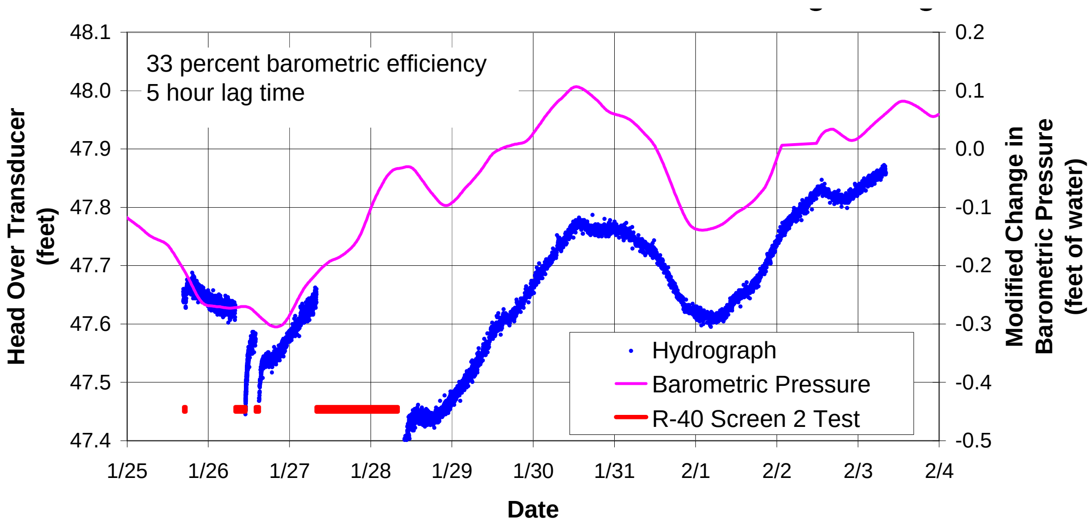


Figure F-5-1-2 Screen R-40i apparent hydrograph and modified TA-54 barometric pressure – 10 hour rolling average

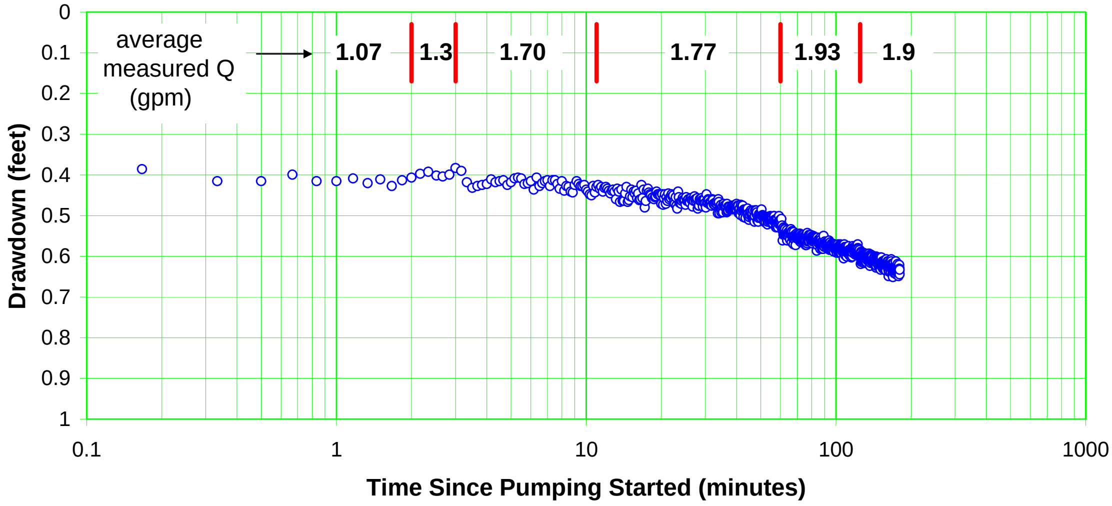


Figure F-5.2-1 Screen R-40i trail 1 drawdown

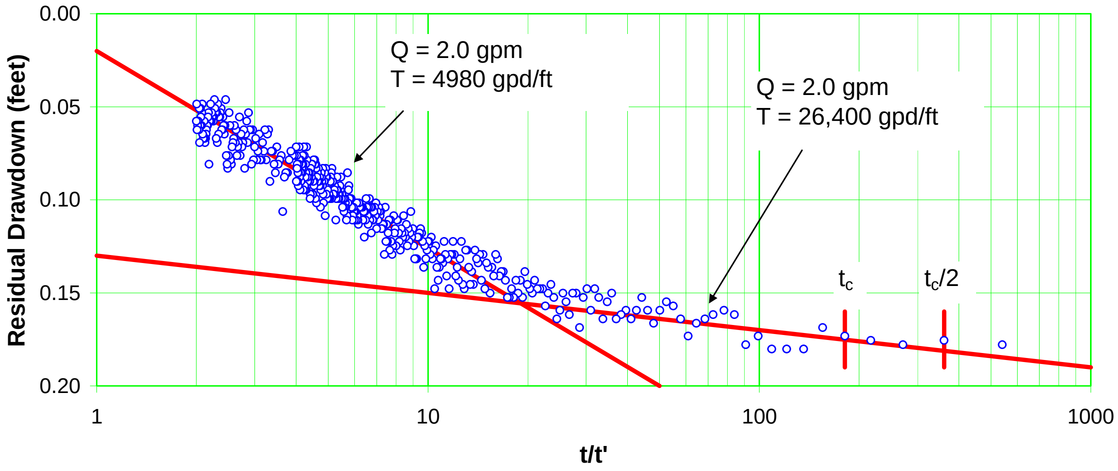


Figure F-5.2-2 Screen R-40 I trail 1 recovery

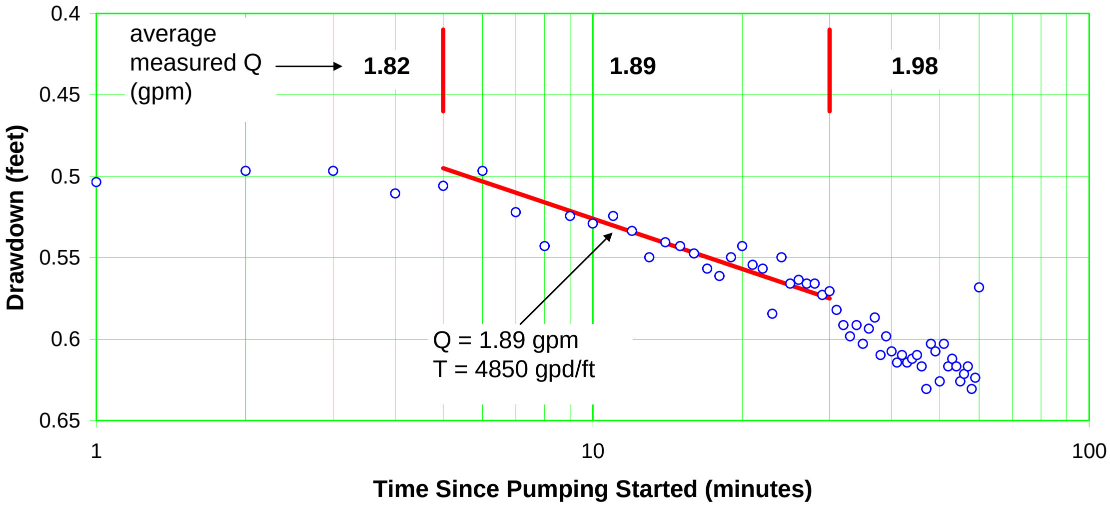


Figure F-5.3-1 Screen R-40i trail 2 drawdown

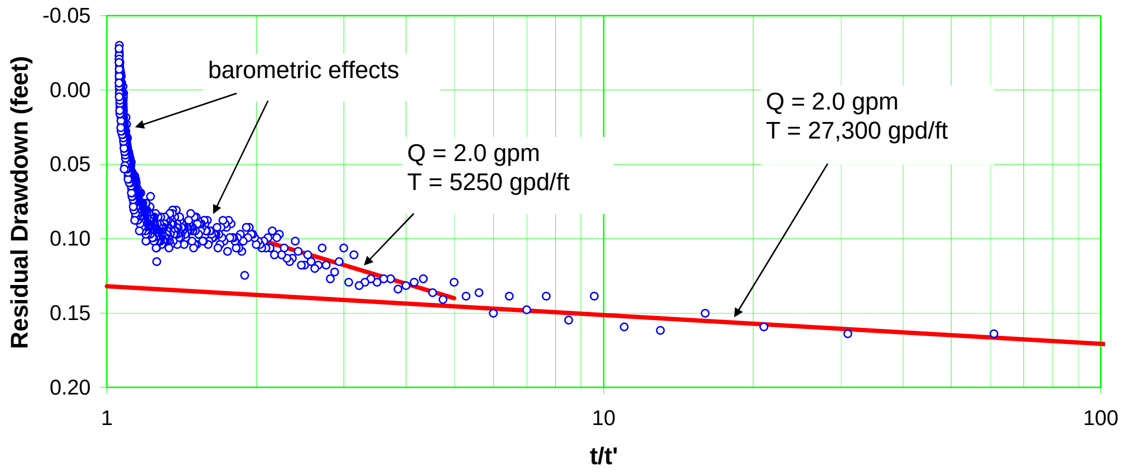


Figure F-5.3-2 Screen R-40 trail 2 recovery

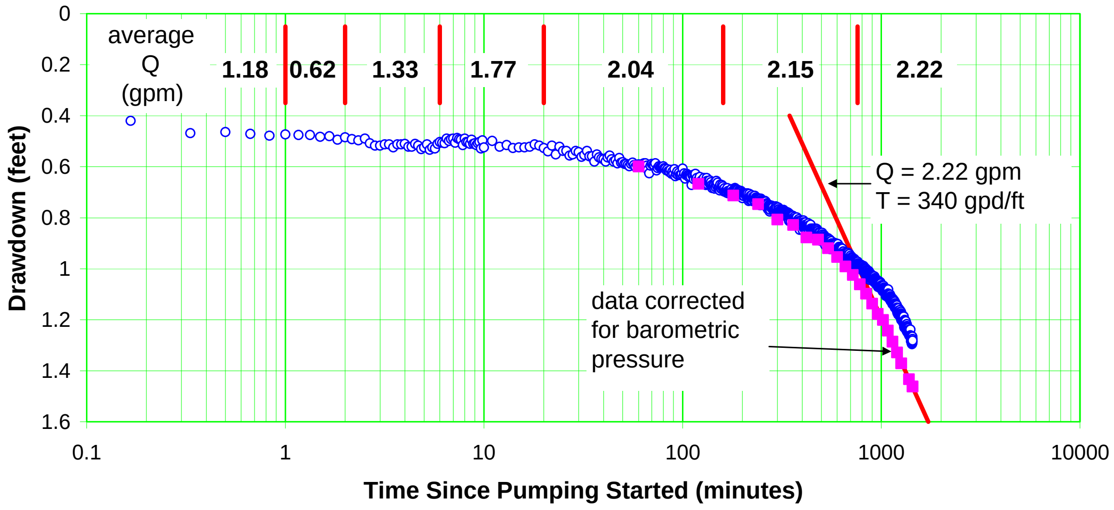


Figure F-5.4-1 Screen R-40i drawdown

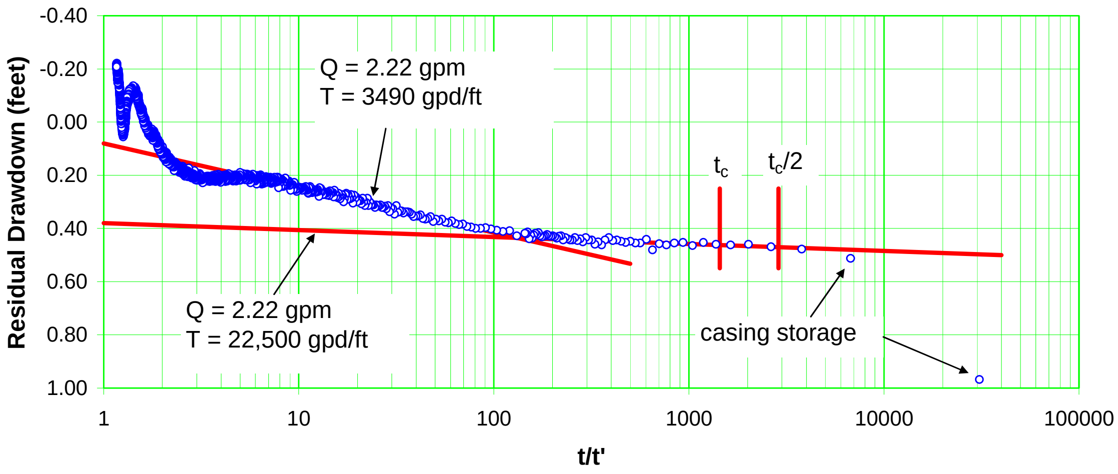


Figure F-5.4-2 Screen R-40i recovery

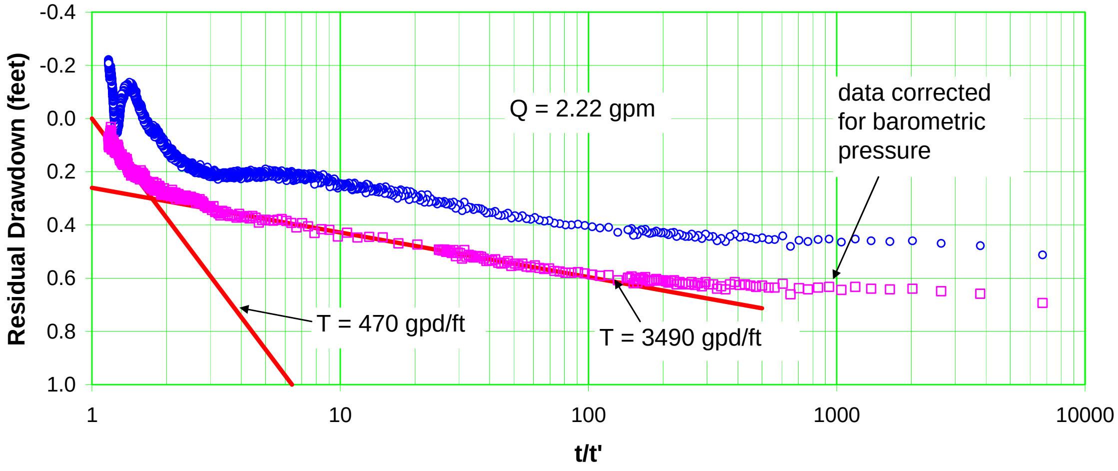


Figure F-5.4-3 Screen R-40i corrected recovery

Table F-4.6-1
R-40 Screen 2 Specific Capacity

Test	Discharge Rate (gpm)	Drawdown at 60 Min (ft)	Specific Capacity (gpm/ft)	Corrected Drawdown at 60 Min (ft)	Corrected Specific Capacity (gpm/ft)	Average Drawdown at 60 Min (ft)	Average Specific Capacity (gpm/ft)
Trial 1	2.20	5.05	0.44	4.26	0.52	4.66	0.48
Trial 2	2.84	6.86	0.41	5.40	0.53	6.13	0.47
24-Hour	3.44	8.66	0.40	6.33	0.54	7.50	0.47
Trial 3	3.99	10.24	0.39	6.98	0.57	8.61	0.48

Table F-4.8-1
R-40 Screen 2 Early-Time Transmissivity

Test	Discharge Rate	Transmissivity (gpd/ft)			
		Drawdown	Corrected Drawdown	Average Drawdown (gpd/ft)	Recovery (gpd/ft)
Trial 1	2.20	not determined	not determined	not determined	390
Trial 2	2.84	340	650	495	410
24-H	3.44	320	670	495	840
Trial 3	3.99	350	970	660	415
Average		**337**	**763**	**550**	**514**

Appendix G

Borehole Abandonment Information Form

ATTACHMENT 1: MONITORING WELL AND BOREHOLE ABANDONMENT INFORMATION

5034-1

Monitoring Well and Borehole Abandonment Information

Records Use only

Date/Time: 01/08/2009 - 16:36

Sheet 1 of 1

Technical Area: 54

Focus Area (if applicable, or other location details): LWSP

Borehole ID: R-40

Well Type (monitoring, etc.): Monitoring

Site Work Plan: Drilling Work Plan for Regional and Intermediate Wells at Technical Area 54

Depth from Surface to Bottom of Hole: 0 to 630 ft.

Grout Depth/Location: NA

Bentonite Depth/Location: NA

Other Fill Material Depth/Location: Base-course gravel 0 to 2 ft. Neat cement 2 ft to 40 ft. Concrete 40 ft to 630 ft.

Surface Construction: No surface construction

Grout/Backfill Composition: Neat cement is 95 % portland cement, 5% bentonite gel. Concrete is 4000 psi.

Additional Comments/Details: Drilling start date: 07/11/2008; drilling end date: 09/23/2008; borehole located 20 ft SW of completed R-40 well; stratigraphy identical to completed R-40 borehole (see R-40 well completion report, Figure 3.1-1).

Attach "Borehole/Well Completion Information Form" or the original "as-completed" drawings for the abandoned hole.