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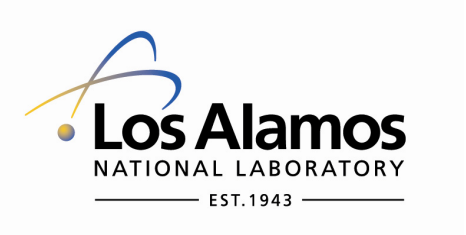
Completion Report for Regional Aquifer Well R-66



Prepared by the Environmental Programs Directorate

EP2012-0060

Completion Report for Regional Aquifer Well R-66

April 2012

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EXECUTIVE SUMMARY

This completion report describes the drilling, installation, well development, aquifer testing, and sampling system installation for regional well R-66. R-66 is located in Los Alamos Canyon, just east of the confluence of DP Canyon within Technical Area 21 (TA-21) at Los Alamos National Laboratory (LANL or the Laboratory). This report was prepared pursuant to the requirements in Section IV.A.3.e.iv of the March 1, 2005 (revised 2008) Compliance Order on Consent.

Regional aquifer well R-66 was installed to monitor groundwater in the upper part of the regional aquifer downgradient of TA-21 and associated infiltration zones in Los Alamos and DP Canyons. R-66 will also be used as a sentinel well for municipal production well Otowi 4 and to replace Test Well 3. Installation of R-66 was approved by the New Mexico Environment Department (NMED) in March 2011.

The R-66 borehole was drilled using fluid-assisted dual-rotary reverse-circulation and conventional drilling methods. Drilling fluid additives included potable water, a foaming agent, and a polymer emulsion. Injection of foam and the polymer emulsion was discontinued at 696 ft below ground surface (bgs), approximately 100 ft above the anticipated top of the regional aquifer.

Geologic formations encountered during drilling included, in descending stratigraphic order, Quaternary alluvium, Otowi Member of the Bandelier Tuff (including the Guaje Pumice Bed), upper Puye Formation, Cerros del Rio volcanic series, lower Puye Formation, Miocene pumiceous sediments, and Miocene riverine and fanglomerate deposits.

Groundwater encountered during drilling included one perched-intermediate zone and the regional aquifer. The perched groundwater zone was encountered in the upper Puye Formation above Cerros del Rio lavas. The regional water table occurs within Miocene riverine and fanglomerate sands and gravels at a depth of 792.8 ft bgs as measured in the completed well.

Well R-66 was completed per the NMED-approved well design with one screened interval from 819.4 ft to 839.7 ft bgs.

CONTENTS

1.0 INTRODUCTION 1

2.0 ADMINISTRATIVE PREPARATION 1

3.0 DRILLING ACTIVITIES 2
3.1 Drilling Approach 2
3.2 Chronology of Drilling Activities 2

4.0 SAMPLING ACTIVITIES 3
4.1 Cuttings Sampling 3
4.2 Water Sampling 4

5.0 GEOLOGY AND HYDROGEOLOGY 4
5.1 Stratigraphy 4
5.2 Groundwater 5
5.2.1 Regional Aquifer Groundwater Elevations 6

6.0 BOREHOLE LOGGING 6
6.1 Video Logging 6
6.2 Geophysical Logging 6

7.0 WELL INSTALLATION 6
7.1 Well Design 6
7.2 Well Construction 7

8.0 POSTINSTALLATION ACTIVITIES 7
8.1 Well Development 7
8.1.1 Well Development Field Parameters 8
8.2 Aquifer Testing 8
8.3 Water Volumes Introduced Versus Volumes Removed 8
8.4 Dedicated Sampling System Installation 8
8.5 Wellhead Completion 9
8.6 Geodetic Survey 9
8.7 Waste Management and Site Restoration 9

9.0 DEVIATIONS FROM PLANNED ACTIVITIES 10

10.0 ACKNOWLEDGMENTS 10

11.0 REFERENCES AND MAP DATA SOURCES 10
11.1 References 10
11.2 Map Data Sources 11

Figures

Figure 1.0-1 Location of well R-66 13
Figure 5.1-1 R-66 borehole stratigraphy 14
Figure 5.2-1 Regional aquifer groundwater elevations 15
Figure 7.2-1 As-built construction diagram for well R-66 16
Figure 8.4-1a As-built schematic for well R-66 17

Figure 8.4-1b Technical notes for well R-66 18
Figure 8.4-1c Pump performance curve 19

Tables

Table 3.1-1 Fluid Quantities Used in the Regional Aquifer during R-66 Drilling and Well Construction 21
Table 4.2-1 Summary of Groundwater Screening Samples Collected at Well R-66 21
Table 6.0-1 R-66 Logging Runs 22
Table 7.2-1 R-66 Annular Fill Materials 22
Table 8.6-1 R-66 Survey Coordinates 22
Table 8.7-1 Summary of Waste Samples Collected at R-66 23

Appendixes

Appendix A Well R-66 Borehole Lithologic Log
Appendix B Groundwater Screening Analytical Results
Appendix C Borehole Video Logging (on DVD included with this document)
Appendix D Geophysical Log (on CD included with this document)
Appendix E R-66 Final Well Design and New Mexico Environment Department Approval
Appendix F Geodetic Survey

Acronyms and Abbreviations

amsl	above mean sea level
ASTM	American Society for Testing and Materials
bgs	below ground surface
Consent Order	Compliance Order on Consent
DO	dissolved oxygen
EES-14	Earth and Environmental Sciences Group 14
EP	Environmental Programs (Directorate)
EPA	U.S. Environmental Protection Agency
gpd	gallons per day
gpm	gallons per minute
hp	horsepower
I.D.	inside diameter
LANL	Los Alamos National Laboratory, or the Laboratory
LDY	laydown yard

mV	millivolt
NAD	North American Datum
NMED	New Mexico Environment Department
NTU	nephelometric turbidity unit
O	Otowi
O.D.	outside diameter
ORP	oxidation-reduction potential
PVC	polyvinyl chloride
Qal	Quaternary alluvium
Qbt	Tshirege Member of the Bandelier Tuff
Qbof	Otowi Member of the Bandelier Tuff
Qbog	Guaje Pumice Bed of the Otowi Member of the Bandelier Tuff
RPF	Records Processing Facility
SC	specific conductance
SVOC	semivolatile organic compound
TA	technical area
Tb4	Cerros del Rio volcanic series
Tcar	Miocene riverine deposits
TD	total depth
TDS	total dissolved solids
Tjfp	Miocene pumiceous sediments
TOC	total organic carbon
TPH-DRO	total petroleum hydrocarbon–diesel range organics
TPH-GRO	total petroleum hydrocarbon–gasoline range organics
Tpf	Puye Formation
TW	test well
VOC	volatile organic compound
WCSF	waste characterization strategy form

1.0 INTRODUCTION

This well completion report summarizes the drilling, well construction, well development, aquifer testing, and sampling system installation for regional well R-66. The report is written in accordance with the requirements in Section IV.A.3.e.iv of the March 1, 2005 (revised 2008) Compliance Order on Consent (the Consent Order). Well R-66 was drilled and installed from October 15, 2011, to November 16, 2011, at Los Alamos National Laboratory (LANL or the Laboratory) for the Environmental Programs (EP) Directorate.

Well R-66 is located within Technical Area 21 (TA-21) in Los Alamos Canyon near the confluence with DP Canyon (Figure 1.0-1). The primary purpose of well R-66 is to monitor groundwater in the upper part of the regional aquifer downgradient of TA-21 and associated infiltration zones in Los Alamos and DP Canyons. R-66 will also be used as a sentinel well for municipal production well Otowi (O) 4 and to replace Test Well (TW) 3.

The drilling work plan for installing well R-66 was approved by the New Mexico Environment Department (NMED) in its March 31, 2011, letter, "Approval with Modification, Drilling Work Plan for Regional Aquifer Well R-66 (Test Well 3r)" (LANL 2011, 111601; NMED 2011, 201630). Well R-66 well was installed as planned, with a single screen set between 819.4 to 839.7 ft below ground surface (bgs). The water level was 792.8 ft bgs after the completed well was developed.

Characterization during drilling included collection of cuttings samples at 5-ft intervals from ground surface to total depth (TD) for lithologic evaluation. Borehole logs included video and natural gamma logs.

Postinstallation activities included well development, aquifer testing, sampling system installation, surface completion, and geodetic surveying. Future activities will include site restoration and waste management.

The information presented in this report was 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 activities and supporting figures, tables, and appendixes associated with the R-66 well drilling and installation project.

2.0 ADMINISTRATIVE PREPARATION

The following documents were prepared to guide activities associated with the drilling, installation, and sampling of regional aquifer well R-66:

- "Drilling Work Plan for Test Well 3r (R-66)," Los Alamos National Laboratory document (LANL 2011, 111601)
- "Field Implementation Plan for Regional Aquifer Well R-66 at Los Alamos National Laboratory, Technical Area-21" (Eberline Services 2011, 211432)
- "[Integrated Work Document for] Implementation of the Drilling Work Plan for Regional Aquifer Well R-66 for Task Order 2, subcontract number 89795-002-11, under the Drilling Master Task Order Agreement (MTOA), subcontract number 89795-000-11(Eberline Services 2011, 211433)
- "Spill Prevention Control and Countermeasures Plan for the ADEP Groundwater Monitoring Well Drilling Operations, Los Alamos National Laboratory, Revision 6" (North Wind Inc. 2011, 213292)
- "Waste Characterization Strategy Form for R-66 (formerly known as TW-3r) Installation of Regional Aquifer Well" (LANL 2011, 208399)

3.0 DRILLING ACTIVITIES

This section describes the drilling strategy and approach and provides a chronological summary of field activities conducted during the drilling of R-66.

3.1 Drilling Approach

The R-66 borehole was drilled using a Foremost DR-24 HD dual-rotary drilling rig with casing rotator. The dual-rotary system allows for advancement of casing with the casing rotator while drilling with conventional air/mist/foam methods with the drill string. The Foremost DR-24 HD drill rig was equipped with 5.5-in.-outside diameter (O.D.) dual-wall reverse circulation drill pipe, tricone bits, downhole hammer bits, and general drilling equipment. Casing sizes used in drilling activities included 20-, 16-, 12-, and 10-in. nominal diameters. Casing sizes were selected to ensure the required 2-in. minimum annular thickness of the filter pack would be achieved around a 5.6-in.-O.D. well screen, as required by Section X.C.3 of the Consent Order. The dual-rotary and standard rotary (open hole) techniques used filtered compressed air and fluid-assisted air to evacuate cuttings from the borehole.

Drilling fluids, including compressed air, municipal water, a mixture of municipal water with Baroid brand AQF-2 foaming agent, and EZ-MUD, a Baroid-brand polymer emulsion, were used as needed to advance the borehole to a depth of 696 ft bgs, approximately 100 ft above the anticipated top of the regional aquifer (796 ft bgs). The AQF-2 was used to help lift cuttings from the borehole, and EZ-MUD was used between the 12- and 16-in. casings to lubricate the 12-in. casing as it was advanced. Only compressed air and municipal water were used for drilling below 696 ft bgs. Table 3.1-1 presents total amounts of drilling fluids introduced into the borehole from the date when the top of the regional aquifer was encountered (715 ft on November 4, 2011) to when the regional aquifer was sealed off by bentonite during well construction (November 10).

3.2 Chronology of Drilling Activities

Decontamination of the drill rig and associated tools was performed before the crew arrived at the drill site. Drilling equipment and supplies were mobilized and prepared for drilling between October 14 and 15, 2011. Drilling of the R-66 borehole began on October 15, when a 20-in.-diameter surface casing was installed with a 16.93-in.-diameter Super Jaws underreaming bit and dual-rotary reverse-circulation drilling method. Air and municipal water were used to bring up the drill cuttings. The 20-in.-diameter casing was advanced to a depth of 53 ft bgs in the Otowi Member of the Bandelier Tuff. The boring was blown clear of water inside the casing, and the drill string was pulled. The inside of the casing was also checked with a downhole camera. The water level, measured inside the casing for an hour, remained stable at 51.4 ft, indicating the 20-in. casing had adequately sealed off alluvial water.

Drilling continued on October 16 and 17 with the 16.93-in.-diameter Super Jaws bit and a 16-in.-diameter casing to a depth of 275 ft. On October 17, AQF-2 was added to the air/water mixture at 215 ft to facilitate cutting returns. Based on cuttings, the Cerros del Rio volcanic series basalt was encountered at 277 ft bgs on October 17. After the borehole was advanced to 284 ft bgs using only air, the boring was cleared of water. Rising water levels inside the casing were monitored for approximately 3 h, indicating a perched water zone above the basalt. The casing was retracted to 269 ft bgs and a bentonite seal consisting of 0.375-in. bentonite chips was emplaced between 269 and 279 ft bgs to seal off perched water above the basalt. The 16-in. casing was lowered into the bentonite plug and set at 279.6 ft bgs.

On October 18, open borehole drilling commenced using a 14.75-in.-diameter down-the-hole hammer bit and municipal water as the drilling fluid. Drilling continued to 310 ft when AQF-2 was added to the drilling

fluid. On November 20, after the borehole had been drilled to 405 ft, a Laboratory video log was run in the open hole. Possible seepage in the basalt was noted at 312 to 319 ft bgs, 326 to 333 ft bgs, and 350 to 352 ft bgs. Water was observed squirting from a pinhole at 370 ft bgs. The water in the borehole was assumed to be drilling fluids because of red clay–filled fractures in the basalt, and most of the observed seepage was from irregular sections of the borehole.

The 12-in. casing was lowered down the hole and drilling commenced with an 11.63-in. tricone bit. Drilling was halted when the 12-in. casing became stuck at a depth of approximately 412 ft bgs (bottom of hole at approximately 429 ft bgs). On October 22, the 12-in. casing was retracted to approximately 372 ft and cement was tremied down inside the 12-in. casing. The borehole was cemented from 393 to 411 ft bgs and the cement allowed to set up for approximately 14 h. On October 23, drilling resumed with the 11.63-in. tricone bit and 12-in. casing. The cuttings from the cemented interval were diverted into a rolloff bin. Drilling continued to 455 ft bgs.

On October 23, the seal between the 12-in. and 16-in. casing was lost at a depth of approximately 456 ft bgs, and pressured drilling fluids began to escape to the surface along the outside of the 12-in. casing. After several attempts at replacing the blow out preventer, the drilling method was switched to conventional drilling with the drill cuttings diverted from the drill collar directly into the pit. Drilling resumed to approximately 515 ft bgs when drilling became more difficult. Angular cuttings and high torque on the rig indicated the bit was drilling through cobbles. The 11.63-in. tricone bit was pulled out and replaced with the 13.41-in.-diameter Super Jaws underreaming bit. Drilling continued to 545 ft where drilling slowed because of the flow of cuttings between 12-in. and 16-in. casing and the need to switch back to reverse-circulation drilling. After continued problems with the new blow out preventer seals, the Laboratory approved the use of EZ-MUD on October 29 to lubricate outside of the 12-in. casing. Reverse-circulation methods were used with the addition of air/water and the use of EZ-MUD from 575 to 673 ft bgs.

On November 1, the 11.63-in. tricone bit with conventional drilling was used to advance the borehole between 673 and 696 ft bgs. Drilling was halted at 696 ft bgs to check for potential perched water. The fluids were flushed out of the boring and air was used to dry out the borehole. The rig and compressed air were shut off for 1 h to determine if water would flow into the boring. After 1 h, a small amount of muddy water was blown out through the cyclone, although insufficient in quantity to collect a groundwater sample. It was observed that little to no perched water was present at 696 ft bgs. Drilling was switched over to reverse circulation between 696 and 715 ft bgs, using only water and air for drilling fluid. The 12-in. casing was set at 695 ft bgs.

On November 4, drilling continued to a depth of 715 ft bgs using reverse circulation and a 9.88-in.-diameter tricone bit and 10-in. casing. At approximately 770 ft bgs, water content appeared to be increasing. TD was reached on November 5 at a depth of 910.4 ft bgs. At that time, the depth to water in the borehole was 794.6 ft bgs.

4.0 SAMPLING ACTIVITIES

The following sections describe the cuttings and groundwater sampling activities for regional aquifer well R-66. All sampling activities were conducted in general accordance with applicable quality procedures.

4.1 Cuttings Sampling

Cuttings samples were collected at 5-ft intervals from the borehole beginning at ground surface to the total depth of 910.4 ft bgs. At each interval, the site geologist collected approximately 500 mL of bulk

cuttings from the discharge cyclone, placed them in resealable plastic bags, labeled them, and archived them in core boxes. Smaller fractions (>#10 and >#35 mesh) were sieved from the bulk cuttings and placed in chip trays along with unsieved (whole rock) cuttings. Samples were recovered from more than 97% of the borehole; samples were not recovered from 10 to 20 ft bgs, 675 to 680 ft bgs, and 690 to 695 ft bgs. Radiation control technicians screened cuttings before they were removed from the site, and screening measurements were within the range of background values. The core boxes and chip trays were delivered to the Laboratory's archive at the conclusion of drilling activities.

Section 5.1 summarizes the stratigraphy encountered at well R-66 during drilling; Appendix A provides lithologic descriptions of the drill cuttings.

4.2 Water Sampling

One perched-intermediate groundwater sample was collected on October 17, 2011, at a depth of 280 ft bgs. Water was evacuated from the borehole by airlifting. The borehole was allowed to recharge before the sample was collected. The groundwater sample was analyzed for dissolved metals, cations, anions, and tritium.

Seven groundwater samples were collected during well development for water-quality analyses. Six of the samples were analyzed for total organic carbon (TOC), dissolved metals, anions, and cations. One sample collected on December 7 was also analyzed for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), total petroleum hydrocarbons (TPH) diesel range organics (DRO) and TPH–gasoline range organics (GRO).

Table 4.2-1 summarizes screening samples collected at well R-66. Appendix B discusses screening, groundwater chemistry, and field water-quality parameters.

5.0 GEOLOGY AND HYDROGEOLOGY

A brief description of the geologic and hydrogeologic features encountered at R-66 is presented below. The Laboratory's geology task leader and site geologists examined cuttings to determine geologic contacts and hydrogeologic conditions. Drilling observations, video logging, and water-level measurements were used to characterize groundwater occurrences.

5.1 Stratigraphy

The stratigraphy and contacts presented below are based on lithologic descriptions of cuttings samples collected from the discharge cyclone, borehole geophysical logs, and video logs. Geologic units are described below in order of youngest to oldest geologic units. Figure 5.1-1 illustrates the stratigraphy at R-66, and Appendix A provides a detailed lithologic log based on visual examination and analysis of drill cuttings.

Quaternary Alluvium, Qal 3 (0 to 35 ft bgs)

The Quaternary alluvium consists of moderately to well-sorted nonindurated sandy silt and clay and gravely silt and clayey sands. Fragments include intermediate composition volcanics, felsic crystals, and pumice fragments.

Otowi Member of the Bandelier Tuff, Qbof (35 to 154 ft bgs)

The Otowi Member of the Bandelier Tuff consists of white to light gray pumiceous, nonwelded to moderately welded ash-flow tuff with vitric, fibrous pumices, phenocrysts, and lithic clasts that include a variety of pale brown and olive gray to brownish-gray intermediate composition volcanic rocks.

Guaje Pumice Bed of the Otowi Member of the Bandelier Tuff, Qbog (154 to 172 ft bgs)

The Guaje Pumice Bed is white to gray and reddish-gray and contains pumice fragments with subordinate amounts of volcanic lithics and quartz and sanidine phenocrysts. The presence of this unit was difficult to determine based on drill cuttings alone. The unit boundaries were determined based on the high borehole gamma-ray response commonly found in this unit in nearby wells.

Puye Formation, Tpf (172 to 277 ft bgs)

The Puye Formation consists of grayish brown and orange-pink, poorly to moderately sorted volcaniclastic sediments with subangular to subrounded boulders, cobbles, gravels, sands, and silts. Clasts in these sedimentary deposits consist of dacitic detritus shed from the Tschicoma Formation exposed in the Sierra de los Valles highlands west of the Pajarito Plateau.

Cerros del Rio Volcanic Series, Tb4 (277 to 394 ft bgs)

The Cerros del Rio volcanic series consists of light gray to light brownish-gray and olive black, massive to vesicular basaltic lava flows separated by porous zones of interflow breccias.

Puye Formation, Tpf (394 to 560 ft bgs)

The Puye Formation consists of moderate brown and grayish-orange to very dusky red, poorly to moderately sorted volcaniclastic sediments with subangular to subrounded boulders, cobbles, gravels, sands, and silts. Clasts in these sedimentary deposits consist of dacitic detritus shed from the Tschicoma Formation exposed in the Sierra de los Valles highlands west of the Pajarito Plateau.

Miocene Pumiceous Sediments, Tjfp (560 to 625 ft bgs)

Miocene pumiceous sediments form an unassigned unit that consists of light brown and very light gray to pinkish-gray tuffaceous silty sand with multicolored dacitic and rhyolitic gravel. Cuttings from this unit contain abundant reworked subrounded white vitric pumice and gray vitric and devitrified rhyolite lava clasts. Pumice clasts contain sparse biotite phenocrysts.

Miocene Riverine Deposits, Tcar (625 to 910.4 ft bgs)

Miocene riverine deposits consist of medium brown and grayish orange-pink fine to medium silty sand with fine subrounded to rounded gravel composed of dacite and minor quartzite. The sand and silt fractions are dominated by rounded and frosted quartz with subordinate intermediate volcanic clasts and feldspars. These deposits are probably correlative with the Chamita Formation of the Santa Fe Group.

5.2 Groundwater

A perched groundwater zone was detected in the upper part of the Puye Formation, above the Cerros del Rio volcanic series at a drilled depth of 280 ft bgs. A groundwater screening sample was collected from

the drill rig discharge line on October 17, 2011. The water stabilized at a depth of 203.6 ft bgs on October 18. The perched groundwater zone was sealed off from the borehole beneath it by landing the16-in.-diameter casing at 279.6 ft bgs within a bentonite chip seal.

On November 5, after drilling to a depth of 910.4 ft bgs, the water level for the regional aquifer inside the drill casing was measured at 794.6 ft bgs. On January 8, 2012, following well installation and development and before aquifer testing, the depth to water in the completed well was 792.8 ft bgs.

5.2.1 Regional Aquifer Groundwater Elevations

Based on the depth of water at 792.8 ft bgs measured on January 8, 2012, the water-level elevation before aquifer testing was approximately 5833.1 ft above mean sea level (amsl). This elevation is approximately 2.9 ft lower than the predicted elevation of 5836 ft amsl for R-66 based on the current regional aquifer water level map (Figure 5.2-1). The water level for R-66 measured after well installation and development is a preliminary value, and the water level may fluctuate as pressures equilibrate in the newly installed well.

Water levels at R-66 will continue to be monitored and data will be incorporated in periodic updates of the water-table elevation map.

6.0 BOREHOLE LOGGING

The following sections describe the borehole logging conducted at R-66. Table 6.0-1 presents a summary of all logging.

6.1 Video Logging

Laboratory personnel ran a video log of the R-66 borehole on October 20, 2011, from the ground surface to 401 ft to observe the cased borehole for perched groundwater. Table 6.0-1 provides a description of this log. The video log is provided on a DVD as Appendix C of this report.

6.2 Geophysical Logging

Laboratory personnel ran a natural gamma log in the R-66 borehole on November 6, 2011, from the ground surface to 910 ft bgs. The Laboratory geophysical log is included as Appendix D of this report (on CD).

7.0 WELL INSTALLATION

The R-66 well was installed between November 8 and 16, 2011. The following sections summarize the well design and well construction activities.

7.1 Well Design

The R-66 well was designed in accordance with the field implementation plan for R-66 (Eberline Services 2011, 211432) and a final NMED-approved well design developed after TD was reached (Appendix E). The well was designed with one screened interval to monitor regional groundwater quality and water levels near the regional water table in the Miocene riverine and fanglomerate sediments.

7.2 Well Construction

Well R-66 was constructed of 5.0-in.-inside diameter (I.D.)/5.6-in.-O.D. passivated type 304 stainless-steel welded and threaded casing fabricated to American Society for Testing and Materials (ASTM) standard A312. Figure 7.2-1 presents the final well construction details. The screened interval consists of a 20.3-ft length of 5.0-in.-I.D. rod-based, 0.020-in. slot, wire-wrapped well screen. Compatible external stainless-steel couplings (also passivated-type 304-stainless steel fabricated to ASTM A312 standards) were used to join all individual threaded casing and screen sections. Casing and screen were provided by the Laboratory and were steam pressure–washed before installation. A 2.5-in.-O.D. steel, flush-threaded tremie pipe string, also decontaminated before use, was used to deliver annular fill materials and potable water downhole during well construction.

On November 7, 2011, the 12-in. well casing was removed from the borehole. The final well design was received on November 7, and the well casing and screens were cleaned to prepare for construction. The 10-in.-diameter casing was retracted to a depth of 870.7 ft bgs. Before well construction, the bottom of the hole was tagged at a depth of 906 ft bgs (4.4 ft of slough in bottom of hole). A seal of 0.375-in. bentonite chips was added to the borehole via tremie pipe from depths of 906 to 866.5 ft bgs. The well was installed on November 9 and the screened interval was placed at a depth of 819.4 to 839.7 ft bgs.

On November 9, the 10-in.-diameter casing was retracted to a depth of 841.7 ft bgs. The remainder of the bentonite seal, consisting of 3/8-in. bentonite chips, was installed via tremie pipe from a depth of 866.5 to 843 ft bgs. The seal was allowed to hydrate for 4 h.

The primary filter pack, consisting of 10/20 sand, was emplaced via tremie pipe beginning on November 10. The filter pack was installed at a depth of 843.5 to 817.5 ft bgs and the well screen was swabbed. After the screen was swabbed, the primary filter pack settled to a depth of 816.5 ft bgs. Additional sand was used to bring the 10/20 sand filter pack up to 814.4 ft bgs. The secondary filter pack consisting of 20/40 sand was emplaced via tremie pipe from a depth of 814.4 to 811.7 ft bgs. Annular fill material consisting of hydrated 3/8-in. bentonite chips and 10/20 sand was emplaced via tremie pipe from a depth of 811.7 and 805.7 ft bgs and allowed to hydrate for a minimum of 4 h. Between November 10 and November 15, annular fill consisting of hydrated 3/8-in. bentonite chips and 10/20 sand was emplaced via tremie pipe from 805.7 to 541 ft bgs and was allowed to free fall from 541 to 60.5 ft bgs. A surface seal consisting of 51 mix cement was placed above the annular fill from 60.5 to 4 ft bgs on November 15 and 16. Table 7.2-1 lists the volumes of annular fill materials used at R-66.

The 10-in.-diameter casing was retracted gradually as the well backfill was emplaced between November 8 and November 13. The 20-in.-diameter surface casing was removed on November 15.

8.0 POSTINSTALLATION ACTIVITIES

Following well installation at R-66, the well was developed and tested. The well head and surface pad were completed on January 27, 2012. The sampling system was installed on March 7. A final geodetic survey was completed on March 12. Site-restoration activities will be completed following the final disposition of contained drill cuttings and groundwater, per the NMED-approved waste disposal decision trees.

8.1 Well Development

Well development was conducted between November 17 and December 18, 2011. Well development began with swabbing and bailing to remove formation fines in the filter pack and sump. The swabbing tool

used was a 4-in.-diameter, 1-in.-thick rubber disc attached to a weighted-steel rod. The swabbing tool was lowered by wireline using the Foremost DR-24 HD rig and drawn repeatedly across the screened interval. The bailing tool was a 3.5-in.-O.D. by 10.2-ft-long stainless-steel bailer. The tool was lowered by wireline and was used to remove water from the well that was then discharged into a 55-gal. drum. A total of 48 gal. of groundwater was bailed between November 17 and 18.

After bailing, a 10-horsepower (hp) 4-in. Grundfos submersible pump was installed in the well on November 20. The intake shroud of the pump was set at a depth of 824.6 to 825.6 ft bgs. The average pump rate was 2.0 gallons per minute (gpm) during the approximate 37 h of pumping development. Approximately 4068 gal. of water was removed during development.

8.1.1 Well Development Field Parameters

The field parameters of turbidity, temperature, pH, dissolved oxygen (DO), oxidation-reduction potential (ORP), and specific conductance were monitored via a flow-through cell at R-66 during well development and aquifer testing. Six water samples were collected for TOC analysis during well development. TOC values less than 2 mg/L and turbidity less than 5 nephelometric turbidity units (NTU) indicate the well has been developed adequately. Appendix B discusses the field parameters measured during well development.

The field parameter measurements at the end of well development were: pH of 7.96, temperature of 23.7°C, specific conductance of 28.9 µS/cm, and turbidity of 0 NTU. Table B-2.3-1 presents all field parameters and discharge volumes recorded during development. Additional well development occurred as a result of aquifer testing.

8.2 Aquifer Testing

Aquifer pumping tests, including preliminary step tests and a cross well test, were conducted at R-66 between January 6 to 20, 2012, by David Schafer and Associates. Approximately 83,950 gal. of water was removed during aquifer testing. The results of these tests are reported in the March 2012 “Report for the Cross-Hole Pumping Test at R-66 and TW-3” (LANL 2012, 209526). Table B-2.3-1 presents all the field parameters and discharge volumes recorded during aquifer testing.

8.3 Water Volumes Introduced Versus Volumes Removed

Water introduced below 715 ft bgs included 12,000 gal. used during drilling and 6470 gal. used during well construction in the regional aquifer for a total of approximately 18,470 gal. An estimated 3000 gal. of water was recovered during the drilling and well construction activities in the regional aquifer, for a total of approximately 15,470 gal. introduced into the regional aquifer. Approximately 88,018 gal. of water was removed from the screened interval during well development and aquifer testing.

8.4 Dedicated Sampling System Installation

A dedicated sampling system for R-66 was installed on March 7, 2012. The system uses a single 3.0-hp Franklin Electric motor and 4.0-in.-O.D. environmentally retrofitted Grundfos submersible pump. The pump riser pipe consists of threaded and coupled nonannealed 1.0-in.-I.D. passivated stainless steel. Two 1-in.-I.D. schedule 80 polyvinyl chloride (PVC) tubes are installed along with, and banded to, the pump riser. A dedicated In-Situ Level Troll 500 transducer was installed in one of the tubes, and the second tube will be used for manual water-level measurements. Both PVC tubes are equipped with a 2.5-ft section of 0.020-in. slotted screen and a closed bottom. Figure 8.4-1a shows details of the

dedicated sampling system. Figure 8.4-1b presents technical notes describing the sampling system components. Figure 8.4-1c shows the Grundfos pump performance curve.

8.5 Wellhead Completion

A reinforced concrete surface pad, 10 ft ×10 ft × 6 in. thick, was installed at the R-66 wellhead on January 27, 2012. The concrete pad was slightly elevated above ground surface and crowned to promote runoff. The pad will provide long-term structural integrity for the well. A brass monument marker was embedded in the northwest corner of the pad. A 16-in.-O.D. steel protective casing with a locking lid was installed around the stainless-steel well riser. A 0.5-in. weep hole was drilled near the base of the protective casing to prevent water accumulation inside the protective casing. Pea gravel was emplaced between the protective casing and well casing to a height of 1 ft above the weep hole. On February 6, four steel bollards, covered by high-visibility plastic sleeves, were set at the outside edges of the pad to protect the well from accidental vehicle damage. They are designed for easy removal to allow access to the well. Figure 8.4-1a shows details of the wellhead completion.

8.6 Geodetic Survey

A licensed professional land surveyor conducted a geodetic survey on February 13 and March 12, 2012 (Table 8.6-1). The survey data 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 relative to New Mexico State Plane Coordinate System Central Zone 83 (North American Datum [NAD] 83); elevation is expressed in feet amsl using the National Geodetic Vertical Datum of 1929. Survey points included ground-surface elevation near the concrete pad, the top of the monument marker in the concrete pad, the top of the well casing, and the top of the protective casing. The survey data are provided in Table 8.6-1, and the survey location report is provided in Appendix F.

8.7 Waste Management and Site Restoration

Waste generated from the R-66 project includes drilling fluids, purged groundwater, drill cuttings, decontamination water, and contact waste. Table 8.7-1 summarizes the waste characterization samples collected during drilling, construction, and development of the R-66 well. All waste streams produced during drilling and development activities were sampled in accordance with the “Waste Characterization Strategy Form for R-66 (formerly known as TW-3r) Installation of Regional Aquifer Well” (LANL 2011, 208399).

Fluids produced during drilling and well development are expected to be land-applied after a review of associated analytical results per the waste characterization strategy form (WCSF) and ENV-RCRA-QP-010.2, Land Application of Groundwater. If the drilling fluids are determined to be nonhazardous but do not meet the criteria for land application, the drilling fluids will be evaluated for treatment and disposal at one of the Laboratory’s wastewater treatment facilities or other authorized disposal facility. If the analytical data indicate the drilling fluids are hazardous/nonradioactive or mixed low-level waste, the drilling fluids either will be treated on-site or will be disposed of at an authorized facility.

Cuttings produced during drilling are anticipated to be land-applied after a review of associated analytical results per the WCSF and ENV-RCRA-QP-011.2, Land Application of Drill Cuttings. If the drill cuttings do not meet the criteria for land application, they will be disposed of at an authorized facility.

Decontamination fluid used for cleaning the drill rig and equipment is currently containerized. The fluid waste was sampled and will be disposed of at an authorized facility. Characterization of contact waste will be based upon acceptable knowledge, pending analyses of the waste samples collected from the drill fluids, drill cuttings, purge water, and decontamination fluid.

Site restoration activities will include removing drilling fluids and cuttings from the pit and managing the fluids and cuttings in accordance with applicable procedures, removing the polyethylene liner, removing the containment area berms, and backfilling and regrading the containment area.

9.0 DEVIATIONS FROM PLANNED ACTIVITIES

Drilling and sampling at R-66 were performed in general accordance with "Field Implementation Plan for Regional Aquifer Well R-66 at Los Alamos National Laboratory, Technical Area-21" (Eberline Services 2011, 211432).

Three major deviations occurred during the installation of R-66. The first occurred on October 22, 2011, when cement was placed in the borehole between 393 and 411 ft bgs. The 12-in. casing had become stuck and the cement was added and then was drilled through to allow the 12-in. casing to be advanced.

The second deviation occurred on October 29, with the use of EZ-MUD to lubricate the space between the 12-in. and 16-in. casing. The Laboratory approved the use of EZ-MUD on October 29 for use during casing advancement between 575 and 696 ft bgs.

The third deviation occurred with the use of welded well casing on R-66 although the work plan called for threaded casing. At the Laboratory's request, 769.2 ft of welded casing was used in R-66. Threaded/coupled casing was used for the remaining 86.6 ft needed for R-66.

10.0 ACKNOWLEDGMENTS

Yellow Jacket Drilling drilled the R-66 borehole, installed the well, and helped to conduct well development and aquifer testing.

Kleinfelder West, Inc. provided field geologist and well drilling supervisor services as well as report preparation.

David Schafer and Associates performed aquifer tests and analyzed the data, which are reported in the March 2012 "Report for the Cross-Hole Pumping Test at R-66 and TW-3."

Laboratory personnel ran downhole video and natural gamma logging equipment.

11.0 REFERENCES AND MAP DATA SOURCES

11.1 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. The information is also included in text citations. ER IDs are assigned by the EP 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.

Eberline Services, October 11, 2011. "[Integrated Work Document for] Implementation of the Drilling Work Plan for Regional Aquifer Well R-66 for Task Order 2, subcontract number 89795-002-11, under the Drilling Master Task Order Agreement (MTOA), subcontract number 89795-000-11," Albuquerque, New Mexico. (Eberline Services 2011, 211433)

Eberline Services, October 12, 2011. "Field Implementation Plan for Regional Aquifer Well R-66 at Los Alamos National Laboratory, Technical Area-21," FIP-LANS89795-03, Los Alamos, New Mexico. (Eberline Services 2011, 211432)

LANL (Los Alamos National Laboratory), January 2011. "Drilling Work Plan for Test Well 3r (R-66)," Los Alamos National Laboratory document LA-UR-11-0184, Los Alamos, New Mexico. (LANL 2011, 111601)

LANL (Los Alamos National Laboratory), September 19, 2011. "Waste Characterization Strategy Form for R-66 (formerly known as TW-3r) Installation of Regional Aquifer Well," EP2011-0306, Los Alamos National Laboratory, Los Alamos, New Mexico. (LANL 2011, 208399)

LANL (Los Alamos National Laboratory), February 2012. "Report for the Cross-Hole Pumping Test at R-66 and TW-3," Los Alamos National Laboratory document LA-UR-12-0673, Los Alamos, New Mexico. (LANL 2012, 209526)

NMED (New Mexico Environment Department), March 31, 2011. "Approval with Modifications, Drilling Work Plan for Regional Well R-66 (Test Well 3r)," New Mexico Environment Department letter to G.J. Rael (DOE-LASO) and M.J. Graham (LANL) from J.P. Bearzi (NMED-HWB), Santa Fe, New Mexico. (NMED 2011, 201630)

North Wind Inc., July 2011. "Spill Prevention Control and Countermeasures Plan for the ADEP Groundwater Monitoring Well Drilling Operations, Los Alamos National Laboratory, Revision 6," plan prepared for Los Alamos National Laboratory, Los Alamos, New Mexico. (North Wind, Inc., 2011, 213292)

11.2 Map Data Sources

Coarse Scale Drainage Arcs; Los Alamos National Laboratory, Water Quality and Hydrology Group of the Risk Reduction and Environmental Stewardship Program; as published 03 June 2003.

Dirt Road Arcs; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 19 March 2008; as published 04 January 2008.

Hypsography, 100 ft Contour Interval; Los Alamos National Laboratory, ENV Environmental Remediation and Surveillance Program; 1991.

Inactive Outfalls; Los Alamos National Laboratory, Water Quality and Hydrology Group of the Environmental Stewardship Division at Los Alamos National Laboratory Los Alamos New Mexico; 01 September 2003.

Paved Road Arcs; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 19 March 2008; as published 04 January 2008.

Penetrations; Los Alamos National Laboratory, Environment and Remediation Support Services, ER2006-0664; 1:2,500 Scale Data, 01 July 2006.

Structures; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 19 March 2008; as published 04 January 2008.

Technical Area Boundaries; Los Alamos National Laboratory, Site Planning and Project Initiation Group, Infrastructure Planning Division; 19 September 2007.

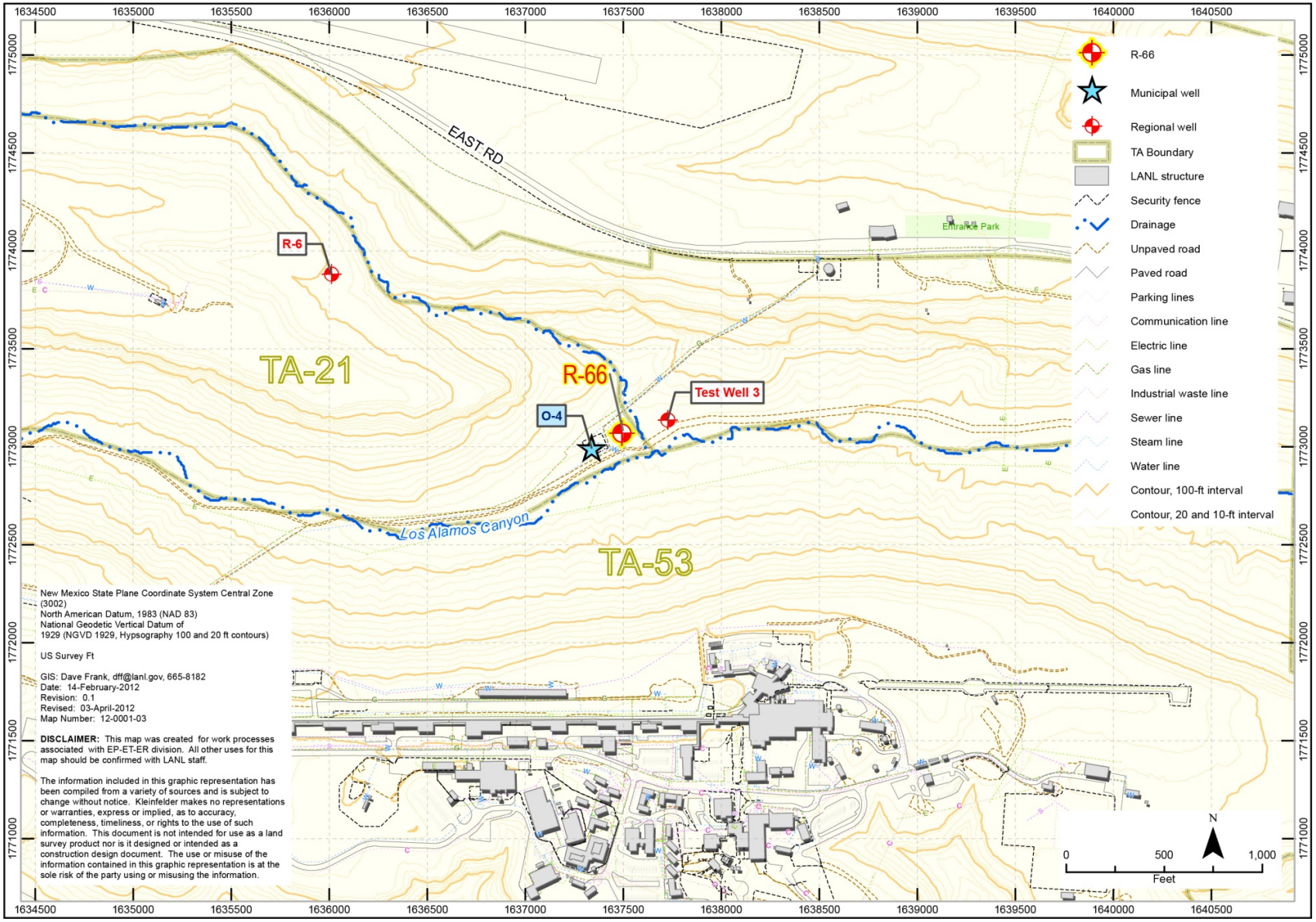


Figure 1.0-1 Location of well R-66

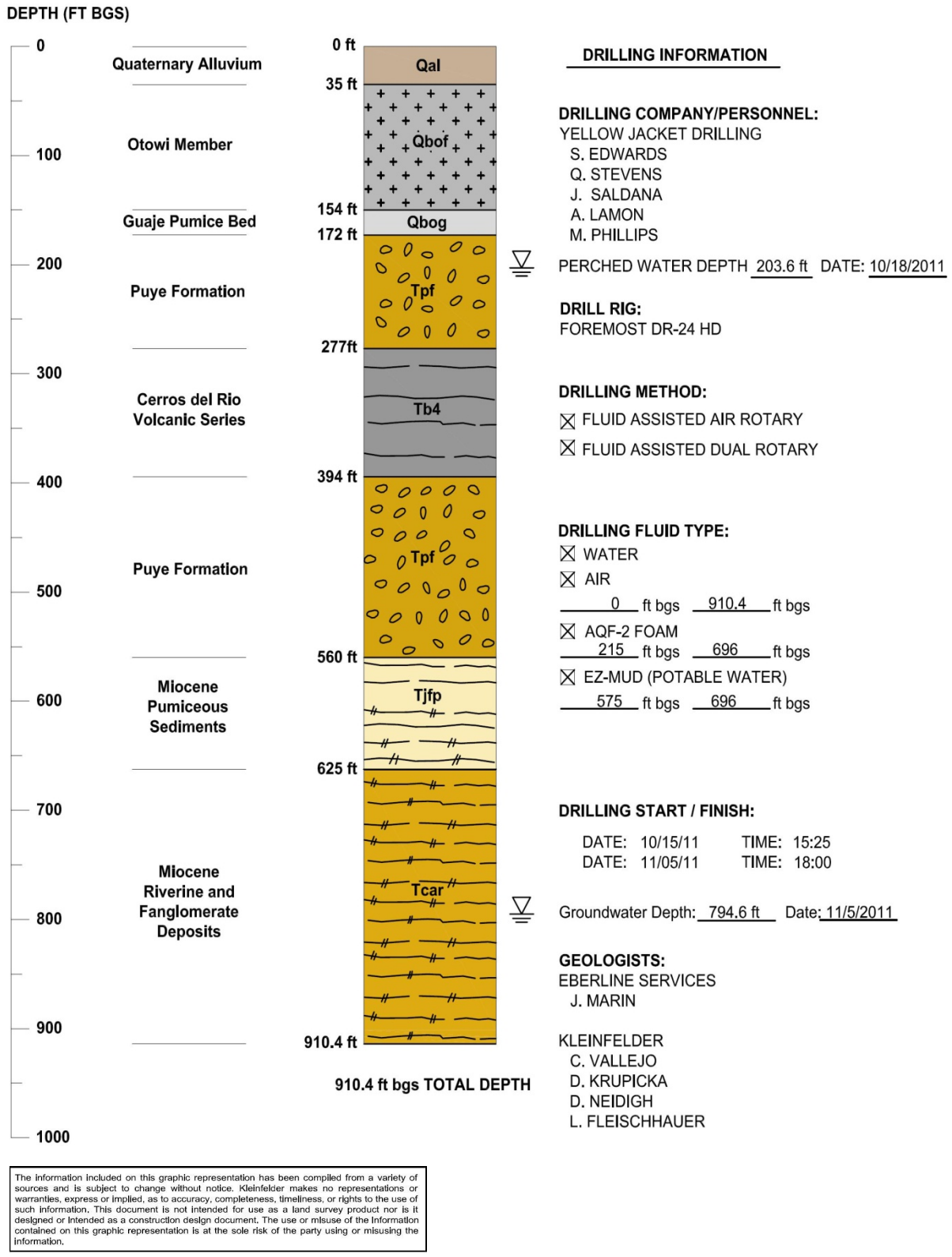


Figure 5.1-1 R-66 borehole stratigraphy

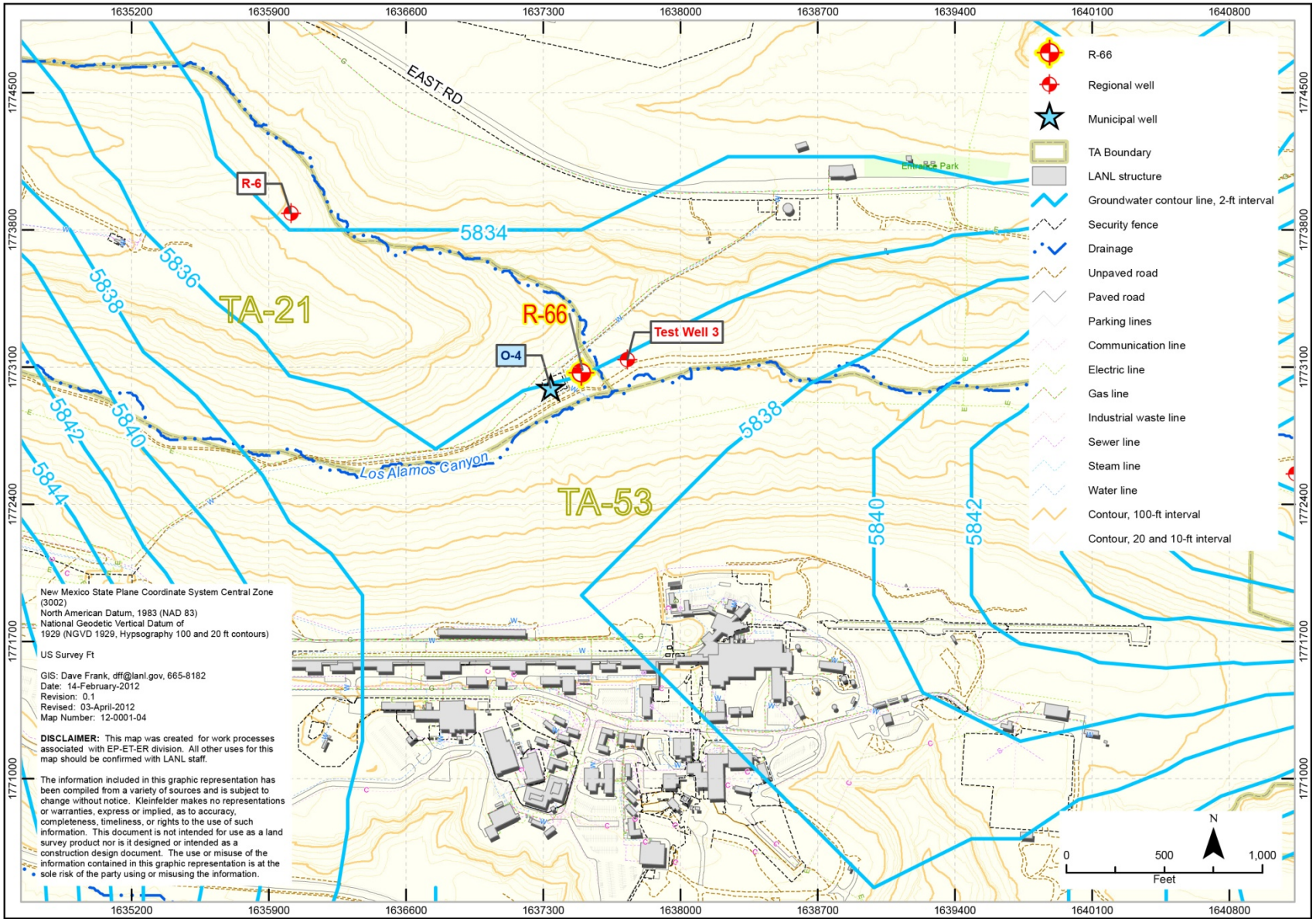


Figure 5.2-1 Regional aquifer groundwater elevations

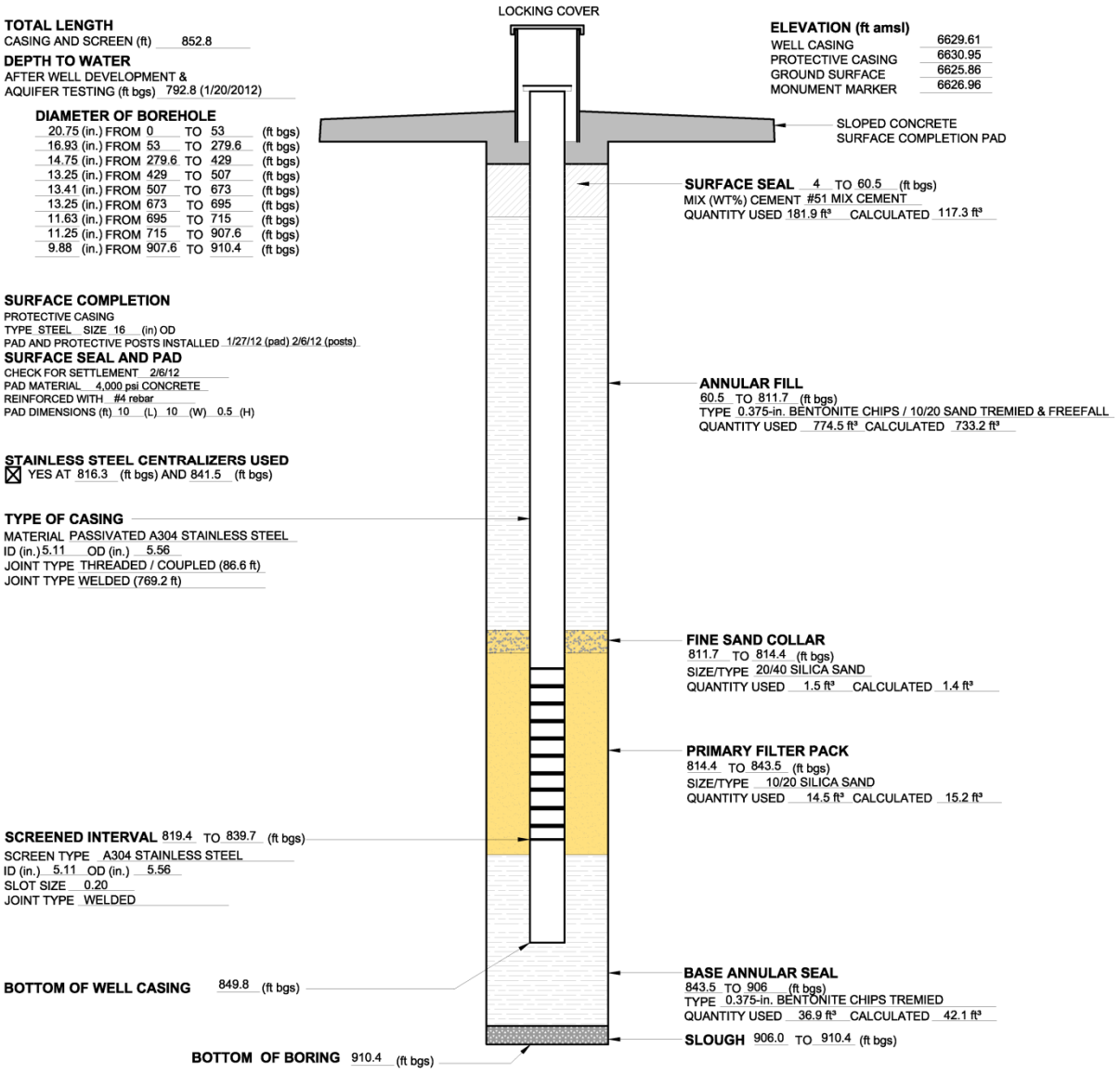
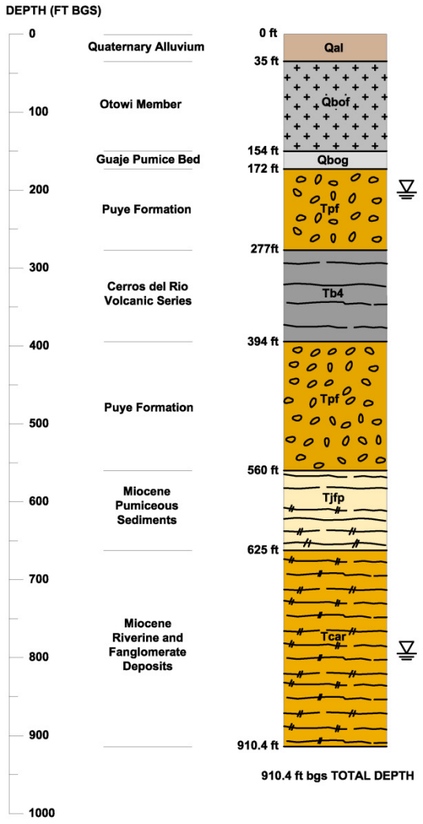


Figure 7.2-1 As-built construction diagram for well R-66



DRILLING INFORMATION

DRILLING COMPANY/PERSONNEL:
YELLOW JACKET DRILLING
S. EDWARDS
Q. STEVENS
J. SALDANA
A. LAMON
M. PHILLIPS

PERCHED WATER DEPTH 203.6 ft DATE: 10/18/2011

DRILL RIG:
FOREMOST DR-24 HD

DRILLING METHOD:
X FLUID ASSISTED AIR ROTARY
X FLUID ASSISTED DUAL ROTARY

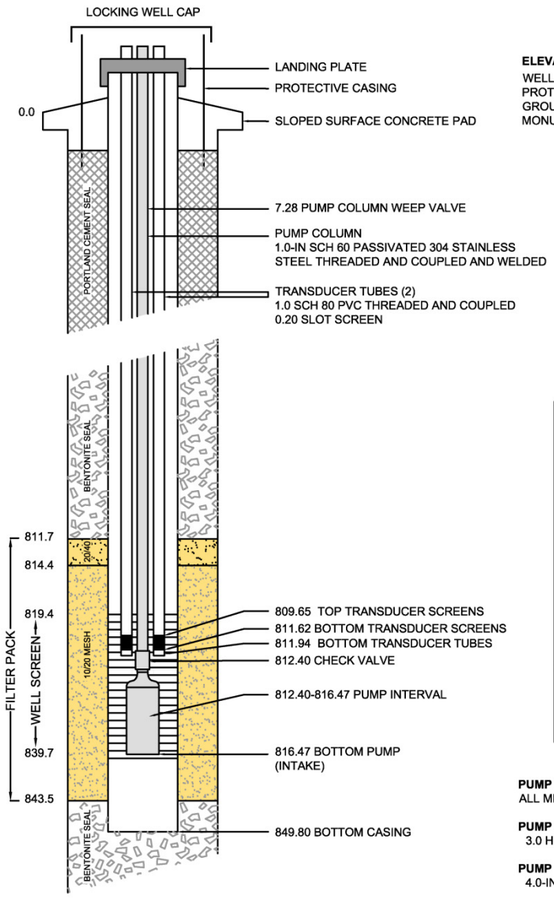
DRILLING FLUID TYPE:
X WATER
X AIR
0 ft bgs 910.4 ft bgs
X AQF-2 FOAM
215 ft bgs 696 ft bgs
X EZ-MUD (POTABLE WATER)
575 ft bgs 696 ft bgs

DRILLING START / FINISH:
DATE: 10/15/11 TIME: 15:25
DATE: 11/05/11 TIME: 18:00

Groundwater Depth: 794.6 ft Date: 11/5/2011

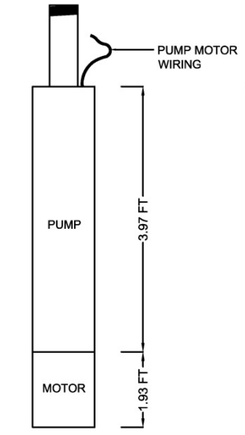
GEOLOGISTS:
EBERLINE SERVICES
J. MARIN

KLEINFELDER
C. VALLEJO
D. KRUPICKA
D. NEIDIGH
L. FLEISCHHAUER



ELEVATION (ft amsl)

WELL CASING	6629.61
PROTECTIVE CASING	6630.95
GROUND SURFACE	6625.86
MONUMENT MARKER	6626.96



PUMP DETAIL (LENGTHS IN FT., ALL MEASUREMENTS ARE APPROXIMATE)

PUMP MOTOR
3.0 HP FRANKLIN ELECTRIC

PUMP
4.0-IN GRUNDFOS

NOTE: PUMP COLUMN BANDED WITH WIRING AND TRANSDUCER TUBES (PUMP WIRING NOT SHOWN FOR CLARITY)

DEPTHS MEASURED IN FEET BELOW GROUND SURFACE

WELL DEVELOPMENT BEGAN
DATE 11/17/2011
TIME 12:15

WELL DEVELOPMENT FINISHED
DATE 12/18/11
TIME 15:00

DEVELOPMENT METHOD
X SWABBING X BAILING
X PUMPING
TOTAL PURGE VOLUME
4,068 gal.

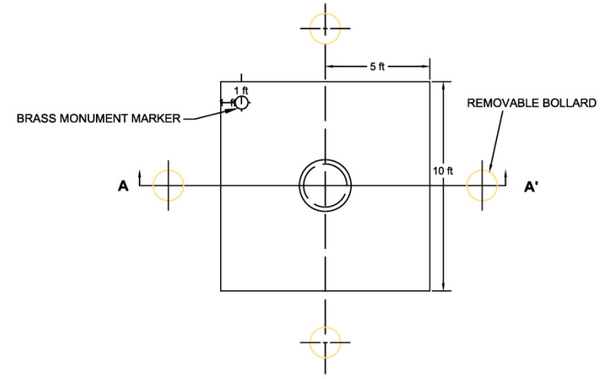
FINAL PARAMETERS

pH	7.71
TEMPERATURE (°C)	22.05
SPECIFIC CONDUCTANCE (µS/cm)	30.7
TURBIDITY (NTU)	243

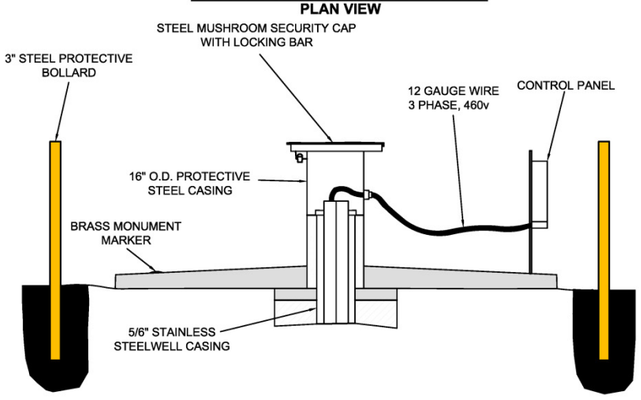
WELL COMPLETION BEGAN
DATE 11/8/2011 TIME 17:42

WELL COMPLETION FINISHED
DATE 11/16/2011 TIME 11:00

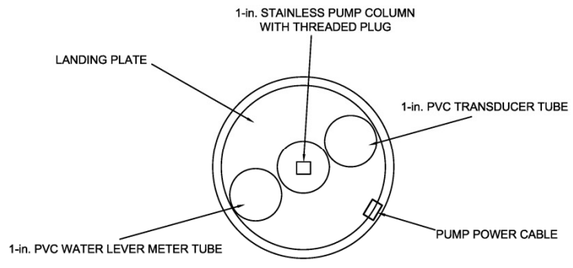
WELL COMPLETION DETAILS



SURFACE COMPLETION
PLAN VIEW



WELL HEAD DETAILS
CROSS-SECTION VIEW A-A'



WELL HEAD
PLAN VIEW

Figure 8.4-1a As-built schematic for well R-66

R-66 TECHNICAL NOTES

SURVEY INFORMATION[1]

BRASS MARKER

NORTHING	1773068.55	ft
EASTING	1637492.97	ft
ELEVATION	6626.96	ft amsl
GROUND SURFACE	6625.86	ft amsl
PROTECTIVE CASING	6630.95	ft amsl

[1] Coordinates based on New Mexico State Plane Grid Coordinates Central Zone (NAD83); Elevation based on National Geodetic Vertical Datum 1929 in feet above mean seal level (ft amsl)

WELL CASING

NORTHING	1773065.77	ft
EASTING	1637496.12	ft
ELEVATION	6629.61	ft amsl

BOREHOLE GEOPHYSICAL LOGS

LANL NATURAL GAMMA LOGS	0 to 910.4 ft bgs
LANL VIDEO LOGS	0 to 401.0 ft bgs

DRILLING INFORMATION

DRILLING COMPANY	***DRILLING PERSONNEL:***
Yellow Jacket Drilling	S. Edwards J. Saldana
DRILL RIG	Q. Stevens M. Phillips
Foremost DR-24 HD	A. Lamon
DRILLING METHODS	***GEOLOGISTS:***
Fluid-assisted air rotary	KLEINFELDER - C. VALLEJO, D. KRUPICKA,
Fluid-assisted dual rotary	D. NEIDIGH, L. FLEISCHHAUER
	EBERLINE SERVICES- J. MARIN

DRILLING FLUIDS

Air; Quick-Foam (discontinued at 696 ft bgs); and
EZ-Mud (from 575 ft to 696 ft bgs); potable water

MILESTONE DATES

DRILLING

START	10/15/2011	15:25
FINISH	11/5/2011	18:00

WELL COMPLETION

START	11/8/2011	17:42
FINISH	11/16/2011	11:00

WELL DEVELOPMENT

START	11/17/2011	12:15
FINISH	12/18/2011	15:00

WELL DEVELOPMENT

DEVELOPMENT METHODS:

Performed swabbing, bailing, jetting, and pumping

Volume Purged: 4,068 gal

Final Parameter Measurements

pH:	7.71
TEMPERATURE (°C):	22.05
SPECIFIC CONDUCTANCE (µS/cm):	30.7
TURBIDITY (NTU):	243

STEP TEST AND CROSS-WELL TEST

WATER PRODUCED:	83,950 gal
AVERAGE FLOW RATE:	13.1 gpm
PERFORMED ON:	1/12 - 16/2012

Static Water Level Post Well Development :

792.8 ft bgs Date Measured: 1/20/2012

DEDICATED SAMPLING SYSTEM

PUMP TYPE

MAKE	GRUNDFOS 5S30-820CBM
MODEL	B91126361-P11049020
SN#	23586
PUMP INTAKE DEPTH (ft bgs):	814.4
SUGGESTED PUMPING RATE (gpm):	5
PUMP WIRE GAGE:	10
PUMP VOLTAGE REQS:	480 V

MOTOR

MAKE	FRANKLIN 3450 RPM, 3 HP
MODEL	2343268902
SN#	09F14-23-1301

PUMP COLUMN

1-in. ID Threaded/Coupled
Schedule 80 Passivated 304 Stainless steel

TRANSDUCER TUBE

1-IN. ID Flush Threaded Schedule 80 PVC with 2.5 ft long 0.20-in screen between 809.65 and 811.62 ft bgs

TRANSDUCER

DATE INSTALLED	3/21/2012
MAKE	InSitu LevelTroll
MODEL	500 -30 psi
SN#	305890

Figure 8.4-1b Technical notes for well R-66

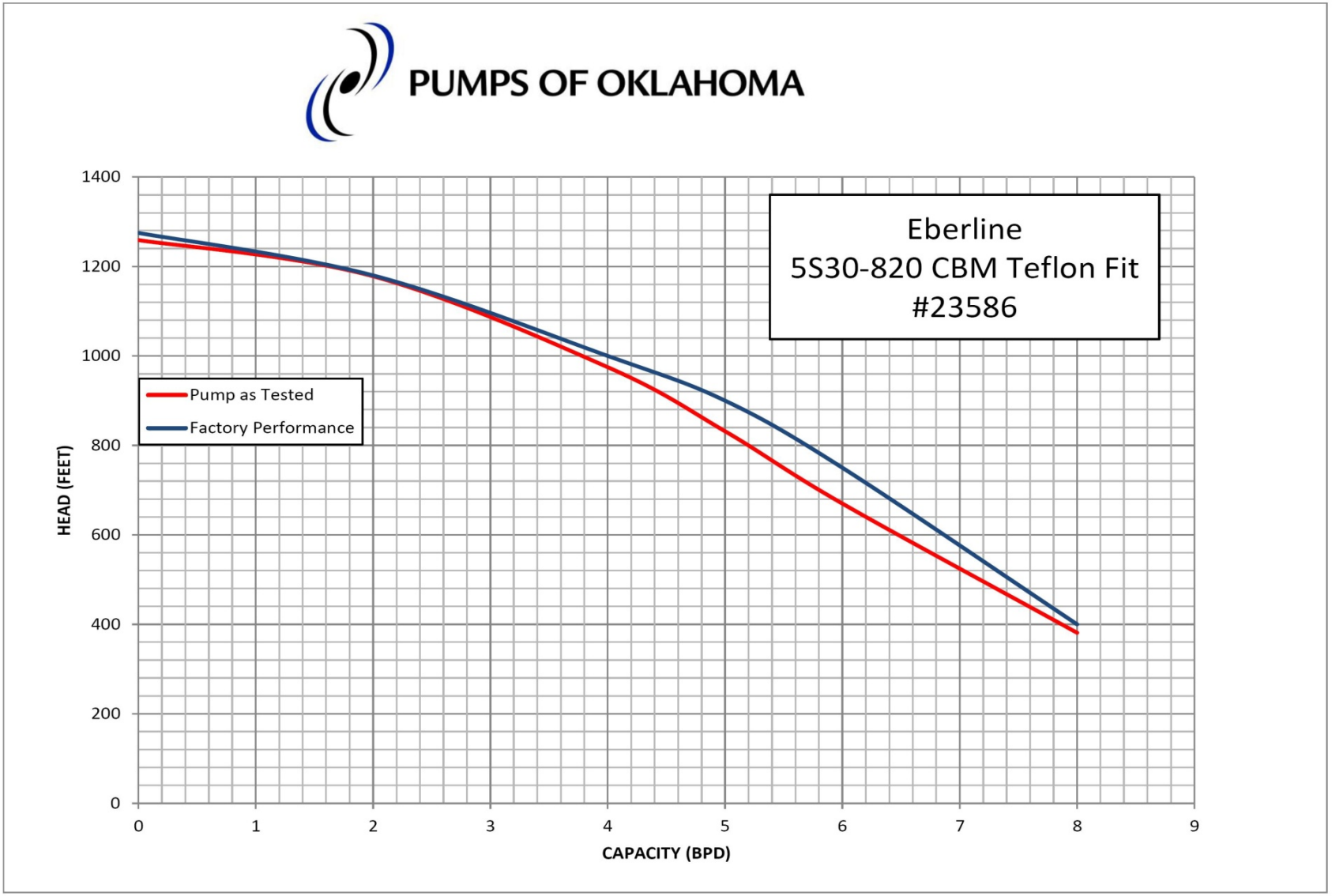


Figure 8.4-1c Pump performance curve

Table 3.1-1
Fluid Quantities Used in the Regional Aquifer during R-66 Drilling and Well Construction

Date and Shift*	Well Construction Activity	Daily Water Tally (gal.)	Cumulative Water Tally (gal.)	Estimate of Fluids Recovered (gal.)	Cumulative Estimate of Fluids Recovered (gal.)
11/4/11 PM	Drilling: 715–820 ft bgs	6000	6000	1500	1500
11/5/11 AM	Drilling: 820–900 ft bgs	6000	12,000	1500	3000
11/8/11 PM	Bottom bentonite seal placement	2700	14,700	0	3000
11/9/11 PM	Sand pack placement	2750	17,450	0	3000
11/10/11 AM	Sand pack placement	420	17,870	0	3000
11/10/11 PM	Upper bentonite seal placement	600	18,470	0	3000

Note: Cumulative water added − cumulative recovered = gallons introduced into regional aquifer: 18,470 − 3000 = 15,470 gal.
*AM = Day shift, PM = night shift.

Table 4.2-1
Summary of Groundwater Screening Samples Collected at Well R-66

Location ID	Sample ID	Date Collected	Collection Depth (ft bgs)	Sample Type	Dissolved Metals	Anions	Cations	TOC	Tritium	VOC, SVOC, TPH-DRO, TPH-GRO
Drilling										
R-66	GW66-12-1104	10/17/11	280	Grab – Perched groundwater	X[a]	X	X	NA[b]	X	NA
Well Development										
R-66	GW66-12-1783	12/7/11	820b	Initial development water	X	X	X	X	NA	NA
R-66	GW66-12-1784	12/7/11	820	End of development for date	X	X	X	X	NA	NA
R-66	GW66-12-1898	12/7/11	820	Sample collected because of petroleum odor	NA	NA	NA	NA	NA	X
R-66	GW66-12-1785	12/8/11	820	End of development for date	X	X	X	X	NA	NA
R-66	GW66-12-1786	12/16/11	830	End of development for date	X	X	X	X	NA	NA
R-66	GW66-12-1787	12/17/11	835	End of development for date	X	X	X	X	NA	NA
R-66	GW66-12-1788	12/18/11	840	End of development for date	X	X	X	X	NA	NA

[a] X = Analyzed.
[b] NA = Not analyzed.

Table 6.0-1
R-66 Logging Runs

Date	Type of Log	Depth (ft bgs)	Description
10/20/11	Video	0–401	LANL video from ground surface to 401 ft bgs. Observed a possible seepage in the basalt at 312–319 ft bgs, 326–333 ft bgs, 350–352 ft bgs plus water squirting from a pinhole at 370 ft bgs. All seepage likely drilling fluids.
11/6/2011	Natural gamma	0–910.4	LANL natural gamma log run from ground surface to 910.4 ft bgs.

Table 7.2-1
R-66 Annular Fill Materials

Material	Volume (ft^3)
Surface seal: #51 mix Portland	181.9
Upper seal: 0.375-in. bentonite chips and 10/20 silica sand	774.5
Transition sand collar: 20/40 silica sand	1.5
Primary filter pack: 10/20 silica sand	14.5
Lower seal: 0.375-in. bentonite chips	36.9

Table 8.6-1
R-66 Survey Coordinates

Identification	Northing	Easting	Elevation
R-66 brass monument marker	1773068.55	1637492.97	6626.96
R-66 top of 16-in. protective casing	1773065.95	1637496.81	6630.95
R-66 top of well casing	1773065.77	1637496.12	6629.61
R-66 ground surface	1773071.45	1637492.94	6625.86

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

Table 8.7-1
Summary of Waste Samples Collected at R-66

Well	Event ID	Sample ID	Date Collected	Description	Sample Matrix
R-66	3657	WST53-12-694	10/18/2011	Trip blank for VOC fluid sample	Liquid
R-66	3657	WST53-12-692	10/18/2011	VOC sample drill fluids top third of borehole	Liquid
R-66	3656	WST53-12-687	10/18/2011	VOC sample drill cuttings top third of borehole	Solid
R-66	3656	WST53-12-688	10/18/2011	Trip blank for VOC cuttings sample	Liquid
R-66	3657	WST53-12-691	10/26/2011	VOC sample drilling fluids middle third	Liquid
R66	3657	WST53-12-695	10/26/2011	Field trip blank for middle VOC sample	Liquid
R-66	3656	WST53-12-686	10/26/2011	VOC sample for VOC cuttings middle third	Solid
R-66	3656	WST53-12-689	10/26/2011	Field trip blank for middle VOC sample	Liquid
R-66	3668	WST53-12-894	11/9/2011	Drill cuttings waste composite sample	Solid
R-66	3657	WST53-12-696	11/5/2011	Field trip blank for final VOC sample drill fluids	Liquid
R-66	3657	WST53-12-693	11/5/2011	Final VOC sample drill fluids	Liquid
R-66	3656	WST53-12-690	11/5/2011	Field trip blank for final VOC sample drill cuttings	Liquid
R-66	3656	WST53-12-685	11/5/2011	Final VOC sample drill cuttings	Solid
R-66/ Pajarito laydown yard (LDY)	3655	WST53-12-679	11/18/2011	Unfiltered portion of decon water (10 in. drill casing plus well stainless) items never downhole	Liquid
R-66/ Pajarito LDY	3655	WST53-12-683	11/18/2011	Field trip blank for WST53-12-679	Liquid
R-66/ Pajarito LDY	3655	WST53-12-681	11/18/2011	Field duplicate (quality assurance sample) part of decon sample WST53-12-679	Liquid
R-66/ Pajarito LDY	3655	WST53-12-677	11/18/2011	Filtered portion of WST53-12-679 decon water of materials before downhole at R-66	Liquid
R-66	3669	WST53-12-895	11/29/2011	Drill fluids full suite (no VOCs) unfiltered	Liquid
R-66	3669	WST53-12-896	11/29/2011	Drill fluids filtered portion of full suite	Liquid
R-66	3669	WST53-12-897	11/29/2011	Drill fluids field dup portion of full suite	Liquid
R-66	3731	CALA-12-1919	12/15/2011	Tritium, VOCs, SVOCs, TPH-GRO, TPH-DRO	Liquid
R-66	3731	CALA-12-1921	12/15/2011	Trip blank for CALA-12-1919	Liquid
R-66	3670	WST53-12-901	1/20/2012	R-66 development water waste sample	Liquid
R-66	3670	WST53-12-899	1/20/2012	R-66 development water waste sample	Liquid
R-66	3670	WST53-12-902	1/20/2012	R-66 development water waste sample	Liquid
R-66	3670	WST53-12-900	1/20/2012	R-66 development water waste sample	Liquid

Appendix A

Well R-66 Borehole Lithologic Log

Borehole Identification (ID): R-66	**Technical Area (TA): 21**	**Page: 1 of 3**
Drilling Company: Yellow Jacket Drilling, Inc.	**Start Date/Time:** 10/15/11 15:25	**End Date/Time:** 11/5/11 18:00
Drilling Method: Reverse Circulation (RC) Open Borehole; RC Dual Rotary Casing Advance	**Machine:** DR24HD	**Sampling Method:** Grab
Ground Elevation: 6626.9 ft amsl		**Total Depth:** 910.4 ft bgs
Drillers: S. Edwards, J. Saldana, Q. Stevens, A. Lamon, M. Phillips	**Site Geologists:** J. Marin, D. Krupicka, L. Fleischhauer, D. Neidigh, C. Vallejo	

Depth (ft bgs)	Lithologic Description	Lithologic Symbol	Notes
0–5	QUATERNARY ALLUVIUM: WR: clastic sediments, brownish black (5YR 2/1), silty sand with 10–20% fine-grained subrounded gravel.	Qal	
5–10	WR: clastic sediments, brownish black (5YR 2/1), silty gravel.	Qal	
10–20	No recovery		
20–35	WR: Poorly graded sand with gravel (SP). Olive gray (5Y 4/1), 80% fine- to medium-grained subangular sand of mixed composition, dominantly quartz and felsic fragments. Less than 10% fine-grained subangular gravel, mainly intermediate composition volcanics. Becoming fine grained at 30 ft, with more varied composition, moderate yellowish brown (10YR 5/4).	Qal	
35–120	OTOWI MEMBER OF THE BANDELIER TUFF: WR: Tuff, moderate yellowish brown (10YR 5/4) poorly welded with fine ash matrix. Contains minor (5–10%) lithic fragments of mainly intermediate composition volcanics. +10F: sub-angular to sub-rounded <1–5 mm in size. +35F: Abundant felsic phenocrysts (clear), sub-rounded.	Qbo	
120–154	WR: Tuff, moderate yellowish brown (10YR 5/4) poorly welded fine ash matrix, with very fine-grained lithic fragments and quartz or felsic phenocrysts (clear). +35F: Varying percentages of quartz phenocrysts, mainly intermediate composition volcanic fragments.	Qbo	
154–172	GUAJE PUMICE BED OF THE OTOWI MEMBER OF THE BANDELIER TUFF: WR: Pumice bed, yellowish gray (5Y 8/1), poorly welded, fine ash matrix with some subangular vitric ash fragments; some manganese and iron specks. +35F: Composed of 90% subhedral quartz fragments.	Qbog	
172–195	PUYE FORMATION: WR: Poorly graded gravel/gravel with sand (GP), from very light gray (N8) to moderately reddish brown (10R 4/6), 70–90% gravel, mainly subangular intermediate composition volcanics, generally 3–10 mm in size. +35F: Medium- to coarse-grained sand, medium dark gray (N4), to moderate reddish brown (10R 4/6), subrounded to subangular. Mostly lithic fragments with 10–30% anhedral quartz grains.	Tpf	
195–210	WR: Poorly graded sand or sand with gravel, grayish brown (5YR 3/2), some subangular gravel, 3–15 mm in size, mainly intermediate composition volcanics, trace tuff fragments.	Tpf	
210–265	WR: Composition ranges from poorly graded sand with gravel (SP) to poorly graded gravel with sand (GP), or gravel with silt and sand (GP-GM), light brown (5yr 6/4) to grayish brown (5YR 3/2). +10F: Fine-grained subangular gravel, 3–10 mm in size, mainly intermediate composition volcanics. +35F: Fine- to medium-grained gravelly sand, dusty brown (5YR 7/2).	Tpf	
265–277	WR: As above but becoming more mafic, with subangular basalt sand and fine-grained gravel-sized material present.	Tpf	
277–300	CERROS DEL RIO VOLCANIC SERIES: Basalt, black (N1), vesicular, aphanitic groundmass. Less than 2% light green phenocrysts (possibly olivine), 2–5% euhedral pyroxene phenocrysts and volcanic glass fragments	Tb4	
300–315	Basalt, black (N1), massive with trace to some vesicles, aphanitic with trace phenocrysts, dark green to pale yellow, (possibly olivine).	Tb4	

Borehole Identification (ID): R-66	**Technical Area (TA): 21**	**Page: 2 of 3**
Drilling Company: Yellow Jacket Drilling, Inc.	**Start Date/Time:** 10/15/11 15:25	**End Date/Time:** 11/5/11 18:00
Drilling Method: Reverse Circulation (RC) Open Borehole; RC Dual Rotary Casing Advance	**Machine:** DR24HD	**Sampling Method:** Grab
Ground Elevation: 6626.9 ft amsl		**Total Depth:** 910.4 ft bgs
Drillers: S. Edwards, J. Saldana, Q. Stevens, A. Lamon, M. Phillips	**Site Geologists:** J. Marin, D. Krupicka, L. Fleischhauer, D. Neidigh, C. Vallejo	

Depth (ft bgs)	Lithologic Description	Lithologic Symbol	Notes
315–340	Basalt, scoria, or interbedded scoria basalt, dark reddish brown (10R 3/4), to dusty brown (5YR 3/2), aphanitic ground mass, no observed phenocrysts, clay lining in vesicles.	Tb4	
340–365	Basalt, grayish black (N2) to black (N1), massive with trace vesicles, aphanitic with trace olivine (?) phenocrysts, little to no alteration.	Tb4	
365–394	Basalt, dark gray (N3) to black (N1), massive with trace vesicles, mostly aphanitic but locally microcrystalline with trace olivine and/or pyroxene phenocrysts (euhedral with green to brassy sheen), only very minor weathering.	Tb4	
394–415	PUYE FORMATION Sandy gravel, pale reddish brown (10YR 5/4). WR: 30–40% gravel up to 12 mm in size, 70–60% sand. +10F: gravel, intermediate composition volcanics, up to 12 mm in size, broken. +35F: rock fragments with trace of felsic grains, angular.	Tpf	
415–435	Clastic Sediments, sandy gravel, very light gray (N8). WR: 40–50% gravel up to 15 mm in size, broken to subrounded, intermediate composition volcanics and sand, coarse- to fine-grained with ash. +10F: gravel, intermediate composition volcanics, up to 15 mm in size. +35F: sand, intermediate composition volcanics, 95–85%, felsic grains, trace to 15%.	Tpf	
435–450	Clastic Sediments, pale yellowish brown (10YR 6/2) sandy gravel to light brownish gray (5YR 6/1). WR: 40–60% gravel, sand with trace of fine ash. Gravel consisting of intermediate composition volcanics, broken to sub-rounded. +10F: Gravel up to 8 mm in size, broken to rounded, with trace of ashy fine-grained sandstone or siltstone at 440–445. +35F: Sand consisting of intermediate composition volcanics, trace felsics, subrounded.	Tpf	
450–455	Clastic Sediments, same as above, except WR is 80% sand.	Tpf	
455–460	Clastic Sediments, pale yellowish brown (10YR 6/2) sandy gravel to light brownish gray (5YR 6/1). WR: Gravel consisting of intermediate composition volcanics, broken to subrounded. +10F: Gravel up to 8 mm in size, broken to rounded. +35F: Sand consisting of intermediate composition volcanics, trace felsics, subrounded.	Tpf	
460–470	Clastic sediments, gravelly sand, pale yellowish brown (10YR 6/2). WR: gravel 15–25% intermediate composition volcanics, broken to rounded, sand 85–75%, intermediate composition volcanics, trace fine ash. +10F: intermediate composition volcanics, gravel up to 10 mm in size. +35F: Sand, intermediate composition volcanics, trace felsics.	Tpf	
470–475	Clastic Sediments, gravelly silty sand to silty sand, grayish orange (5YR 7/2). WR: Silty sand with much fine ash, trace felsics. +10F: broken gravel, intermediate composition volcanics, with trace pumice. +35F: fine-grained sand, intermediate composition volcanics, with ash.	Tpf	
475–505	Clastic sediments, light gray (N7). WR: Gravel, intermediate composition volcanics, broken (angular) and coarse-grained sand, intermediate composition volcanics, with trace felsics. +10F: Gravel, composed of intermediate composition volcanics mostly broken (angular) and coarse-grained sand composed of intermediate composition volcanics, with trace felsics, mostly angular. +35F: sand, composed of intermediate composition volcanics, with <5% felsics, mostly angular.	Tpf	

Borehole Identification (ID): R-66	**Technical Area (TA): 21**	**Page: 3 of 3**
Drilling Company: Yellow Jacket Drilling, Inc.	**Start Date/Time:** 10/15/11 15:25	**End Date/Time:** 11/5/11 18:00
Drilling Method: Reverse Circulation (RC) Open Borehole; RC Dual Rotary Casing Advance	**Machine:** DR24HD	**Sampling Method:** Grab
Ground Elevation: 6626.9 ft amsl		**Total Depth:** 910.4 ft bgs
Drillers: S. Edwards, J. Saldana, Q. Stevens, A. Lamon, M. Phillips	**Site Geologists:** J. Marin, D. Krupicka, L. Fleischhauer, D. Neidigh, C. Vallejo	

Depth (ft bgs)	Lithologic Description	Lithologic Symbol	Notes
505–560	Clastic sediments, grayish orange pink (5YR 7/2) to light gray (N7). WR: Gravel and sand composed of intermediate composition volcanics, mostly broken (angular) with fine ash. +10F: Gravel, composed of intermediate composition volcanics mostly broken (angular) with some rounded surfaces. +35F: sand, composed of intermediate composition volcanics, mostly angular with rounding on some coarse grains.	Tpf	
560–550	MIOCENE PUMICEOUS SEDIMENTS: Volcaniclastic sediments, grayish orangish pink (5YR 7/2). WR: Sand to fine-grained gravelly sand, consisting of 70–75% pumice and ash; 25–30% fine-grained gravel composed of intermediate composition volcanics, fine sand fraction contains abundant felsic grains. +35F: Sand with 30–40% pumice, 30–40% fine felsic grains and the remainder intermediate composition volcanics.	Tjfp	
575–605	Volcaniclastic sediments, pale brown (5YR 5/2). WR: Sand to fine-grained gravelly sand, consisting of 10–15% intermediate composition volcanics, 10% quartz in finer fraction and the remainder composed of pumice. +10F: 50% intermediate composition volcanics, 30% vitric pumice. +35F: 15-20% intermediate composition volcanics, 10–15% quartz.	Tjfp	
605–625	Volcaniclastic sediments, light brown (5YR 6/4) to moderate reddish brown (10R 4/6). WR: Sand, fine- to medium-grained. +10F: 30% intermediate composition volcanics, 40% pumice. +35F: 80% intermediate composition volcanics, 20% quartz.	Tjfp	
625–675	MIOCENE RIVERINE AND FANGLOMERATE DEPOSITS: Clastic sediments, grayish red (10R 4/2) well sorted fine-to medium-grained sand, rounded to subrounded.	Tcar	
675–680	No Recovery	Tcar	
680–690	Clastic sediments, grayish red (10R 4/2) well sorted fine- to medium-grained sand, rounded to subrounded.	Tcar	
690–695	Clastic sediments, dusty yellowish brown (10YR 2/2), well sorted fine- to medium-grained sand, rounded to subrounded.	Tcar	
695–705	No recovery		
705–715	Clastic sediments, moderate brown (5YR 4/4), fine- to medium-grained sand, rounded to subrounded.	Tcar	
715–825	Clastic sediments, moderate yellowish brown (10YR 5/2), gravelly sand. +10F: gravel, rounded to sub-rounded, up to 20 mm in size.	Tcar	
825–910.4	Clastic sediments, moderate brown (5YR 4/4) sandy gravel. WR: broken pieces of fine-grained gravel with fine- to coarse-grained sand.	Tcar	
Bottom of Borehole			

Notations and Abbreviations

7.5YR8/1 = Munsell soil color notation where hue (e.g., 7.5YR), value (e.g., 8), and chroma (e.g., 1) are expressed. Hue indicates soil color's relation to red, yellow, green, blue, and purple. Value indicates soil color's lightness. Chroma indicates soil color's strength.

% material, = percentage of material in sieved sample fraction (e.g., 35% crystals, 99% volcanic lithics, etc.)

+10F = plus No. 10 sieve sample fraction

+40F = plus No. 40 sieve sample fraction

bgs = below ground surface

FMI = formation micro-imager (Schlumberger borehole logging tool)

GP = gravel with sand

GP-GM = gravel with silt and sand

Qbt = Tshirege Member of the Bandelier Tuff

Qct = Cerro Toledo interval

Qbo = Otowi Member of the Bandelier Tuff

Qbog = Guaje Pumice Bed of the Otowi Member of the Bandelier Tuff

RC = reverse circulation

SP =sand with gravel

Tpf = Puye Formation

WR = whole rock

Appendix B

Groundwater Screening Analytical Results

B-1.0 SCREENING GROUNDWATER ANALYSIS AT R-66

Well R-66 is a regional aquifer monitoring well with one screened interval from 819.4 to 839.7 ft below ground surface in the Miocene riverine and fanglomerate deposits. Well R-66 is located within Technical Area 21 (TA-21) in Los Alamos Canyon near the confluence with DP Canyon at Los Alamos National Laboratory (LANL or the Laboratory). This appendix presents the screening analytical results for samples collected during well development and aquifer testing at R-66.

B-1.1 Laboratory Analyses

During drilling, one sample was collected from a perched zone in the Puye Formation. The borehole sample from the perched zone was analyzed for tritium, dissolved metals, anions, and cations

Seven groundwater samples were collected for analyses during well development. Six of the samples were analyzed for total organic carbon (TOC), dissolved metals, anions, and cations. One sample collected on December 7, 2011, was also analyzed for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), total petroleum hydrocarbons (TPH) diesel range organics (DRO) and TPH–gasoline range organics (GRO). The Laboratory's Earth and Environmental Sciences Group 14 (EES-14) conducted the analyses. Table B-1.0-1 lists samples submitted for analysis from R-66.

B-1.2 Field Analyses

Groundwater samples were also collected from a flow-through cell at regular intervals during well development and aquifer testing and measured for pH, specific conductance (SC), temperature, dissolved oxygen (DO), total dissolved solids (TDS), oxidation-reduction potential (ORP), and turbidity.

B-2.0 SCREENING ANALTICAL RESULTS

This section presents the analytical results and field parameters measured during drilling, well development, and aquifer testing.

B-2.1 Analytical Results

The Laboratory's EES-14 conducted the analyses. Table B-1.0-1 lists the samples submitted for analyses from R-66.

B-2.1.1 Analytical Results for Groundwater from Perched Zone

The perched zone borehole sample was analyzed for tritium, dissolved metals, anions, and cations. Tritium was detected at 1260 pCi/L. No dissolved metals, anions, or cations were detected above drinking water standards. Table B-2.1-1 lists the analytical results for perched groundwater sample GW66-12-1104.

B-2.2 Analytical Results for Groundwater Collected during Well Development and Aquifer Testing

Groundwater samples were analyzed for TOC, dissolved metals, anions, and cations. One sample collected on December 7, 2011, was also analyzed for VOCs, SVOCs, TPH-DRO, and TPH-GRO.

B-2.2.1 Total Organic Carbon

TOC was detected in three samples of the six groundwater samples collected during well development and aquifer testing at well R-66. TOC values ranged from nondetect (<0.2 mg/L) to 1.3755 mg/L (Table B-2.2-1). TOC was not detected (<0.2 mg/L) in the final sample (GW66-12-1788) collected at the end of well development.

B-2.2.2 Dissolved Metals, Anions, and Cations

No dissolved metals, anions, cations, or pH values were detected above drinking water standards. The analytical results are listed in Table B-2.2-1.

B-2.2.3 VOCs, SVOCs, and TPH

One regional aquifer sample (GW66-12-1898) was collected during well development and analyzed for VOCs, SVOCs, TPH-DRO, and TPH-GRO (Table B-1.0-1). The analytical data are presented in Table B-2.2-1.

One VOC concentration was detected above drinking water standards in sample GW66-12-1898: toluene was 2.81 mg/L. All other VOCs were reported as nondetect; however, the reporting limits exceeded most of the standards.

One SVOC was detected: bis(2-ethylhexyl)phthalate at 25.8 mg/L; no drinking water standard is available for bis(2-ethylhexyl)phthalate. All other SVOCs were reported as nondetect; however, the reporting limits exceeded most of the standards. TPH-DRO concentration was estimated at 0.0752 mg/L (J−). TPH-GRO concentration was nondetect.

B-2.3 Field Parameters

Field parameters measured during well development and aquifer testing are presented in Table B-2.3-1. The following field parameters were measured: pH levels ranged from 4.00 to 8.67; temperature ranged from 3.95 °C to 29.87 °C; SC ranged from 22.3 µS/cm to 41.7 µS/cm; DO ranged from 5.61% to 8.97%; ORP ranged from 0 to 242 millivolts (mV); and turbidity ranged from −5 to 990 nephelometric turbidity units (NTU). The final parameters measured at the end of aquifer testing were pH of 7.71, temperature of 22.05°C, DO of 6.14%, specific conductance of 30.7 µS/cm and turbidity of 243 NTU.

The turbidity values vary markedly and were erratic. Much of the well development and aquifer testing occurred when the ambient air temperature was below freezing (0°C) The Horiba water-quality meter, used to measure field parameters is not designed to be used in weather conditions below 0°C. It is likely the cold temperatures while measurements were collected adversely affected the accuracy of the readings.

B-3.0 SUMMARY OF SCREENING ANALYTCAL RESULTS

The perched zone borehole sample was analyzed for tritium, dissolved metals, anions, and cations. Tritium was detected at 1260 pCi/L. No dissolved metals, anions, or cations were detected above drinking water standards.

For the regional aquifer samples collected from the completed well at the end of well development and at the end of aquifer testing, TOC concentrations were below the target level of 2.0 mg/L, and turbidity was below 5 NTU at the end of development but above 5 NTU at the end of aquifer testing. Toluene was detected in sample GW66-12-1898 at 2.81 mg/L, which is above the New Mexico groundwater quality standard. In the same sample, bis(2-ethylhexyl)phthalate was also detected; no New Mexico groundwater quality standard is available for this compound.

R-66 will be sampled quarterly for 1 yr, and then data will be assessed and incorporated into the Interim Facility-Wide Groundwater Monitoring Plan. Data from ongoing sampling at R-66 will be analyzed and presented in the appropriate Laboratory periodic monitoring report.

Table B-1.0-1
Samples from R-66 Submitted for Analysis

Location ID	Sample ID	Date Collected	Sample Type	Analysis
Drilling				
R-66	GW66-12-1104	10/17/11	Grab—Perched groundwater	Tritium, dissolved metals, cations, and anions
Well Development				
R-66	GW66-12-1783	12/7/11	Initial development water	TOC, dissolved metals, cations, and anions
R-66	GW66-12-1784	12/7/11	End of development for date	TOC, dissolved metals, cations, and anions
R-66	GW66-12-1898	12/7/11	Petroleum odor noted	VOCs, SVOCs, TPH-DRO, TPH-GRO
R-66	GW66-12-1785	12/8/11	End of development for date	TOC, dissolved metals, cations, and anions
R-66	GW66-12-1786	12/16/11	End of development for date	TOC, dissolved metals, cations, and anions
R-66	GW66-12-1787	12/17/11	End of development for date	TOC, dissolved metals, cations, and anions
R-66	GW66-12-1788	12/18/11	End of development for date	TOC, dissolved metals, cations, and anions

Table B-2.1-1
Analytical Results from Perched Zone at 280 ft bgs

Sample Name	Analytical Suite	Analytical Method	Analyte Description	Lab Result (mg/L)	Units	Lab Qualifier Code[a]	Groundwater Standards[b] (mg/L)
GW66-12-1104	ANION	EPA:300.0-EES	Bromide	0.101	mg/L	NQ	na[c]
GW66-12-1104	ANION	EPA:300.0	Oxalate	0.010	mg/L	U	na
GW66-12-1104	ANION	EPA:300.0-EES	Chloride	19.459	mg/L	NQ	250
GW66-12-1104	ANION	EPA:300.0-EES	Fluoride	0.329	mg/L	NQ	1.6
GW66-12-1104	ANION	EPA:300.0-EES	Nitrite	0.010	mg/L	U	1[d]
GW66-12-1104	ANION	EPA:300.0-EES	Nitrate	8.679	mg/L	NQ	10
GW66-12-1104	ANION	EPA:300.0	Phosphorus, orthophosphate (expressed as PO_4)	0.010	mg/L	U	na
GW66-12-1104	ANION	EPA:300.0-EES	Sulfate	8.327	mg/L	NQ	600
GW66-12-1104	H3	EPA:906.0	Tritium	1260.000	pCi/L	NQ	na
GW66-12-1104	METALS	EPA:200.8	Silver	0.001	mg/L	U	0.05
GW66-12-1104	METALS	EPA:200.8	Aluminum	0.331	mg/L	NQ	5
GW66-12-1104	METALS	EPA:200.8	Arsenic	0.001	mg/L	NQ	0.1
GW66-12-1104	METALS	EPA:200.8	Boron	0.095	mg/L	NQ	0.75
GW66-12-1104	METALS	EPA:200.8	Barium	0.469	mg/L	NQ	1
GW66-12-1104	METALS	EPA:200.8	Beryllium	0.001	mg/L	U	0.004[d]
GW66-12-1104	METALS	EPA:200.7	Calcium	18.669	mg/L	NQ	na
GW66-12-1104	METALS	EPA:200.8	Cadmium	0.001	mg/L	U	0.01
GW66-12-1104	METALS	EPA:200.8	Cobalt	0.001	mg/L	U	0.05
GW66-12-1104	METALS	EPA:200.8	Chromium	0.003	mg/L	NQ	0.05
GW66-12-1104	METALS	EPA:200.8	Cesium	0.001	mg/L	U	na
GW66-12-1104	METALS	EPA:200.8	Copper	0.001	mg/L	U	1
GW66-12-1104	METALS	EPA:200.8	Iron	0.141	mg/L	NQ	1
GW66-12-1104	METALS	EPA:200.8	Mercury	0.000	mg/L	NQ	0.002
GW66-12-1104	METALS	EPA:200.7	Potassium	9.985	mg/L	NQ	na

Table B-2.1-1 (continued)

Sample Name	Analytical Suite	Analytical Method	Analyte Description	Lab Result (mg/L)	Units	Lab Qualifier Code[a]	Groundwater Standards[b] (mg/L)
GW66-12-1104	METALS	EPA:200.7	Lithium	0.011	mg/L	NQ	na
GW66-12-1104	METALS	EPA:200.8	Magnesium	5.747	mg/L	NQ	na
GW66-12-1104	METALS	EPA:200.8	Manganese	0.144	mg/L	NQ	0.2
GW66-12-1104	METALS	EPA:200.8	Molybdenum	0.004	mg/L	NQ	1
GW66-12-1104	METALS	EPA:200.7	Sodium	20.464	mg/L	NQ	na
GW66-12-1104	METALS	EPA:200.8	Nickel	0.003	mg/L	NQ	0.2
GW66-12-1104	METALS	EPA:200.8	Lead	0.000	mg/L	NQ	0.05
GW66-12-1104	METALS	EPA:200.8	Antimony	0.001	mg/L	U	0.006[d]
GW66-12-1104	METALS	EPA:200.8	Selenium	0.001	mg/L	U	0.05
GW66-12-1104	METALS	EPA:200.7	Silicon dioxide	65.452	mg/L	NQ	na
GW66-12-1104	METALS	EPA:200.8	Tin	0.001	mg/L	U	na
GW66-12-1104	METALS	EPA:200.7	Strontium	0.113	mg/L	NQ	na
GW66-12-1104	METALS	EPA:200.8	Titanium	0.015	mg/L	NQ	na
GW66-12-1104	METALS	EPA:200.8	Thallium	0.001	mg/L	U	0.002[d]
GW66-12-1104	METALS	EPA:200.8	Uranium	0.003	mg/L	NQ	0.03
GW66-12-1104	METALS	EPA:200.8	Vanadium	0.002	mg/L	NQ	na
GW66-12-1104	METALS	EPA:200.8	Zinc	0.099	mg/L	NQ	10
GW66-12-1104	WET_CHEM	EPA:310.1-EES	Alkalinity-CO3	0.800	mg/L	U	na
GW66-12-1104	WET_CHEM	EPA:310.1-EES	Alkalinity-CO3+HCO3	93.433	mg/L	NQ	na
GW66-12-1104	WET_CHEM	EPA:150.1-EES	pH	7.184	SU[e]	NQ	6–9

[a] U = Undetected; UJ = undetected, estimated value; J- = Estimated value, may be biased low; J = estimated value; R = data are rejected as a result of major problems with quality assurance/quality control parameters; NQ = not qualified, result is valid.

[b] Groundwater quality standards from Section 20.6.2.3103 Subsections A, B, and C, unless otherwise noted.

[c] na = No regulation level available for drinking water.

[d] National Primary Drinking Water Regulations maximum contaminant level.

[e] SU = Standard unit.

Table B-2.2-1
Analytical Results Collected during R-66 Well Development and Aquifer Testing

Sample Name	Date Collected	Analytical Suite	Analytical Method	Analyte Description	Lab Result (mg/L)	Lab Qualifier Code[a]	Groundwater Standards[b] (mg/L)
GW66-12-1783	12/7/2011	ANION	EPA:300.0-EES	Bromide	0.011	NQ	na[c]
GW66-12-1783	12/7/2011	ANION	EPA:300.0	Oxalate	0.010	U	na
GW66-12-1783	12/7/2011	ANION	EPA:300.0-EES	Chloride	11.638	NQ	250
GW66-12-1783	12/7/2011	ANION	EPA:300.0-EES	Fluoride	0.564	NQ	1.6
GW66-12-1783	12/7/2011	ANION	EPA:300.0-EES	Nitrite	0.099	NQ	1.0[d]
GW66-12-1783	12/7/2011	ANION	EPA:300.0-EES	Nitrate	2.668	NQ	10.0
GW66-12-1783	12/7/2011	ANION	EPA:300.0	Phosphorus, orthophosphate (expressed as PO_4)	0.010	U	na
GW66-12-1783	12/7/2011	ANION	EPA:300.0-EES	Sulfate	9.244	NQ	600
GW66-12-1783	12/7/2011	METALS	EPA:200.8	Silver	0.001	U	0.05
GW66-12-1783	12/7/2011	METALS	EPA:200.7	Aluminum	0.001	U	5.0
GW66-12-1783	12/7/2011	METALS	EPA:200.8	Arsenic	0.001	NQ	0.1
GW66-12-1783	12/7/2011	METALS	EPA:200.7	Boron	0.073	NQ	0.75
GW66-12-1783	12/7/2011	METALS	EPA:200.7	Barium	0.367	NQ	1.0
GW66-12-1783	12/7/2011	METALS	EPA:200.8	Beryllium	0.001	U	0.004[d]
GW66-12-1783	12/7/2011	METALS	EPA:200.7	Calcium	18.373	NQ	na
GW66-12-1783	12/7/2011	METALS	EPA:200.8	Cadmium	0.001	U	0.01
GW66-12-1783	12/7/2011	METALS	EPA:200.8	Cobalt	0.001	U	0.05
GW66-12-1783	12/7/2011	METALS	EPA:200.8	Chromium	0.002	NQ	0.05
GW66-12-1783	12/7/2011	METALS	EPA:200.8	Cesium	0.001	U	na
GW66-12-1783	12/7/2011	METALS	EPA:200.8	Copper	0.002	NQ	1.0
GW66-12-1783	12/7/2011	METALS	EPA:200.7	Iron	0.016	NQ	1.0
GW66-12-1783	12/7/2011	METALS	EPA:200.8	Mercury	0.000	NQ	0.002
GW66-12-1783	12/7/2011	METALS	EPA:200.7	Potassium	2.414	NQ	na
GW66-12-1783	12/7/2011	METALS	EPA:200.7	Lithium	0.028	NQ	na
GW66-12-1783	12/7/2011	METALS	EPA:200.7	Magnesium	5.247	NQ	na

Table B-2.2-1 (continued)

Sample Name	Date Collected	Analytical Suite	Analytical Method	Analyte Description	Lab Result (mg/L)	Lab Qualifier Code[a]	Groundwater Standards[b] (mg/L)
GW66-12-1783	12/7/2011	METALS	EPA:200.7	Manganese	0.056	NQ	0.2
GW66-12-1783	12/7/2011	METALS	EPA:200.8	Molybdenum	0.002	NQ	1.0
GW66-12-1783	12/7/2011	METALS	EPA:200.7	Sodium	22.897	NQ	na
GW66-12-1783	12/7/2011	METALS	EPA:200.8	Nickel	0.002	NQ	0.2
GW66-12-1783	12/7/2011	METALS	EPA:200.8	Lead	0.001	NQ	0.05
GW66-12-1783	12/7/2011	METALS	EPA:200.8	Antimony	0.001	U	0.006[d]
GW66-12-1783	12/7/2011	METALS	EPA:200.8	Selenium	0.001	U	0.05
GW66-12-1783	12/7/2011	METALS	EPA:200.7	Silicon Dioxide	69.005	NQ	na
GW66-12-1783	12/7/2011	METALS	EPA:200.8	Tin	0.001	U	na
GW66-12-1783	12/7/2011	METALS	EPA:200.7	Strontium	0.098	NQ	na
GW66-12-1783	12/7/2011	METALS	EPA:200.7	Titanium	0.002	U	na
GW66-12-1783	12/7/2011	METALS	EPA:200.8	Thallium	0.001	U	0.002[d]
GW66-12-1783	12/7/2011	METALS	EPA:200.8	Uranium	0.001	NQ	0.03
GW66-12-1783	12/7/2011	METALS	EPA:200.8	Vanadium	0.007	NQ	na
GW66-12-1783	12/7/2011	METALS	EPA:200.7	Zinc	1.039	NQ	10.0
GW66-12-1783	12/7/2011	WET_CHEM	EPA:310.1-EES	Alkalinity-CO_3	0.800	U	na
GW66-12-1783	12/7/2011	WET_CHEM	EPA:310.1-EES	Alkalinity-CO_3+HCO_3	135.001	NQ	na
GW66-12-1783	12/7/2011	WET_CHEM	EPA:150.1-EES	pH	7.420	NQ	6–9
GW66-12-1783	12/7/2011	WET_CHEM	SW-846:9060-EES	TOC	1.376	NQ	na
GW66-12-1784	12/7/2011	ANION	EPA:300.0-EES	Bromide	0.010	U	na
GW66-12-1784	12/7/2011	ANION	EPA:300.0	Oxalate	0.010	U	na
GW66-12-1784	12/7/2011	ANION	EPA:300.0-EES	Chloride	9.072	NQ	250
GW66-12-1784	12/7/2011	ANION	EPA:300.0-EES	Fluoride	0.510	NQ	1.6
GW66-12-1784	12/7/2011	ANION	EPA:300.0-EES	Nitrite	0.100	NQ	1.0[d]
GW66-12-1784	12/7/2011	ANION	EPA:300.0-EES	Nitrate	3.052	NQ	10.0
GW66-12-1784	12/7/2011	ANION	EPA:300.0	Phosphorus, orthophosphate (expressed as PO_4)	0.010	U	na

Table B-2.2-1 (continued)

Sample Name	Date Collected	Analytical Suite	Analytical Method	Analyte Description	Lab Result (mg/L)	Lab Qualifier Code[a]	Groundwater Standards[b] (mg/L)
GW66-12-1784	12/7/2011	ANION	EPA:300.0-EES	Sulfate	5.477	NQ	600
GW66-12-1784	12/7/2011	METALS	EPA:200.8	Silver	0.001	U	0.05
GW66-12-1784	12/7/2011	METALS	EPA:200.7	Aluminum	0.001	U	5.0
GW66-12-1784	12/7/2011	METALS	EPA:200.8	Arsenic	0.001	NQ	0.1
GW66-12-1784	12/7/2011	METALS	EPA:200.7	Boron	0.093	NQ	0.75
GW66-12-1784	12/7/2011	METALS	EPA:200.7	Barium	0.312	NQ	1.0
GW66-12-1784	12/7/2011	METALS	EPA:200.8	Beryllium	0.001	U	0.004[d]
GW66-12-1784	12/7/2011	METALS	EPA:200.7	Calcium	17.264	NQ	na
GW66-12-1784	12/7/2011	METALS	EPA:200.8	Cadmium	0.001	U	0.01
GW66-12-1784	12/7/2011	METALS	EPA:200.8	Cobalt	0.001	U	0.05
GW66-12-1784	12/7/2011	METALS	EPA:200.8	Chromium	0.004	NQ	0.05
GW66-12-1784	12/7/2011	METALS	EPA:200.8	Cesium	0.001	U	na
GW66-12-1784	12/7/2011	METALS	EPA:200.8	Copper	0.001	U	1.0
GW66-12-1784	12/7/2011	METALS	EPA:200.7	Iron	0.014	NQ	1.0
GW66-12-1784	12/7/2011	METALS	EPA:200.8	Mercury	0.000	NQ	0.002
GW66-12-1784	12/7/2011	METALS	EPA:200.7	Potassium	2.331	NQ	na
GW66-12-1784	12/7/2011	METALS	EPA:200.7	Lithium	0.025	NQ	na
GW66-12-1784	12/7/2011	METALS	EPA:200.7	Magnesium	5.116	NQ	na
GW66-12-1784	12/7/2011	METALS	EPA:200.7	Manganese	0.053	NQ	0.2
GW66-12-1784	12/7/2011	METALS	EPA:200.8	Molybdenum	0.003	NQ	1.0
GW66-12-1784	12/7/2011	METALS	EPA:200.7	Sodium	17.317	NQ	na
GW66-12-1784	12/7/2011	METALS	EPA:200.8	Nickel	0.002	NQ	0.2
GW66-12-1784	12/7/2011	METALS	EPA:200.8	Lead	0.000	NQ	0.05
GW66-12-1784	12/7/2011	METALS	EPA:200.8	Antimony	0.001	U	0.006[d]
GW66-12-1784	12/7/2011	METALS	EPA:200.8	Selenium	0.001	U	0.05
GW66-12-1784	12/7/2011	METALS	EPA:200.7	Silicon dioxide	77.097	NQ	na

Table B-2.2-1 (continued)

Sample Name	Date Collected	Analytical Suite	Analytical Method	Analyte Description	Lab Result (mg/L)	Lab Qualifier Code[a]	Groundwater Standards[b] (mg/L)
GW66-12-1784	12/7/2011	METALS	EPA:200.8	Tin	0.001	U	na
GW66-12-1784	12/7/2011	METALS	EPA:200.7	Strontium	0.083	NQ	na
GW66-12-1784	12/7/2011	METALS	EPA:200.7	Titanium	0.002	U	na
GW66-12-1784	12/7/2011	METALS	EPA:200.8	Thallium	0.001	U	0.002[d]
GW66-12-1784	12/7/2011	METALS	EPA:200.8	Uranium	0.001	NQ	0.03
GW66-12-1784	12/7/2011	METALS	EPA:200.8	Vanadium	0.011	NQ	na
GW66-12-1784	12/7/2011	METALS	EPA:200.7	Zinc	0.392	NQ	10.0
GW66-12-1784	12/7/2011	WET_CHEM	EPA:310.1-EES	Alkalinity-CO_3	0.800	U	na
GW66-12-1784	12/7/2011	WET_CHEM	EPA:310.1-EES	Alkalinity-CO_3+HCO_3	122.590	NQ	na
GW66-12-1784	12/7/2011	WET_CHEM	EPA:150.1-EES	pH	7.328	NQ	6–9
GW66-12-1784	12/7/2011	WET_CHEM	SW-846:9060-EES	TOC	0.228	NQ	na
GW66-12-1785	12/8/2011	ANION	EPA:300.0-EES	Bromide	0.010	U	na
GW66-12-1785	12/8/2011	ANION	EPA:300.0	Oxalate	0.010	U	na
GW66-12-1785	12/8/2011	ANION	EPA:300.0-EES	Chloride	9.878	NQ	250
GW66-12-1785	12/8/2011	ANION	EPA:300.0-EES	Fluoride	0.549	NQ	1.6
GW66-12-1785	12/8/2011	ANION	EPA:300.0-EES	Nitrite	0.123	NQ	1.0[d]
GW66-12-1785	12/8/2011	ANION	EPA:300.0-EES	Nitrate	2.963	NQ	10.0
GW66-12-1785	12/8/2011	ANION	EPA:300.0	Phosphorus, orthophosphate (expressed as PO_4)	0.010	U	na
GW66-12-1785	12/8/2011	ANION	EPA:300.0-EES	Sulfate	5.448	NQ	600
GW66-12-1785	12/8/2011	METALS	EPA:200.8	Silver	0.001	U	0.05
GW66-12-1785	12/8/2011	METALS	EPA:200.7	Aluminum	0.001	U	5.0
GW66-12-1785	12/8/2011	METALS	EPA:200.8	Arsenic	0.002	NQ	0.1[d]
GW66-12-1785	12/8/2011	METALS	EPA:200.7	Boron	0.079	NQ	0.75
GW66-12-1785	12/8/2011	METALS	EPA:200.7	Barium	0.313	NQ	1.0
GW66-12-1785	12/8/2011	METALS	EPA:200.8	Beryllium	0.001	U	0.004[d]
GW66-12-1785	12/8/2011	METALS	EPA:200.7	Calcium	17.146	NQ	na

Table B-2.2-1 (continued)

Sample Name	Date Collected	Analytical Suite	Analytical Method	Analyte Description	Lab Result (mg/L)	Lab Qualifier Code[a]	Groundwater Standards[b] (mg/L)
GW66-12-1785	12/8/2011	METALS	EPA:200.8	Cadmium	0.001	U	0.005[d]
GW66-12-1785	12/8/2011	METALS	EPA:200.8	Cobalt	0.001	U	0.05
GW66-12-1785	12/8/2011	METALS	EPA:200.8	Chromium	0.003	NQ	0.05
GW66-12-1785	12/8/2011	METALS	EPA:200.8	Cesium	0.001	U	na
GW66-12-1785	12/8/2011	METALS	EPA:200.8	Copper	0.001	U	1.0
GW66-12-1785	12/8/2011	METALS	EPA:200.7	Iron	0.020	NQ	1.0
GW66-12-1785	12/8/2011	METALS	EPA:200.8	Mercury	0.000	U	0.002
GW66-12-1785	12/8/2011	METALS	EPA:200.7	Potassium	2.340	NQ	na
GW66-12-1785	12/8/2011	METALS	EPA:200.7	Lithium	0.025	NQ	na
GW66-12-1785	12/8/2011	METALS	EPA:200.7	Magnesium	5.150	NQ	na
GW66-12-1785	12/8/2011	METALS	EPA:200.7	Manganese	0.056	NQ	0.2
GW66-12-1785	12/8/2011	METALS	EPA:200.8	Molybdenum	0.001	U	1.0
GW66-12-1785	12/8/2011	METALS	EPA:200.7	Sodium	17.883	NQ	na
GW66-12-1785	12/8/2011	METALS	EPA:200.8	Nickel	0.001	U	0.2
GW66-12-1785	12/8/2011	METALS	EPA:200.8	Lead	0.001	NQ	0.05
GW66-12-1785	12/8/2011	METALS	EPA:200.8	Antimony	0.001	U	0.006[d]
GW66-12-1785	12/8/2011	METALS	EPA:200.8	Selenium	0.001	U	0.05
GW66-12-1785	12/8/2011	METALS	EPA:200.7	Silicon dioxide	76.560	NQ	na
GW66-12-1785	12/8/2011	METALS	EPA:200.8	Tin	0.001	U	na
GW66-12-1785	12/8/2011	METALS	EPA:200.7	Strontium	0.083	NQ	na
GW66-12-1785	12/8/2011	METALS	EPA:200.7	Titanium	0.002	U	na
GW66-12-1785	12/8/2011	METALS	EPA:200.8	Thallium	0.001	U	0.002[d]
GW66-12-1785	12/8/2011	METALS	EPA:200.8	Uranium	0.001	NQ	0.03
GW66-12-1785	12/8/2011	METALS	EPA:200.8	Vanadium	0.011	NQ	na
GW66-12-1785	12/8/2011	METALS	EPA:200.7	Zinc	0.325	NQ	10.0
GW66-12-1785	12/8/2011	WET_CHEM	EPA:310.1-EES	Alkalinity-CO_3	0.800	U	na

Table B-2.2-1 (continued)

Sample Name	Date Collected	Analytical Suite	Analytical Method	Analyte Description	Lab Result (mg/L)	Lab Qualifier Code[a]	Groundwater Standards[b] (mg/L)
GW66-12-1785	12/8/2011	WET_CHEM	EPA:310.1-EES	Alkalinity-CO_3+HCO_3	118.340	NQ	na
GW66-12-1785	12/8/2011	WET_CHEM	EPA:150.1-EES	pH	7.501	NQ	6–9
GW66-12-1785	12/8/2011	WET_CHEM	SW-846:9060-EES	TOC	0.200	U	na
GW66-12-1786	12/16/2011	ANION	EPA:300.0-EES	Bromide	0.026	NQ	na
GW66-12-1786	12/16/2011	ANION	EPA:300.0	Oxalate	0.010	U	na
GW66-12-1786	12/16/2011	ANION	EPA:300.0-EES	Chloride	4.135	NQ	250
GW66-12-1786	12/16/2011	ANION	EPA:300.0-EES	Fluoride	0.441	NQ	1.6
GW66-12-1786	12/16/2011	ANION	EPA:300.0-EES	Nitrite	0.010	U	1.0[d]
GW66-12-1786	12/16/2011	ANION	EPA:300.0-EES	Nitrate	2.675	NQ	10.0
GW66-12-1786	12/16/2011	ANION	EPA:300.0	Phosphorus, orthophosphate (expressed as PO_4)	0.010	U	na
GW66-12-1786	12/16/2011	ANION	EPA:300.0-EES	Sulfate	4.431	NQ	600
GW66-12-1786	12/16/2011	METALS	EPA:200.8	Silver	0.001	U	0.05
GW66-12-1786	12/16/2011	METALS	EPA:200.7	Aluminum	0.001	U	5.0
GW66-12-1786	12/16/2011	METALS	EPA:200.8	Arsenic	0.001	NQ	0.1
GW66-12-1786	12/16/2011	METALS	EPA:200.7	Boron	0.096	NQ	0.75
GW66-12-1786	12/16/2011	METALS	EPA:200.7	Barium	0.438	NQ	1.0
GW66-12-1786	12/16/2011	METALS	EPA:200.8	Beryllium	0.001	U	0.004[d]
GW66-12-1786	12/16/2011	METALS	EPA:200.7	Calcium	17.425	NQ	na
GW66-12-1786	12/16/2011	METALS	EPA:200.8	Cadmium	0.001	U	0.01
GW66-12-1786	12/16/2011	METALS	EPA:200.8	Cobalt	0.001	U	0.05
GW66-12-1786	12/16/2011	METALS	EPA:200.8	Chromium	0.003	NQ	0.05
GW66-12-1786	12/16/2011	METALS	EPA:200.8	Cesium	0.001	U	na
GW66-12-1786	12/16/2011	METALS	EPA:200.8	Copper	0.001	U	1.0
GW66-12-1786	12/16/2011	METALS	EPA:200.7	Iron	0.016	NQ	1.0
GW66-12-1786	12/16/2011	METALS	EPA:200.8	Mercury	0.000	U	0.002
GW66-12-1786	12/16/2011	METALS	EPA:200.7	Potassium	2.080	NQ	na

Table B-2.2-1 (continued)

Sample Name	Date Collected	Analytical Suite	Analytical Method	Analyte Description	Lab Result (mg/L)	Lab Qualifier Code[a]	Groundwater Standards[b] (mg/L)
GW66-12-1786	12/16/2011	METALS	EPA:200.7	Lithium	0.023	NQ	na
GW66-12-1786	12/16/2011	METALS	EPA:200.7	Magnesium	5.194	NQ	na
GW66-12-1786	12/16/2011	METALS	EPA:200.7	Manganese	0.028	NQ	0.2
GW66-12-1786	12/16/2011	METALS	EPA:200.8	Molybdenum	0.002	NQ	1.0
GW66-12-1786	12/16/2011	METALS	EPA:200.7	Sodium	15.147	NQ	na
GW66-12-1786	12/16/2011	METALS	EPA:200.8	Nickel	0.003	NQ	0.2
GW66-12-1786	12/16/2011	METALS	EPA:200.8	Lead	0.001	NQ	0.05
GW66-12-1786	12/16/2011	METALS	EPA:200.8	Antimony	0.001	U	0.006[d]
GW66-12-1786	12/16/2011	METALS	EPA:200.8	Selenium	0.001	U	0.05
GW66-12-1786	12/16/2011	METALS	EPA:200.7	Silicon dioxide	76.152	NQ	na
GW66-12-1786	12/16/2011	METALS	EPA:200.8	Tin	0.001	U	na
GW66-12-1786	12/16/2011	METALS	EPA:200.7	Strontium	0.079	NQ	na
GW66-12-1786	12/16/2011	METALS	EPA:200.7	Titanium	0.002	U	na
GW66-12-1786	12/16/2011	METALS	EPA:200.8	Thallium	0.001	U	0.002[d]
GW66-12-1786	12/16/2011	METALS	EPA:200.8	Uranium	0.001	NQ	0.03
GW66-12-1786	12/16/2011	METALS	EPA:200.8	Vanadium	0.011	NQ	na
GW66-12-1786	12/16/2011	METALS	EPA:200.7	Zinc	0.944	NQ	10.0
GW66-12-1786	12/16/2011	WET_CHEM	EPA:310.1-EES	Alkalinity-CO_3	0.800	U	na
GW66-12-1786	12/16/2011	WET_CHEM	EPA:310.1-EES	Alkalinity-CO_3+HCO_3	117.690	NQ	na
GW66-12-1786	12/16/2011	WET_CHEM	EPA:150.1-EES	pH	7.494	NQ	6–9
GW66-12-1786	12/16/2011	WET_CHEM	SW-846:9060-EES	TOC	0.373	NQ	na
GW66-12-1787	12/17/2011	ANION	EPA:300.0-EES	Bromide	0.010	U	na
GW66-12-1787	12/17/2011	ANION	EPA:300.0	Oxalate	0.010	U	na
GW66-12-1787	12/17/2011	ANION	EPA:300.0-EES	Chloride	4.018	NQ	250
GW66-12-1787	12/17/2011	ANION	EPA:300.0-EES	Fluoride	0.462	NQ	1.6
GW66-12-1787	12/17/2011	ANION	EPA:300.0-EES	Nitrite	0.010	U	1.0[d]

Table B-2.2-1 (continued)

Sample Name	Date Collected	Analytical Suite	Analytical Method	Analyte Description	Lab Result (mg/L)	Lab Qualifier Code[a]	Groundwater Standards[b] (mg/L)
GW66-12-1787	12/17/2011	ANION	EPA:300.0-EES	Nitrate	2.824	NQ	10.0
GW66-12-1787	12/17/2011	ANION	EPA:300.0	Phosphorus, orthophosphate (expressed as PO_4)	0.010	U	na
GW66-12-1787	12/17/2011	ANION	EPA:300.0-EES	Sulfate	4.372	NQ	600
GW66-12-1787	12/17/2011	METALS	EPA:200.8	Silver	0.001	U	0.05
GW66-12-1787	12/17/2011	METALS	EPA:200.7	Aluminum	0.001	U	5.0
GW66-12-1787	12/17/2011	METALS	EPA:200.8	Arsenic	0.002	NQ	0.1
GW66-12-1787	12/17/2011	METALS	EPA:200.7	Boron	0.081	NQ	0.75
GW66-12-1787	12/17/2011	METALS	EPA:200.7	Barium	0.424	NQ	1.0
GW66-12-1787	12/17/2011	METALS	EPA:200.8	Beryllium	0.001	U	0.004[d]
GW66-12-1787	12/17/2011	METALS	EPA:200.7	Calcium	17.574	NQ	na
GW66-12-1787	12/17/2011	METALS	EPA:200.8	Cadmium	0.001	U	0.01
GW66-12-1787	12/17/2011	METALS	EPA:200.8	Cobalt	0.001	U	0.05
GW66-12-1787	12/17/2011	METALS	EPA:200.8	Chromium	0.003	NQ	0.05
GW66-12-1787	12/17/2011	METALS	EPA:200.8	Cesium	0.001	U	na
GW66-12-1787	12/17/2011	METALS	EPA:200.8	Copper	0.001	U	1.0
GW66-12-1787	12/17/2011	METALS	EPA:200.7	Iron	0.010	U	1.0
GW66-12-1787	12/17/2011	METALS	EPA:200.8	Mercury	0.000	U	0.002
GW66-12-1787	12/17/2011	METALS	EPA:200.7	Potassium	2.069	NQ	na
GW66-12-1787	12/17/2011	METALS	EPA:200.7	Lithium	0.023	NQ	na
GW66-12-1787	12/17/2011	METALS	EPA:200.7	Magnesium	5.241	NQ	na
GW66-12-1787	12/17/2011	METALS	EPA:200.7	Manganese	0.028	NQ	0.2
GW66-12-1787	12/17/2011	METALS	EPA:200.8	Molybdenum	0.002	NQ	1.0
GW66-12-1787	12/17/2011	METALS	EPA:200.7	Sodium	14.723	NQ	na
GW66-12-1787	12/17/2011	METALS	EPA:200.8	Nickel	0.002	NQ	0.2
GW66-12-1787	12/17/2011	METALS	EPA:200.8	Lead	0.001	NQ	0.05
GW66-12-1787	12/17/2011	METALS	EPA:200.8	Antimony	0.001	U	0.006[d]

Table B-2.2-1 (continued)

Sample Name	Date Collected	Analytical Suite	Analytical Method	Analyte Description	Lab Result (mg/L)	Lab Qualifier Code[a]	Groundwater Standards[b] (mg/L)
GW66-12-1787	12/17/2011	METALS	EPA:200.8	Selenium	0.001	U	0.05
GW66-12-1787	12/17/2011	METALS	EPA:200.7	Silicon Dioxide	76.986	NQ	na
GW66-12-1787	12/17/2011	METALS	EPA:200.8	Tin	0.001	U	na
GW66-12-1787	12/17/2011	METALS	EPA:200.7	Strontium	0.079	NQ	na
GW66-12-1787	12/17/2011	METALS	EPA:200.7	Titanium	0.002	U	na
GW66-12-1787	12/17/2011	METALS	EPA:200.8	Thallium	0.001	U	0.002[d]
GW66-12-1787	12/17/2011	METALS	EPA:200.8	Uranium	0.001	NQ	0.03
GW66-12-1787	12/17/2011	METALS	EPA:200.8	Vanadium	0.011	NQ	na
GW66-12-1787	12/17/2011	METALS	EPA:200.7	Zinc	0.307	NQ	10.0
GW66-12-1787	12/17/2011	WET_CHEM	EPA:310.1-EES	Alkalinity-CO_3	0.800	U	na
GW66-12-1787	12/17/2011	WET_CHEM	EPA:310.1-EES	Alkalinity-CO_3+HCO_3	114.830	NQ	na
GW66-12-1787	12/17/2011	WET_CHEM	EPA:150.1-EES	pH	7.094	NQ	6–9
GW66-12-1787	12/17/2011	WET_CHEM	SW-846:9060-EES	TOC	0.200	U	na
GW66-12-1788	12/18/2011	ANION	EPA:300.0-EES	Bromide	0.016	NQ	na
GW66-12-1788	12/18/2011	ANION	EPA:300.0	Oxalate	0.010	U	na
GW66-12-1788	12/18/2011	ANION	EPA:300.0-EES	Chloride	4.011	NQ	250
GW66-12-1788	12/18/2011	ANION	EPA:300.0-EES	Fluoride	0.414	NQ	1.6
GW66-12-1788	12/18/2011	ANION	EPA:300.0-EES	Nitrite	0.010	U	1.0[d]
GW66-12-1788	12/18/2011	ANION	EPA:300.0-EES	Nitrate	2.851	NQ	10.0
GW66-12-1788	12/18/2011	ANION	EPA:300.0	Phosphorus, orthophosphate (expressed as PO_4)	0.010	U	na
GW66-12-1788	12/18/2011	ANION	EPA:300.0-EES	Sulfate	4.209	NQ	600
GW66-12-1788	12/18/2011	METALS	EPA:200.8	Silver	0.001	U	0.05
GW66-12-1788	12/18/2011	METALS	EPA:200.7	Aluminum	0.001	U	5.0
GW66-12-1788	12/18/2011	METALS	EPA:200.8	Arsenic	0.002	NQ	0.1
GW66-12-1788	12/18/2011	METALS	EPA:200.7	Boron	0.074	NQ	0.75
GW66-12-1788	12/18/2011	METALS	EPA:200.7	Barium	0.344	NQ	1.0

Table B-2.2-1 (continued)

Sample Name	Date Collected	Analytical Suite	Analytical Method	Analyte Description	Lab Result (mg/L)	Lab Qualifier Code[a]	Groundwater Standards[b] (mg/L)
GW66-12-1788	12/18/2011	METALS	EPA:200.8	Beryllium	0.001	U	0.004[d]
GW66-12-1788	12/18/2011	METALS	EPA:200.7	Calcium	17.528	NQ	na
GW66-12-1788	12/18/2011	METALS	EPA:200.8	Cadmium	0.001	U	0.01
GW66-12-1788	12/18/2011	METALS	EPA:200.8	Cobalt	0.001	U	0.05
GW66-12-1788	12/18/2011	METALS	EPA:200.8	Chromium	0.004	NQ	0.05
GW66-12-1788	12/18/2011	METALS	EPA:200.8	Cesium	0.001	U	na
GW66-12-1788	12/18/2011	METALS	EPA:200.8	Copper	0.001	U	1.0
GW66-12-1788	12/18/2011	METALS	EPA:200.7	Iron	0.010	U	1.0
GW66-12-1788	12/18/2011	METALS	EPA:200.8	Mercury	0.000	U	0.002
GW66-12-1788	12/18/2011	METALS	EPA:200.7	Potassium	2.160	NQ	na
GW66-12-1788	12/18/2011	METALS	EPA:200.7	Lithium	0.024	NQ	na
GW66-12-1788	12/18/2011	METALS	EPA:200.7	Magnesium	5.295	NQ	na
GW66-12-1788	12/18/2011	METALS	EPA:200.7	Manganese	0.025	NQ	0.2
GW66-12-1788	12/18/2011	METALS	EPA:200.8	Molybdenum	0.002	NQ	1.0
GW66-12-1788	12/18/2011	METALS	EPA:200.7	Sodium	14.634	NQ	na
GW66-12-1788	12/18/2011	METALS	EPA:200.8	Nickel	0.002	NQ	0.2
GW66-12-1788	12/18/2011	METALS	EPA:200.8	Lead	0.000	U	0.05
GW66-12-1788	12/18/2011	METALS	EPA:200.8	Antimony	0.001	U	0.006[d]
GW66-12-1788	12/18/2011	METALS	EPA:200.8	Selenium	0.001	U	0.05
GW66-12-1788	12/18/2011	METALS	EPA:200.7	Silicon dioxide	78.180	NQ	na
GW66-12-1788	12/18/2011	METALS	EPA:200.8	Tin	0.001	U	na
GW66-12-1788	12/18/2011	METALS	EPA:200.7	Strontium	0.079	NQ	na
GW66-12-1788	12/18/2011	METALS	EPA:200.7	Titanium	0.002	U	na
GW66-12-1788	12/18/2011	METALS	EPA:200.8	Thallium	0.001	U	0.002[d]
GW66-12-1788	12/18/2011	METALS	EPA:200.8	Uranium	0.001	NQ	0.03
GW66-12-1788	12/18/2011	METALS	EPA:200.8	Vanadium	0.012	NQ	na

Table B-2.2-1 (continued)

Sample Name	Date Collected	Analytical Suite	Analytical Method	Analyte Description	Lab Result (mg/L)	Lab Qualifier Code[a]	Groundwater Standards[b] (mg/L)
GW66-12-1788	12/18/2011	METALS	EPA:200.7	Zinc	0.665	NQ	10.0
GW66-12-1788	12/18/2011	WET_CHEM	EPA:310.1-EES	Alkalinity-CO_3	0.800	U	na
GW66-12-1788	12/18/2011	WET_CHEM	EPA:310.1-EES	Alkalinity-CO_3+HCO_3	114.540	NQ	na
GW66-12-1788	12/18/2011	WET_CHEM	EPA:150.1-EES	pH	7.198	NQ	6–9
GW66-12-1788	12/18/2011	WET_CHEM	SW-846:9060-EES	TOC	0.200	U	na
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Acenaphthene	1.040	U	na
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Acenaphthylene	1.040	U	na
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Aniline	10.400	U	na
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Anthracene	1.040	U	na
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Atrazine	10.400	U	0.003[d]
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Azobenzene	10.400	U	na
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Benzidine	10.400	U	na
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Benzo(a)anthracene	1.040	U	na
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Benzo(a)pyrene	1.040	U	0.0007
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Benzo(b)fluoranthene	1.040	U	na
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Benzo(g,h,i)perylene	1.040	U	na
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Benzo(k)fluoranthene	1.040	U	na
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Benzoic acid	20.800	U	na
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Benzyl alcohol	10.400	U	na
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Bis(2-chloroethoxy)methane	10.400	U	na
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Bis(2-chloroethyl)ether	10.400	U	na
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Bis(2-ethylhexyl)phthalate	25.800	NQ	na
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Bromophenyl-phenylether[4-]	10.400	U	na
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Butylbenzylphthalate	10.400	U	na
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Chloro-3-methylphenol[4-]	10.400	U	na
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Chloroaniline[4-]	10.400	U	na

Table B-2.2-1 (continued)

Sample Name	Date Collected	Analytical Suite	Analytical Method	Analyte Description	Lab Result (mg/L)	Lab Qualifier Code[a]	Groundwater Standards[b] (mg/L)
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Chloronaphthalene[2-]	1.040	U	na
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Chlorophenol[2-]	10.400	U	na
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Chlorophenyl-phenyl[4-] ether	10.400	U	na
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Chrysene	1.040	U	na
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Dibenz(a,h)anthracene	1.040	U	na
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Dibenzofuran	10.400	U	na
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Dichlorobenzene[1,2-]	10.400	U	na
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Dichlorobenzene[1,3-]	10.400	U	na
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Dichlorobenzene[1,4-]	10.400	U	na
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Dichlorobenzidine[3,3'-]	10.400	U	na
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Dichlorophenol[2,4-]	10.400	U	na
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Diethylphthalate	10.400	U	0.006[d]
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Dimethyl Phthalate	10.400	U	na
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Dimethylphenol[2,4-]	10.400	U	na
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Di-n-butylphthalate	10.400	U	na
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Dinitro-2-methylphenol[4,6-]	10.400	U	na
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Dinitrophenol[2,4-]	20.800	U	na
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Dinitrotoluene[2,4-]	10.400	U	na
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Dinitrotoluene[2,6-]	10.400	U	na
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Di-n-octylphthalate	10.400	U	na
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Dinoseb	10.400	U	0.007[d]
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Dioxane[1,4-]	10.400	U	na
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Diphenylamine	10.400	U	na
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Fluoranthene	1.040	U	na
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Fluorene	1.040	U	na
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Hexachlorobenzene	10.400	U	0.001[d]

Table B-2.2-1 (continued)

Sample Name	Date Collected	Analytical Suite	Analytical Method	Analyte Description	Lab Result (mg/L)	Lab Qualifier Code[a]	Groundwater Standards[b] (mg/L)
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Hexachlorobutadiene	10.400	U	na
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Hexachlorocyclopentadiene	10.400	U	0.05[d]
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Hexachloroethane	10.400	U	na
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Indeno(1,2,3-cd)pyrene	1.040	U	na
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Isophorone	10.400	U	na
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Methylnaphthalene[1-]	1.040	U	na
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Methylnaphthalene[2-]	1.040	U	na
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Methylphenol[2-]	10.400	U	na
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Methylphenol[4-]	10.400	U	na
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Naphthalene	1.040	U	0.03
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Nitroaniline[2-]	10.400	U	na
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Nitroaniline[3-]	10.400	U	na
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Nitroaniline[4-]	10.400	U	na
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Nitrobenzene	10.400	U	na
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Nitrophenol[2-]	10.400	U	na
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Nitrophenol[4-]	10.400	U	na
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Nitrosodiethylamine[N-]	10.400	U	na
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Nitrosodimethylamine[N-]	10.400	U	na
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Nitroso-di-n-butylamine[N-]	10.400	U	na
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Nitroso-di-n-propylamine[N-]	10.400	U	na
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Nitrosopyrrolidine[N-]	10.400	U	na
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Oxybis(1-chloropropane)[2,2'-]	10.400	U	na
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Pentachlorobenzene	10.400	U	na
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Pentachlorophenol	10.400	U	0.001[d]
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Phenanthrene	1.040	U	na
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Phenol	10.400	U	0.005[d]

Table B-2.2-1 (continued)

Sample Name	Date Collected	Analytical Suite	Analytical Method	Analyte Description	Lab Result (mg/L)	Lab Qualifier Code[a]	Groundwater Standards[b] (mg/L)
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Pyrene	1.040	U	na
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Pyridine	10.400	U	na
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Tetrachlorobenzene[1,2,4,5]	10.400	U	na
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Tetrachlorophenol[2,3,4,6-]	10.400	U	na
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Trichlorobenzene[1,2,4-]	10.400	U	na
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Trichlorophenol[2,4,5-]	10.400	U	na
GW66-12-1898	12/7/2011	SVOC	SW-846:8270C	Trichlorophenol[2,4,6-]	10.400	U	na
GW66-12-1898	12/7/2011	TPH-DRO	SW-846:8015M_ Extractable	TPH-DRO	0.075	J	na
GW66-12-1898	12/7/2011	TPH-GRO	SW-846:8015M_ Purgeable	TPH-GRO	50.000	U	na
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Acetone	10.000	U	na
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Acetonitrile	25.000	U	na
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Acrolein	5.000	U	na
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Acrylonitrile	5.000	U	na
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Benzene	1.000	U	0.01
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Bromobenzene	1.000	U	na
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Bromochloromethane	1.000	U	na
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Bromodichloromethane	1.000	U	na
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Bromoform	1.000	U	na
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Bromomethane	1.000	U	na
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Butanol[1-]	50.000	U	na
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Butanone[2-]	5.000	U	na
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Butylbenzene[n-]	1.000	U	na
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Butylbenzene[sec-]	1.000	U	na
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Butylbenzene[tert-]	1.000	U	na

Table B-2.2-1 (continued)

Sample Name	Date Collected	Analytical Suite	Analytical Method	Analyte Description	Lab Result (mg/L)	Lab Qualifier Code[a]	Groundwater Standards[b] (mg/L)
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Carbon disulfide	5.000	U	na
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Carbon tetrachloride	1.000	U	0.01
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Chloro-1,3-butadiene[2-]	1.000	U	na
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Chloro-1-propene[3-]	5.000	U	na
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Chlorobenzene	1.000	U	0.1[d]
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Chlorodibromomethane	1.000	U	na
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Chloroethane	1.000	U	na
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Chloroform	1.000	U	0.1
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Chloromethane	1.000	U	na
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Chlorotoluene[2-]	1.000	U	na
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Chlorotoluene[4-]	1.000	U	na
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Dibromo-3-chloropropane[1,2-]	1.000	U	0.0002[d]
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Dibromoethane[1,2-]	1.000	U	na
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Dibromomethane	1.000	U	na
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Dichlorobenzene[1,2-]	1.000	U	na
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Dichlorobenzene[1,3-]	1.000	U	na
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Dichlorobenzene[1,4-]	1.000	U	na
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Dichlorodifluoromethane	1.000	U	na
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Dichloroethane[1,1-]	1.000	U	0.025
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Dichloroethane[1,2-]	1.000	U	0.01
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Dichloroethene[1,1-]	1.000	U	0.005[d]
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Dichloroethene[cis-1,2-]	1.000	U	0.07[d]
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Dichloroethene[trans-1,2-]	1.000	U	na
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Dichloropropane[1,2-]	1.000	U	0.005[d]
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Dichloropropane[1,3-]	1.000	U	na
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Dichloropropane[2,2-]	1.000	U	na

Table B-2.2-1 (continued)

Sample Name	Date Collected	Analytical Suite	Analytical Method	Analyte Description	Lab Result (mg/L)	Lab Qualifier Code[a]	Groundwater Standards[b] (mg/L)
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Dichloropropene[1,1-]	1.000	U	na
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Dichloropropene[cis-1,3-]	1.000	U	na
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Dichloropropene[trans-1,3-]	1.000	U	na
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Diethyl ether	1.000	U	na
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Ethyl methacrylate	5.000	U	na
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Ethylbenzene	1.000	U	0.75
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Hexachlorobutadiene	1.000	U	na
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Hexanone[2-]	5.000	U	na
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Iodomethane	5.000	U	na
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Isobutyl alcohol	50.000	U	na
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Isopropylbenzene	1.000	U	na
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Isopropyltoluene[4-]	1.000	U	na
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Methacrylonitrile	5.000	U	na
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Methyl methacrylate	5.000	U	na
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Methyl tert-butyl ether	1.000	U	na
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Methyl-2-pentanone[4-]	5.000	U	na
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Methylene chloride	10.000	U	0.1
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Naphthalene	1.000	U	na
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Propionitrile	5.000	U	na
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Propylbenzene[1-]	1.000	U	na
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Styrene	1.000	U	0.1[d]
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Tetrachloroethane[1,1,1,2-]	1.000	U	na
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Tetrachloroethane[1,1,2,2-]	1.000	U	0.01
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Tetrachloroethene	1.000	U	na
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Toluene	2.810	NQ	0.75
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Trichloro-1,2,2-trifluoroethane[1,1,2-]	5.000	U	na

Table B-2.2-1 (continued)

Sample Name	Date Collected	Analytical Suite	Analytical Method	Analyte Description	Lab Result (mg/L)	Lab Qualifier Code[a]	Groundwater Standards[b] (mg/L)
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Trichlorobenzene[1,2,3-]	1.000	U	na
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Trichlorobenzene[1,2,4-]	1.000	U	0.07[d]
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Trichloroethane[1,1,1-]	1.000	U	0.06
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Trichloroethane[1,1,2-]	1.000	U	0.01
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Trichloroethene	1.000	U	0.005[d]
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Trichlorofluoromethane	1.000	U	na
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Trichloropropane[1,2,3-]	1.000	U	na
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Trimethylbenzene[1,2,4-]	1.000	U	na
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Trimethylbenzene[1,3,5-]	1.000	U	na
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Vinyl acetate	5.000	U	na
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Vinyl chloride	1.000	U	0.001
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Xylene[1,2-]	1.000	U	na
GW66-12-1898	12/7/2011	VOC	SW-846:8260B	Xylene[1,3-]+Xylene[1,4-]	2.000	U	0.62

[a] U = Undetected; UJ = undetected, estimated value; J- = Estimated value, may be biased low; J = estimated value; R = data are rejected as a result of major problems with quality assurance/quality control parameters; NQ = not qualified, result is valid.

[b] Groundwater quality standards from Section 20.6.2.3103 Subsections A, B, and C, unless otherwise noted.

[c] na = No regulation level available for drinking water.

[d] National Primary Drinking Water Regulations maximum contaminant level.

Table B-2.3-1
Purge Volumes and Field Parameters during Well Development and Aquifer Testing at R-66

Date	Time	Daily Volume (gal.)	Cumulative Purge Volume (gal.)	pH	SC (µS/cm)	Turbidity (NTU)	DO (%)	Temp (°C)	TDS (g/L)	ORP (mV)
Well Development										
11/17/11	1440	18.3	18							
11/18/11	1010			4.00						
	1015	30	48	7.10	41.7	-5	7.32	12.4	2.3	0
11/29/11	1015									
12/6/11	1500	175	223							
12/7/12	1402			6.54	33.3	330	8.10	12.15	0.21	158
	1445			7.76	31.2	584	6.57	15.24	0.21	154
	1511			7.97	29.9	487	7.55	16.49	0.19	133
	1536			8.04	30.4	176	7.83	17.75	0.19	133
	1604			7.96	29.0	383	8.74	19.57	0.19	126
	1606	137	360							
12/8/11	730			7.64	29.4	487	8.97	12.8	0.2	202
	800			7.94	28.4	197	7.51	20.6	0.18	103
	845			8.03	28.6	481	7.02	20.32	0.19	156
	920			7.99	27.2	200	7.41	21.7	0.18	158
	950			7.89	29.2	353	6.88	22.43	0.19	171
	1015			7.91	27.9	305	6.76	22.3	0.18	169
	1046			7.98	28.4	267	6.48	19.8	0.18	170
	1120			7.93	29.2	540	7.63	23.0	0.19	159
	1149			7.94	28.4	548	7.04	22.2	0.18	157
	1220			7.93	29.6	132	7.66	21.97	0.19	149
	1250			7.91	29.5	538	7.73	22.13	0.19	145
	1320			7.85	29.8	519	7.52	22.38	0.19	142
	1327			7.87	30.7	699	8.11	23.61	0.20	142
	1330	704	1064							
12/15/11	1410	30	1094							
12/16/11	823			7.72	29.3	38.3	7.10	15.86	0.19	167
	854			7.79	27.3	317	8.02	18.18	0.18	153
	902			4.00						
	903			7.61	30.3	10.4	7.45	18.16	0.21	192
	925			7.93	28.2	295	7.25	20.8	0.18	176
	955			8.00	28.9	144	7.06	21.06	0.19	169

Table B-2.3-1 (continued)

Date	Time	Daily Volume (gal.)	Cumulative Purge Volume (gal.)	pH	SC (µS/cm)	Turbidity (NTU)	DO (%)	Temp (°C)	TDS (g/L)	ORP (mV)
12/16/11	1008			8.00	28.2	137	7.13	22.03	0.18	169
	1055			8.02	27.3	158	7.22	27.3	0.18	162
	1142			8.12	27.1	445	7.27	22.1	0.18	150
	1215			8.67	22.3	269	7.01	22.3	0.18	164
	1240			8.07	28.4	311	6.92	22.5	0.18	161
	1247			7.91	28.7	175	7.56	23.1	0.19	168
	1315			8.16	27.9	372	7.13	21.8	0.18	159
	1347			8.17	27.9	410	7.13	21.8	0.18	160
	1415			8.10	25.7	163	7.34	22.8	0.17	164
	1458			8.07	26.8	176	7.17	19.9	0.18	168
	1510			8.10	28.8	388	7.23	22.4	0.18	163
	1513	1003	2097							
12/17/11	720			8.00	29.1	307	7.51	12.97	0.19	181
	755			8.06	26.9	705	7.07	15.3	0.17	173
	833			8.07	26.8	676	7.37	19.8	0.17	167
	840			8.04	29.1	129	7.43	20.7	0.19	163
	908			8.01	28.7	55.8	7.43	22.8	0.19	165
	934			8.03	27.8	210	7.20	21.8	0.18	162
	955			8.01	28.6	336	7.18	22.6	0.19	165
	1032			8.00	26.7	218	7.31	22.9	0.18	168
	1106			8.03	26.9	194	7.30	23.2	0.17	170
	1140			8.00	26.9	21.1	7.29	23.2	0.18	171
	1211			8.01	26.9	23.7	7.29	23.1	0.18	170
	1246			8.03	28.8	22.8	7.45	23.6	0.19	174
	1314			7.99	28.7	10.0	7.06	22.7	0.19	174
	1348			7.98	28.4	15.4	7.19	22.6	0.18	177
	1420			8.04	28.9	13.5	7.48	22.6	0.19	179
	1450	1012	3109	8.01	29.1	6.7	7.22	21.9	0.19	182
12/18/11	745			7.97	29.2	23.3	7.84	13.5	0.19	191
	800			8.03	27.3	20.6	7.12	17.99	0.18	183
	830			8.06	28.2	13.3	6.88	22.5	0.18	172
	902			8.05	28.0	1.2	7.86	22.5	0.18	172
	932			8.03	28.2	9.9	7.29	22.9	0.18	173
	1002			8.01	27.6	3.9	7.44	23	0.18	174

Table B-2.3-1 (continued)

Date	Time	Daily Volume (gal.)	Cumulative Purge Volume (gal.)	pH	SC (µS/cm)	Turbidity (NTU)	DO (%)	Temp (°C)	TDS (g/L)	ORP (mV)
12/18/11	1032			8.05	27.9	0	7.13	23	0.18	177
	1103			8.03	28.6	0	7.90	22.3	0.18	187
	1132			8.05	27.7	0	7.49	23.4	0.18	185
	1200			8.06	27.8	0	7.60	24.2	0.18	175
	1230			8.03	28.6	0	7.13	23.6	0.19	177
	1300			7.98	28.7	2.0	7.76	23.9	0.19	177
	1330			8.02	28.9	0.2	7.41	24.2	0.19	181
	1405			8.02	29.1	0	7.40	23.7	0.19	180
	1432			7.97	28.9	0	7.63	23.7	0.19	185
	1458			7.96	28.9	0	7.65	23.7	0.19	183
	1500	958.5	4,068							
Total Removed during Well Development: 4068 gal.										
Aquifer Testing										
01/6/12	1505	560.3	4,628							
01/7/12	1230	1558.4	6187							
01/12/12	811			6.33	29.4	57.1	5.61	23.01	0.19	179
	900			7.80	26.6	305	6.28	21.95	0.17	90
	930			7.79	26.8	404	6.02	21.61	0.17	88
	1000			7.81	26.1	-5	6.27	21.72	0.19	90
	1030			7.78	25.9	403	6.40	21.69	0.17	86
	1100			7.78	27.2	137	6.10	22.23	0.18	84
	1130			7.82	26.4	841	6.33	23.02	0.17	80
	1200			7.88	27.3	315	6.64	22.88	0.18	82
	1230			7.88	26.9	705	6.03	22.89	0.18	82
	1300			7.90	25.8	345	6.41	22.73	0.17	82
	1330			7.88	26.5	25.6	6.45	22.89	0.17	79
	1400			7.84	27.3	187	6.69	22.55	0.18	82
	1430			7.84	26.8	312	6.45	22.55	0.18	86
	1500			7.86	26.3	-5	6.13	22.49	0.18	91
	1530			7.85	26.7	-5	6.13	22.78	0.17	82
	1600			7.89	26.8	29.1	6.19	22.91	0.18	82
	1630			7.86	27.2	29.7	6.33	22.61	0.18	81
	1700			7.85	27.3	67.6	6.05	22.6	0.18	82
	1730			7.85	28.1	152	6.47	16.42	0.18	105

Table B-2.3-1 (continued)

Date	Time	Daily Volume (gal.)	Cumulative Purge Volume (gal.)	pH	SC (µS/cm)	Turbidity (NTU)	DO (%)	Temp (°C)	TDS (g/L)	ORP (mV)
01/12/12	1800			7.61	28.4	185	6.82	18.44	0.18	136
	1830			7.55	28.5	169	6.71	7.41	0.18	144
	1900			7.49	28.6	158	6.60	3.59	0.19	153
	1930			7.66	28.4	136	6.67	?	0.19	155
	2030			7.88	27.8	244	6.80	23.42	0.18	104
	2100			8.00	27.2	263	7.17	23.38	0.18	91
	2120			7.81	26.0	766	7.05	23.34	0.17	90
	2200			7.80	25.2	0.5	7.31	23.25	0.16	90
	2230			7.79	26.2	438	7.21	23.29	0.17	92
	2300			7.78	25.9	821	7.36	23.18	0.17	92
	2330			7.79	25.7	288	7.49	23.16	0.17	91
01/13/12	000	13,613.3	19,800	7.77	26.3	647	7.53	23.28	0.17	93
	800			7.77	26.3	647	7.53	23.28	0.17	93
	830			7.88	25.8	407	7.60	23.23	0.17	95
	100			7.78	25.9	406	7.65	23.23	0.17	96
	130			7.77	25.6	425	7.54	23.27	0.17	96
	200			7.76	26.9	-5	7.65	23.16	0.17	96
	230			7.77	27.1	589	7.64	23.21	0.18	96
	300			7.78	26.7	355	7.20	23.23	0.17	95
	330			7.76	26.3	395	7.71	23.19	0.17	97
	400			7.77	26.5	714	7.83	23.17	0.17	99
	430			7.77	26.7	762	7.78	23.23	0.17	98
	500			7.79	26.7	496	7.78	23.21	0.17	98
	530			7.87	26.4	5.38	7.74	23.05	0.17	101
	600			7.78	26.4	183	7.84	23.08	0.17	100
	630			7.77	27.5	227	7.75	23.19	0.18	101
	700			7.77	27.0	367	7.86	23.18	0.17	97
	730			7.75	28.7	102	7.48	23.14	0.19	97
	800			7.77	28.1	235	7.68	23.15	0.18	91
	830			7.76	27.5	565	7.70	23.14	0.18	90
	900			7.75	26.4	511	7.60	23.31	0.17	89
	930			7.76	26.0	832	7.68	23.4	0.17	90
	1000			7.76	27.0	<-5>	7.66	23.58	0.18	90
	1030			7.76	27.5	290	7.55	22.25	0.18	95
	1130			7.78	27.6	529	7.51	23.33	0.19	88

Table B-2.3-1 (continued)

Date	Time	Daily Volume (gal.)	Cumulative Purge Volume (gal.)	pH	SC (µS/cm)	Turbidity (NTU)	DO (%)	Temp (°C)	TDS (g/L)	ORP (mV)
01/13/12	1200			7.78	28.1	576	7.32	23.49	0.18	90
	1230			7.78	27.8	626	7.35	23.49	0.18	93
	1300			7.77	27.8	586	7.79	23.59	0.18	92
	1330			7.17	27.9	493	7.66	23.81	0.18	94
	1430			7.77	27.6	228	7.77	23.44	0.18	94
	1500			7.76	27.4	309	7.85	23.13	0.18	96
	1530			7.86	27.9	223	7.80	23.07	0.18	95
	1600			7.75	28.0	311	7.56	22.82	0.18	96
	1630			7.87	28.0	409	7.69	22.80	0.18	96
	1700			7.76	28.1	341	7.67	22.71	0.18	95
	1730			7.87	28.3	238	7.61	22.59	0.18	95
	1800			7.73	28.9	878	7.73	24.04	0.19	92
	1830			7.72	29.1	139	7.67	24.05	0.19	97
	1900			7.72	28.8	185	7.58	23.96	0.19	96
	1930			7.71	29.0	93.4	7.63	23.98	0.19	97
	2000			7.74	29.3	45	7.40	24.00	0.19	95
	2030			7.25	28.2	142	7.45	23.76	0.18	93
	2100			7.76	27.7	143	7.38	23.71	0.18	95
	2130			7.77	28.5	-5	7.26	23.73	0.19	96
	2200			7.76	28.5	527	7.53	23.6	0.19	96
	2230			7.76	27.8	858	7.46	23.68	0.18	94
	2300			7.75	28.0	577	7.62	23.64	0.18	98
	2330			7.76	28.4	648	7.35	23.58	0.18	99
01/14/12	000	20,595.2	40,395							
	030			7.73	29.1	703	7.46	23.55	0.19	98
	100			7.75	28.8	-5	7.23	23.55	0.19	99
	130			7.75	29.4	401	7.16	23.59	0.19	99
	200			7.75	30.6	31	7.13	23.54	0.20	99
	230			7.72	29.8	102	7.20	23.60	0.19	99
	300			7.78	29.8	75	7.22	23.55	0.19	95
	330			7.73	29.9	28	7.09	23.46	0.19	99
	400			7.70	30.1	103	7.22	23.46	0.19	100
	430			7.73	29.8	415	7.21	23.51	0.19	101
	500			7.71	30.0	35	7.27	23.5	0.19	103

Table B-2.3-1 (continued)

Date	Time	Daily Volume (gal.)	Cumulative Purge Volume (gal.)	pH	SC (µS/cm)	Turbidity (NTU)	DO (%)	Temp (°C)	TDS (g/L)	ORP (mV)
01/14/12	530			7.71	29.7	16	7.21	23.51	0.19	104
	600			7.72	29.9	31.7	7.21	23.45	0.19	105
	630			7.73	30.8	39	6.99	23.49	0.20	109
	700			7.74	29.8	154	6.92	23.49	0.19	106
	730			7.73	30.1	40	6.83	23.46	0.20	108
	800			7.71	29.8	17	6.82	23.52	0.19	113
	830			7.70	29.5	-5	7.25	23.64	0.19	113
	900			7.71	30.2	49.2	6.99	23.60	0.19	115
	930			7.70	29.7	119	6.96	23.26	0.19	118
	1000			7.73	29.6	30.4	6.94	23.85	0.19	123
	1030			7.74	30.4	83.3	6.87	23.85	0.20	124
	1100			7.71	30.1	567	6.78	23.46	0.20	136
	1130			7.84	30.0	853	7.04	23.94	0.19	142
	1200			7.72	29.8	821	6.83	24.03	0.19	146
	1230			7.81	29.3	-5	6.79	24.05	0.19	150
	1300			7.80	29.8	3.8	6.73	24.12	0.19	153
	1330			7.82	29.3	231	6.76	24.15	0.19	159
	1400			7.71	29.3	-5	6.79	23.80	0.19	165
	1430			7.74	29.0	-5	6.64	24.33	0.19	166
	1500			7.81	29.8	-5	6.68	23.65	0.19	173
	1530			7.79	30.4	-5	6.75	23.54	0.20	178
	1600			7.71	29.8	681	6.81	23.33	0.19	181
	1630			7.72	29.5	7.3	6.69	23.27	0.19	185
	1700			7.68	29.5	24.2	6.93	23.27	0.19	189
	1730			7.72	29.9	62.8	6.71	23.18	0.19	190
	1800			7.71	30.2	26.9	6.73	23.19	0.20	194
	1830			7.72	30.3	413	6.63	23.18	0.20	197
	1900			7.71	30.9	-5	6.64	23.12	0.20	197
	1930			7.71	30.6	990	6.62	23.13	0.20	195
	2000			7.71	30.6	-5	6.60	23.03	0.20	197
	2030			7.71	30.6	926	6.71	23.05	0.20	196
	2100			7.70	30.6	5.6	6.89	23.01	0.20	198
	2130			7.72	30.9	25.9	6.62	23.04	0.20	194
	2200			7.21	30.7	108	6.57	23.03	0.20	198

Table B-2.3-1 (continued)

Date	Time	Daily Volume (gal.)	Cumulative Purge Volume (gal.)	pH	SC (µS/cm)	Turbidity (NTU)	DO (%)	Temp (°C)	TDS (g/L)	ORP (mV)
01/14/12	2230			7.71	30.4	122	6.53	23.05	0.20	200
	2300			7.71	30.5	21.9	6.52	23.03	0.20	205
	2330			7.71	30.4	69.4	6.50	23.02	0.20	207
01/15/12	000	20,525	60,920	7.71	30.3	107	6.46	23.02	0.20	210
	030			7.71	30.7	-5	6.72	23.15	0.20	210
	100			7.72	30.7	98	6.85	28.97	0.20	213
	130			7.71	30.7	77	7.02	23.25	0.20	200
	200			7.69	30.9	13	7.06	23.94	0.20	195
	230			7.68	30.9	29	6.99	23.85	0.20	188
	300			7.69	30.9	35	6.86	23.91	0.20	187
	330			7.70	30.7	136	6.91	23.87	0.20	189
	400			7.67	30.5	73	6.77	23.68	0.20	196
	430			7.70	30.5	66	6.67	23.68	0.20	198
	500			7.69	30.4	182	6.61	23.54	0.20	200
	530			7.70	30.8	278	6.62	23.61	0.20	203
	630			7.70	30.8	235	6.62	23.59	0.20	203
	700			7.69	31.0	9	6.61	23.63	0.20	204
	730			7.70	30.8	28	6.70	23.76	0.20	198
	800			7.70	31.4	38	6.94	23.64	0.20	205
	830			7.70	30.9	8.6	6.73	23.64	0.20	205
	900			7.70	30.4	31.1	6.94	23.72	0.20	205
	930			7.80	30.4	119	6.91	23.78	0.20	206
	1000			7.71	29.9	122	6.82	23.83	0.19	207
	1030			7.71	30.6	147	6.88	23.87	0.20	209
	1100			7.71	30.5	77.2	6.83	23.93	0.20	211
	1130			7.70	30.3	487	6.69	24.10	0.20	204
	1200			7.83	30.7	933	6.65	24.16	0.20	196
	1230			7.76	30.7	20.9	6.57	24.2	0.20	192
	1300			7.74	30.5	54	6.39	23.45	0.20	220
	1330			7.73	30.4	102	6.32	23.19	0.20	226
	1400			7.73	30.3	133	6.33	23.10	0.20	229
	1430			7.81	30.4	147	6.24	23.68	0.20	229
	1500			7.83	30.4	97.2	6.41	22.95	0.20	231
	1530			7.72	30.4	402	6.33	23.11	0.20	231
	1600			7.73	30.1	73	6.28	22.98	0.20	231
	1630			7.72	30.0	826	6.34	23.02	0.19	227

Table B-2.3-1 (continued)

Date	Time	Daily Volume (gal.)	Cumulative Purge Volume (gal.)	pH	SC (µS/cm)	Turbidity (NTU)	DO (%)	Temp (°C)	TDS (g/L)	ORP (mV)
1/15/12	1700			7.73	30.2	964	6.28	22.88	0.20	236
	1730			7.72	30.2	-5	6.31	22.82	0.20	236
	1800			7.74	29.9	17.8	6.18	22.84	0.19	234
	1830			7.73	30.3	12.1	6.21	22.77	0.20	236
	1900			7.73	30.7	40	6.20	22.72	0.20	231
	1930			7.72	30.3	16.4	6.26	22.67	0.20	226
	2000			7.72	30.8	21.2	6.25	22.78	0.20	224
	2030			7.72	30.8	26.5	6.20	22.54	0.20	226
	2100			7.71	30.7	30.4	6.46	22.85	0.20	225
	2130			7.72	30.7	26.5	6.20	22.57	0.20	226
	2200			7.72	30.6	27.5	6.15	22.66	0.20	219
	2230			7.72	30.5	39.4	6.31	22.55	0.20	224
	2300			7.73	31.0	60.2	6.30	22.67	0.20	224
	2330			7.71	31.0	75.3	6.30	22.45	0.20	218
1/16/12	000	20,312.5	81,233	7.74	30.9	78.1	6.35	22.4	0.20	217
	30			7.73	30.3	52.1	6.38	22.43	0.20	220
	100			7.73	30.9	51.6	6.40	22.47	0.20	219
	130			7.72	30.9	79.2	6.30	22.39	0.20	221
	200			7.71	30.9	101	6.18	22.44	0.20	221
	230			7.71	30.9	125.3	6.25	22.27	0.20	221
	300			7.73	30.8	91.7	6.21	22.25	0.20	225
	330			7.71	30.9	87.9	6.40	22.41	0.20	226
	400			7.71	30.8	112.3	6.25	22.53	0.20	227
	430			7.72	31.0	172.3	6.16	22.53	0.20	229
	500			7.73	31.0	187	6.10	22.49	0.20	230
	530			7.74	30.9	204	6.26	22.46	0.20	233
	600			7.72	30.9	246	6.26	22.15	0.20	242
	630			7.68	30.8	207	6.33	22.21	0.20	240
	700			7.71	30.7	243	6.14	22.05	0.20	242
	800	6785.7	88,018							
	700			7.71	30.7	243	6.14	22.05	0.20	242
	800	6785.7	88,018							

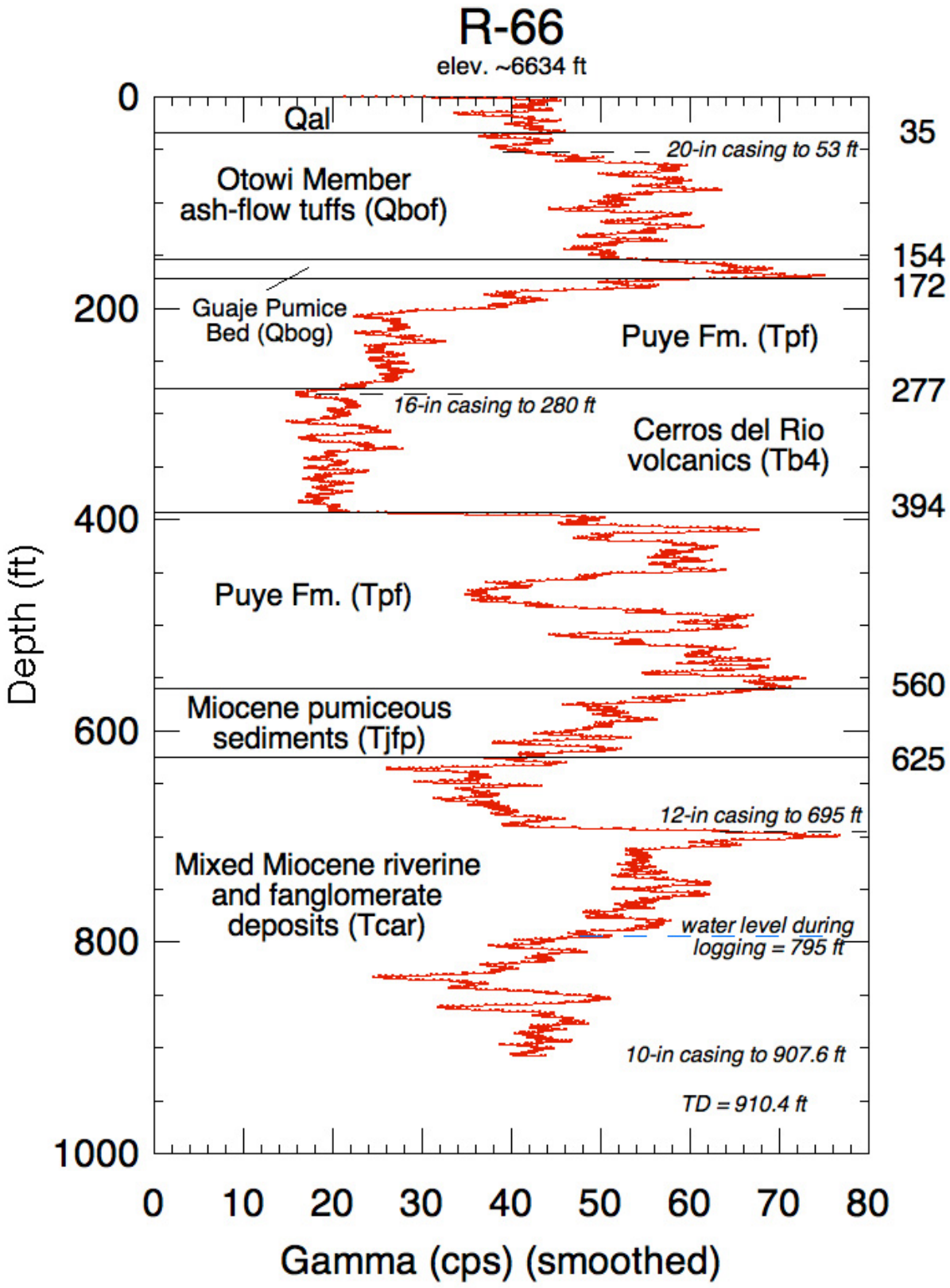
Notes: Blank cells indicate data were not collected. The turbidity values vary markedly and were erratic. Much of the well development and aquifer testing occurred when the ambient air temperature was below freezing (0°C). The Horiba water-quality meter, used to measure field parameters, is not designed to be used in weather conditions below 0°C. It is likely that the cold temperatures while measurements were collected adversely affected the accuracy of the readings.

Appendix C

Borehole Video Logging
(on DVD included with this document)

Appendix D

Geophysical Log
(on CD included with this document)


R-66
elev. ~6634 ft
Qal
Otowi Member
ash-flow tuffs (Qbof)
20-in casing to 53 ft
Guaje Pumice
Bed (Qbog)
Puye Fm. (Tpf)
16-in casing to 280 ft
Cerros del Rio
volcanics (Tb4)
Puye Fm. (Tpf)
Miocene pumiceous
sediments (Tjfp)
12-in casing to 695 ft
Mixed Miocene riverine
and fanglomerate
deposits (Tcar)
water level during
logging = 795 ft
10-in casing to 907.6 ft
TD = 910.4 ft
35
154
172
277
394
560
625
Depth (ft)
0
200
400
600
800
1000
0
10
20
30
40
50
60
70
80
Gamma (cps) (smoothed)

Appendix E

R-66 Final Well Design and
New Mexico Environment Department Approval

R-66 Well: Proposed Well Design

Well Objectives

R-66 is a regional groundwater monitoring well located in Los Alamos Canyon near the confluence with DP Canyon (Figure 1). It replaces well TW-3, which was constructed in 1949 and does not meet current monitoring-well construction standards. The primary goal of well R-66 is to monitor groundwater in the upper part of the regional aquifer down gradient of TA-21 and associated potential infiltration zones in Los Alamos and DP Canyons. Well R-66 will also be used as a sentinel well for municipal production well O-4, to determine if Laboratory contamination is present in the upper part of the regional aquifer near this supply well. Well R-66 will also be used in conjunction with well TW-3 to perform a cross-hole pumping test to determine hydraulic properties in the upper part of the regional aquifer. The results of the cross-hole test will be compared with results of a single-hole pump test for R-66 to determine scale effects on hydraulic properties.

Because of the downgradient proximity of R-66 to TA-21 contamination, the well screen is set near the top of regional saturation to maximize the detection of potential contaminants after they enter the regional aquifer.

Recommended Well Design

It is recommended that R-66 be installed with a single 20-ft screen of rod-based, wire-wrapped 20-slot screen 25 ft below the top of the regional groundwater level. The primary filter pack will consist of 10/20 sand extending 5 ft above and 5 ft below the well screen. A 2-ft secondary filter pack will be placed above the primary filter pack as shown in Figure 2. The well design is based on the drilling work plan objectives and on subsurface information collected during drilling that includes lithologic types, depth of groundwater, geophysical logs, and drilling information.

Well Design Considerations

Preliminary lithological contacts from visual examination of cuttings and from natural gamma logging identified the following geologic contacts in descending stratigraphic order: Alluvium (0–35 ft), Otowi Member of the Bandelier Tuff (35–154 ft), Guaje Pumice Bed (154–172 ft), upper Puye Formation (172-279 ft), Cerros del Rio volcanics (279-394 ft), lower Puye Formation (394–555 ft), Miocene pumiceous sands and gravel (555-625 ft), and mixed Miocene riverine and fanglomerate deposits (625–910.4 ft). The regional aquifer occurs within the mixed Miocene riverine and fanglomerate deposits. The riverine deposits are part of the Chamita Formation and consist of fine to medium crystal sands and well-round volcanic gravels that contain small amounts (<15%) of Precambrian quartzite. These riverine deposits are interbedded with fanglomerate deposits made up of lithic sands and subangular volcanic gravels that are probably derived from the Jemez volcanic field. The sands and gravels that make up these riverine and fanglomerate deposits contain little or no silt or clay, indicating these deposits are likely to be relatively productive during pumping and sampling.

The depth to regional groundwater was predicted at approximately 796 ft based on the water table map for the area. Depth to water was 795 ft bgs when 10-in drill casing was at 907.6 ft depth. Multiple readings by an electronic sounder collected over 12 hrs indicated the water level

was stable. Based on these measurements, the 795-ft water level was used to determine the well-screen placement in the proposed design (Figure 2).

Other Design Considerations

The R-66 well screen is placed 25 ft below the water table. Most single-screen monitoring wells installed by the Laboratory in recent years have well screens that are submerged 15 to 20 ft below the water table. Additional submergence of the R-66 well screen is proposed because this well is in very close proximity to municipal supply well Otowi-4. Drawdown of the water table during pumping of Otowi 4 is expected to be small or neglible based on drawdowns observed at TW-3 during Otowi 4 pumping. However, R-66 is closer to Otowi 4 than TW-3 and there may be some drawdown of the local water table during municipal pumping. Additionally, R-66 is the pumping well for the cross-hole test with TW-3. The pump test will be performed at rates of up to 30 gpm and additional submergence is needed to ensure that the R-66 screen remains fully saturated during the test.

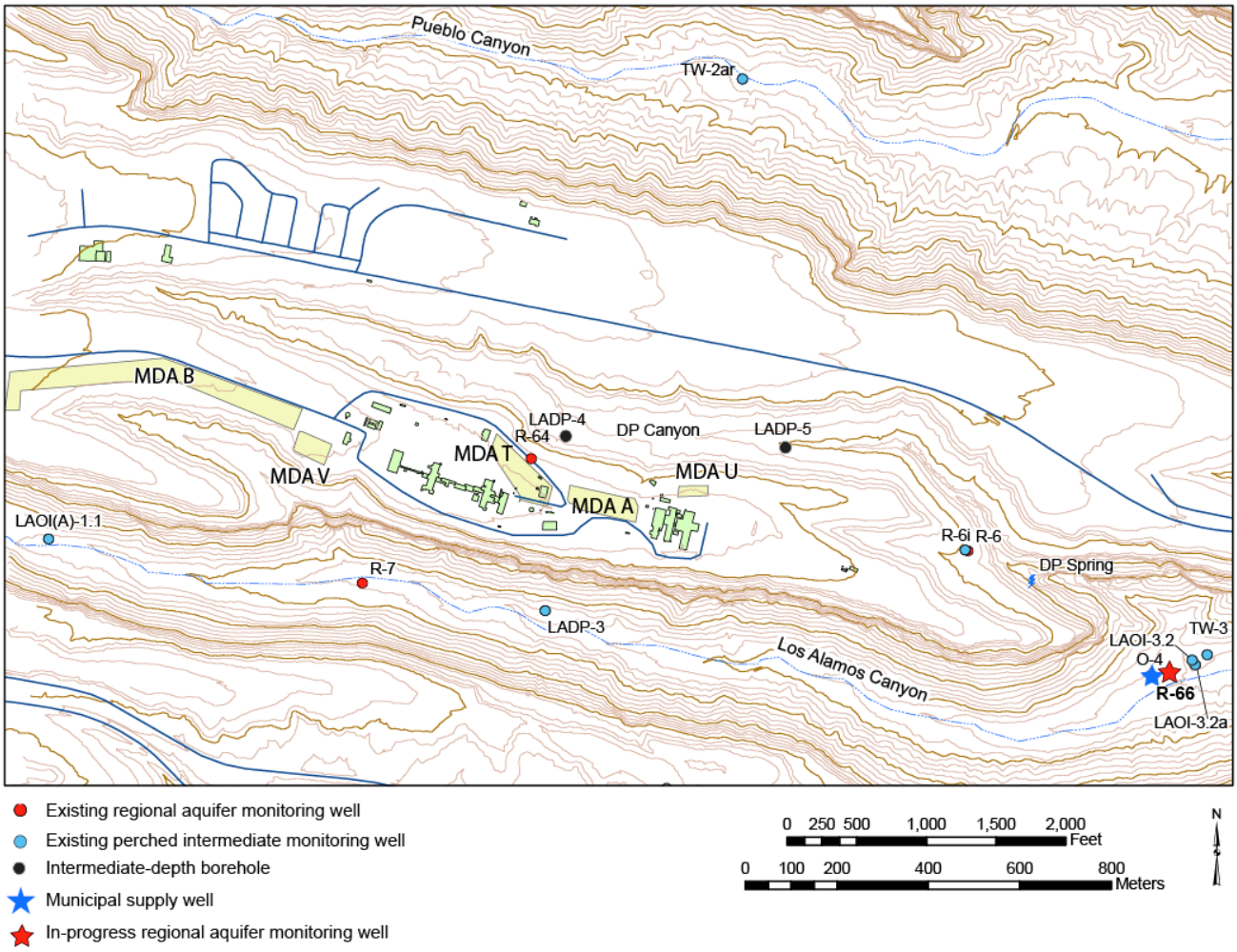


Figure 1. Map showing the location of well R-66 well near the confluence of Los Alamos and DP Canyons

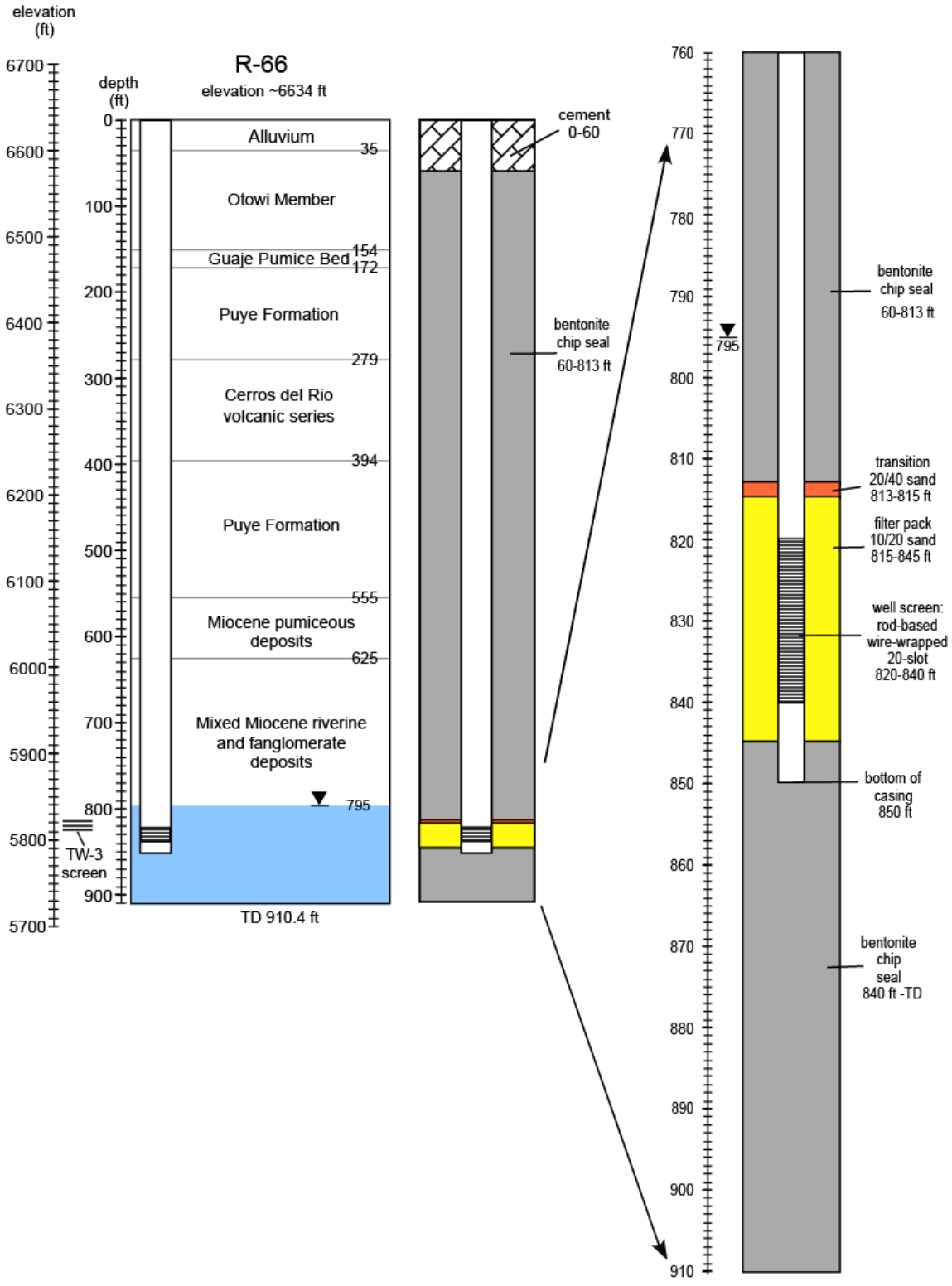


Figure 2. Stratigraphy and proposed design for well R-66. The position of the TW-3 well screen is shown to the left of the stratigraphic section.

-----Original Message-----
From: Dale, Michael, NMENV [mailto:Michael.Dale@state.nm.us]
Sent: Monday, November 07, 2011 11:32 AM
To: Everett, Mark C
Cc: Cobrain, Dave, NMENV; Shen, Hai; Woodworth, Lance A; Ball, Theodore T; Kulis, Jerzy, NMENV
Subject: RE: R-66 proposed well design

Mark,

This e-mail serves as NMED approval for installation of regional aquifer well R-66 as proposed in the document attached to the original e-mail received by NMED today November 7, 2011 at 9:43 AM. This approval is based on the information available to NMED at the time of the approval. NMED understands that LANL will provide the results of preliminary water-quality sampling, any modifications to the proposed well design, and any additional information related to the installation of well R-66 as soon as such information becomes available. LANL must notify (via e-mail) NMED of well development and the cross-hole pumping test at R-66 at least two business days prior to commencing these activities. LANL shall give notice of this installation to the New Mexico Office of the State Engineer as soon as possible.

Thanks,

Michael R. Dale
Hazardous Waste Bureau
New Mexico Environment Department
2905, Rodeo Park Drive East, Building 1
Santa Fe, NM 87505
HWB Cell Phone: (505) 231-5423
Phone (505) 476-6046 / Fax (505) 476-6030 Main HWB Phone (505) 476-6000 Los Alamos Phone (505) 661-2673 _____
From: Everett, Mark C [meverett@lanl.gov]
Sent: Monday, November 07, 2011 9:43 AM
To: Dale, Michael, NMENV; Kulis, Jerzy, NMENV
Cc: Cobrain, Dave, NMENV; Shen, Hai; Woodworth, Lance A; Ball, Theodore T
Subject: R-66 proposed well design

Michael,

Attached, please find our proposed well design for R-66. Please contact me with any questions or concerns, otherwise respond to this e-mail with your approval.

Thanks,

Mark Everett, PG
ADEP ET-EI
Los Alamos National Laboratory
(505) 667-5931

Appendix F

Geodetic Survey

2-13-2012

PT#	NORTHING	EASTING	ELEV.	DESCRIPTION
1000	1754880.48	1648970.39	6523.00	B0006
1001	1771610.40	1651994.04	6309.91	B0002
0001	1769437.37	1635540.50	6987.52	R-62 WELL CASING 2
0002	1773065.95	1637496.81	6630.48	R-66 PROTECTIVE CASING
0003	1773065.77	1637496.12	6628.82	R-66 WELL CASING
0004	1773068.55	1637492.97	6626.96	R-66 MONUMENT
0005	1773071.45	1637492.94	6625.86	R-66 GROUND

3-12-2012

PT#	NORTHING	EASTING	ELEV.	DESCRIPTION
1	1769438.42	1635540.73	6988.26	R-62 PROTECTIVE CASING
2	1773065.95	1637496.81	6630.95	R-66 PROTECTIVE CASING
3	1773065.77	1637496.12	6629.61	R-66 WELL CASING