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Refer To: ADEM-17-0056
LAUR: 17-22162
Locates Action No.: n/a

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Subject: Well Completion Report for Chromium Plume Control Interim Measure and Plume-Center Characterization Injection Wells CrIN-1, CrIN-2, CrIN-3, CrIN-4, and CrIN-5

Dear Mr. Kieling:

Enclosed please find two hard copies with electronic files of the Well Completion Report for Chromium Plume Control Interim Measure and Plume-Center Characterization Injection Wells CrIN-1, CrIN-2, CrIN-3, CrIN-4, and CrIN-5. The submittal of this report satisfies the 2016 Compliance Order on Consent Appendix B Milestones and Targets, Chromium IM & Characterization, Number 5, Chromium Injection Well (4) Completion Reports for Fiscal Year 2016 on March 31, 2017.

If you have any questions, please contact Stephani Swickley at (505) 606-1628 (sfuller@lanl.gov) or Cheryl Rodriguez at (505) 665-5330 (cheryl.rodriguez@em.doe.gov).

Sincerely,

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Sincerely,

David S. Rhodes, Director
Office of Quality and Regulatory Compliance
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BR/DR/SS:sm

Enclosures: Two hard copies with electronic files – Well Completion Report for Chromium Plume Control Interim Measure and Plume-Center Characterization Injection Wells CrIN-1, CrIN-2, CrIN-3, CrIN-4, and CrIN-5 (EP2017-0006)

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LA-UR-17-22162
March 2017
EP2017-0006

Well Completion Report for Chromium Plume Control Interim Measure and Plume-Center Characterization Injection Wells CrIN-1, CrIN-2, CrIN-3, CrIN-4, and CrIN-5

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Prepared by the Associate Directorate for Environmental Management

Los Alamos National Laboratory, operated by Los Alamos National Security, LLC, for the U.S. Department of Energy (DOE) under Contract No. DE-AC52-06NA253 and under DOE Office of Environmental Management Contract No. DE-EM0003528, has prepared this document pursuant to the Compliance Order on Consent, signed June 24, 2016. The Compliance Order on Consent contains requirements for the investigation and cleanup, including corrective action, of contamination at Los Alamos National Laboratory.
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EP2017-0006

Well Completion Report for Chromium Plume Control Interim Measure and Plume-Center Characterization Injection Wells CrIN-1, CrIN-2, CrIN-3, CrIN-4, and CrIN-5

March 2017

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EXECUTIVE SUMMARY

This well completion report describes the drilling, well construction, development, aquifer testing, and dedicated injection/pumping system installation for groundwater injection wells CrIN-1, CrIN-2, CrIN-3, CrIN-4, and CrIN-5, located within Los Alamos National Laboratory (LANL or the Laboratory). The primary purpose of the chromium injection (CrIN) wells is to achieve hydraulic control of off-site hexavalent chromium plume migration within the regional aquifer in Mortandad Canyon at the Laboratory. The wells were drilled and constructed in accordance with the New Mexico Environment Department's (NMED's) January 22, 2016, approval with modifications of the "Drilling Work Plan for Chromium Plume Control Interim Measure and Plume-Center Characterization Injection Wells CrIN-1 through CrIN-6." This completion report does not include injection well CrIN-6. Installation of injection well CrIN-6 will be conducted under the December 13, 2016, "Drilling Work Plan for Groundwater Injection Well CrIN-6," approved by NMED on January 4, 2017.

All the CrIN boreholes were drilled using dual-rotary air-drilling methods to total depth. Fluid additives used included potable water, foam, and polymer. Foam-assisted drilling was used to total depth. Two of the wells, CrIN-1 and CrIN-2, are conventional vertical completions, while CrIN-3, CrIN-4, and CrIN-5 are angled completions.

The following geologic formations were encountered: Quaternary alluvium, Tshirege Member Unit 2v, Tshirege Member Unit 1v, Tshirege Member Unit 1g, Cerro Toledo Formation, Otowi Member of the Bandelier Tuff, Guaje Pumice Bed of the Otowi Member, the Cerros del Rio volcanics, the Puye Formation, and Miocene pumiceous sediments.

The wells were completed as single-screen wells within the uppermost portion of the regional aquifer. The screened intervals are all within Puye Formation sediments.

The wells were completed in accordance with NMED-approved well designs. They were developed and the regional aquifer groundwater met target water-quality parameters. Aquifer testing indicates the CrIN wells will perform effectively in meeting the planned objectives. Injection/pumping systems and transducers were installed in the wells.

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Appendixes

Appendix A Stratigraphic and Lithologic Descriptions

Appendix B Geophysical Logs (on CD included with this document)

Appendix C Final Well Design and New Mexico Environment Department Approval

Appendix D Analysis of CrIN Pumping Test Data

Acronyms and Abbreviations

amsl	above mean sea level
ASTM	American Society for Testing and Materials
bgs	below ground surface
btoc	below top of casing
Consent Order	Compliance Order on Consent
CrIN	chromium injection
DTW	depth to water
EES	Earth and Environmental Sciences (Laboratory group)
EM	Environmental Management
ESH	Environment, Safety, and Health (Laboratory directorate)
FCV	flow control valve
gpm	gallons per minute
hp	horsepower
I.D.	inside diameter
JWGS	Jet West Geophysical Services, LLC
LANL	Los Alamos National Laboratory
NAD	North American Datum
NMED	New Mexico Environment Department
NR	not recorded
NTU	nephelometric turbidity unit
O.D.	outside diameter
PVC	polyvinyl chloride
TD	total depth

1.0 INTRODUCTION

This completion report summarizes borehole drilling, well construction, well development, aquifer testing, and dedicated pumping system installation for groundwater injection wells CrIN-1, CrIN-2, CrIN-3, CrIN-4, and CrIN-5. The report is prepared in accordance with the guidance in Appendix F, Section II, of the June 2016 Compliance Order on Consent (the Consent Order). The groundwater injection boreholes were drilled and completed between May and September 2016 at Los Alamos National Laboratory (LANL or the Laboratory) for the Environmental Management (EM) Directorate. The wells were drilled and constructed in accordance with the New Mexico Environment Department's (NMED's) January 22, 2016, approval with modifications of the "Drilling Work Plan for Chromium Plume Control Interim Measure and Plume-Center Characterization Injection Wells CrIN-1 through CrIN-6" (LANL 2015, 601048; NMED 2016, 601158). This completion report does not include injection well CrIN-6. Installation of injection well CrIN-6 will be conducted under the December 13, 2016, "Drilling Work Plan for Groundwater Injection Well CrIN-6," approved by NMED on January 4, 2017 (LANL 2015, 601048; NMED 2017, 602097).

The objective of the chromium injection (CrIN) wells is to control the migration of chromium-contaminated groundwater. The wells are located in Mortandad Canyon (Figure 1.0-1), just south and east of the centroid along the downgradient perimeter of the hexavalent chromium plume in the regional groundwater beneath the canyon. Injection wells CrIN-1 and CrIN-2 are located in the canyon bottom and are conventional vertical completions. Injection well CrIN-3, also in the canyon bottom, is an angled completion drilled from regional monitoring well R-44's pad at 17 degrees (from vertical) toward the west. Injection wells CrIN-4 and CrIN-5 are located on the mesa top and were drilled from regional monitoring well R-50's pad. CrIN-4 was drilled at 11 degrees (from vertical) toward the east, and CrIN-5 was drilled at 25 degrees (from vertical) toward the southwest.

The boreholes were drilled to varying total depths (TDs). During drilling, cuttings samples were collected at 10-ft intervals from ground surface to TD. The injection wells were installed with screened intervals in the uppermost portion of the regional aquifer within Puye Formation volcaniclastic sediments.

Post-installation activities at each location included well development, aquifer testing, surface completion, geodetic surveying, and injection/pumping system installation. 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 EM Records Processing Facility. This report contains brief descriptions of activities and supporting figures, tables, and appendixes associated with the CrIN well drilling project.

2.0 ADMINISTRATIVE PLANNING

The following documents were prepared to guide activities associated with the drilling, installation, and development of injection wells CrIN-1 through CrIN-5:

- "Drilling Work Plan for Chromium Plume Control Interim Measure and Plume-Center Characterization Injection Wells CrIN-1 through CrIN-6" (LANL 2015, 601048);
- "Storm Water Pollution Prevention Plan, CrIN Well Pads and Construction Support Activities, Los Alamos National Laboratory" (LANL 2016, 602108);
- "[Integrated Work Document for] Implementation of the Drilling Work Plan for Groundwater Extraction Well CrEX-1" (Holt Services Inc. 2016, 602106);

- "IDW [Integrated Work Document] for Drilling and Installation of LANL Vertical Chromium Injection Wells" (Yellow Jacket Drilling 2016, 602107);
- "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); and
- "Waste Characterization Strategy Form for Chromium Wells CrIN-1 [with complete Attachment 4]" (LANL 2014, 600344).

3.0 DRILLING ACTIVITIES

This section describes the drilling approach and provides a summary of field activities conducted at the CrIN wells.

3.1 Drilling Approach

The drilling method, equipment, and drill-casing were selected to drill the CrIN wells to the required depths. The drilling approach ensured that a sufficiently sized drill casing was used to meet the required 3-in.-minimum annular thickness of the filter pack around an 8.62-in.–outside-diameter (-O.D.) well screens.

Two separate drilling service providers worked on the CrIN well drilling project. One company, Yellow Jacket Drilling, drilled and completed the vertical wells (CrIN-1 and CrIN-2), and another company, Holt Services, Inc., drilled and completed the angle wells (CrIN-3, CrIN-4, and CrIN-5).

Dual-rotary drilling methods using two Foremost DR-24HD drill rigs were employed to drill the CrIN boreholes. The drill rigs were equipped with conventional direct-circulation drilling rods, tricone bits, downhole hammer bits, underreaming hammer bits, deck-mounted air compressors, auxiliary compressors, and general drilling equipment. In all wells, A53 grade B flush-welded mild carbon-steel casing (24-in.-O.D., 20-in.-O.D., 18-in.-O.D., 16-in.-O.D., and 14-in.–inside-diameter [I.D.]) was used for drilling.

The dual-rotary drilling technique used filtered compressed air and fluid-assisted air to evacuate cuttings from the borehole during drilling. Drilling fluids, other than air, used in the borehole included potable water and a mixture of potable water with Baroid Quik Foam foaming agent and Baroid EZ-Mud polymer emulsion. The fluids were used to cool the bit and help lift cuttings from the borehole. Foaming agents were used during the entire drilling effort to assist in lifting cuttings to the surface. The vertical boreholes were drilled using both casing-advance and open-hole methods.

The angled boreholes were drilled using only the dual-rotary and casing advance method (no open hole intervals) and relied on the rigidity of the drill casing to maintain the predetermined angle. The rig's tower was braced with prefabricated structural steel to hold the tower at the proper angle. Each angled borehole was different and required its own unique set of bracing. The drilling pads were also prepared specifically for the angle-drilling operation. Shallow trenches were excavated to position the drill rig so the bottom of the rig's tower could rest on firm ground.

The angled boreholes were surveyed at several points during the drilling process and upon reaching TD to ensure they remained and terminated on target. An inertial microsensor gyro surveying tool that is unaffected by magnetic environments was used for surveying. Figure 3.1-1 presents the TD surveys and original drilling targets for the three angled boreholes, CrIN-3, CrIN-4, and CrIN-5.

3.2 Drilling Activities

In late March and early April 2016, two Foremost DR-24HD drill rigs, drilling equipment, and supplies were mobilized to Mortandad Canyon to support the CrIN drilling project. Equipment and tooling were decontaminated before mobilization to the site. The two drilling operations worked concurrently to project completion. Table 3.2-1 presents chronological milestone dates for duration of drilling and well construction of the CrIN wells.

Drilling operations proceeded smoothly and as expected at all locations. Only two minor events occurred that hampered progress. Angled drilling started at the CrIN-4 location and proceeded normally until the Cerros del Rio basalt was encountered. At approximately 200 ft into the basalt, the underreaming hammer bit sheared off two of its three arms. The drilling tools were removed from the borehole and the broken bit parts were fished out. The drilling service provider elected to switch to a different type of underreaming hammer bit, and no further problems were encountered. Well construction was slowed at the vertical CrIN-1 location when the drive shoe on the 14-in. drill casing had not been successfully severed on the initial attempt, resulting in the removal of the stainless-steel well casing from the borehole. It was cut apart, sent off-site for rebevelling, and then reinstalled.

4.0 SAMPLING ACTIVITIES

This section describes the cuttings and groundwater sampling activities for the CrIN wells. No groundwater samples were collected during drilling. All sampling activities were conducted in accordance with applicable quality procedures.

4.1 Cuttings Sampling

Cuttings samples were collected from the CrIN well boreholes at 10.0-ft intervals from ground surface to the TD. At each interval, the drillers collected approximately 500 mL of bulk cuttings from the discharge cyclone, placed them in canvas or plastic bags, labeled them, and stored them on-site. Radiological control technicians screened the cuttings before the cuttings were removed from the site. All screening measurements were within the range of background values. The cuttings samples were delivered to the Laboratory's archiving facility at the conclusion of drilling activities.

Section 5.1 of this report summarizes the stratigraphy encountered at CrIN wells.

5.0 GEOLOGY AND HYDROGEOLOGY

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

5.1 Stratigraphy

Rock units for the boreholes are presented below in order of youngest to oldest in stratigraphic occurrence. Lithologic descriptions are based on binocular microscope analysis of drill cuttings collected from the discharge hose. Lithologic descriptions for each geologic unit encountered at each borehole are in included in Appendix A. Figures 5.1-1 through 5.1-5 illustrate the stratigraphy at the CrIN boreholes.

CrIN-1

The following were encountered during the drilling of CrIN-1: alluvium, Qal (0–100 ft below ground surface [bgs]); Otowi Member of the Bandelier Tuff, Qbo (100–240 ft bgs); Guaje Pumice Bed of the Otowi Member

of the Bandelier Tuff, Qbog (240–260 ft bgs); Cerros del Rio volcanics, Tb 4 (260–675 ft bgs); Puye Formation, Tpf (675–960 ft bgs); Miocene pumiceous sediments, Tjfp (960–1000 ft bgs); and Miocene Jemez alluvial sediments, Tcar (1000–1040 ft bgs).

CrIN-2

The following were encountered during the drilling of CrIN-2: alluvium, Qal (0–60 ft bgs); Cerro Toledo interval, Qct (60–110 ft bgs); Otowi Member of the Bandelier Tuff, Qbo (110–270 ft bgs); Guaje Pumice Bed of the Otowi Member of the Bandelier Tuff, Qbog (270–300 ft bgs); Cerros del Rio volcanics, Tb 4 (300–740 ft bgs); Puye Formation, Tpf (740–990 ft bgs); and Miocene pumiceous sediments, Tjfp (990–1062 ft bgs).

CrIN-3

CrIN-3 is an angled borehole drilled 17 degrees from vertical. Stratigraphic contacts are listed in linear feet along borehole length. Figure 5.1-3 presents the stratigraphy vertically, and approximated vertical depth projections are provided in parentheses.

The following were encountered during the drilling of CrIN-3: alluvium, Qal (0–30 ft); Tshirege Member of the Bandelier Tuff Unit 1g, Qbt 1g (30–70 ft); Cerro Toledo interval, Qct (70–110 ft); Otowi Member of the Bandelier Tuff, Qbo (110–330 ft); Guaje Pumice Bed of the Otowi Member of the Bandelier Tuff, Qbog (330–340 ft); Puye Formation, Tpf (340–350 ft); Cerros del Rio volcanics, Tb 4 (350–755 ft); and Puye Formation, Tpf (755–1021 ft).

CrIN-4

CrIN-4 is an angled borehole drilled 11 degrees from vertical. Stratigraphic contacts are listed in linear feet along borehole length. Figure 5.1-4 presents stratigraphy vertically and approximated vertical depth projections are provided in parentheses.

The following were encountered during the drilling of CrIN-4: Tshirege Member of the Bandelier Tuff Unit 2, Qbt 2 (0–30 ft); Tshirege Member of the Bandelier Tuff Unit 1v, Qbt 1v (30–150 ft); Tshirege Member of the Bandelier Tuff Unit 1g, Qbt 1g (150–230 ft); Cerro Toledo interval, Qct (230–250 ft); Otowi Member of the Bandelier Tuff, Qbo (250–500 ft); Guaje Pumice Bed of the Otowi Member of the Bandelier Tuff, Qbog (500–540 ft); Puye Formation, Tpf (540–560 ft); Cerros del Rio volcanics, Tb 4 (560–900 ft); and Puye Formation, Tpf (900–1202 ft).

CrIN-5

CrIN-5 is an angled borehole drilled 25 degrees from vertical. Stratigraphic contacts are listed in linear feet along borehole length. Figure 5.1-5 presents stratigraphy vertically and approximated vertical depth projections parenthetically.

The following units were encountered during the drilling of CrIN-5: Tshirege Member of the Bandelier Tuff Unit 2, Qbt 2 (0–40 ft); Tshirege Member of the Bandelier Tuff Unit 1v, Qbt 1v (40–160 ft); Tshirege Member of the Bandelier Tuff Unit 1g, Qbt 1g (160–250 ft); Cerro Toledo interval, Qct (250–280 ft); Otowi Member of the Bandelier Tuff, Qbo (280–560 ft); Guaje Pumice Bed of the Otowi Member of the Bandelier Tuff, Qbog (560–580 ft); Puye Formation, Tpf (580–610 ft); Cerros del Rio volcanics, Tb 4 (610–970 ft); Puye Formation, Tpf (970–1292 ft).

5.2 Groundwater

The CrIN-1 borehole was advanced to the TD of 1040 ft bgs. The water level was 879.0 ft bgs on June 21, 2016, before well installation. The depth to water (DTW) in the completed well was 871.4 ft bgs on July 17.

The CrIN-2 borehole was advanced to the TD of 1062 ft bgs. The water level was 899.0 ft bgs on May 10 before well installation. The DTW in the completed well was 899.1 ft bgs on May 27.

The CrIN-3 borehole was advanced to the TD of 1021.1 ft. The water level was 924.0 ft (linear) below the top of drill casing on August 17 before well installation. The DTW in the completed well was 928.8 ft (linear), or approximately 888.2 ft bgs (estimated) on September 7.

The CrIN-4 borehole was advanced to the TD of 1202.5 ft. The water level was 1078.1 ft (linear) below the top of drill casing on May 11 before well installation. The DTW in the completed well was 1078.9 ft (linear), or approximately 1059.1 ft bgs (estimated) on June 15.

The CrIN-5 borehole was advanced to the TD of 1292 ft. The water level was 1156.8 ft (linear) below the top of drill casing on July 1 before well installation. The DTW in the completed well was 1159.1 ft (linear), or approximately 1050.5 ft bgs (estimated) on July 30.

6.0 BOREHOLE LOGGING

All of the CrIN boreholes were logged by Jet West Geophysical Services, LLC (JWGS), upon reaching TD (Table 6.0-1). Logging consisted of cased-hole gamma ray and neutron density. The gamma and neutron logs are included in Appendix B (on CD included with this document).

Two video logs were run to assist in drilling and well construction activities. Video logging was conducted on April 23, 2016, at CrIN-4 to determine the orientation of the broken underreaming hammer arms and to help fish them out of the borehole. Video logging was conducted on June 27 at CrIN-1 to determine if the drive shoe was still attached to the 14-in. drill casing. Video logs were also run to document the condition of the completed wells. Video logging was conducted with Laboratory logging equipment and staff.

7.0 WELL INSTALLATION

The CrIN wells were installed following drilling completion, geophysical logging, water-level observation, and the cutting off of the drive shoe on the bottom of the drill casing at each location.

7.1 Well Design

The CrIN wells were designed in accordance with the objectives outlined in the approved “Drilling Work Plan for Chromium Plume Control Interim Measure and Plume-Center Characterization Injection Wells CrIN-1 through CrIN-6” (LANL 2015, 601048; NMED 2016, 601158). The drill cuttings, driller’s logs, results of the downhole geophysics, and DTW were reviewed. The primary objective in setting the screens was to achieve hydraulic control of off-site plume migration. A secondary objective was to keep the well screens entirely within the Puye Formation to achieve the greatest hydraulic effect for plume control in the interval(s) believed to contain the highest chromium concentrations.

The CrIN wells were designed with nominal 50-ft screened intervals to hydraulically manipulate chromium-contaminated groundwater near the top of the regional aquifer within the Puye Formation. CrIN-5 was designed with a 60-ft screen to yield an effective vertical submergence of 54 ft because of its 25-degree angle. The well designs were submitted to NMED and approved before starting construction

(LANL 2015, 601048; NMED 2016, 601158). The final CrIN well designs and NMED's approvals are included in Appendix C.

7.2 Well Construction

The CrIN wells were constructed of 8.0-in.-I.D./8.63-in.-O.D. Type A304 passivated stainless-steel, beveled and welded casing fabricated to American Society for Testing and Materials (ASTM) A312 standards. The screened sections utilize 10.0-ft and 20.0-ft lengths of 8.0-in.-I.D. 0.040-in. slot, rod-based, wire-wrapped screens to make up the screen intervals. Two sets of four stainless-steel centralizers were welded to the well casing approximately 5.0 ft above and below the screened interval at all of the wells. One set of four stainless-steel centralizers were welded to the well casing every 60 ft the entire length of the well at the angled wells. All individual casing and screen sections were welded together using compatible stainless-steel welding rods. Twenty-foot-long stainless-steel sumps were placed below the bottom of the well screens. Two-inch steel tremie pipes were used to deliver backfill and annular fill materials downhole during well construction. Stainless-steel well casing, screens, and tremie pipes were decontaminated before installation.

Figures 7.2-1 through 7.2-5 present as-built schematics showing construction details for the completed wells. Tables 7.2-1 through 7.2-5 present the annular fill materials used.

8.0 POST-INSTALLATION ACTIVITIES

Following well installation, the wells were developed and aquifer pumping tests were conducted. Dedicated injection/pumping systems have been installed. The wellhead surface completions have been installed as part of the treatment system piping and infrastructure project. A geodetic survey has been performed. Site-restoration activities will be completed following the final disposition of contained drill cuttings and groundwater. Drill cuttings will be managed in accordance with the NMED-approved Decision Tree for the Land Application of Drill Cuttings (April 2016). Drilling, purge, and development waters will be managed in accordance with the NMED-approved Decision Tree for Land Application of Groundwater (November 2016).

8.1 Well Development

The wells were developed following the completion of well construction. Initially, the screened intervals were swabbed and bailed to remove formation fines in the filter pack and well sump. Bailing continued until water clarity visibly improved. Following swabbing and bailing, final well development was then performed with a submersible pump.

The swabbing tools employed were 7.5-in.-O.D., 1-in.-thick nylon discs attached to a weighted steel rods. The wireline-conveyed tools were drawn repeatedly across the screened intervals, causing a surging action across the screens and filter packs. Various bailing tools were employed to remove sediment from the well sumps. The tools were repeatedly lowered by wireline, filled, withdrawn from the wells, and emptied into the cuttings pits.

After bailing, 30-horsepower (hp), 6-in. submersible pumps were installed in the wells for the final stage of well development. The screened intervals were pumped from top to bottom and from bottom to top in 2-ft increments.

As part of well development, the CrIN wells were disinfected with a chlorine treatment following aquifer testing and before the installation of a dedicated injection and pumping system to eliminate any biological fouling that could occur in the well screen and submerged filter pack intervals while the wells sat idle before being brought online. Sodium hypochlorite was mixed at the surface with potable water to a

concentration of 100 ppm. The total volume of the solution was calculated and mixed to an equivalent of 4 casing volumes in the well(s). The solution was introduced to the screen interval via tremie pipe and either surged (vertical locations) or recirculated with a pump (angled locations) for 2 h and was allowed to remain in the well(s) for a period of approximately 12 h. Within 24 h of application, the well(s) were purged to remove at least 10 casing volumes of water.

8.1.1 Well Development Field Parameters

The field parameters of turbidity, temperature, and pH were monitored with a multi-parameter instrument and a flow-through cell at the CrIN wells during well development. Field water-quality parameters for development and aquifer testing at each well are presented in Tables 8.1-1 through 8.1-5.

8.2 Aquifer Testing

Following development, the wells underwent aquifer testing consisting of step drawdown tests and 24-h constant rate tests. Constant rate pumping was followed by a 24-h recovery period. All the aquifer tests used 30-hp pumps. Turbidity, temperature, and pH were measured during the aquifer tests. Table 8.2-1 presents a summary of testing dates and pumping rates. Field water-quality parameters and aquifer testing volumes are presented in Tables 8.1-1 through 8.1-5. The CrIN wells' aquifer test results and analysis are presented in Appendix D.

8.3 Injection and Pumping System Installation

Dedicated injection and pumping systems have been installed in the CrIN wells. The systems have a 6-in. Grundfos submersible pump with a 30-hp Franklin Electric motor inside a stainless-steel pump shroud. A flow-control valve is positioned above the pump shroud and is separated from the pump by a check valve. The flow-control valves provide controlled, noncavitating head loss from the column pipe. An inflatable swellable element resides within the flow-control valves. The rate of water injection can be controlled by pneumatically manipulating the element. The element may be fully inflated to shut the flow-control valve and allow pumping from the wells with a single column pipe. The pump and flow-control valve assemblies are fully positioned in the well sumps to prevent the injected water from being delivered directly next to the screen intervals. The column pipe consists of 3.0-in. spline-lock, schedule 80, 304 stainless-steel. Two 1.0-in.-I.D. schedule 80 polyvinyl chloride (PVC) tubes are installed along with, and banded to, the pump column. A dedicated 100 psi In-Situ Level Troll 500 transducer is 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 short section of 0.010-in. slotted screen and a closed bottom.

Pumping system details for the CrIN wells are presented in Figures 8.3-1a through 8.3-5a. Figures 8.3-1b through 8.3-5b present technical notes for the wells and dedicated hardware.

8.4 Wellhead Completion

Reinforced concrete subsurface vaults have been installed at the CrIN wellheads. The vaults are slightly elevated aboveground surface and will provide long-term structural integrity for the well and piping infrastructure. Brass monument markers have been embedded in the northwest corner of the vaults. Six steel bollards, covered by high-visibility plastic sleeves, will be 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 8.4-1 shows details of the current injection well vault completions.

8.5 Geodetic Survey

A licensed professional land surveyor conducted a geodetic survey of all of the CrIN wells on January 26, 2017. 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 will be expressed relative to New Mexico State Plane Coordinate System Central Zone 83 (North American Datum [NAD] 83); elevation is expressed in feet above mean sea level (amsl) using the National Geodetic Vertical Datum of 1929.

Survey points include ground-surface elevation near the concrete vaults, the top of the brass monument marker in the top of the concrete vaults, and the top of the well casings. Survey data for the CrIN wells are presented in Table 8.5-1.

8.6 Waste Management and Site Restoration

Waste generated from the CrIN drilling project includes drilling fluids, drill cuttings, and contact waste. A summary of the waste characterization samples collected during drilling, construction, and development of the CrIN wells is presented in Tables 8.6-1 through 8.6-5. All waste streams produced during drilling and development activities were sampled in accordance with the "Waste Characterization Strategy Form for Chromium Well CrEX-1 [with complete Attachment 4]" (LANL 2014, 600344). Development water was land-applied under a temporary permission to discharge (NMED 2014, 600128).

Fluids produced during drilling and containerized in the pits will be evaporated on-site. Evaporation activities began in June 2016.

Analytical results for fluids produced during well development and pump testing will be reviewed with the goal of land application. Data will be reviewed manually and within the automated waste determination program per the waste characterization strategy form (LANL 2014, 600344) and ENV-RCRA-QP-010, "Land Application of Groundwater." If it is determined that drilling fluids are nonhazardous but cannot meet the criteria for land application, the drilling fluids will be reevaluated for treatment and disposal at one of the Laboratory's wastewater treatment facilities or other authorized disposal facility. If analytical data indicate the drilling fluids are hazardous/nonradioactive or mixed low-level waste, the drilling fluids will be shipped to an off-site treatment, storage, and disposal facility.

Cuttings produced during drilling were sampled, and analytical results will be reviewed with the goal of land application. Once the fluids are evaporated or removed from the pit, a composite volatile organic analyte sample of the cuttings will be collected and evaluated against land-application criteria (ENV-RCRA-QP-011, "Land Application of Drill Cuttings"). If cuttings meet land-application criteria, materials will be spread across the pad area, and the site will be reseeded as required for site reclamation. Water generated from development and aquifer testing activities was treated and land applied under DP-1793 Work Plan 3.

Characterization of contact waste will be based upon acceptable knowledge, referencing the analyses of the waste samples collected from the drilling fluids, drill cuttings, and decontamination fluids. A waste profile form will be completed, and the contact wastes will be removed from the site following land application of the pit-contained drill cuttings. The pit liner will be included in the contact waste disposal materials.

Site restoration activities are conducted by Logistics Heavy Equipment/ Roads and Grounds personnel at the Laboratory. Activities include evaporating drilling fluids, removing cuttings from the pit, and managing the development/pump test fluids in accordance with applicable procedures. The polyethylene liner will be

removed following land application of the cuttings, and the containment area berms will be removed and leveled. Activities also include backfilling and regrading the containment area, as appropriate.

9.0 DEVIATIONS FROM PLANNED ACTIVITIES

Drilling and well construction at the CrIN wells were performed as specified in approved "Drilling Work Plan for Chromium Plume Control Interim Measure and Plume-Center Characterization Injection Wells CrIN-1 through CrIN-6" (LANL 2015, 601048; NMED 2016, 601158). No deviations from the plan occurred.

10.0 ACKNOWLEDGMENTS

Yellow Jacket Drilling drilled and installed injection wells CrIN-1 and CrIN-2.

Holt Services, Inc., drilled and installed injection wells CrIN-3, CrIN-4, and CrIN-5.

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 or ESH ID. This information is also included in text citations. ER IDs were assigned by the Environmental Programs Directorate's Records Processing Facility (IDs through 599999), and ESH IDs are assigned by the Environment, Safety, and Health (ESH) Directorate (IDs 600000 and above). IDs are used to locate documents in the Laboratory's Electronic Document Management System and, where applicable, in the master reference set.

Copies of the master reference set are maintained at the NMED Hazardous Waste Bureau and the ESH 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.

Holt Services Inc., March 13, 2016. "IWD [Integrated Work Document] for 2016 Drilling and Installation of LANL Wells CrIN-4, CrIN-5, and CrIN-3," Los Alamos, New Mexico. (Holt Services Inc., 2016, 602106)

LANL (Los Alamos National Laboratory), February 28, 2014. "Waste Characterization Strategy Form for Chromium Well CrEx-1 [with complete Attachment 4]," Los Alamos National Laboratory, Los Alamos, New Mexico. (LANL 2014, 600344)

LANL (Los Alamos National Laboratory), December 2015. "Drilling Work Plan for Chromium Plume Control Interim Measure and Plume-Center Characterization Injection Wells CrIN-1 through CrIN-6," Los Alamos National Laboratory document LA-UR-15-29392, Los Alamos, New Mexico. (LANL 2015, 601048)

LANL (Los Alamos National Laboratory), February 4, 2016. "Storm Water Pollution Prevention Plan, CrIN Well Pads and Construction Support Activities, Los Alamos National Laboratory," Los Alamos National Laboratory, Los Alamos, New Mexico. (LANL 2016, 602108)

NMED (New Mexico Environment Department), August 8, 2014. "Temporary Permission to Discharge, Treated Ground Water from Aquifer Testing at Pilot Pumping Well CrEX-1 (AI: 856, PRD20140007)," New Mexico Environment Department letter to A. Dorries (LANL) and G. Turner (DOE) from J. Schoeppner (NMED-GWQB), Santa Fe, New Mexico. (NMED 2014, 600128)

NMED (New Mexico Environment Department), January 22, 2016. "Approval with Modifications, Drilling Work Plan for Chromium Plume Control Interim Measure and Plume-Center Characterization Injection Wells CrIN-1 through CrIN-6," New Mexico Environment Department letter to D. Hintze (DOE-EM-LA) and M. Brandt (LANL) from J.E. Kieling (NMED-HWB), Santa Fe, New Mexico. (NMED 2016, 601158)

NMED (New Mexico Environment Department), January 4, 2017. "Approval [for the] Drilling Work Plan for Groundwater Injection Wells CrIN-6," New Mexico Environment Department letter to D. Hintze (DOE-EM-LA) and M. Brandt (LANL) from J.E. Kieling (NMED-HWB), Santa Fe, New Mexico. (NMED 2017, 602097)

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)

Yellow Jacket Drilling, March 2, 2016. "IWD [Integrated Work Document] for Drilling and Installation of LANL Vertical Chromium Injection Wells," Los Alamos, New Mexico. (Yellow Jacket Drilling 2016, 602107)

11.2 Map Data Sources

Point Feature Locations of the Environmental Restoration Project Database; Los Alamos National Laboratory, Waste and Environmental Services Division, EP2008-0109; 12 April 2010.

Hypsography, 100 and 20 Foot Contour Interval; Los Alamos National Laboratory, ENV Environmental Remediation and Surveillance Program; 1991.

Surface Drainages, 1991; Los Alamos National Laboratory, ENV Environmental Remediation and Surveillance Program, ER2002-0591; 1:24,000 Scale Data; Unknown publication date.

Paved Road Arcs; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 28 May 2009.

Dirt Road Arcs; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 28 May 2009.

Structures; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 28 May 2009.

Technical Area Boundaries; Los Alamos National Laboratory, Site Planning & Project Initiation Group, Infrastructure Planning Division; 4 December 2009.

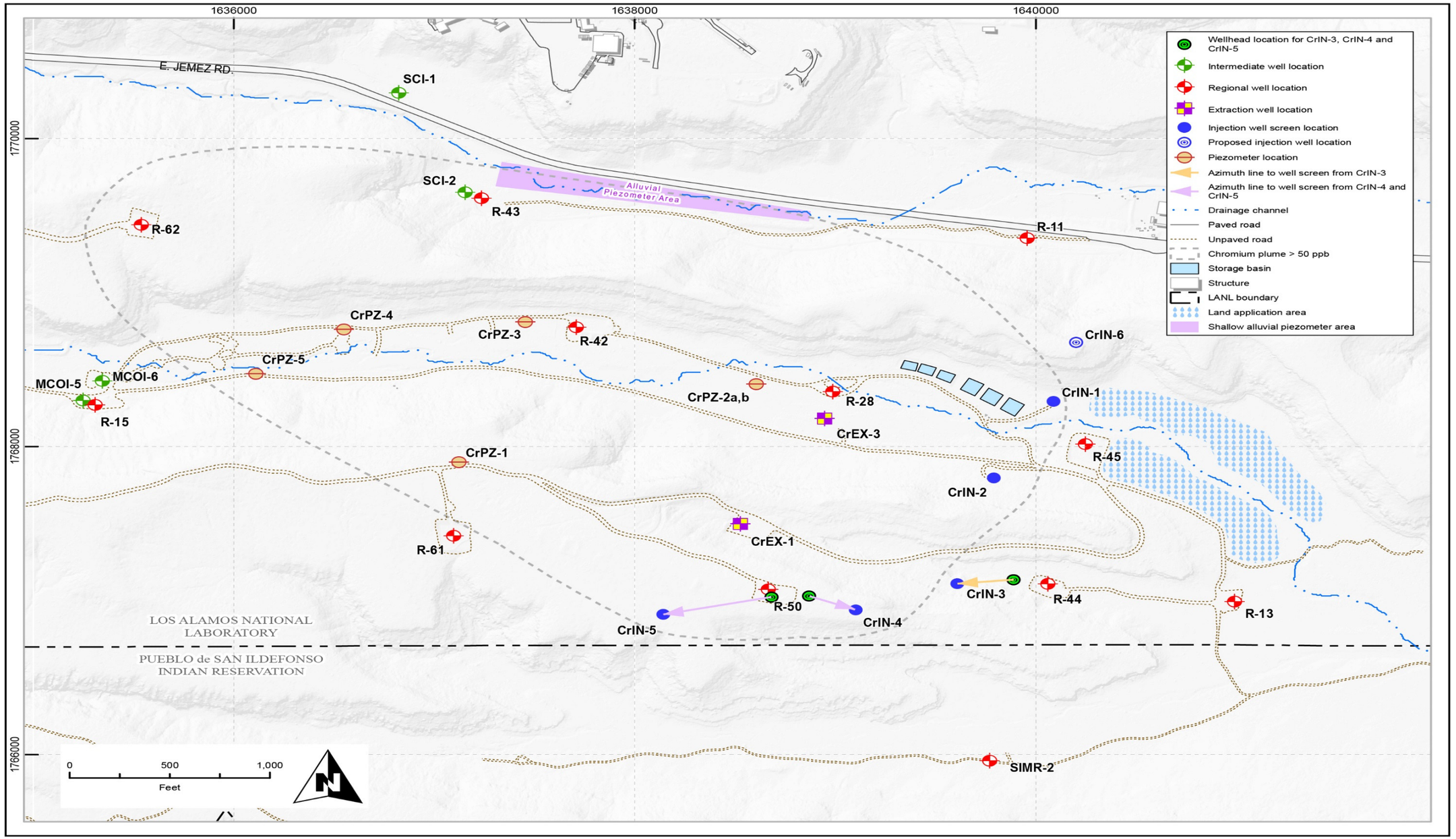


Figure 1.0-1 Location of injection wells CrIN-1, CrIN-2, CrIN-3, CrIN-4, and CrIN-5

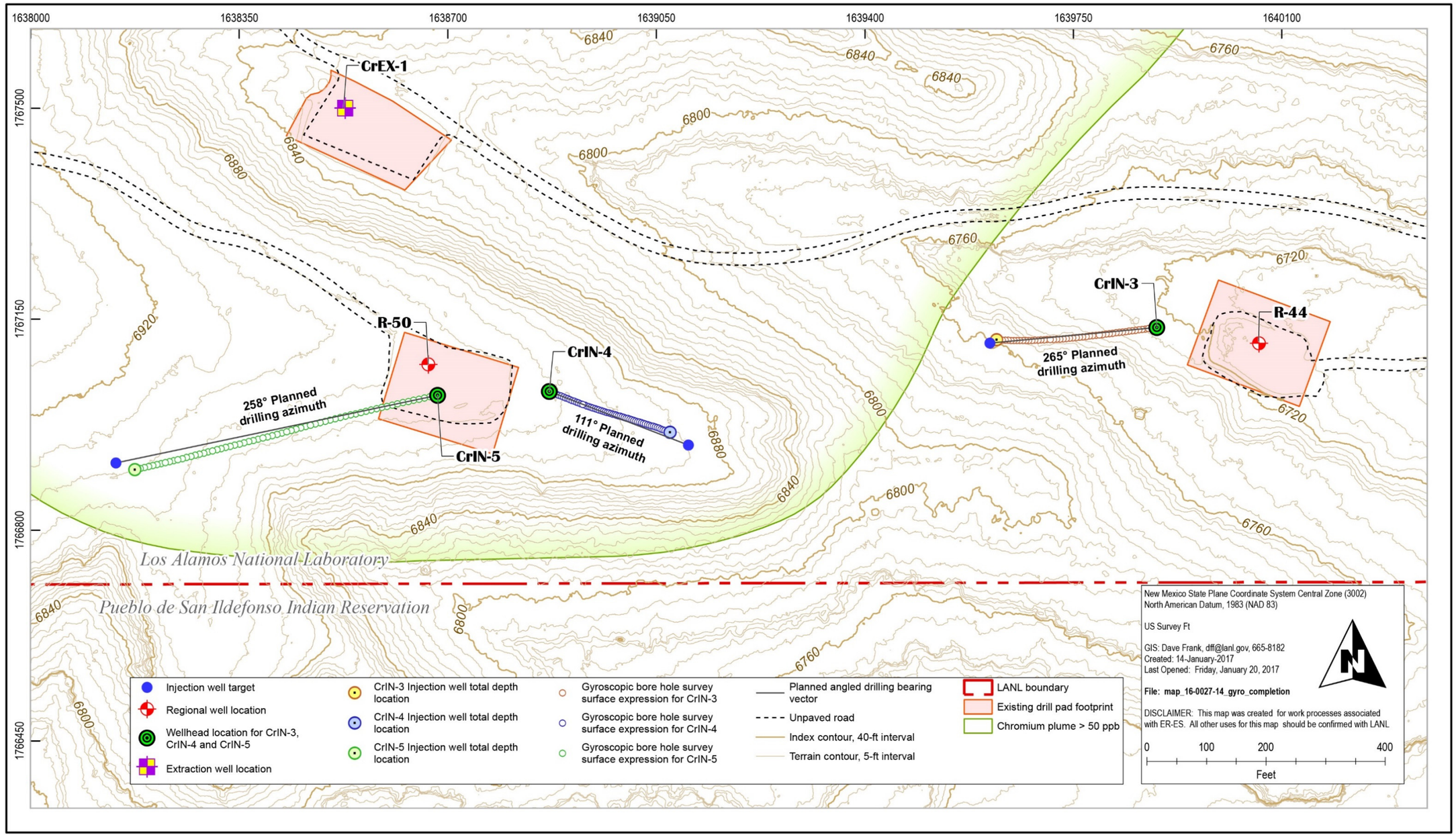


Figure 3.1-1 TD surveys and original drilling targets for CrIN-3, CrIN-4, and CrIN-5

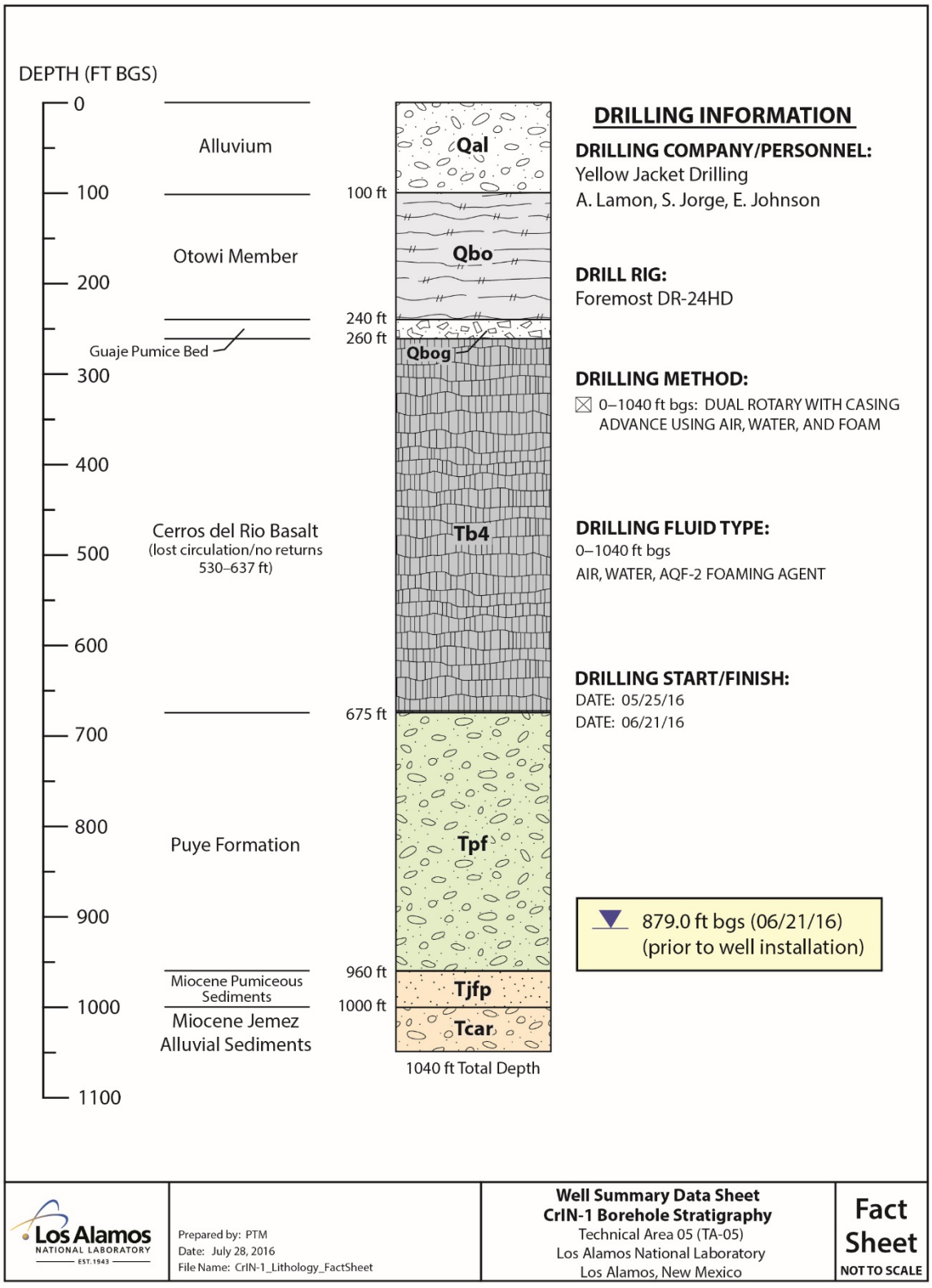


Figure 5.1-1 Injection well CrIN-1 borehole stratigraphy

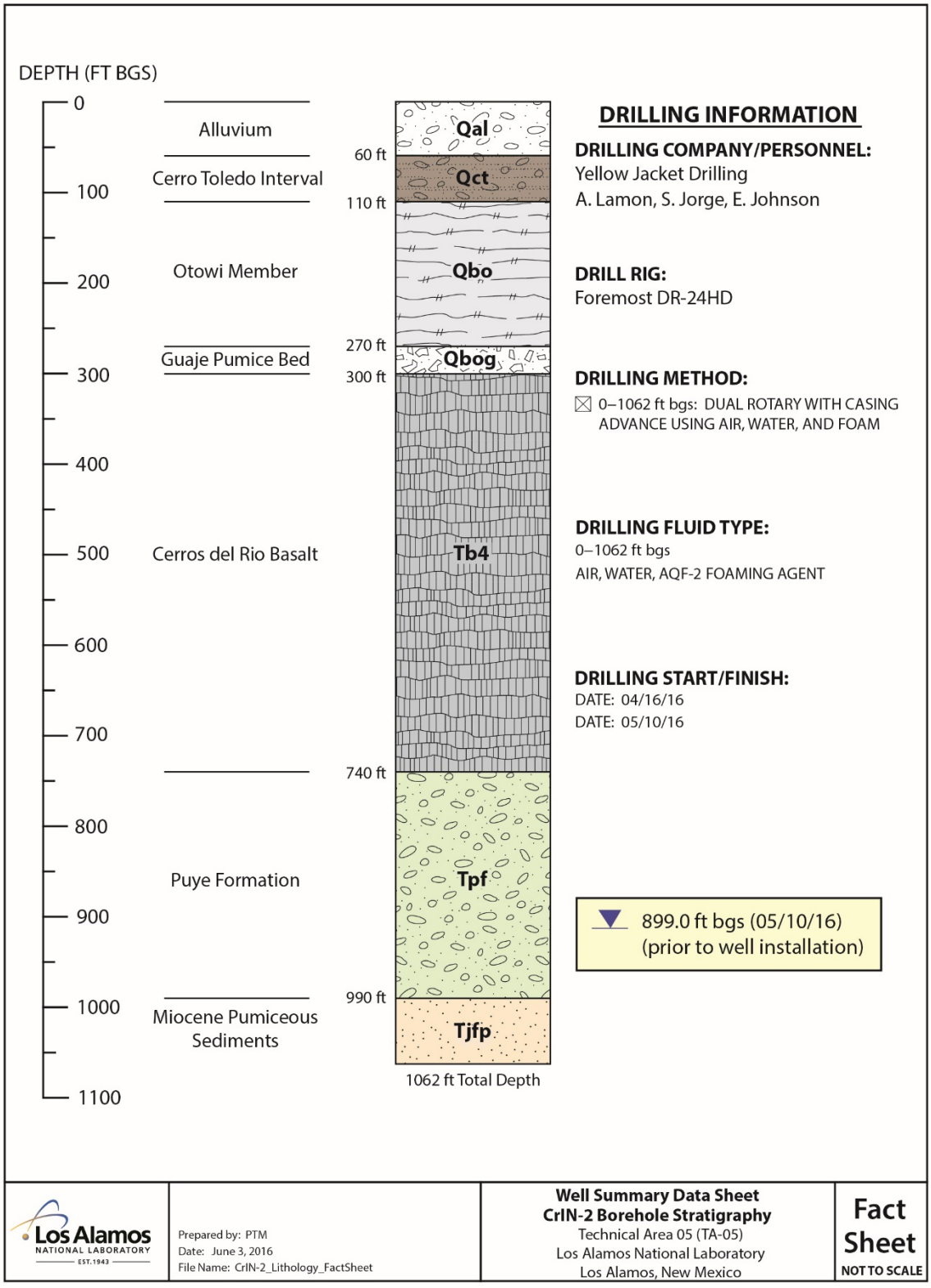


Figure 5.1-2 Injection well CrIN-2 borehole stratigraphy

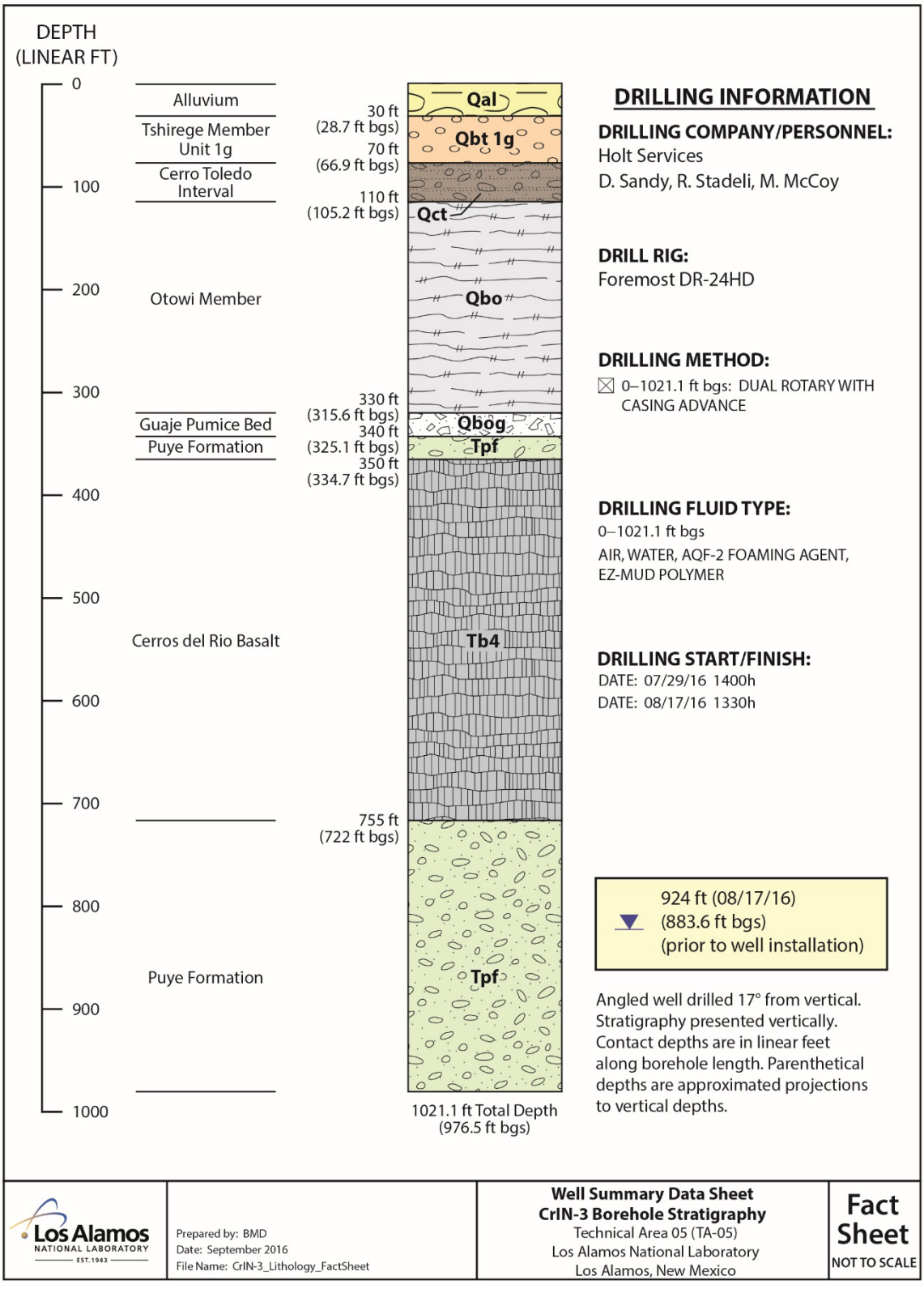


Figure 5.1-3 Injection well CrIN-3 borehole stratigraphy

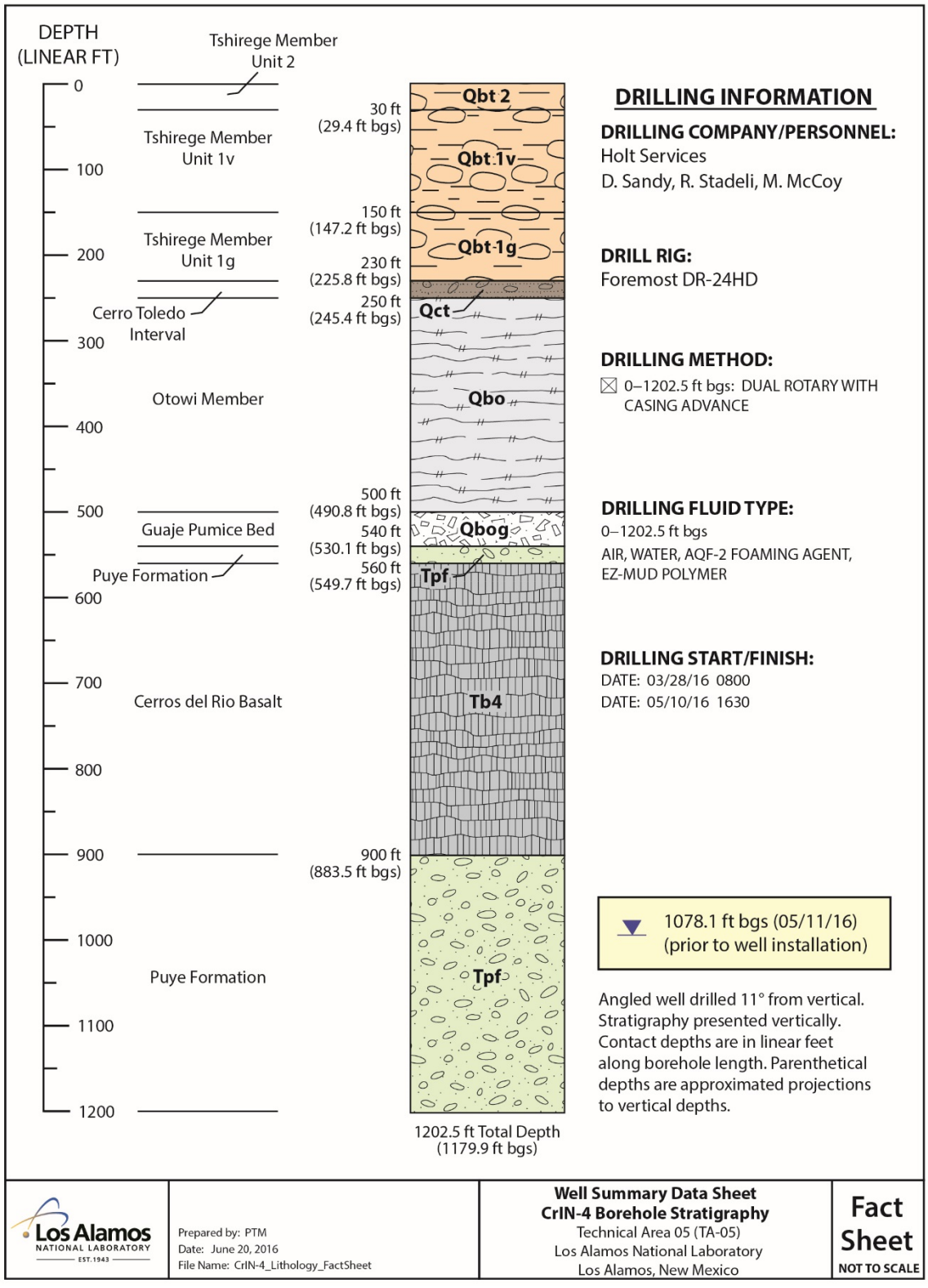


Figure 5.1-4 Injection well CrIN-4 borehole stratigraphy

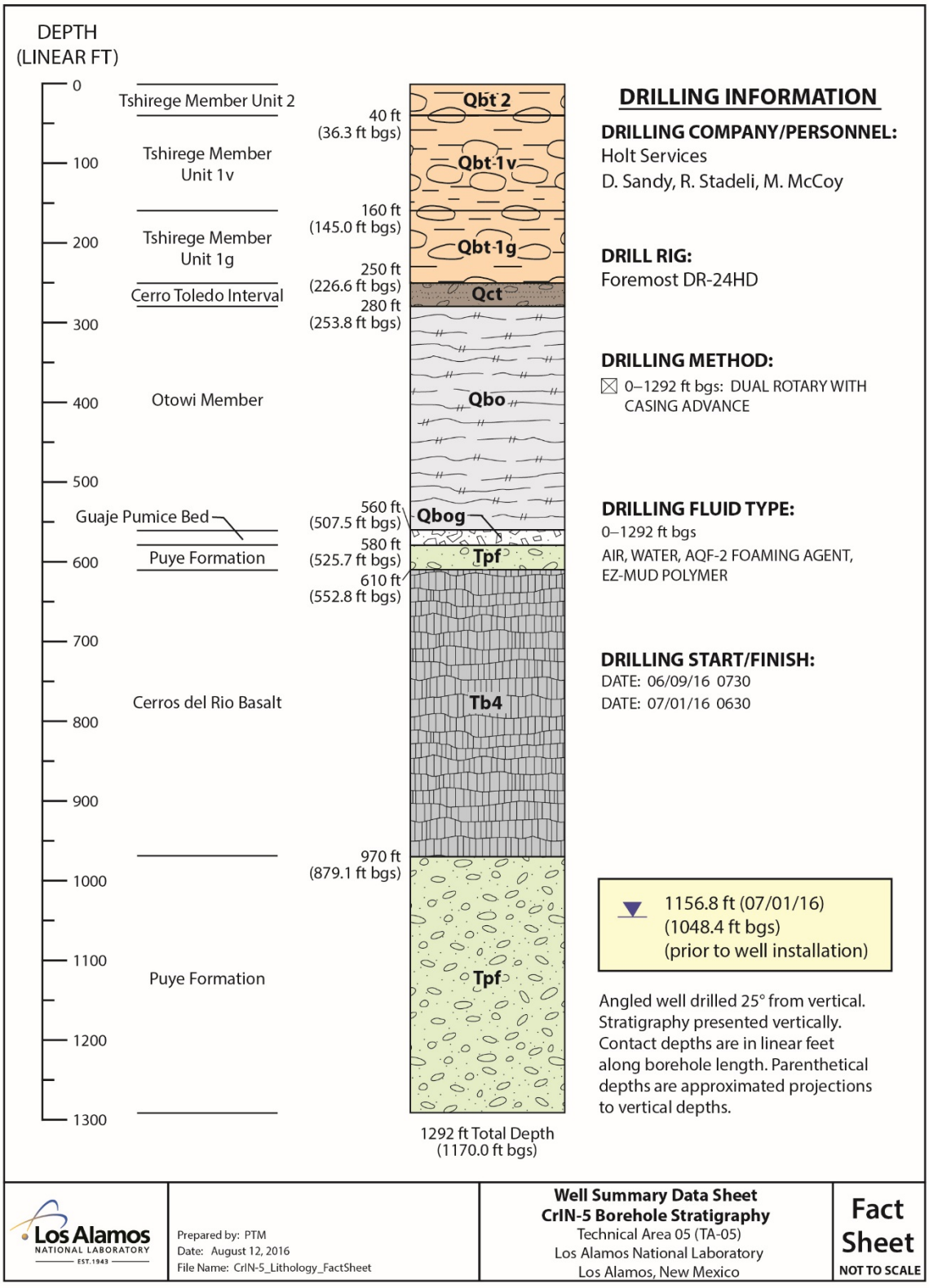


Figure 5.1-5 Injection well CrIN-5 borehole stratigraphy

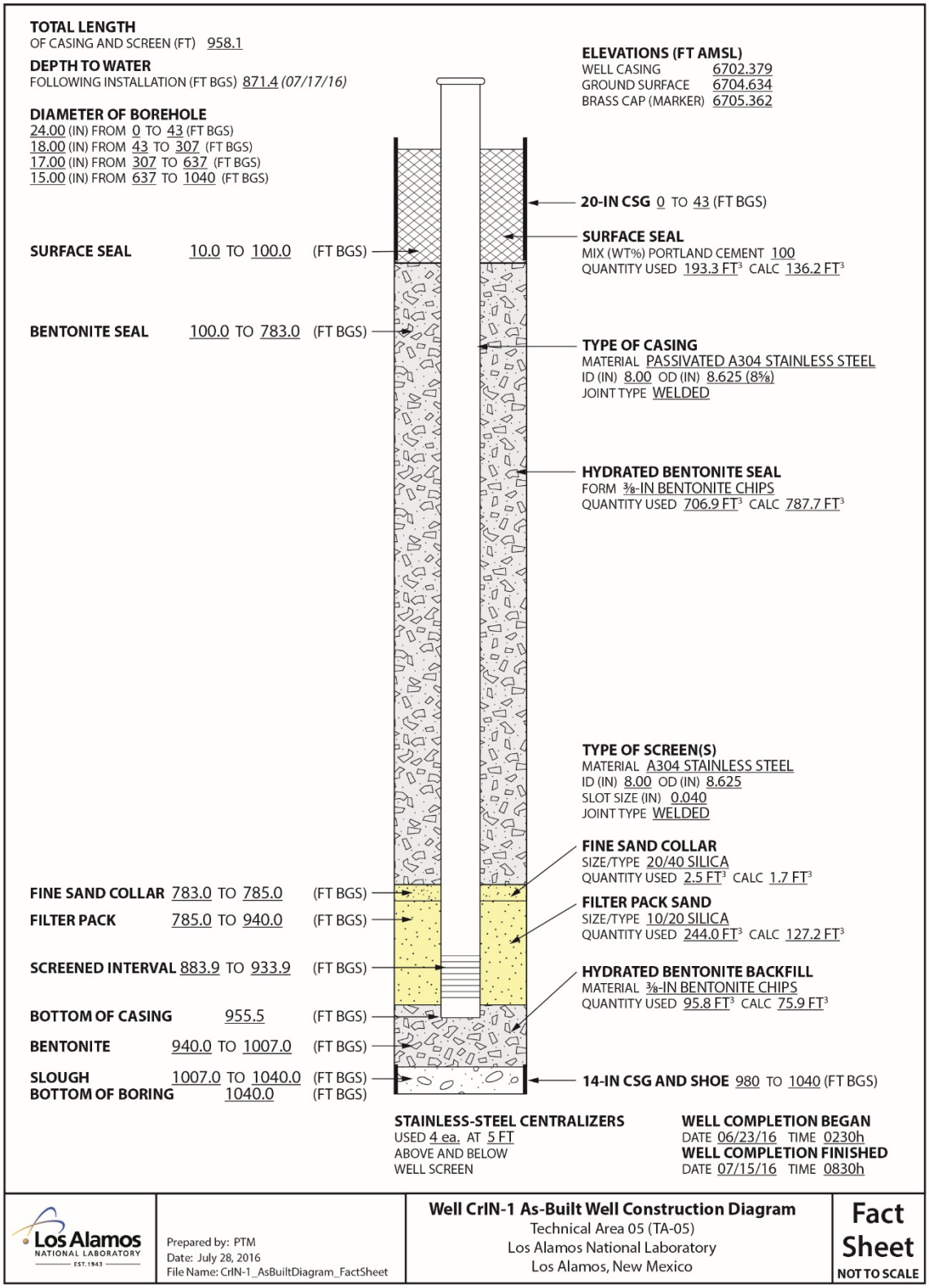


Figure 7.2-1 Injection well CrIN-1 as-built well construction diagram

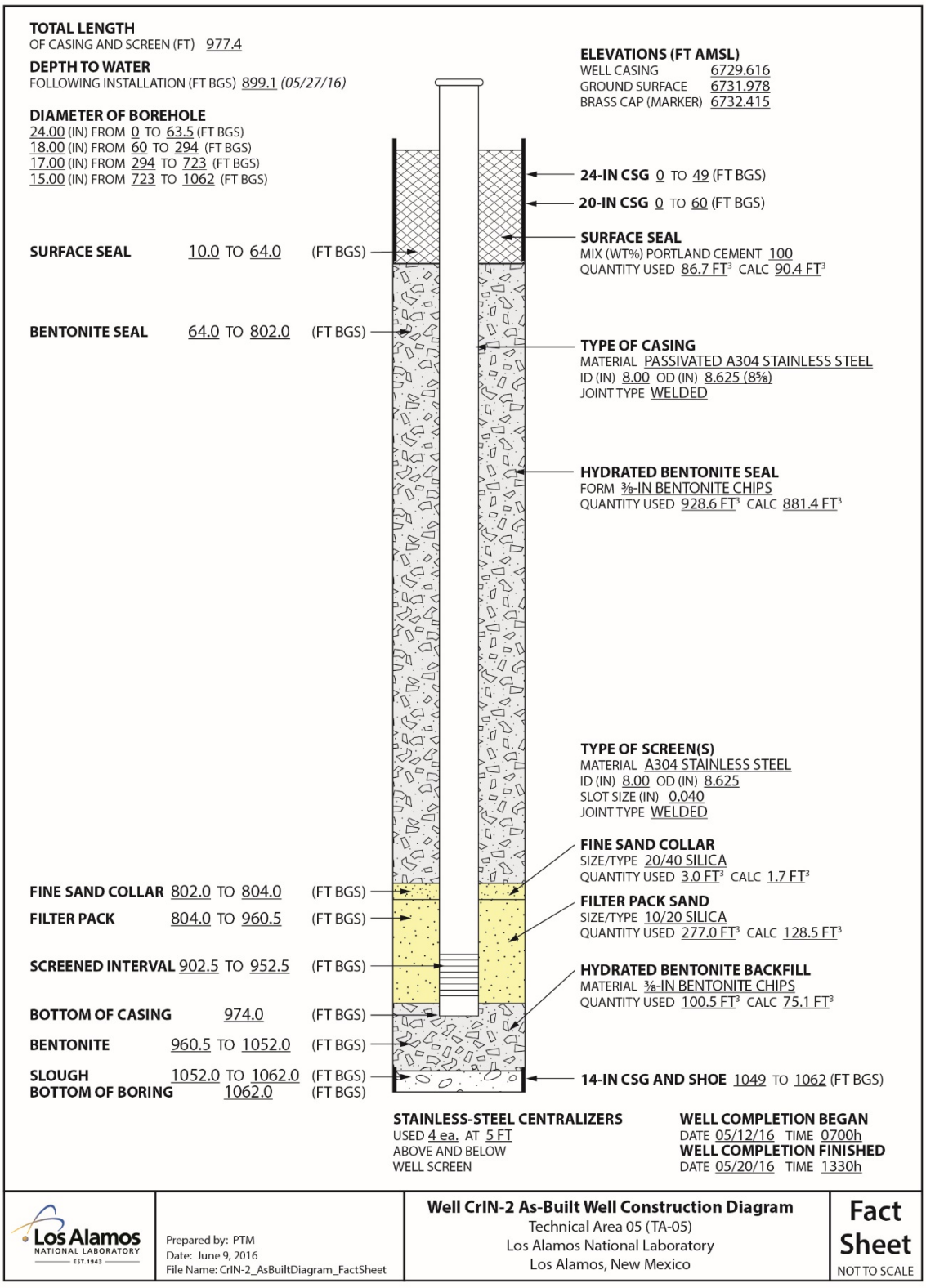


Figure 7.2-2 Injection well CrIN-2 as-built well construction diagram

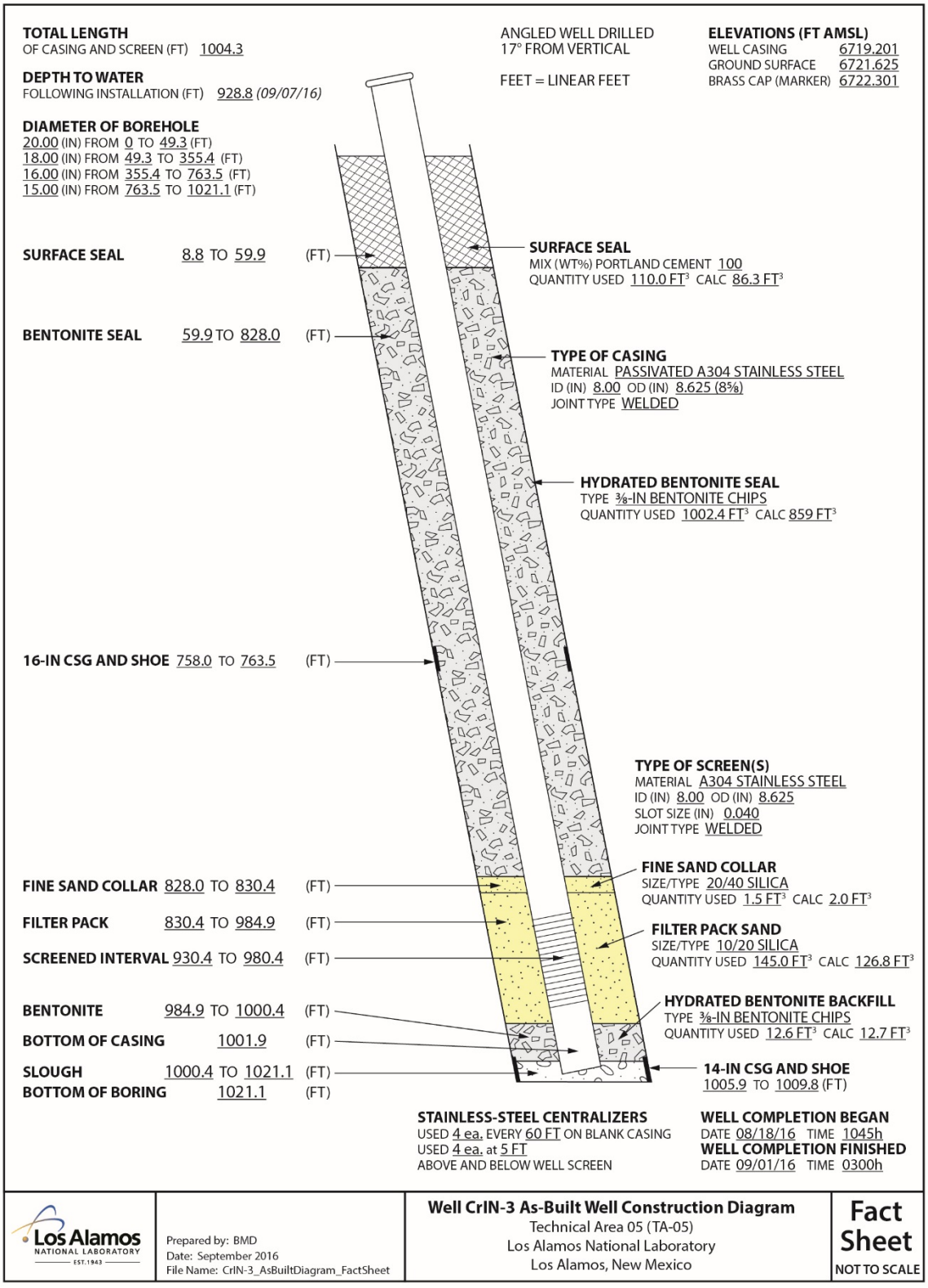


Figure 7.2-3 Injection well CrIN-3 as-built well construction diagram

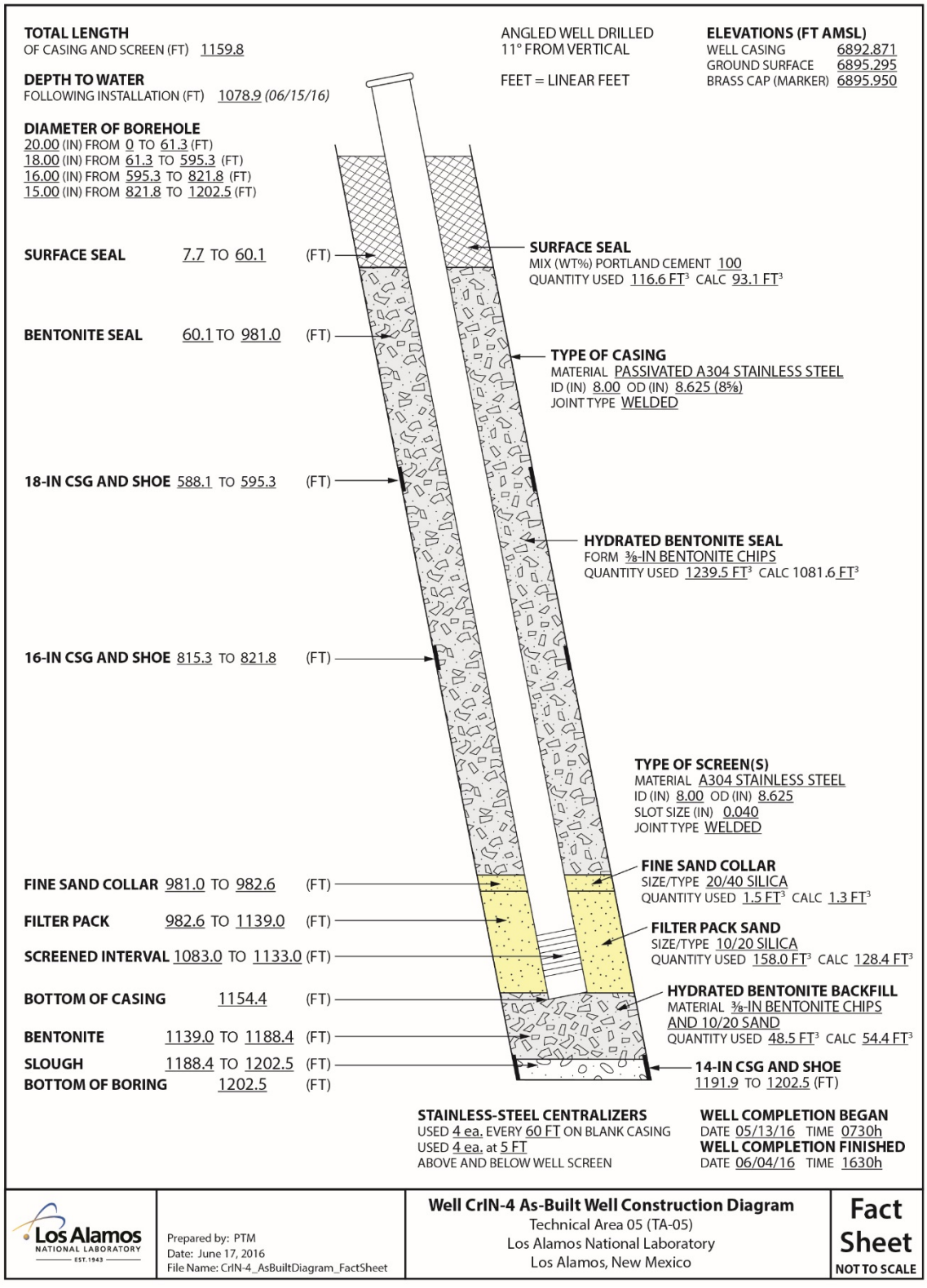


Figure 7.2-4 Injection well CrIN-4 as-built well construction diagram

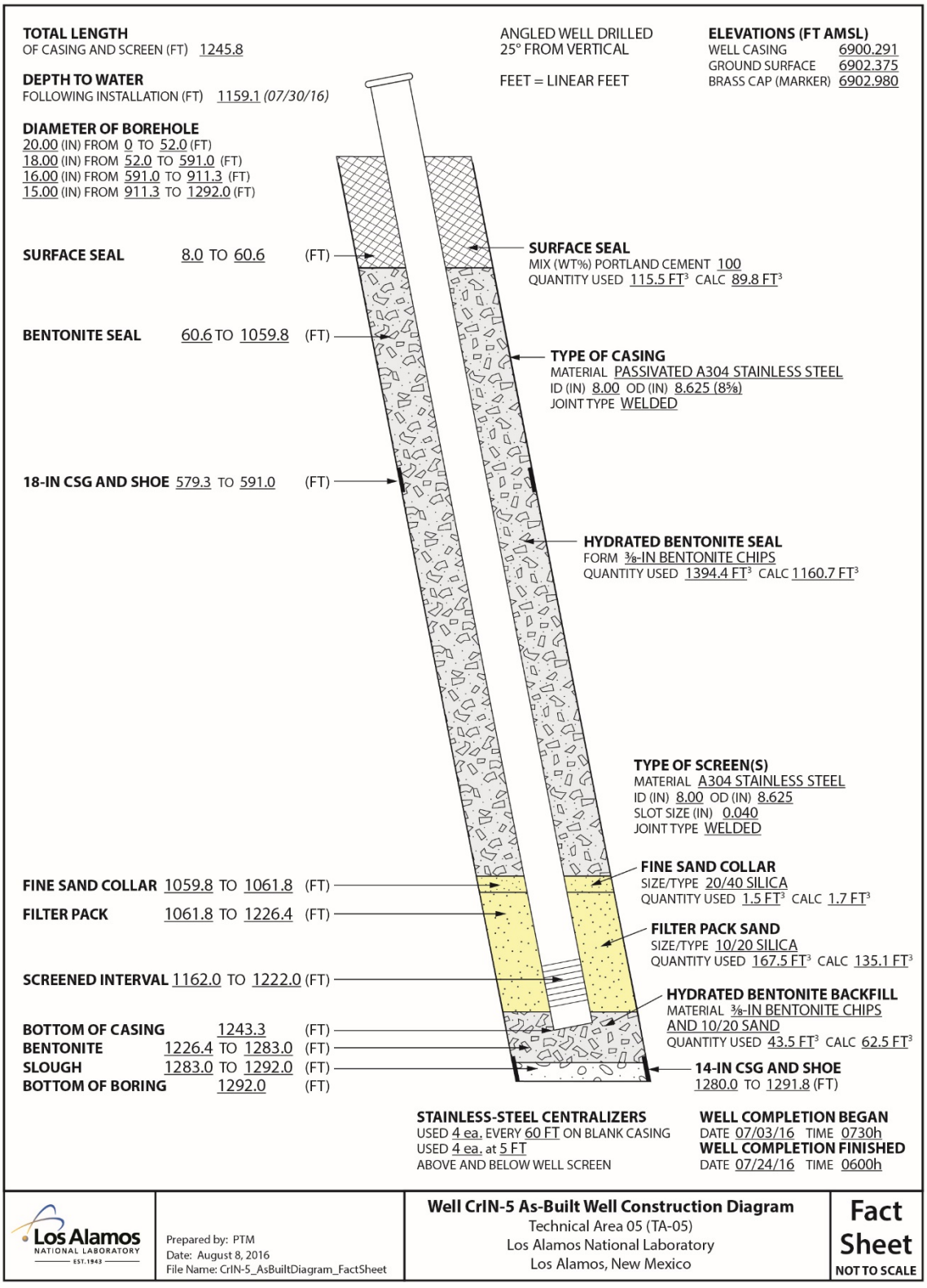


Figure 7.2-5 Injection well CrIN-5 as-built well construction diagram

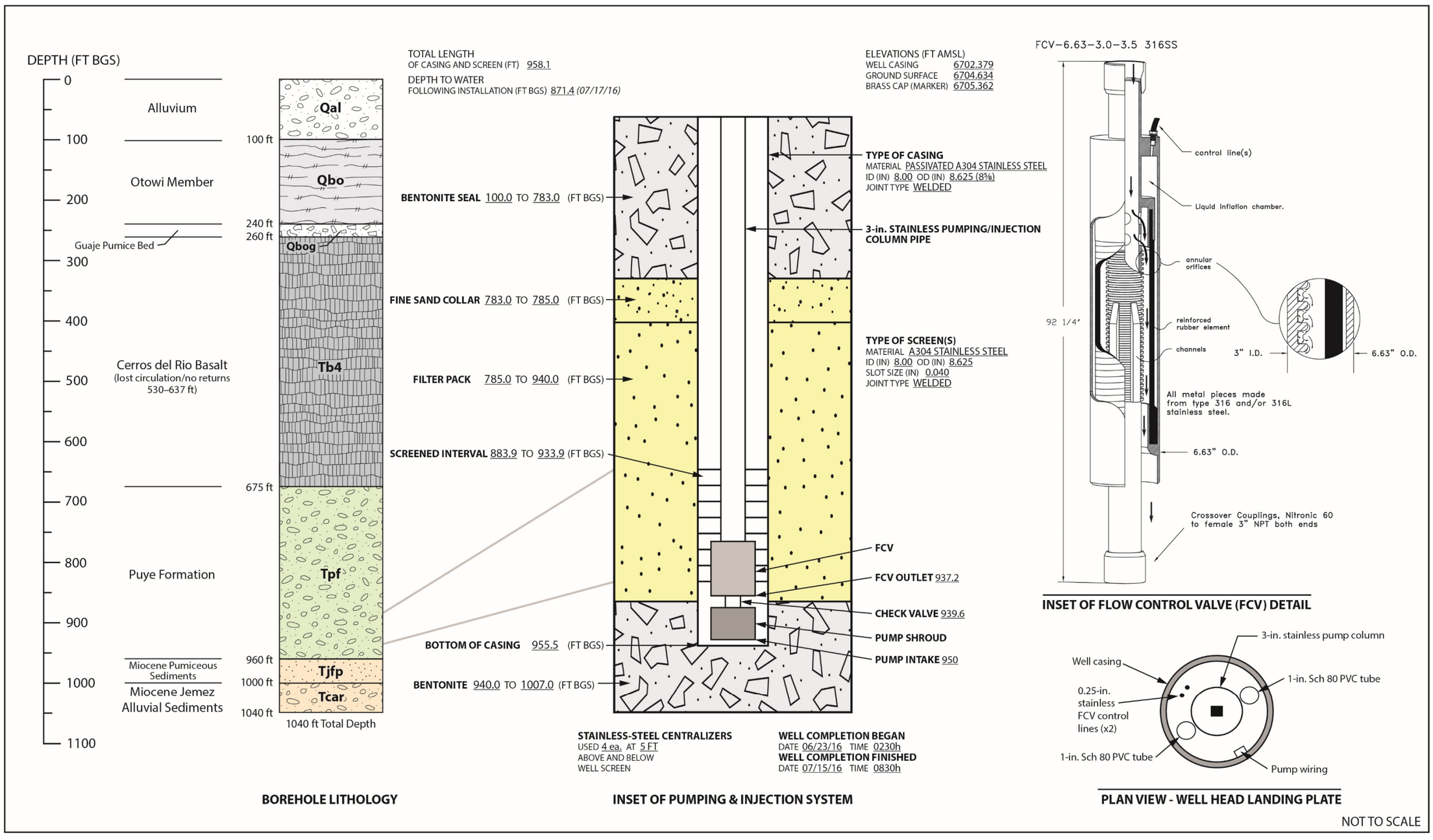


Figure 8.3-1a Injection well CrIN-1 as-built diagram with borehole lithology and technical well completion details

CrIN-1 TECHNICAL NOTES:

SURVEY INFORMATION *
Brass Marker
Northing: 1768296.963
Easting: 1640089.494
Elevation: 6705.362

Well Casing (top of well seal)
Northing: 1768293.719
Easting: 1640089.572
Elevation: 6702.379

Well Seal Thickness
0.09 ft.

BOREHOLE GEOPHYSICAL LOGS
Logger: Jet West Geophysical Services
Logs: Natural Gamma Ray, Neutron Density
Date: 06/20/2016

DRILLING INFORMATION
Drilling Company
Yellow Jacket Drilling, Inc.

Drill Rig
Foremost DR-24HD

Drilling Methods
Dual rotary fluid-assisted air rotary

Drilling Fluids
Air, potable water, AQF foam

MILESTONE DATES
Drilling
Start: 05/25/2016
Finished: 06/21/2016

Well Completion
Start: 06/23/2016
Finished: 07/13/2016

Well Development
Start: 07/14/2016
Finished: 07/18/2016

WELL DEVELOPMENT
Development Methods
Swabbing, bailing, and pumping

Parameter Measurements (Final)
pH: 7.74
Temperature: 19.61˚C
Turbidity: 0.9 NTU

AQUIFER TESTING
Step Tests
Pumping Rates: 30, 50, 70 gpm
Performed on: 07/18/2016
24-h Constant-Rate Pumping Test
Water Produced: 106,440 gal.
Pumping Rate: 70 gpm
Performed on: 07/19/2016–07/20/2016

DEDICATED HARDWARE
Pump
Make: Grundfos
Type: 85S300-26

Motor
Make: Franklin Electric
Model: 2366168120

Flow Control Valve
Make: Baski, 6-5/8-in.
S/N: 28732

Pump Column
3-inch, sch. 80, 304 stainless steel, spline lock couplings

Gauge Tubes
2 X 1.0-in. flush threaded sch. 80 PVC

Transducer
Make: In-Situ Level TROLL
Model: LT 500
Range: 100 psig/231 ft
S/N: TBD

NOTE:
* Coordinates based on New Mexico State Plane Grid Coordinates, Central Zone (NAD83); Elevation expressed in feet amsl using the National Geodetic Vertical Datum of 1929.

Figure 8.3-1b As-built technical notes for injection well CrIN-1

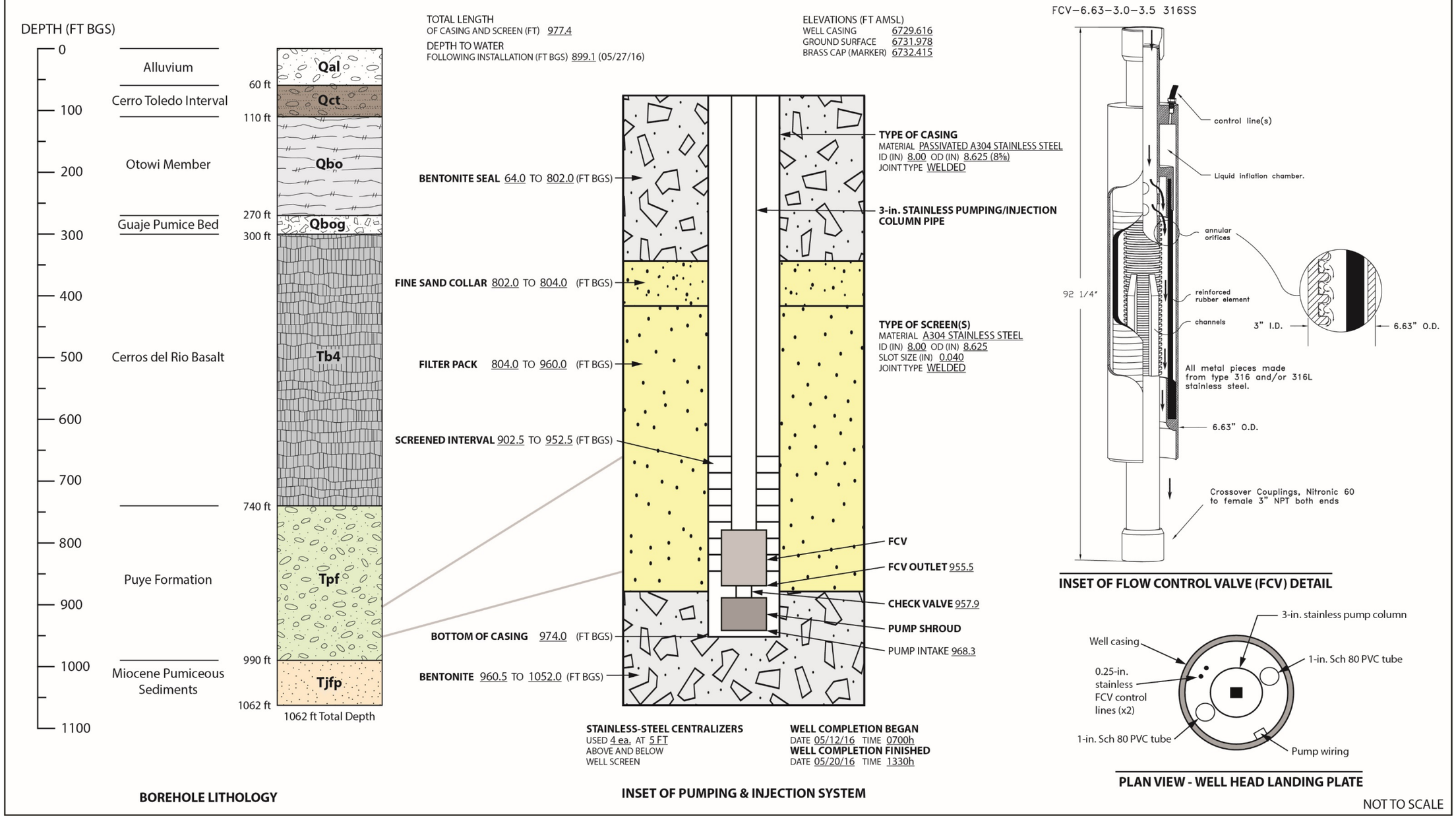


Figure 8.3-2a Injection well CrIN-2 as-built diagram with borehole lithology and technical well completion details

CrIN-2 TECHNICAL NOTES:

SURVEY INFORMATION *
Brass Marker
Northing: 1767800.805
Easting: 1639791.482
Elevation: 6732.415

Well Casing (top of well seal)
Northing: 1767797.468
Easting: 1639791.835
Elevation: 6729.616

Well Seal Thickness
0.09 ft.

BOREHOLE GEOPHYSICAL LOGS
Logger: Jet West Geophysical Services
Logs: Natural Gamma Ray, Neutron Density
Date: 05/09/2016

DRILLING INFORMATION
Drilling Company
Yellow Jacket Drilling, Inc.

Drill Rig
Foremost DR-24HD

Drilling Methods
Dual rotary fluid-assisted air rotary

Drilling Fluids
Air, potable water, AQF foam

MILESTONE DATES
Drilling
Start: 04/16/2016
Finished: 05/10/2016

Well Completion
Start: 05/12/2016
Finished: 05/20/2016

Well Development
Start: 05/25/2016
Finished: 05/30/2016

WELL DEVELOPMENT
Development Methods
Swabbing, bailing, and pumping

Parameter Measurements (Final)
pH: 7.75
Temperature: 20.52˚C
Turbidity: 0.8 NTU

AQUIFER TESTING
Step Tests
Pumping Rates: 30, 50, 70 gpm
Performed on: 05/31/2016
24-h Constant-Rate Pumping Test
Water Produced: 83,080 gal.
Pumping Rate: 58 gpm
Performed on: 06/01/2016–06/02/2016

DEDICATED HARDWARE
Pump
Make: Grundfos
Type: 85S300-26

Motor
Make: Franklin Electric
Model: 2366168120

Flow Control Valve
Make: Baski, 6-5/8-in.
S/N: 28733

Pump Column
3-inch, sch. 80, 304 stainless steel, spline lock couplings

Gauge Tubes
2 X 1.0-in. flush threaded sch. 80 PVC

Transducer
Make: In-Situ Level TROLL
Model: LT 500
Range: 100 psig/231 ft
S/N: TBD

NOTE:
* Coordinates based on New Mexico State Plane Grid Coordinates, Central Zone (NAD83); Elevation expressed in feet amsl using the National Geodetic Vertical Datum of 1929.

Figure 8.3-2b As-built technical notes for injection well CrIN-2

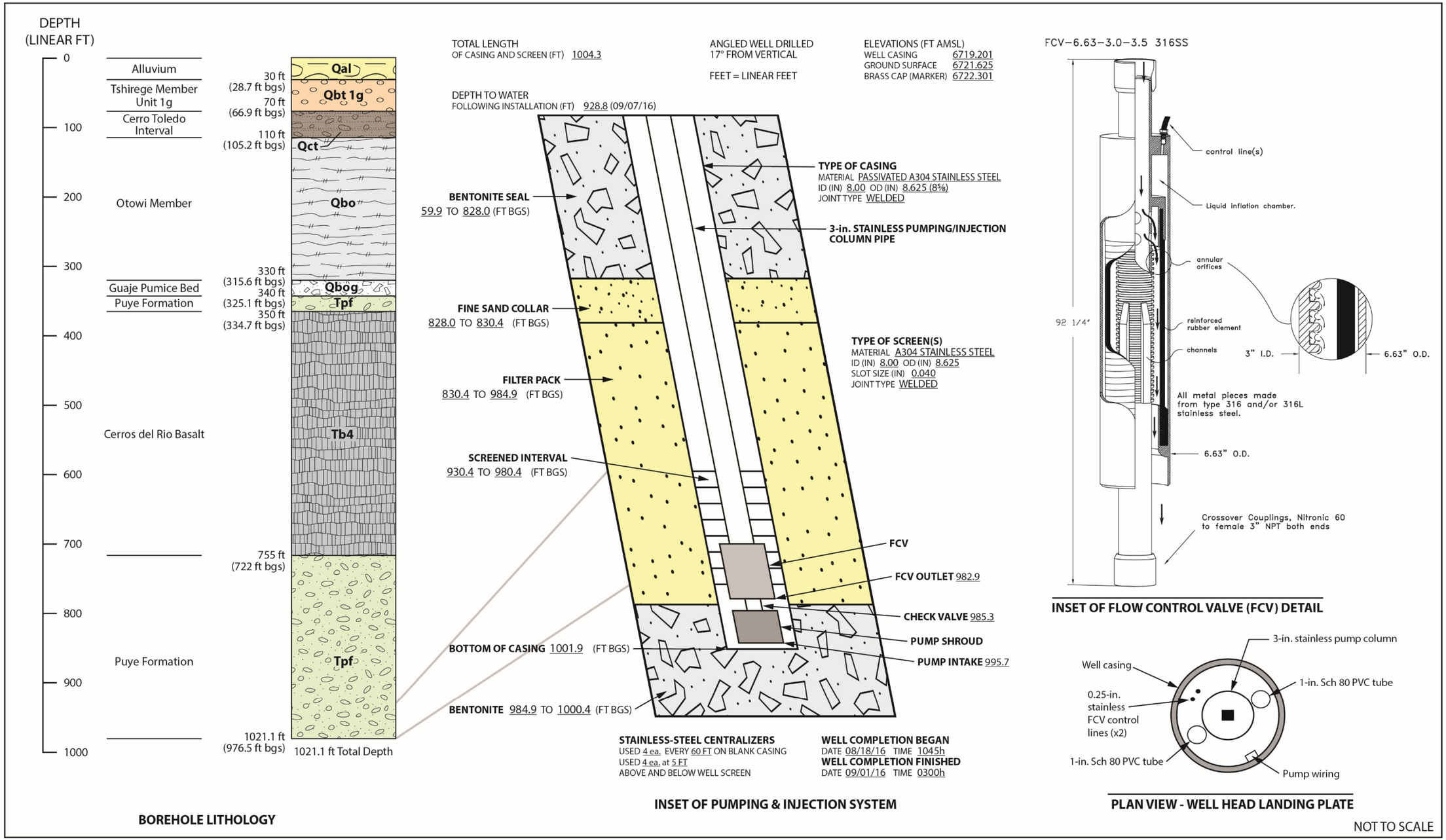


Figure 8.3-3a Injection well CrIN-3 as-built diagram with borehole lithology and technical well completion details

CrIN-3 TECHNICAL NOTES:

SURVEY INFORMATION *
Brass Marker
Northing: 1767139.006
Easting: 1639887.412
Elevation: 6722.301

Well Casing (top of well seal)
Northing: 1767135.850
Easting: 1639888.440
Elevation: 6719.201

Well Seal Thickness
0.08 ft.

BOREHOLE GEOPHYSICAL LOGS
Logger: Jet West Geophysical Services
Logs: Natural Gamma Ray, Neutron Density
Date: 08/15/2016

DRILLING INFORMATION
Drilling Company
Holt Services, Inc.

Drill Rig
Foremost DR-24HD

Drilling Methods
Dual rotary fluid-assisted air rotary

Drilling Fluids
Air, potable water, AQF foam, EZ Mud

MILESTONE DATES
Drilling
Start: 07/29/2016
Finished: 08/17/2016

Well Completion
Start: 08/18/2016
Finished: 09/01/2016

Well Development
Start: 09/03/2016
Finished: 09/07/2016

WELL DEVELOPMENT
Development Methods
Swabbing, bailing, and pumping

Parameter Measurements (Final)
pH: 7.73
Temperature: 19.97˚C
Turbidity: 1.3 NTU

AQUIFER TESTING
Step Tests
Pumping Rates: 50, 60, 80 gpm
Performed on: 09/08/2016
24-h Constant-Rate Pumping Test
Water Produced: 117,579 gal.
Pumping Rate: 81 gpm
Performed on: 09/08/2016–09/09/2016

DEDICATED HARDWARE
Pump
Make: Grundfos
Type: 85S300-26

Motor
Make: Franklin Electric
Model: 2366168120

Flow Control Valve
Make: Baski, 6-5/8-in.
S/N: 28865

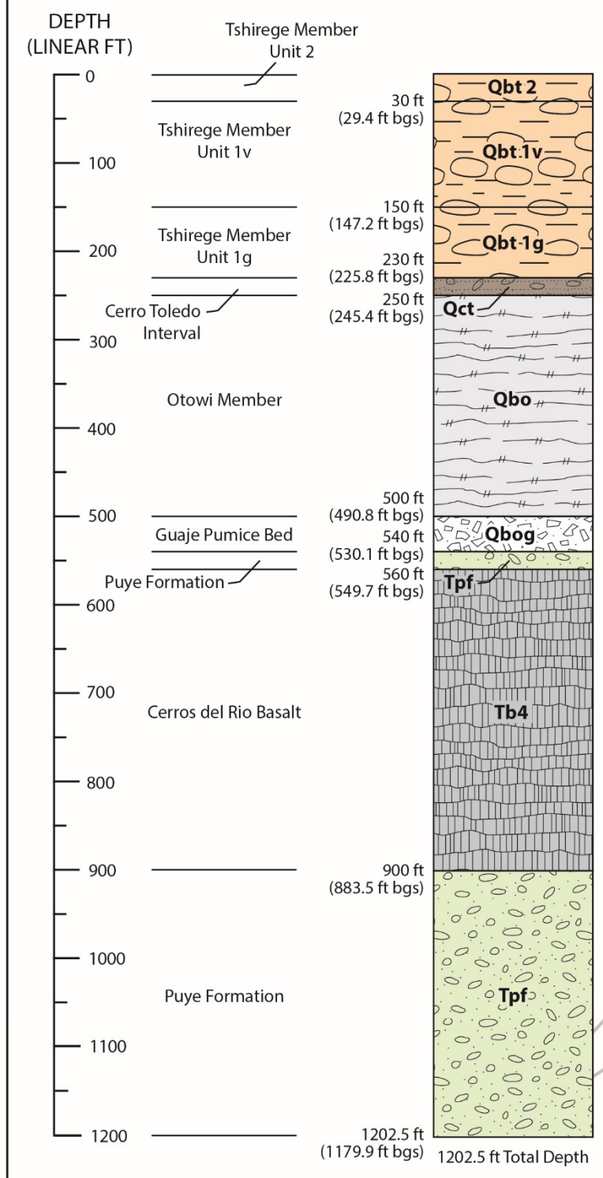
Pump Column
3-inch, sch. 80, 304 stainless steel, spline lock couplings

Gauge Tubes
2 X 1.0-in. flush threaded sch. 80 PVC

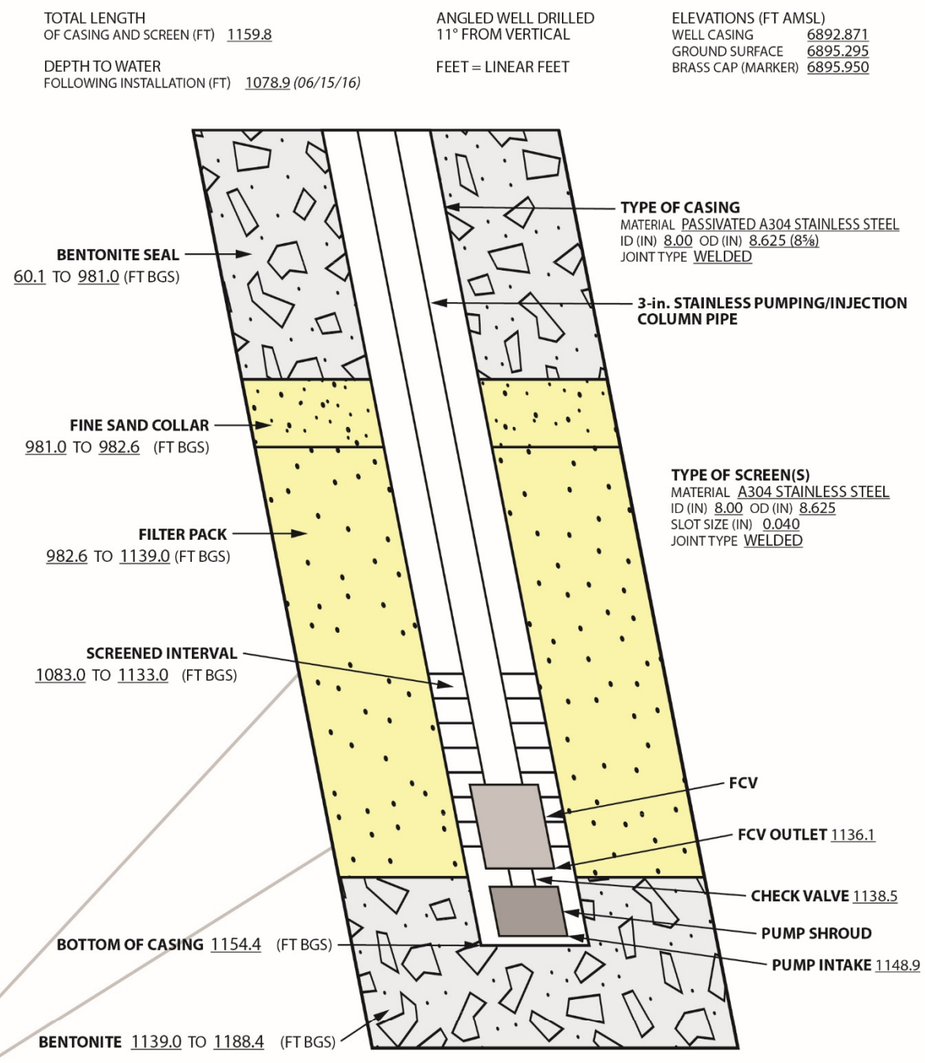
Transducer
Make: In-Situ Level TROLL
Model: LT 500
Range: 100 psig/231 ft
S/N: TBD

NOTE:
* Coordinates based on New Mexico State Plane Grid Coordinates, Central Zone (NAD83); Elevation expressed in feet amsl using the National Geodetic Vertical Datum of 1929.

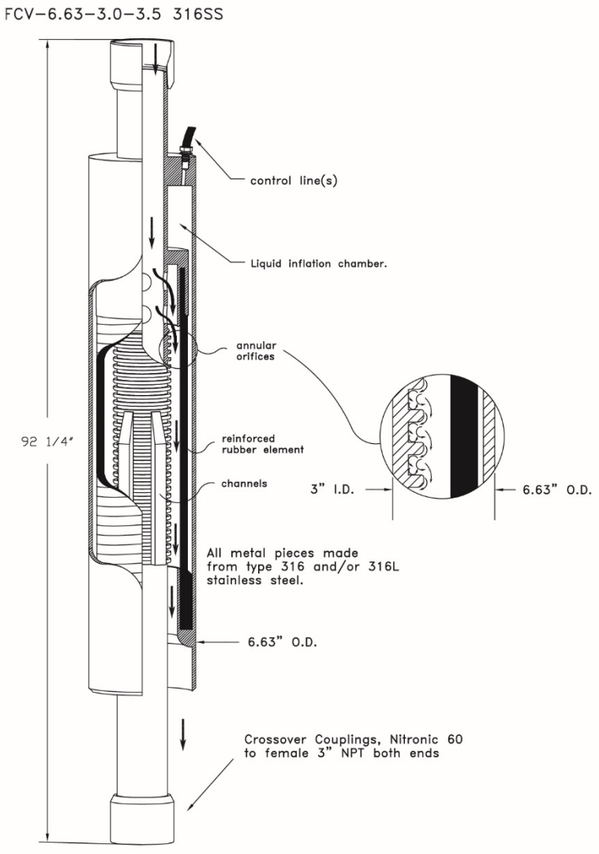
Figure 8.3-3b As-built technical notes for injection well CrIN-3



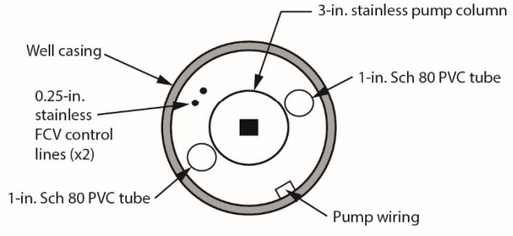
BOREHOLE LITHOLOGY



INSET OF PUMPING & INJECTION SYSTEM



INSET OF FLOW CONTROL VALVE (FCV) DETAIL



PLAN VIEW - WELL HEAD LANDING PLATE

NOT TO SCALE

Figure 8.3-4a Injection well CrIN-4 as-built diagram with borehole lithology and technical well completion details

CrIN-4 TECHNICAL NOTES:

SURVEY INFORMATION *
Brass Marker
Northing: 1767032.919
Easting: 1638863.128
Elevation: 6895.950

Well Casing (top of well seal)
Northing: 1767029.532
Easting: 1638871.688
Elevation: 6892.871

Well Seal Thickness
0.08 ft.

BOREHOLE GEOPHYSICAL LOGS
Logger: Jet West Geophysical Services
Logs: Natural Gamma Ray, Neutron Density
Date: 05/11/2016

DRILLING INFORMATION
Drilling Company
Holt Services, Inc.

Drill Rig
Foremost DR-24HD

Drilling Methods
Dual rotary fluid-assisted air rotary

Drilling Fluids
Air, potable water, AQF foam, EZ Mud

MILESTONE DATES
Drilling
Start: 03/28/2016
Finished: 05/10/2016

Well Completion
Start: 05/13/2016
Finished: 06/04/2016

Well Development
Start: 06/13/2016
Finished: 06/20/2016

WELL DEVELOPMENT
Development Methods
Swabbing, bailing, and pumping

Parameter Measurements (Final)
pH: 7.69
Temperature: 20.70˚C
Turbidity: 2.5 NTU

AQUIFER TESTING
Step Tests
Pumping Rates: 38, 60, 75 gpm
Performed on: 06/21/2016
24-h Constant-Rate Pumping Test
Water Produced: 88,847 gal.
Pumping Rate: 62 gpm
Performed on: 06/21/2016–06/22/2016

DEDICATED HARDWARE
Pump
Make: Grundfos
Type: 85S300-26

Motor
Make: Franklin Electric
Model: 2366168120

Flow Control Valve
Make: Baski, 6-5/8-in.
S/N: 28808

Pump Column
3-inch, sch. 80, 304 stainless steel, spline lock couplings

Gauge Tubes
2 X 1.0-in. flush threaded sch. 80 PVC

Transducer
Make: In-Situ Level TROLL
Model: LT 500
Range: 100 psig/231 ft
S/N: 464659

NOTE:
* Coordinates based on New Mexico State Plane Grid Coordinates, Central Zone (NAD83); Elevation expressed in feet amsl using the National Geodetic Vertical Datum of 1929.

Figure 8.3-4b As-built technical notes for injection well CrIN-4

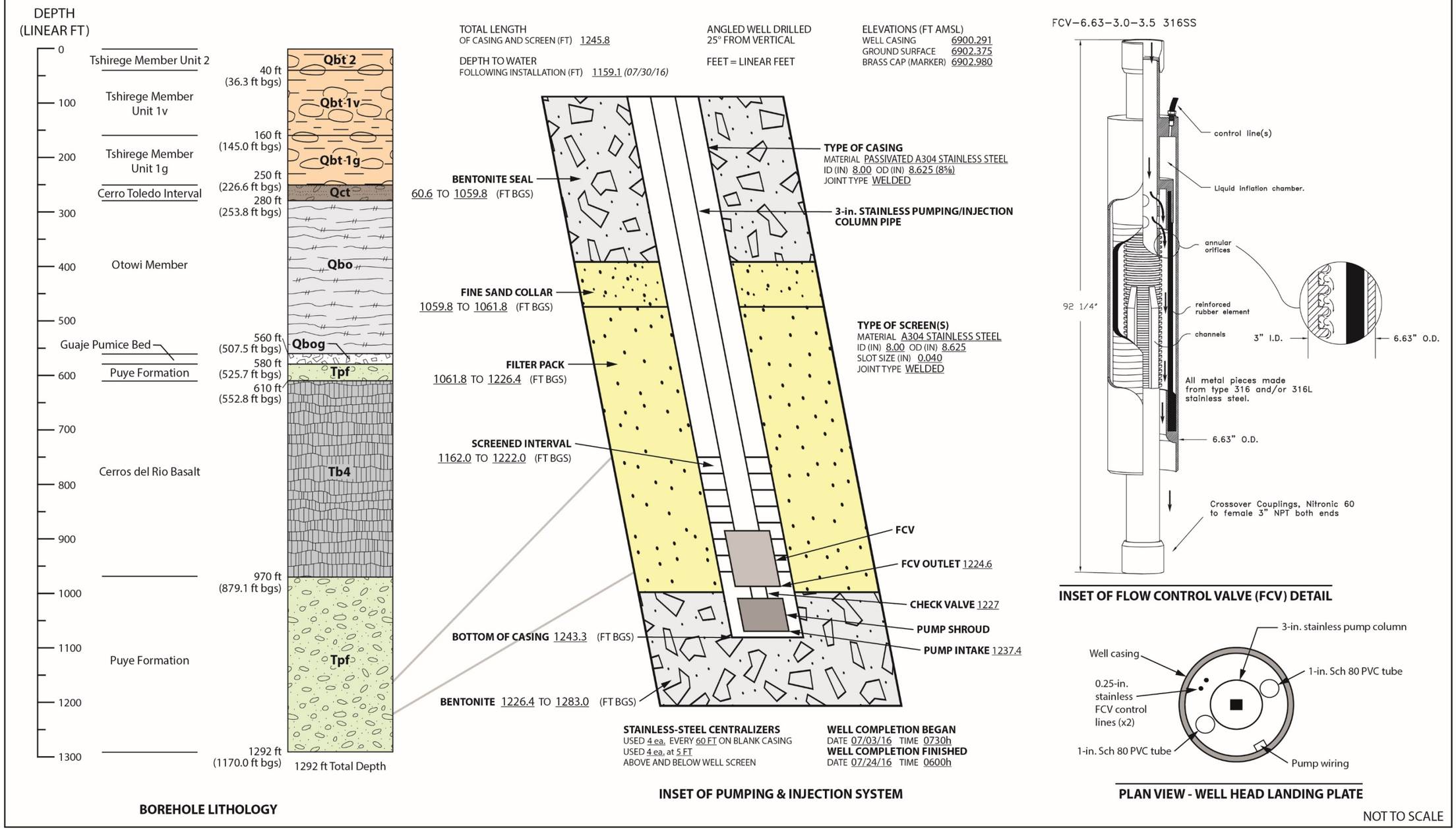


Figure 8.3-5a Injection well CrIN-5 as-built diagram with borehole lithology and technical well completion details

CrIN-5 TECHNICAL NOTES:

SURVEY INFORMATION *
Brass Marker
Northing: 1767025.241
Easting: 1638678.338
Elevation: 6902.980

Well Casing (top of well seal)
Northing: 1767023.434
Easting: 1638680.808
Elevation: 6900.291

Well Seal Thickness
0.08 ft.

BOREHOLE GEOPHYSICAL LOGS
Logger: Jet West Geophysical Services
Logs: Natural Gamma Ray, Neutron Density
Date: 07/01/2016

DRILLING INFORMATION
Drilling Company
Holt Services, Inc.

Drill Rig
Foremost DR-24HD

Drilling Methods
Dual rotary fluid-assisted air rotary

Drilling Fluids
Air, potable water, AQF foam, EZ Mud

MILESTONE DATES
Drilling
Start: 06/09/2016
Finished: 07/01/2016

Well Completion
Start: 07/03/2016
Finished: 07/24/2016

Well Development
Start: 07/26/2016
Finished: 08/02/2016

WELL DEVELOPMENT
Development Methods
Swabbing, bailing, and pumping

Parameter Measurements (Final)
pH: 6.87
Temperature: 21.33˚C
Turbidity: 0.0 NTU

AQUIFER TESTING
Step Tests
Pumping Rates: 32, 50, 68 gpm
Performed on: 08/03/2016
24-h Constant-Rate Pumping Test
Water Produced: 88,435 gal.
Pumping Rate: 61 gpm
Performed on: 08/03/2016–08/04/2016

DEDICATED HARDWARE
Pump
Make: Grundfos
Type: 85S300-26

Motor
Make: Franklin Electric
Model: 2366168120

Flow Control Valve
Make: Baski, 6-5/8-in.
S/N: 28807

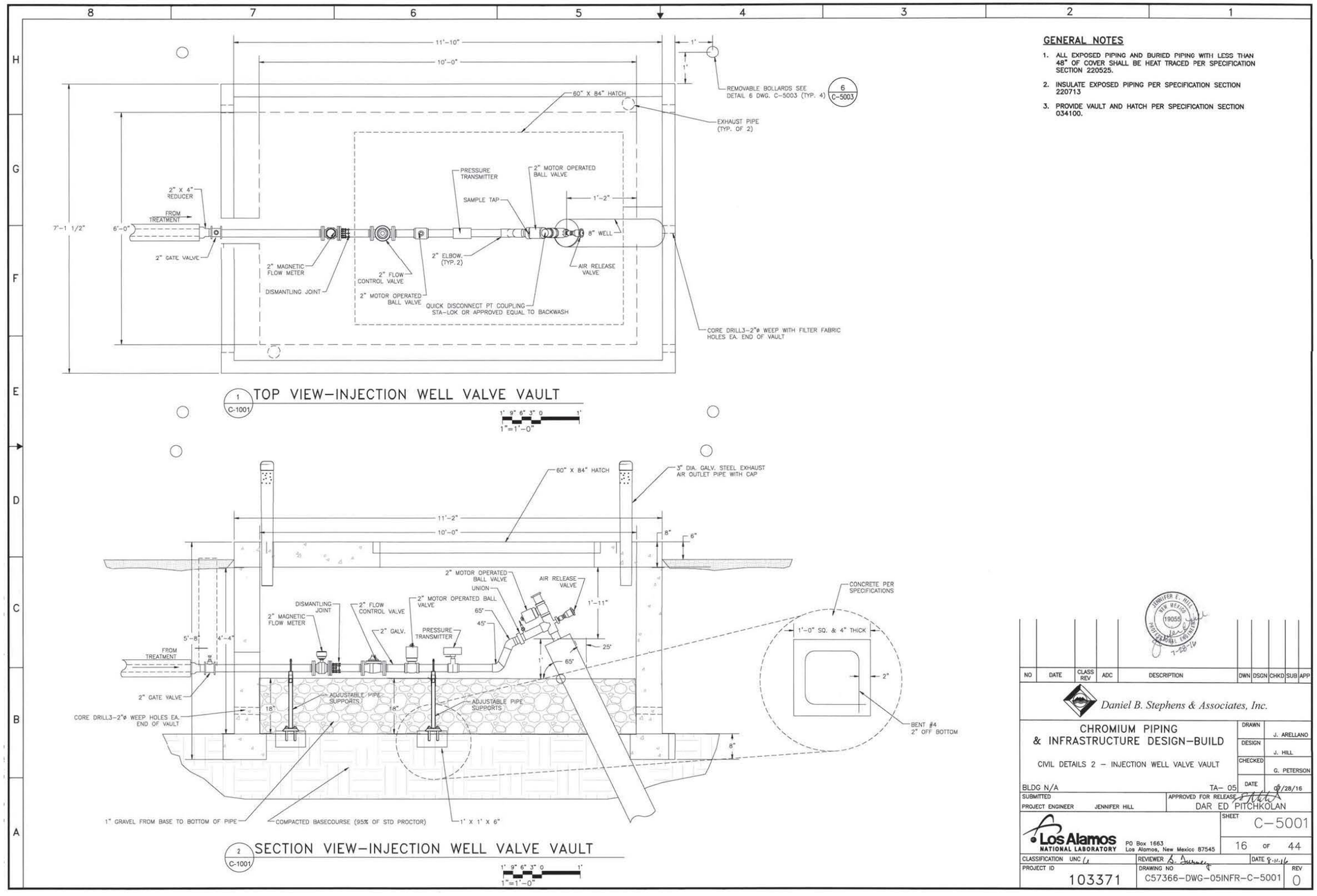
Pump Column
3-inch, sch. 80, 304 stainless steel, spline lock couplings

Gauge Tubes
2 X 1.0-in. flush threaded sch. 80 PVC

Transducer
Make: In-Situ Level TROLL
Model: LT 500
Range: 100 psig/231 ft
S/N: 464415

NOTE:
* Coordinates based on New Mexico State Plane Grid Coordinates, Central Zone (NAD83); Elevation expressed in feet amsl using the National Geodetic Vertical Datum of 1929.

Figure 8.3-5b As-built technical notes for injection well CrIN-5



GENERAL NOTES

1. ALL EXPOSED PIPING AND BURIED PIPING WITH LESS THAN 48" OF COVER SHALL BE HEAT TRACED PER SPECIFICATION SECTION 220525.
2. INSULATE EXPOSED PIPING PER SPECIFICATION SECTION 220713
3. PROVIDE VAULT AND HATCH PER SPECIFICATION SECTION 034100.

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP

Daniel B. Stephens & Associates, Inc.

CHROMIUM PIPING & INFRASTRUCTURE DESIGN-BUILD

CIVIL DETAILS 2 – INJECTION WELL VALVE VAULT

DRAWN J. ARELLANO
DESIGN J. HILL
CHECKED G. PETERSON
DATE 07/28/16

BLDG N/A TA- 05

SUBMITTED PROJECT ENGINEER JENNIFER HILL

APPROVED FOR RELEASE DAR ED PITCHKOLAN

Los Alamos NATIONAL LABORATORY PO Box 1663 Los Alamos, New Mexico 87545

SHEET C-5001

16 OF 44

CLASSIFICATION UNC REVIEWER DATE 8-11-16

PROJECT ID 103371

DRAWING NO C57366-DWG-05INFR-C-5001

REV 0

Figure 8.4-1 Surface completion of injection well vaults

Table 3.2-1
Chronological Drilling Milestone Dates

Well	Drilling Start	Drilling Finish	Well Construction Start	Well Construction Finish
CrIN-4	3/28/2016	5/10/2016	5/13/2016	6/04/2016
CrIN-2	4/16/2016	5/10/2016	5/12/2016	5/20/2016
CrIN-1	5/25/2016	6/21/2016	6/23/2016	7/15/2016
CrIN-5	6/09/2016	7/01/2016	7/03/2016	7/24/2016
CrIN-3	7/29/2016	8/17/2016	8/18/2016	9/01/2016

Table 6.0-1
Logging Runs

Date(s)	Location	Type of Log	Depth (ft bgs)	Description
4/23/2016	CrIN-4	Video	0–729	View broken underreamer.
5/09/2016	CrIN-2	Gamma ray and neutron	0–1051	JWGS cased hole stacked gamma ray and neutron density to TD.
5/11/2016	CrIN-4	Gamma ray and neutron	0-1193	JWGS cased hole stacked gamma ray and neutron density to TD.
6/20/2016	CrIN-1	Gamma ray and neutron	0–1011	JWGS cased hole stacked gamma ray and neutron density to TD.
6/27/2016	CrIN-1	Video	0–985	View condition of casing cut.
7/01/2016	CrIN-5	Gamma ray and neutron	0–1281	JWGS cased hole stacked gamma ray and neutron density to TD.
8/09/2016	CrIN-4	Video	0–1154	As-built video to document completion condition.
8/09/2016	CrIN-2	Video	0–974	As-built video to document completion condition.
8/10/2016	CrIN-1	Video	0–955	As-built video to document completion condition.
8/15/2016	CrIN-3	Gamma ray and neutron	0–1003	JWGS cased hole stacked gamma ray and neutron density to TD.
9/23/2016	CrIN-5	Video	0–1243	As-built video to document completion condition.
10/13/2016	CrIN-3	Video	0–1001	As-built video to document completion condition.

Table 7.2-1
CrIN-1 Injection Well Annular Fill Materials

Material	Volume
Upper surface seal: cement slurry	193.3 ft^3
Upper bentonite seal: bentonite chips	706.9 ft^3
Fine sand collar: 20/40 silica sand	2.5 ft^3
Filter pack: 10/20 silica sand	244.0 ft^3
Backfill: bentonite chips	95.8 ft^3

Table 7.2-2
CrIN-2 Injection Well Annular Fill Materials

Material	Volume
Upper surface seal: cement slurry	86.7 ft^3
Upper bentonite seal: bentonite chips	928.6 ft^3
Fine sand collar: 20/40 silica sand	3.0 ft^3
Filter pack: 10/20 silica sand	277.0 ft^3
Backfill: bentonite chips	100.5 ft^3

Table 7.2-3
CrIN-3 Injection Well Annular Fill Materials

Material	Volume
Upper surface seal: cement slurry	110.0 ft^3
Upper bentonite seal: bentonite chips	1002.4 ft^3
Fine sand collar: 20/40 silica sand	1.5 ft^3
Filter pack: 10/20 silica sand	145.0 ft^3
Backfill: bentonite chips	12.6 ft^3

Table 7.2-4
CrIN-4 Injection Well Annular Fill Materials

Material	Volume
Upper surface seal: cement slurry	116.6 ft^3
Upper bentonite seal: bentonite chips	1239.5 ft^3
Fine sand collar: 20/40 silica sand	1.5 ft^3
Filter pack: 10/20 silica sand	158.0 ft^3
Backfill: bentonite chips	48.5 ft^3

Table 7.2-5
CrIN-5 Injection Well Annular Fill Materials

Material	Volume
Upper surface seal: cement slurry	115.5 ft^3
Upper bentonite seal: bentonite chips	1394.4 ft^3
Fine sand collar: 20/40 silica sand	1.5 ft^3
Filter pack: 10/20 silica sand	167.5 ft^3
Backfill: bentonite chips and 10/20 silica sand	43.5 ft^3

Table 8.1-1
Field Water-Quality Parameters and Well Performance for Development of Well CrIN-1

Date	Time	Pumping Rate (gpm[a])	Depth to Water (ft bgs)	Drawdown (ft)	Cumulative Purge Volume (gal.)	pH	Turbidity (NTU[b])	Temperature (Degree C)
Well Development								
7/17/2016	9:15	0	876.51	0.00	0	n/a[c]	n/a	n/a
	9:45	27	881.59	5.08	n/a	n/a	n/a	n/a
	10:01	27	882.15	5.64	150	4.18	97.7	19.14
	10:30	27	882.25	5.74	810	7.39	33	20.32
	10:45	27	882.39	5.88	1210	7.3	27.2	20.07
	11:00	27	882.33	5.82	1600	7.38	21.7	19.68
	11:15	40	883.50	6.99	1980	7.39	17.2	19.38
	11:30	40	884.88	8.37	2680	7.44	20.7	19.52
	11:45	40	885.04	8.53	3330	7.51	27.4	21.97
	12:00	40	885.21	8.70	4010	7.56	24.2	22.05
	12:15	40	885.21	8.70	4650	7.59	15.1	23.08
	12:30	40	885.19	8.68	5330	7.55	9.05	25.53
	12:45	40	885.18	8.67	6060	7.57	9.32	27.73
	13:00	40	885.12	8.61	6730	7.58	8.85	27.95
	13:15	40	885.16	8.65	7410	7.59	8.01	28.34
	14:00	40	886.32	9.81	7410	n/a	n/a	n/a
	14:15	40	886.29	9.78	8410	n/a	9.32	25.47
	14:30	40	886.30	9.79	9050	5.18	7.81	19.48
	14:45	40	886.31	9.80	9710	7.37	7.32	21.51
	15:00	40	886.28	9.77	10370	7.57	5.39	20.24
	15:15	40	886.20	9.69	11070	7.59	4.87	22.4
	15:30	40	886.21	9.70	11730	7.66	5.83	22.15
	15:45	40	886.23	9.72	12440	7.66	3.74	22.52
	16:00	40	886.23	9.72	13140	7.65	4.89	22.97
	16:15	40	886.24	9.73	13760	7.63	3.81	23.87
	16:30	40	886.23	9.72	14440	7.65	2.79	23.41
	16:45	40	886.25	9.74	15160	7.63	2.13	22.63
	17:00	40	886.24	9.73	15810	7.63	2.9	22.28
	17:45	60	887.64	11.13	n/a	n/a	n/a	n/a
	17:55	60	887.32	10.81	17060	7.60	5.91	23.87
	18:15	60	887.33	10.82	18240	7.66	5.55	24.17
	18:30	60	887.99	11.48	19180	7.67	3.15	24.82

Table 8.1-1 (continued)

Date	Time	Pumping Rate (gpm[a])	Depth to Water (ft bgs)	Drawdown (ft)	Cumulative Purge Volume (gal.)	pH	Turbidity (NTU[b])	Temperature (Degree C)
Well Development								
7/17/2016	18:45	60	887.99	11.48	20180	7.66	3.97	24.73
	19:00	75	890.44	13.93	21320	7.66	1.77	32.61
	19:15	75	890.72	14.21	22360	7.66	5.72	23.69
	19:30	75	890.80	14.29	23485	n/a	3.97	22.57
	19:35	75	n/a	n/a	23950	n/a	n/a	n/a
7/18/2016	7:45	0	876.67	0.00	23950	n/a	n/a	n/a
	8:10	70	888.64	11.97	24760	n/a	n/a	n/a
	8:15	70	889.24	12.57	25000	6.52	4.4	20.67
	8:30	70	889.84	13.17	26100	6.97	3.38	20.58
	8:45	70	889.98	13.31	27190	7.24	1.34	21.35
	9:15	n/a	890.06	13.39	29320	7.45	3.04	20.37
	9:30	n/a	886.85	10.18	30230	7.5	2.33	21.59
	9:45	n/a	n/a	n/a	31870	7.54	2.29	21.73
24-h Aquifer Test								
7/19/2016	9:00	70	879.63	7.95	41610	n/a	n/a	n/a
	9:15	70	884.23	12.55	42740	7.64	1.98	19.20
	9:30	70	884.68	13.00	43800	7.77	1.44	19.56
	9:45	70	884.79	13.11	44920	7.75	1.70	20.04
	10:00	70	884.84	13.16	46010	7.74	1.54	20.46
	10:15	70	884.84	13.16	47130	7.75	1.29	20.70
	10:30	70	884.86	13.18	48240	7.75	1.84	20.79
	10:45	70	884.85	13.17	49350	7.74	1.15	21.19
	11:00	70	884.84	13.16	50460	7.73	1.75	20.20
	11:15	70	884.83	13.15	51570	7.73	1.25	20.38
	11:30	70	884.82	13.14	52660	7.74	1.56	21.75
	11:45	70	884.82	13.14	53780	7.73	1.45	22.28
	12:00	70	884.80	13.12	54880	7.73	1.55	22.88
	12:15	70	884.79	13.11	56000	7.73	1.23	23.33
	12:30	70	884.76	13.08	57110	7.73	1.84	23.62
	12:45	70	884.74	13.06	58220	7.74	1.45	24.06
	13:00	70	884.72	13.04	59330	7.73	1.93	23.16
	13:15	70	884.70	13.02	60460	7.74	1.26	23.87
	13:30	70	884.67	12.99	61550	7.74	1.36	24.56
	13:45	70	884.67	12.99	62670	7.75	1.45	24.29

Table 8.1-1 (continued)

Date	Time	Pumping Rate (gpm[a])	Depth to Water (ft bgs)	Drawdown (ft)	Cumulative Purge Volume (gal.)	pH	Turbidity (NTU[b])	Temperature (Degree C)
24-h Aquifer Test								
7/19/2016	14:00	70	884.63	12.95	63770	7.73	0.72	21.21
	14:18	70	884.61	12.93	65170	7.81	1.32	21.46
	14:30	70	884.60	12.92	66010	7.50	1.90	19.37
	14:45	70	884.56	12.88	67140	7.77	0.42	20.00
	15:00	70	884.54	12.86	68240	7.76	0.64	19.85
	15:15	70	884.53	12.85	69340	7.76	1.86	19.90
	15:30	70	884.51	12.83	70460	7.76	0.76	20.68
	15:45	70	884.48	12.80	71560	7.76	1.28	20.75
	16:00	70	884.47	12.79	72640	7.76	0.97	21.85
	16:15	70	884.43	12.75	73740	7.77	1.38	23.25
	16:30	70	884.41	12.73	74860	7.76	0.75	23.32
7/19/2016	16:45	70	884.40	12.72	75970	7.77	1.04	23.32
	17:00	70	884.38	12.70	77070	7.78	1.08	23.84
	17:15	70	884.35	12.67	78200	7.78	0.74	24.49
	17:30	70	884.35	12.67	79320	7.80	0.70	21.21
	17:45	70	884.32	12.64	80420	7.78	0.73	21.37
	18:00	70	884.30	12.62	81520	7.80	0.81	21.43
	18:15	70	884.28	12.60	82660	7.77	1.05	21.04
	18:30	70	884.26	12.58	83850	7.76	0.59	20.68
	18:45	70	884.24	12.56	84850	7.74	0.63	20.20
	19:00	70	884.23	12.55	85970	7.74	0.76	21.09
	19:15	70	884.22	12.54	87090	7.76	0.87	21.77
	19:35	70	884.21	12.53	88450	7.72	0.64	21.53
	19:45	70	884.20	12.52	87470	7.70	0.85	20.92
	20:00	70	884.21	12.53	90400	7.66	1.74	19.21
	20:15	70	884.19	12.51	91470	7.69	0.82	19.75
	20:30	70	884.18	12.50	92600	7.69	1.07	19.63
	20:45	70	884.17	12.49	93740	7.68	0.60	19.63
	21:00	70	884.14	12.46	94880	7.68	0.57	19.61
	21:15	70	884.12	12.44	95890	7.69	0.67	19.71
	21:30	70	884.13	12.45	97070	7.69	0.56	19.70
	21:45	70	884.10	12.42	98080	7.69	0.92	19.66
	22:00	70	884.09	12.41	101220	7.70	0.58	19.66

Table 8.1-1 (continued)

Date	Time	Pumping Rate (gpm[a])	Depth to Water (ft bgs)	Drawdown (ft)	Cumulative Purge Volume (gal.)	pH	Turbidity (NTU[b])	Temperature (Degree C)
24-h Aquifer Test								
7/19/2016	22:15	70	884.09	12.41	100410	7.69	0.61	19.40
	22:30	70	884.08	12.40	101540	7.68	0.65	19.30
	22:45	70	884.06	12.38	102520	7.70	0.48	19.22
	23:00	70	884.05	12.37	103590	7.70	0.57	19.27
	23:15	70	884.04	12.36	104740	7.71	0.58	19.23
	23:30	70	884.04	12.36	105810	7.70	0.55	19.17
	23:45	70	884.04	12.36	106920	7.65	0.49	18.13
7/20/2016	0:00	70	884.03	12.35	108020	7.69	1.23	17.91
	0:15	70	884.01	12.33	109160	7.69	0.61	17.92
	0:30	70	884.00	12.32	110490	7.69	1.37	18.32
	0:45	70	883.99	12.31	111280	7.68	0.32	18.33
	1:00	70	884.00	12.32	112400	7.69	0.36	18.36
	1:15	70	883.96	12.28	113570	7.66	0.61	18.48
	1:30	70	883.93	12.25	114610	7.68	0.91	18.37
	1:45	70	883.91	12.23	115760	7.67	0.49	18.44
	2:00	70	883.90	12.22	116860	7.72	0.65	18.28
	2:15	70	883.90	12.22	117950	7.71	0.53	18.14
	2:30	70	883.87	12.19	119010	7.70	0.60	17.86
	2:45	70	883.86	12.18	120200	7.71	0.51	17.34
	3:00	70	883.84	12.16	121350	7.73	0.54	17.12
	3:15	70	883.84	12.16	122400	7.70	0.25	17.18
	3:30	70	883.80	12.12	123460	7.70	0.41	17.11
	3:45	70	883.80	12.12	124600	7.74	0.39	16.98
	4:00	70	883.79	12.11	125870	7.73	0.50	16.90
	4:15	70	883.76	12.08	126760	7.73	0.39	16.84
	4:30	70	883.75	12.07	127880	7.79	0.38	16.66
	4:45	70	883.72	12.04	128970	7.76	0.33	16.65
	5:00	70	883.72	12.04	130140	7.75	0.43	16.64
	5:15	70	883.71	12.03	131130	7.75	0.46	16.70
	5:30	70	883.71	12.03	132230	7.79	0.53	16.69
	5:45	70	883.69	12.01	133320	7.72	0.41	16.47
	6:00	70	883.66	11.98	134390	7.71	0.23	16.34
	6:15	70	883.69	12.01	135520	7.70	0.39	16.32

Table 8.1-1 (continued)

Date	Time	Pumping Rate (gpm[a])	Depth to Water (ft bgs)	Drawdown (ft)	Cumulative Purge Volume (gal.)	pH	Turbidity (NTU[b])	Temperature (Degree C)
24-h Aquifer Test								
7/20/2016	6:30	70	883.66	11.98	136630	7.69	0.48	16.56
	6:45	70	883.64	11.96	137730	7.73	0.38	16.72
	7:00	70	883.65	11.97	138890	7.72	0.47	17.02
	7:15	70	883.63	11.95	139920	7.72	0.28	17.58
	7:30	70	883.63	11.95	140990	7.74	0.47	18.20
	7:45	70	883.61	11.93	142150	7.76	0.40	18.71
	8:00	70	883.60	11.92	143190	7.75	0.55	18.83
	8:15	70	883.61	11.93	144300	7.74	0.21	18.98
	8:30	70	883.59	11.91	145390	7.75	0.86	19.20
	8:45	70	883.57	11.89	146530	7.74	0.37	19.42
	9:00	70	883.57	11.89	147610	7.74	0.90	19.61
	9:06	n/a	875.31	3.63	148050	n/a	n/a	n/a

[a] gpm = Gallon per minute

[b] NTU = Nephelometric turbidity unit.

[c] n/a = Not applicable.

Table 8.1-2
Field Water-Quality Parameters and Well Performance for Development of Well CrIN-2

Date	Time	Pumping Rate (gpm[a])	Depth to Water (ft bgs)	Drawdown (ft)	Cumulative Purge Volume (gal.)	pH	Turbidity (NTU[b])	Temperature (Degree C)
Well Development								
5/28/2016	12:40	0	903.91	0.00	0	n/a[c]	n/a	n/a
	12:45	80	912.26	8.35	60	8.09	NR[d]	20.25
	12:50	80	921.63	17.72	980	8.17	223.00	20.11
	13:00	80	912.95	9.04	1560	8.19	206.26	20.14
	13:05	40	909.51	5.60	1900	8.17	130.00	20.16
	13:15	40	909.30	5.39	2340	8.15	62.30	20.47
	13:25	40	909.29	5.38	2780	8.15	47.20	20.11
	13:35	40	909.31	5.40	3260	8.16	37.40	20.36
	13:47	40	909.40	5.49	3740	8.12	28.60	21.09
	13:57	40	909.35	5.44	4290	8.11	24.90	21.63
	14:12	35	908.22	4.31	4920	8.08	19.20	20.65
	14:27	35	909.93	6.02	5440	8.08	16.30	20.32
	14:42	35	907.63	3.72	5940	8.06	17.10	20.23
	14:57	35	907.64	3.73	6430	8.05	13.90	20.33
	16:05	27	905.10	1.19	6740	8.02	18.21	20.40
	16:15	27	905.55	1.64	7000	8.01	14.50	20.46
	16:30	27	905.58	1.67	7380	8.03	17.20	20.58
	16:45	27	905.58	1.67	7850	8.01	13.50	20.77
	17:05	27	906.40	2.49	8380	8.00	10.05	20.91
	17:15	27	906.42	2.51	8700	8.00	12.00	20.58
	17:30	27	906.52	2.61	9050	7.99	8.46	20.74
	17:45	27	906.32	2.41	9480	7.99	6.75	20.51
	18:00	27	906.38	2.47	9870	7.93	8.68	20.41
	18:15	27	906.35	2.44	10300	7.96	5.81	20.51
	18:30	27	906.34	2.43	10670	7.91	5.14	20.44
	18:45	27	906.24	2.33	11070	7.94	6.68	20.38
	19:00	27	906.21	2.30	11410	7.95	4.38	20.35
5/29/2016	8:50	0	902.56	0.00	11520	n/a	n/a	n/a
	9:15	27	906.19	3.63	11940	7.91	13.90	20.61
	9:30	27	906.30	3.74	12370	7.92	11.60	20.81
	9:50	27	906.21	3.65	12770	7.93	9.37	20.83
	10:10	27	906.09	3.53	13300	7.93	6.54	20.78
	11:30	27	906.12	3.56	14080	7.88	8.33	24.67

Table 8.1-2 (continued)

Date	Time	Pumping Rate (gpm[a])	Depth to Water (ft bgs)	Drawdown (ft)	Cumulative Purge Volume (gal.)	pH	Turbidity (NTU[b])	Temperature (Degree C)
Well Development								
5/29/2016	12:40	27	906.37	3.81	15450	7.89	7.96	21.61
	13:00	27	906.36	3.80	16430	7.87	3.29	21.52
	13:26	27	906.34	3.78	17140	7.87	2.65	21.34
	13:46	27	906.31	3.75	17700	7.85	2.88	21.77
	14:06	27	906.37	3.81	18250	7.83	1.82	23.37
	14:26	27	906.51	3.95	18910	7.84	1.71	26.12
	14:50	27	906.38	3.82	19700	7.83	3.75	26.65
	15:10	27	906.32	3.76	20310	7.84	1.08	29.83
	15:30	27	906.35	3.79	20910	7.83	1.76	31.62
	16:20	50	n/a	n/a	21150	n/a	n/a	n/a
	16:35	50	909.85	7.29	21920	n/a	n/a	n/a
	16:37	50	909.84	7.28	22040	n/a	n/a	n/a
	16:40	50	909.85	7.29	22220	n/a	n/a	n/a
	17:00	50	903.30	0.74	22850	n/a	n/a	n/a
	17:25	50	909.85	7.29	23070	n/a	n/a	n/a
	17:40	60	903.21	0.65	23100	n/a	n/a	n/a
	17:50	60	910.84	8.28	23800	n/a	n/a	n/a
	17:56	60	910.93	8.37	24190	n/a	n/a	n/a
	18:00	60	910.94	8.38	24410	n/a	n/a	n/a
	18:10	0	903.10	0.54	24410	n/a	n/a	n/a
	18:15	60	n/a	n/a	24490	n/a	n/a	n/a
	18:25	60	910.94	8.38	25200	7.80	4.02	26.37
	18:30	0	n/a	n/a	25510	n/a	n/a	n/a
	18:46	60	n/a	n/a	25540	n/a	n/a	n/a
	18:50	60	910.53	7.97	25830	7.90	1.95	20.33
	19:00	60	n/a	n/a	26480	7.83	2.23	20.34
5/30/2016	8:50	0	902.57	0.00	26580	n/a	n/a	n/a
	9:00	60	909.71	7.14	26820	7.80	40.90	18.43
	9:15	60	910.08	7.51	27800	7.82	6.16	20.15
	9:35	60	910.12	7.55	29120	7.84	2.07	20.22
	9:50	60	910.03	7.46	30710	7.83	2.12	20.21
	10:05	60	910.15	7.58	31100	7.84	1.94	20.23
	10:20	60	910.15	7.58	32090	7.85	1.41	20.27

Table 8.1-2 (continued)

Date	Time	Pumping Rate (gpm[a])	Depth to Water (ft bgs)	Drawdown (ft)	Cumulative Purge Volume (gal.)	pH	Turbidity (NTU[b])	Temperature (Degree C)
Well Development								
5/30/2016	10:30	60	910.15	7.58	32760	7.83	0.45	20.26
	11:35	60	910.48	7.91	34160	7.83	1.86	20.40
	11:50	66	910.44	7.87	35210	7.82	0.71	20.44
	12:05	66	910.49	7.92	36200	7.82	0.66	20.47
	12:20	66	910.44	7.87	37220	7.82	0.62	20.51
	12:35	66	910.44	7.87	38240	7.81	0.49	20.47
	12:50	70	910.41	7.84	39350	7.80	0.64	20.52
	13:05	70	911.33	8.76	40480	7.80	0.13	20.46
	13:20	70	911.38	8.81	41620	7.80	0.13	20.49
	13:35	71	911.39	8.82	42750	7.79	0.60	20.50
	14:00	40	907.80	5.23	44100	7.80	0.22	20.49
	14:15	40	907.79	5.22	44840	7.80	0.05	20.50
	14:35	40	907.74	5.17	45680	7.80	0.02	20.48
Step Test								
5/31/2016	11:50	0	902.82	0.00	46050	n/a	n/a	n/a
	12:00	30	902.82	0.00	46050	n/a	n/a	n/a
	12:15	30	907.88	5.06	46530	7.79	0.46	20.30
	12:30	30	907.82	5.00	47030	7.75	0.38	20.44
	12:45	30	907.89	5.07	47510	7.76	1.01	20.43
	12:55	30	907.89	5.07	47790	7.75	0.62	20.36
	13:00	0	n/a	n/a	48070	n/a	n/a	n/a
	14:00	50	903.85	1.03	48070	n/a	n/a	n/a
	14:15	50	910.15	7.33	48900	7.79	0.19	20.27
	14:30	50	910.15	7.33	49750	7.79	0.61	20.30
	14:45	50	910.14	7.32	50610	7.77	0.68	20.28
	15:00	0	n/a	n/a	51440	n/a	n/a	n/a
	16:00	70	n/a	n/a	51440	n/a	n/a	n/a
	16:37	70	912.16	9.34	51440	7.79	2.39	20.29
	16:52	70	912.41	9.59	52680	7.77	1.02	20.34
	17:07	70	912.46	9.64	53790	7.76	1.41	20.36
	17:22	70	921.44	18.62	54840	7.76	0.97	20.35
	17:30	70	921.45	18.63	55430	7.76	1.43	20.39
24-h Aquifer Test								
6/1/2016	9:58	0	903.93	0.00	55970	n/a	n/a	n/a
	10:00	50	903.93	0.00	55970	n/a	n/a	n/a

Table 8.1-2 (continued)

Date	Time	Pumping Rate (gpm[a])	Depth to Water (ft bgs)	Drawdown (ft)	Cumulative Purge Volume (gal.)	pH	Turbidity (NTU[b])	Temperature (Degree C)
24-h Aquifer Test								
6/1/2016	10:15	50	910.36	6.43	56840	7.78	1.49	20.74
	10:30	50	910.41	6.48	57720	7.78	1.51	20.66
	10:45	58	910.39	6.46	58600	7.77	0.05	20.76
	11:00	58	910.39	6.46	59500	7.77	1.25	21.40
	11:15	58	910.38	6.45	60390	7.77	0.28	21.30
	11:30	58	910.39	6.46	61270	7.79	0.13	21.29
	11:45	58	910.42	6.49	62160	7.78	0.10	21.13
	12:00	58	910.39	6.46	63050	7.77	0.12	21.03
	12:15	58	910.43	6.50	63940	7.78	0.80	20.88
	12:30	58	910.41	6.48	64830	7.77	0.40	20.52
	12:45	58	910.42	6.49	65720	7.77	0.10	21.02
	13:00	58	910.41	6.48	66670	7.77	0.29	21.15
	13:15	58	910.40	6.47	67500	7.77	0.04	21.35
	13:30	58	910.41	6.48	68390	7.77	0.02	21.53
	13:45	58	910.40	6.47	69280	7.77	0.04	21.51
	14:00	58	910.37	6.44	70180	7.76	0.66	21.67
	14:15	58	910.36	6.43	71070	7.76	0.14	20.91
6/1/2016	14:30	58	910.37	6.44	71960	7.77	0.25	20.95
	14:45	58	910.34	6.41	72860	7.76	0.88	20.95
	15:00	58	910.33	6.40	73740	7.76	0.24	20.99
	15:15	58	910.33	6.40	74640	7.77	0.72	21.21
	15:30	58	910.34	6.41	75530	7.76	0.61	20.88
	15:45	58	910.31	6.38	76420	7.76	0.50	20.58
	16:00	58	910.33	6.40	77320	7.76	1.28	20.44
	16:15	58	910.31	6.38	78180	7.76	3.65	20.42
	16:30	58	910.32	6.39	79080	7.76	3.36	20.45
	16:45	58	910.31	6.38	79950	7.76	2.67	20.45
	17:00	58	910.31	6.38	80830	7.76	3.21	20.44
	17:15	58	910.30	6.37	81710	7.76	1.04	20.58
	17:30	58	910.31	6.38	82590	7.76	0.95	20.72
	17:45	58	910.32	6.39	83480	7.76	3.19	20.48
	18:00	58	910.32	6.39	84340	7.76	2.18	20.25
	18:15	58	910.34	6.41	85210	7.76	0.56	19.72
	18:30	58	910.33	6.40	86080	7.76	0.16	19.80

Table 8.1-2 (continued)

Date	Time	Pumping Rate (gpm[a])	Depth to Water (ft bgs)	Drawdown (ft)	Cumulative Purge Volume (gal.)	pH	Turbidity (NTU[b])	Temperature (Degree C)
24-h Aquifer Test								
6/1/2016	18:45	58	910.35	6.42	86940	7.77	1.38	19.83
	19:00	58	910.33	6.40	87810	7.82	1.30	19.87
	19:15	58	910.32	6.39	88720	7.83	1.49	19.72
	19:30	58	910.32	6.39	89560	7.81	1.31	19.68
	19:45	58	910.32	6.39	90460	7.79	1.43	19.66
	20:00	58	910.33	6.40	91280	7.79	2.86	19.59
	20:15	58	910.33	6.40	92140	7.78	2.20	19.53
	20:30	58	910.33	6.40	93010	7.78	1.20	19.53
	20:45	58	910.33	6.40	93850	7.78	1.55	19.52
	21:00	58	910.33	6.40	94730	7.78	2.00	19.52
	21:15	58	910.33	6.40	95600	7.78	2.20	19.52
	21:30	58	910.33	6.40	96450	7.78	2.21	19.48
	21:45	58	910.34	6.41	97330	7.78	1.67	19.48
	22:00	58	910.33	6.40	98100	7.78	1.33	19.48
	22:15	58	910.33	6.40	98810	7.78	1.20	19.44
	22:30	58	910.33	6.40	99220	7.78	1.53	19.43
	22:45	58	910.33	6.40	100680	7.79	0.51	19.35
	23:00	58	910.33	6.40	101540	7.79	1.20	19.43
	23:15	58	910.33	6.40	102330	7.79	1.22	19.48
	23:30	58	910.33	6.40	103170	7.79	0.62	19.34
	23:45	58	910.35	6.42	104030	7.79	0.64	19.41
6/2/2016	0:00	58	910.32	6.39	104860	7.79	0.95	19.42
	0:15	58	910.33	6.40	106020	7.79	1.82	19.40
	0:30	58	910.31	6.38	107370	7.76	1.54	20.21
	0:45	58	910.31	6.38	108160	7.79	0.92	20.20
	1:00	58	910.33	6.40	109060	7.74	1.17	20.19
	1:15	58	910.33	6.40	109880	7.74	1.55	20.20
	1:30	58	910.33	6.40	109380	7.75	1.50	20.21
	1:45	58	910.35	6.42	110380	7.75	1.42	20.20
	2:00	58	910.34	6.41	111530	7.74	1.39	20.21
	2:15	58	910.34	6.41	112480	7.74	1.39	20.20
	2:30	58	910.31	6.38	113210	7.74	1.32	20.21
	2:45	58	910.32	6.39	114240	7.74	1.14	20.21
	3:00	58	910.32	6.39	114890	7.74	0.77	20.21

Table 8.1-2 (continued)

Date	Time	Pumping Rate (gpm[a])	Depth to Water (ft bgs)	Drawdown (ft)	Cumulative Purge Volume (gal.)	pH	Turbidity (NTU[b])	Temperature (Degree C)
24-h Aquifer Test								
6/2/2016	3:15	58	910.36	6.43	115740	7.74	1.20	20.21
	3:30	58	910.35	6.42	116530	7.74	1.27	20.21
	3:45	58	910.33	6.40	117400	7.74	1.15	20.24
	4:00	58	910.37	6.44	118150	7.74	1.26	20.22
	4:15	58	910.38	6.45	119060	7.74	1.10	20.23
	4:30	58	910.35	6.42	119940	7.74	0.90	20.20
	4:45	58	910.39	6.46	120720	7.74	1.12	20.21
	5:00	58	910.40	6.47	121530	7.74	1.10	20.20
	5:15	58	910.40	6.47	122360	7.76	1.15	20.19
	5:30	58	910.40	6.47	123200	7.76	1.20	20.17
	5:45	58	910.40	6.47	124040	7.76	1.10	20.18
	6:00	58	910.41	6.48	124850	7.79	0.87	20.18
	6:15	58	910.41	6.48	125680	7.76	1.01	20.10
	6:30	58	910.37	6.44	126530	7.79	1.63	20.01
	6:45	58	910.37	6.44	127410	7.77	1.47	19.94
	7:00	58	910.37	6.44	128200	7.77	1.29	20.05
	7:15	58	910.34	6.41	129060	7.76	1.06	20.18
	7:30	58	910.31	6.38	129920	7.76	1.05	19.75
	7:45	58	910.31	6.38	130830	7.76	1.09	19.86
	8:00	58	910.32	6.39	131630	7.77	1.30	20.23
	8:15	58	910.32	6.39	132490	7.76	1.47	20.51
	8:30	58	910.31	6.38	133350	7.76	1.03	20.74
	8:45	58	910.31	6.38	134210	7.76	0.86	21.02
	9:00	58	910.33	6.40	135130	7.75	1.06	21.19
	9:15	58	910.32	6.39	135940	7.76	0.14	21.81
	9:30	58	910.31	6.38	136810	7.75	0.12	22.14
	9:45	58	910.32	6.39	137670	7.75	0.80	20.52
	10:09	0	n/a	n/a	139050	n/a	n/a	n/a

[a] gpm = Gallon per minute

[b] NTU = Nephelometric turbidity unit.

[c] n/a = Not applicable.

[d] NR = Not recorded.

Table 8.1-3
Field Water-Quality Parameters and Well Performance for Development of Well CrIN-3

Date	Time	Pumping Rate (gpm[a])	Depth to Water (ft btoc[b])	Drawdown (ft)	Cumulative Purge Volume (gal.)	pH	Turbidity (NTU[c])	Temperature (Degree C)
Well Development[d]								
Well development data for CrIN-3 were lost.								
Step Test								
9/8/2016	7:45	0	932.4	3.6	0	NR[e]	NR	NR
	7:48	52.0	930.3	1.5	340	6.33	11.0	18.39
	7:56	55.0	930.1	1.3	570	NR	NR	NR
	8:02	50.0	929.9	1.1	805	NR	NR	NR
	8:08	44.0	929.7	0.9	1045	7.47	9.7	20.90
	8:15	47.0	929.8	1.0	1285	7.54	25.4	21.00
	8:20	46.0	929.7	0.9	1530	NR	NR	NR
	8:25	47.0	929.7	0.9	1770	7.64	16.2	21.61
	8:30	48.0	929.7	0.9	1860	NR	NR	NR
	8:40	49.0	929.7	0.9	NR	7.67	23.1	21.50
	8:45	48.0	929.9	1.1	NR	NR	NR	NR
	8:55	52.0	930.3	1.5	2915	NR	NR	NR
	8:56	NR	930.4	1.6	3220	7.67	25.5	21.55
	8:58	61.0	930.5	1.7	3530	NR	NR	NR
	9:00	61.0	930.5	1.7	3850	NR	NR	NR
	9:05	61.0	930.5	1.7	4145	NR	NR	NR
	9:10	61.0	930.5	1.7	4450	7.65	33.4	20.53
	9:15	62.0	930.5	1.7	4755	NR	NR	NR
	9:20	64.0	930.5	1.7	5055	NR	NR	NR
	9:25	59.0	930.5	1.7	5360	7.65	7.3	20.48
	9:30	61.0	930.5	1.7	NR	NR	NR	NR
	9:35	61.0	930.5	1.7	NR	NR	NR	NR
	9:40	60.0	930.5	1.7	NR	7.66	8.0	20.46
	9:45	61.0	930.9	2.1	NR	NR	NR	NR
	9:50	75.0	931.4	2.6	NR	NR	NR	NR
	9:55	81.0	931.5	2.7	6125	7.64	6.9	20.00
	10:00	81.0	931.5	2.7	6530	NR	NR	NR
	10:05	80.0	931.6	2.8	6930	NR	NR	NR
	10:10	80.0	931.6	2.8	7330	7.64	5.9	20.04
	10:15	80.0	931.5	2.7	7730	NR	NR	NR
	10:20	80.0	931.6	2.8	8130	NR	NR	NR
	10:25	82.0	931.5	2.7	8540	NR	NR	NR

Table 8.1-3 (continued)

Date	Time	Pumping Rate (gpm[a])	Depth to Water (ft btoc[b])	Drawdown (ft)	Cumulative Purge Volume (gal.)	pH	Turbidity (NTU[c])	Temperature (Degree C)
Step Test								
9/8/2016	10:30	80.6	931.5	2.7	8943	7.64	5.5	20.02
	10:35	80.6	931.6	2.8	9346	NR	NR	NR
	10:40	80.8	931.6	2.8	9750	7.64	5.3	20.01
24-h Aquifer Test								
9/8/2016	15:00	NR	932.1	3.3	9773	NR	NR	NR
	15:15	81.0	931.4	2.6	10787	NR	NR	NR
	15:23	80.0	931.4	2.6	11431	7.55	1.7	20.16
	15:25	81.5	931.4	2.6	11594	NR	NR	NR
	15:35	81.0	931.5	2.7	12399	7.51	3.6	20.12
	15:45	81.0	931.5	2.7	13208	NR	NR	NR
	15:50	80.6	931.5	2.7	13611	7.50	2.8	20.09
	15:55	80.8	931.5	2.7	14015	NR	NR	NR
	16:00	81.0	931.5	2.7	14420	7.51	2.8	20.10
	16:15	81.0	931.5	2.7	15635	7.47	2.9	20.10
	16:30	81.0	931.5	2.7	16850	7.48	3.3	20.05
	16:40	81.5	931.5	2.7	17665	NR	NR	NR
	16:50	80.5	931.5	2.7	18470	7.54	5.3	20.04
	17:00	81.0	931.5	2.7	19280	7.57	4.7	20.03
	17:20	81.0	931.5	2.7	20900	7.59	3.2	20.02
	17:30	80.9	931.5	2.7	21709	7.60	3.0	20.01
	17:45	81.0	931.5	2.7	22924	7.62	2.3	20.01
	18:00	81.1	931.5	2.7	24140	7.62	2.7	20.00
	18:15	81.2	931.5	2.7	25355	7.62	3.5	19.97
	18:30	81.1	931.5	2.7	26573	7.63	2.8	19.94
	18:45	81.1	931.5	2.7	27789	7.63	1.9	19.92
	19:00	81.1	931.5	2.7	29006	7.64	1.9	19.91
	19:30	81.2	931.5	2.7	31442	7.65	2.0	19.89
	20:00	81.3	931.5	2.7	33880	7.66	1.7	19.88
	20:30	81.2	931.5	2.7	36317	7.67	1.9	19.89
	21:00	81.4	931.5	2.7	38760	7.67	1.7	19.88
	21:30	81.3	931.6	2.8	41200	7.67	1.8	19.88
	22:00	81.3	931.6	2.8	43640	7.68	2.1	19.87
	22:30	81.5	931.6	2.8	46086	7.68	2.2	19.87
9/8/2016	23:00	81.5	931.6	2.8	48530	7.69	1.8	19.87
	23:30	81.4	931.6	2.8	50972	7.68	1.7	19.86
	0:00	81.6	931.6	2.8	53421	7.69	1.7	19.83

Table 8.1-3 (continued)

Date	Time	Pumping Rate (gpm[a])	Depth to Water (ft btoc[b])	Drawdown (ft)	Cumulative Purge Volume (gal.)	pH	Turbidity (NTU[c])	Temperature (Degree C)
24-h Aquifer Test								
9/9/2016	0:30	81.4	931.6	2.8	55864	7.69	1.8	19.81
	1:00	81.6	931.6	2.8	58312	7.70	1.6	19.81
	1:30	81.7	931.6	2.8	60762	7.70	1.4	19.80
	2:00	81.6	931.6	2.8	63211	7.70	1.4	19.79
	2:30	81.6	931.6	2.8	65658	7.71	1.5	19.79
	3:00	81.5	931.6	2.8	68103	7.71	1.5	19.79
	3:30	81.6	931.6	2.8	70550	7.71	1.2	19.79
	4:00	81.7	931.6	2.8	73000	7.71	1.2	19.78
	4:30	81.4	931.6	2.8	75443	7.71	1.2	19.77
	5:00	81.7	931.6	2.8	77895	7.72	1.2	19.78
	5:30	81.5	931.6	2.8	80340	7.71	1.3	19.77
	6:00	81.7	931.6	2.8	82791	7.72	1.2	19.77
	6:30	81.7	931.6	2.8	85241	7.72	1.2	19.77
	7:00	82.0	931.6	2.8	87700	7.72	1.2	19.77
	7:30	81.6	931.6	2.8	90149	7.72	1.2	19.80
	8:00	81.9	931.7	2.9	92607	7.73	1.1	19.84
	8:30	81.9	931.7	2.9	95063	7.73	1.2	19.85
	9:00	81.5	931.7	2.9	97509	7.73	1.2	19.87
	9:30	81.5	931.7	2.9	99955	7.73	1.1	19.87
	10:00	81.7	931.7	2.9	102407	7.73	1.2	19.88
	10:30	81.4	931.7	2.9	104850	7.73	1.2	19.89
	11:00	81.8	931.7	2.9	107305	7.73	1.2	19.91
	11:30	81.2	931.7	2.9	109742	7.74	1.4	19.95
	12:00	81.8	931.7	2.9	112195	7.73	1.2	19.99
	12:30	81.3	931.6	2.8	114635	7.73	1.1	20.02
	13:00	81.7	931.6	2.8	117085	7.73	1.2	19.98
	13:30	81.5	931.6	2.8	119530	7.73	1.2	19.97
	14:00	81.5	931.6	2.8	121976	7.73	1.2	19.98
	14:30	81.6	931.6	2.8	124424	7.73	1.3	19.97
	15:00	81.4	931.6	2.8	126867	7.73	1.3	19.97

[a] gpm = Gallon per minute.

[b] ft btoc = Feet below top of casing.

[c] NTU = Nephelometric turbidity unit.

[d] This is the only data point available for well development.

[e] NR = Not recorded.

Table 8.1-4
Field Water-Quality Parameters and Well Performance for Development of Well CrIN-4

Date	Time	Pumping Rate (gpm[a])	Depth to Water (ft btoc[b])	Drawdown (ft)	Cumulative Purge Volume (gal.)	pH	Turbidity (NTU[c])	Temperature (Degree C)
Well Development								
6/19/2016	15:36	NR[d]	NR	NR	NR	8.70	10.6	20.10
	15:38	NR	NR	NR	NR	8.61	3.2	20.16
	17:11	NR	NR	NR	NR	12.19	4.9	21.63
	17:12	NR	NR	NR	NR	12.10	1.3	21.20
	18:37	NR	NR	NR	NR	12.07	4.8	20.80
6/20/2016	12:15	75.00	1090.0	0.00	0	14.14	3.5	20.71
	12:33	75.00	1080.2	-9.83	1020	14.46	24.3	21.32
	12:48	75.00	1090.3	0.23	2153	14.20	4.6	20.31
	13:03	75.00	1090.3	0.30	3280	14.33	0.6	22.67
	13:18	75.00	1090.4	0.37	4413	14.24	1.2	20.71
	13:33	75.00	1090.5	0.42	5542	14.27	2.4	20.49
	13:48	75.00	1090.5	0.48	6682	14.40	2.8	20.95
Step Test								
6/21/2016	10:15	38.50	1080.7	1.2	12369	7.93	5.5	19.07
	10:30	37.50	1080.7	1.2	12932	NR	NR	NR
	10:45	37.46	1080.6	1.1	13494	7.94	8.8	19.93
	11:00	37.40	1081.2	1.7	14055	7.92	6.8	19.68
	11:15	60.50	1082.9	3.4	14922	7.91	NR	19.66
	11:30	59.60	1083.0	3.5	15816	NR	NR	NR
	11:45	59.80	1083.0	3.5	16713	NR	NR	NR
	12:00	59.26	1085.0	5.5	17602	NR	NR	NR
	12:15	74.00	1085.7	6.2	18718	NR	NR	NR
	12:30	74.73	1085.8	6.3	19839	7.90	2.5	19.75
	12:45	74.80	1085.8	6.3	20961	7.89	3.1	19.55
	13:00	74.93	1083.7	4.2	22085	7.89	2.7	19.08
24-h Aquifer Test								
6/21/2016	15:15	62.50	1083.1	3.6	22870	6.93	4.2	21.62
	15:30	62.00	1083.2	3.7	23800	7.22	5.0	21.58
	15:45	62.00	1083.2	3.7	24731	7.23	0.9	21.20
	16:00	62.00	1083.2	3.7	25661	7.21	3.1	21.04
	16:15	62.20	1083.2	3.7	26594	7.20	1.4	20.81
	16:30	61.86	1083.2	3.7	27522	7.25	2.8	20.77
	16:45	61.86	1083.3	3.8	28450	7.26	16.6	20.76
	17:00	62.00	1083.3	3.8	29380	7.28	0.0	20.99

Table 8.1-4 (continued)

Date	Time	Pumping Rate (gpm[a])	Depth to Water (ft btoc[b])	Drawdown (ft)	Cumulative Purge Volume (gal.)	pH	Turbidity (NTU[c])	Temperature (Degree C)
24-h Aquifer Test								
6/21/2016	17:15	61.60	1083.3	3.8	30304	7.27	2.0	20.81
	17:30	61.80	1083.3	3.8	31232	7.30	0.0	20.78
	17:45	61.86	1083.3	3.8	32160	7.30	3.9	20.69
	18:00	61.53	1083.3	3.8	33083	7.29	2.7	20.69
	18:15	61.86	1083.3	3.8	34011	7.28	9.1	20.55
	18:30	61.73	1083.3	3.8	34937	7.30	0.6	20.55
	18:45	61.73	1083.3	3.8	35863	7.32	6.7	20.53
	19:00	61.86	1083.3	3.8	36791	7.35	1.9	20.55
	19:15	61.80	1083.3	3.8	37718	7.20	4.1	20.57
	19:30	61.73	1083.4	3.9	38644	7.26	0.5	20.55
	19:45	61.93	1083.4	3.9	39573	7.35	1.8	20.59
	20:00	61.73	1083.4	3.9	40499	7.39	6.1	20.48
	20:15	61.82	1083.4	3.9	41427	7.38	2.4	20.39
	20:30	62.20	1083.4	3.9	42360	7.41	3.0	20.43
	20:45	62.26	1083.4	3.9	43294	7.39	0.5	20.44
	21:00	61.93	1083.5	4.0	44223	7.36	202.9	20.41
	21:15	68.93	1083.4	3.9	45257	7.35	0.0	20.41
	21:30	55.60	1083.5	4.0	46091	7.42	0.4	20.37
	21:45	62.13	1083.5	4.0	47023	7.38	0.6	20.33
	22:00	62.33	1083.5	4.0	47958	7.40	16.5	20.32
	22:15	61.73	1083.5	4.0	48884	7.39	0.1	20.28
	22:30	61.93	1083.5	4.0	49813	7.42	0.6	20.29
	22:45	62.46	1083.5	4.0	50750	7.41	0.0	20.32
	23:00	61.40	1083.4	3.9	51671	7.39	3.0	20.25
	23:15	61.73	1083.5	4.0	52597	7.10	0.0	20.28
	23:30	61.66	1083.4	3.9	53522	7.18	0.0	20.26
	23:45	67.86	1083.5	4.0	54540	7.19	0.0	20.22
6/22/2016	0:00	55.73	1083.5	4.0	55376	7.23	0.0	20.19
	0:15	61.73	1083.4	3.9	56302	7.34	0.0	20.17
	0:30	61.33	1083.4	3.9	57222	7.43	2.1	20.18
	0:45	68.73	1083.4	3.9	58253	7.46	0.0	20.19
	1:00	55.06	1083.4	3.9	59079	7.41	154.2	20.15
	1:15	61.80	1083.4	3.9	60006	7.47	18.5	20.15
	1:30	61.80	1083.4	3.9	60933	7.52	24.9	20.11
	1:45	61.80	1083.4	3.9	61860	7.52	51.5	20.12

Table 8.1-4 (continued)

Date	Time	Pumping Rate (gpm[a])	Depth to Water (ft btoc[b])	Drawdown (ft)	Cumulative Purge Volume (gal.)	pH	Turbidity (NTU[c])	Temperature (Degree C)
24-h Aquifer Test								
6/22/2016	2:00	61.60	1083.4	3.9	62784	7.46	20.5	20.13
	2:15	61.60	1083.4	3.9	63708	7.21	13.1	20.14
	2:30	61.80	1083.4	3.9	64635	7.43	19.9	20.12
	2:45	61.80	1083.4	3.9	65562	7.48	20.1	20.09
	3:00	61.60	1083.4	3.9	66486	7.47	417.5	20.10
	3:15	61.66	1083.4	3.9	67411	7.30	6.8	20.07
	3:30	61.73	1083.4	3.9	68337	7.37	9.3	20.02
	3:45	61.80	1083.4	3.9	69264	7.34	2.8	20.06
	4:00	61.73	1083.4	3.9	70190	7.28	5.0	20.03
	4:15	61.73	1083.4	3.9	71116	7.36	7.9	20.03
	4:30	61.80	1083.4	3.9	72043	7.50	1217.6	20.04
	4:45	61.66	1083.4	3.9	72968	7.53	14.0	20.03
	5:00	61.60	1083.4	3.9	73892	7.53	1.0	20.03
	5:15	61.66	1083.4	3.9	74817	7.53	1094.8	20.02
	5:30	61.73	1083.4	3.9	75743	7.54	1220.0	19.97
	5:45	61.86	1083.4	3.9	76671	7.56	0.6	19.96
	6:00	61.66	1083.4	3.9	77596	7.59	2.7	19.90
	6:15	61.60	1083.4	3.9	78520	7.52	4.8	19.96
	6:30	61.60	1083.4	3.9	79444	7.28	1.3	20.02
	6:45	61.80	1083.4	3.9	80371	7.48	17.7	20.04
	7:00	61.60	1083.4	3.9	81295	7.54	3.2	20.06
	7:15	65.66	1083.4	3.9	82271	7.34	4.4	20.03
	7:30	64.93	1083.4	3.9	83245	7.39	2.1	20.05
	7:45	62.20	1083.4	3.9	84178	7.40	0.0	20.10
	8:00	54.93	1083.4	3.9	85002	7.46	1.8	20.14
	8:15	61.66	1083.4	3.9	85927	7.52	2.9	20.18
	8:30	61.60	1083.4	3.9	86851	7.57	2.0	20.25
	8:45	61.86	1083.4	3.9	87779	7.45	1.4	20.28
	9:00	61.80	1083.4	3.9	88706	7.51	3.1	20.35
	9:15	61.80	1083.4	3.9	89633	7.64	1.3	20.44
	9:30	61.93	1083.4	3.9	90562	7.66	1.7	20.55
	9:45	61.73	1083.4	3.9	91538	7.59	11.3	20.43
	10:00	61.60	1083.4	3.9	92512	7.64	0.0	20.60
	10:15	62.33	1083.4	3.9	93338	7.61	1.8	20.90
	10:30	61.86	1083.4	3.9	94266	7.61	2.8	21.08

Table 8.1-4 (continued)

Date	Time	Pumping Rate (gpm[a])	Depth to Water (ft btoc[b])	Drawdown (ft)	Cumulative Purge Volume (gal.)	pH	Turbidity (NTU[c])	Temperature (Degree C)
24-h Aquifer Test								
6/22/2016	10:45	61.73	1083.4	3.9	95192	7.58	1.2	21.04
	11:00	61.80	1083.4	3.9	96119	7.62	4.3	20.96
	11:15	61.73	1083.4	3.9	97045	7.51	0.8	21.46
	11:30	62.00	1083.4	3.9	97975	7.54	1.9	21.28
	11:45	62.06	1083.4	3.9	98906	7.56	3.1	21.23
	12:00	62.13	1083.4	3.9	99838	7.46	0.2	21.24
	12:15	61.46	1083.4	3.9	100760	7.58	2.5	21.31
	12:30	62.06	1083.4	3.9	101691	7.60	1.6	21.39
	12:45	61.66	1083.3	3.8	102616	7.62	2.8	21.30
	13:00	61.66	1083.3	3.8	103541	7.57	3.1	20.92
	13:15	62.13	1083.3	3.8	104473	7.67	3.1	20.92
	13:30	62.00	1083.3	3.8	105403	7.69	0.9	20.71
	13:45	62.13	1083.3	3.8	106335	7.69	2.5	20.70

[a] gpm = Gallon per minute.

[b] ft btoc = Feet below top of casing.

[c] NTU = Nephelometric turbidity unit.

[d] NR = Not recorded.

Table 8.1-5
Field Water-Quality Parameters and Well Performance for Development of Well CrIN-5

Date	Time	Pumping Rate (gpm[a])	Depth to Water (ft btoc[b])	Drawdown (ft)	Cumulative Purge Volume (gal.)	pH	Turbidity (NTU[c])	Temperature (Degree C)
Well Development								
8/2/2016	18:14	NR[d]	NR	NR	NR	6.37	17.1	20.56
	18:22	NR	NR	NR	NR	6.93	8.0	20.42
	18:37	NR	NR	NR	NR	7.14	3.6	19.64
	18:52	NR	NR	NR	NR	7.22	1.7	19.57
	18:58	NR	NR	NR	NR	7.26	2.6	19.54
	19:00	NR	NR	NR	NR	7.27	0.5	19.55
	19:04	NR	NR	NR	NR	7.30	0.5	19.61
	19:07	NR	NR	NR	NR	7.25	0.2	19.66
	19:15	NR	NR	NR	NR	7.37	0.1	19.69
Step Test								
8/3/2016	11:00	NR	1157.9	0.9	0	NR	NR	NR
	11:04	NR	1159.1	0.3	373	NR	NR	NR
	11:12	32.00	1159.2	0.4	713	NR	NR	NR
	11:15	32.00	1159.2	0.4	843	NR	NR	NR
	11:30	32.00	1159.2	0.4	1313	NR	NR	NR
	11:45	32.00	1159.3	0.4	1782	NR	NR	NR
	12:00	32.00	1159.3	0.4	2268	NR	NR	NR
	12:09	50.00	1162.9	4.1	2693	NR	NR	NR
	12:15	50.00	1163.1	4.2	2993	NR	NR	NR
	12:30	50.00	1163.1	4.3	3791	NR	NR	NR
	12:45	50.00	1163.2	4.4	4515	NR	NR	NR
	13:00	50.00	1162.6	3.8	5284	NR	NR	NR
	13:08	68.00	1153.7	5.2	5793	NR	NR	NR
	13:15	68.00	1156.0	2.8	6402	NR	NR	NR
	13:30	68.00	1156.1	2.8	7344	NR	NR	NR
	13:45	69.00	1156.0	2.8	8318	NR	NR	NR
	14:00	68.00	1156.0	2.8	9343	NR	NR	NR
24-h Aquifer Test								
8/3/2016	16:00	NR	1161.4	2.6	9343	NR	NR	NR
	16:03	NR	1161.5	2.6	9371	NR	NR	NR
	16:06	60.00	1161.4	2.6	9573	NR	NR	NR
	16:15	61.00	1161.5	2.6	10059	7.19	12.5	20.84
	16:30	61.00	1161.5	2.6	10964	7.21	0.0	21.00
	16:45	61.00	1161.5	2.7	11876	7.27	0.0	20.88
	17:00	61.00	1161.5	2.7	12793	7.32	0.0	20.74
	17:15	61.00	1161.5	2.7	13709	7.33	0.0	20.62

Table 8.1-5 (continued)

Date	Time	Pumping Rate (gpm[a])	Depth to Water (ft btoc[b])	Drawdown (ft)	Cumulative Purge Volume (gal.)	pH	Turbidity (NTU[c])	Temperature (Degree C)
24-h Aquifer Test								
8/3/2016	17:30	61.00	1161.5	2.7	14624	7.36	0.0	20.57
	17:45	61.00	1161.5	2.7	15540	7.38	0.0	20.58
	18:00	61.00	1161.5	2.7	16455	7.39	0.0	20.56
	18:15	61.00	1161.6	2.7	17372	7.39	0.0	20.56
	18:30	61.00	1161.6	2.8	18289	7.40	0.0	20.43
	18:45	61.00	1161.6	2.8	19205	7.40	0.0	20.46
	19:00	61.00	1161.6	2.7	20122	7.38	0.0	20.27
	19:15	61.00	1161.6	2.7	21039	7.40	0.0	19.65
	19:30	61.00	1161.6	2.7	21954	7.43	1.7	19.88
	19:45	61.00	1161.6	2.7	22874	7.46	0.8	19.90
	20:00	61.00	1161.6	2.7	23793	7.47	0.4	20.00
	20:15	61.00	1161.6	2.7	24712	7.46	0.0	20.01
	20:30	61.00	1161.6	2.8	25623	7.46	0.0	20.05
	20:45	61.00	1161.6	2.7	26540	7.46	0.0	19.98
	21:00	61.00	1161.6	2.8	27456	7.44	0.0	19.83
	21:15	61.00	1161.6	2.7	28365	7.45	0.0	19.93
	21:30	61.00	1161.6	2.7	29278	7.45	0.0	20.02
	21:45	61.00	1161.6	2.7	30194	7.46	0.0	20.11
	22:00	61.00	1161.6	2.7	31106	7.46	0.0	20.19
	22:15	61.00	1161.6	2.7	32022	7.46	0.0	20.22
	22:30	61.00	1161.6	2.8	32933	7.46	0.0	20.23
	22:45	61.00	1161.6	2.8	33846	7.46	0.0	20.19
	23:00	61.00	1161.6	2.7	34758	7.47	0.0	20.23
	23:15	61.00	1161.6	2.7	35671	7.47	0.0	20.19
	23:30	61.00	1161.6	2.8	36583	7.46	0.0	20.17
	23:45	61.00	1161.6	2.7	37494	7.46	0.0	20.18
8/4/2016	0:00	61.00	1161.6	2.7	38407	7.47	0.0	20.15
	0:15	61.00	1161.6	2.7	39323	7.46	0.0	20.06
	0:30	61.00	1161.5	2.7	40242	7.47	0.0	20.05
	0:45	61.00	1161.6	2.7	41159	7.47	0.0	20.04
	1:00	61.00	1161.6	2.8	42071	7.46	0.0	20.01
	1:15	61.00	1161.6	2.7	42990	7.47	0.0	20.02
	1:30	61.00	1161.6	2.8	43905	7.47	0.0	20.04
	1:45	61.00	1161.6	2.8	44816	7.47	0.0	20.05
	2:00	61.00	1161.6	2.8	45728	7.48	0.0	20.10
	2:15	61.00	1161.6	2.8	46642	7.47	0.0	20.07
	2:30	61.00	1161.6	2.7	47557	7.47	0.0	20.08

Table 8.1-5 (continued)

Date	Time	Pumping Rate (gpm[a])	Depth to Water (ft btoc[b])	Drawdown (ft)	Cumulative Purge Volume (gal.)	pH	Turbidity (NTU[c])	Temperature (Degree C)
24-h Aquifer Test								
8/4/2016	2:45	61.00	1161.6	2.7	48472	7.48	0.0	20.14
	3:00	61.00	1161.6	2.7	49387	7.48	0.0	20.09
	3:15	61.00	1161.6	2.8	50297	7.48	0.0	20.08
	3:30	61.00	1161.6	2.8	51209	7.48	0.0	20.09
	3:45	61.00	1161.6	2.7	52127	7.48	0.0	20.03
	4:00	61.50	1161.6	2.7	53053	7.48	0.0	20.01
	4:15	61.00	1161.5	2.7	53976	7.48	0.0	20.03
	4:30	61.00	1161.5	2.7	54894	7.48	0.0	20.02
	4:45	61.00	1161.6	2.7	55816	7.48	0.0	19.95
	5:00	61.50	1161.6	2.7	56739	7.48	0.0	19.97
	5:15	61.00	1161.6	2.7	57663	7.48	0.0	19.92
	5:30	61.00	1161.6	2.8	58580	7.49	0.0	19.85
	5:45	61.00	1161.6	2.8	59501	7.48	0.0	19.86
	6:00	61.00	1161.6	2.8	60421	7.49	0.0	19.94
	6:15	61.50	1161.6	2.8	61345	7.49	0.0	19.92
	6:30	61.00	1161.6	2.8	62267	7.49	0.0	19.95
	6:45	61.00	1161.6	2.8	63188	7.49	0.0	19.93
	7:00	61.50	1161.6	2.8	64115	7.49	0.0	20.00
	7:15	61.50	1161.7	2.8	65036	7.49	0.0	20.07
	7:30	61.50	1161.7	2.8	65954	7.49	0.0	20.13
	7:45	61.00	1161.6	2.8	66878	7.49	0.0	20.16
	8:00	61.00	1161.7	2.8	67801	7.49	0.0	20.22
	8:15	61.00	1161.7	2.9	68724	7.49	0.0	20.34
	8:30	61.50	1161.7	2.9	69654	7.51	0.0	20.46
	8:45	61.50	1161.7	2.9	70581	7.50	0.0	20.59
	9:00	61.50	1161.7	2.8	71504	7.48	0.0	20.65
	9:15	61.50	1161.6	2.8	72437	7.46	0.0	20.77
	9:30	61.50	1161.6	2.8	73366	7.42	0.0	20.89
	9:45	62.00	1161.7	2.8	74294	7.38	0.0	20.83
	10:00	62.00	1161.6	2.8	75216	7.35	0.0	20.80
	10:15	61.50	1161.7	2.8	76141	7.32	0.0	20.80
	10:30	62.00	1161.7	2.8	77064	7.31	0.0	20.80
	10:45	62.00	1161.7	2.9	77985	7.31	0.0	20.88
	11:00	61.00	1161.7	2.8	78910	7.32	0.0	20.86
	11:15	61.00	1161.7	2.8	79844	7.35	0.0	20.91
	11:30	61.00	1161.7	2.8	80759	7.37	0.0	20.90
	11:45	61.00	1161.7	2.9	81686	7.38	0.0	20.91

Table 8.1-5 (continued)

Date	Time	Pumping Rate (gpm[a])	Depth to Water (ft btoc[b])	Drawdown (ft)	Cumulative Purge Volume (gal)	pH	Turbidity (NTU[c])	Temperature (Degree C)
24-h Aquifer Test								
8/4/2016	12:00	61.00	1161.7	2.9	82617	7.38	0.0	21.07
	12:15	61.00	1161.7	2.9	83545	7.34	0.0	21.35
	12:30	62.00	1161.7	2.8	84471	7.32	0.0	21.30
	12:45	62.00	1161.7	2.9	85404	7.30	0.0	21.62
	13:00	62.00	1161.7	2.8	86335	7.27	0.0	21.64
	13:15	62.00	1161.6	2.8	87266	7.23	0.0	21.70
	13:30	62.00	1161.7	2.8	88196	7.19	0.0	21.42
	13:45	61.50	1161.7	2.8	89124	7.16	0.0	21.62
	14:00	61.50	1161.6	2.8	90056	7.16	0.0	21.82
	14:15	62.00	1161.7	2.8	90987	7.12	0.0	21.84
	14:30	61.00	1161.6	2.8	91921	7.08	0.0	22.13
	14:45	62.00	1161.6	2.8	92849	7.06	0.0	22.16
	15:00	62.00	1161.6	2.8	93781	7.00	0.0	21.79
	15:15	61.50	1154.8	4.0	94706	6.96	0.0	21.34
	15:30	62.00	1156.0	2.8	95636	6.92	0.0	21.34
	15:45	62.00	1156.0	2.8	96562	6.89	0.0	21.36
	16:00	62.00	1156.0	2.8	96989	6.87	0.0	21.33
	16:04	NR	1156.0	2.8	97737	NR	NR	NR

[a] gpm = Gallon per minute.

[b] ft btoc = Feet below top of casing.

[c] NTU = Nephelometric turbidity unit.

[d] NR = Not reported.

Table 8.2-1
CrIN Aquifer Testing Summary

Well	Step Tests Date	Rates (gpm*)	Constant Rate Date	Rate (gpm)
CrIN-2	5/31/16	30, 50, 70	6/1/16	58
CrIN-4	6/21/16	38, 60, 75	6/21/16	62
CrIN-1	7/18/16	30, 50 70	7/19/16	70
CrIN-5	8/3/16	32, 50, 68	8/3/16	61
CrIN-3	9/8/16	50, 60, 80	9/8/16	81

* gpm = Gallon per minute.

Table 8.5-1
CrIN Wells Survey Coordinates

Identification	Northing	Easting	Elevation
CrIN-1 ground surface near vault	1768282.466	1640104.877	6704.634
CrIN-1 brass cap embedded in vault	1768296.963	1640089.494	6705.362
CrIN-1 top of well casing	1768293.719	1640089.572	6702.379
CrIN-2 ground surface near vault	1767800.123	1639781.404	6731.978
CrIN-2 brass cap embedded in vault	1767800.805	1639791.482	6732.415
CrIN-2 top of well casing	1767797.468	1639791.835	6729.616
CrIN-3 ground surface near vault	1767144.868	1639884.564	6721.625
CrIN-3 brass cap embedded in vault	1767139.006	1639887.412	6722.301
CrIN-3 top of well casing	1767135.850	1639888.440	6719.201
CrIN-4 ground surface near vault	1767025.389	1638874.060	6895.295
CrIN-4 brass cap embedded in vault	1767032.919	1638863.128	6895.950
CrIN-4 top of well casing	1767029.532	1638871.688	6892.871
CrIN-5 ground surface near vault	1767028.501	1638688.837	6902.375
CrIN-5 brass cap embedded in vault	1767025.241	1638678.338	6902.980
CrIN-5 top of well casing	1767023.434	1638680.808	6900.291

Notes: All coordinates are expressed as New Mexico State Plane Coordinate System Central Zone (NAD 83); elevation is expressed in ft amsl using the National Geodetic Vertical Datum of 1929. Provisional survey conducted. Wells will be resurveyed when vault is installed.

Table 8.6-1
Chromium Injection Well CrIN-1 Sample Information

Event ID	Sample ID	Date Collected	Description	Sample Matrix
10718	WSTMO-16-121713	05/31/2016	Drilling fluids (top)	Fluid
10718	WSTMO-16-121717	05/31/2016	Drilling fluids (top) field duplicate	Fluid
10718	WSTMO-16-121720	05/31/2016	Drilling fluids (top) trip blank	Fluid
10718	WSTMO-16-121714	06/20/2016	Drilling fluids (middle)	Fluid
10718	WSTMO-16-121716	06/20/2016	Drilling fluids (middle) field duplicate	Fluid
10718	WSTMO-16-121721	06/20/2016	Drilling fluids (middle) trip blank	Fluid
10718	WSTMO-16-121715	06/20/2016	Drilling fluids (bottom)	Fluid
10718	WSTMO-16-121718	06/20/2016	Drilling fluids (bottom) field duplicate	Fluid
10718	WSTMO-16-121719	06/20/2016	Drilling fluids (bottom) trip blank	Fluid
10890	WSTMO-16-124932	08/22/2016	Drill fluids composite	Fluid
10716	WSTMO-16-124933	08/22/2016	Drill fluids composite	Fluid
10716	WSTMO-16-124934	08/25/2016	Drill fluids composite field duplicate	Fluid
10716	WSTMO-16-121722	05/31/2016	Drill cuttings (top)	Soil
10716	WSTMO-16-121725	05/31/2016	Drill cuttings (top) trip blank	Soil
10716	WSTMO-14-86601	06/20/2016	Drill cuttings (middle)	Soil
10716	WSMTO-14-86603	06/20/2016	Drill cuttings (middle) trip blank	Soil
10716	WSTMO-16-121724	06/20/2016	Drill cuttings (middle)	Soil
10716	WSTMO-16-121727	06/20/2016	Drill cuttings (middle) trip blank	Soil
10889	WSTMO-16-124931	08/22/2016	Drill cuttings (composite)	Soil

Table 8.6-2
Chromium Injection Well CrIN-2 Sample Information

Event ID	Sample ID	Date Collected	Description	Sample Matrix
10670	WSTMO-16-116116	04/19/2016	Drilling fluids (top)	Fluid
10670	WSTMO-16-116115	04/19/2016	Drilling fluids field duplicate	Fluid
10670	WSTMO-16-116114	04/19/2016	Drilling fluids trip blank	Fluid
10671	WSTMO-16-116118	05/02/2016	Drilling fluids (middle)	Fluid
10671	WSTMO-16-116120	05/02/2016	Drilling fluids (middle) field duplicate	Fluid
10671	WSTMO-16-116121	05/02/2016	Drilling fluids (middle) trip blank	Fluid
10671	WSTMO-16-116117	05/10/2016	Drilling fluids (bottom)	Fluid
10671	WSTMO-06-116119	05/10/2016	Drilling fluids (bottom) field duplicate	Fluid
10671	WSTMO-16-116122	05/10/2016	Drilling fluids (bottom) trip blank	Fluid
10719	WSTMO-16-121729	07/20/2016	Drill fluids composite	Fluid
10719	WSTMO-16-121730	07/20/2016	Drill fluids composite	Fluid
10719	WSTMO-16-121731	07/20/2016	Drill fluids composite field duplicate	Fluid
10669	WSTMO-16-111608	04/19/2016	Drill cuttings (top)	Soil
10669	WSTMO-16-116111	04/19/2016	Drill cuttings (top) trip blank	Soil
10669	WSTMO-16-116109	05/02/2016	Drill cuttings (middle)	Soil
10669	WSTMO-16-116112	05/02/2016	Drill cuttings (middle) trip blank	Soil
10669	WSTMO-16-116110	05/10/2016	Drill cuttings (bottom)	Soil
10669	WSTMO-16-116113	05/10/2016	Drill cuttings (bottom) trip blank	Soil
10720	WSTMO-16-121732	07/20/2016	Drill cuttings (composite)	Soil

Table 8.6-3
Chromium Injection Well CrIN-3 Sample Information

Event ID	Sample ID	Date Collected	Description	Sample Matrix
10867	WSTMO-16-124656	08/01/2016	Drilling fluids (top)	Fluid
10867	WSTMO-16-124659	08/01/2016	Drilling fluids (top) field duplicate	Fluid
10867	WSTMO-16-124662	08/01/2016	Drilling fluids (top) trip blank	Fluid
10867	WSTMO-16-124658	08/10/2016	Drilling fluids (middle)	Fluid
10867	WSTMO-16-124660	08/10/2016	Drilling fluids (middle) field duplicate	Fluid
10867	WSTMO-16-124663	08/10/2016	Drilling fluids (middle) trip blank	Fluid
10867	WSTMO-16124657	08/16/2016	Drilling fluids (bottom)	Fluid
10867	WSTMO-16-124661	08/16/2016	Drilling fluids (bottom) field duplicate	Fluid
10867	WSTMO-16-124664	08/16/2016	Drilling fluids (bottom) trip blank	Fluid
10949	WSTMO-16-126034	09/15/2016	Drilling fluids (composite)	Fluid
10949	WSTMO-16-126035	09/15/2016	Drilling fluids (composite)	Fluid
10949	WSTMO-16-126036	09/15/2016	Drilling fluids (composite) field duplicate	Fluid
10866	WSTMO-16-124650	08/01/2016	Drill cuttings (top)	Soil
10866	WSTMO-16-124653	08/01/2016	Drill cuttings (top) trip blank	Soil
10866	WSTMO-16-124651	08/10/2016	Drill cuttings (top)	Soil
10866	WSTMO-16-124654	08/10/2016	Drill cuttings (top) trip blank	Soil
10866	WSTMO-16-124652	08/16/2016	Drill cuttings (top)	Soil
10866	WSTMO-16-124655	08/16/2016	Drill cuttings (top) trip blank	Soil
10950	WSTMO-16-126037	09/15/2016	Drill cuttings (composite)	Soil

Table 8.6-4
Chromium Injection Well CrIN-4 Sample Information

Event ID	Sample ID	Date Collected	Description	Sample Matrix
10646	WSTMO-16-115216	04/01/2016	Drilling fluids (top)	Fluid
10646	WSTMO-16-115219	04/01/2016	Drilling fluids (top) field duplicate	Fluid
10646	WSTMO-16-115220	04/01/2016	Drilling fluids (top) trip blank	Fluid
10646	WSTMO-16-115215	04/15/2016	Drilling fluids (middle)	Fluid
10646	WSTMO-16-115218	04/15/2016	Drilling fluids (middle) field duplicate	Fluid
10646	WSTMO-16-115221	04/15/2016	Drilling fluids (middle) trip blank	Fluid
10646	WSTMO-16-115214	05/11/2016	Drilling fluids (bottom)	Fluid
10646	WSTMO-16-115217	05/11/2016	Drilling fluids (bottom) field duplicate	Fluid
10646	WSTMO-16-115222	05/11/2016	Drilling fluids (bottom) trip blank	Fluid
10849	WSTMO-16-124363	07/25/2016	Drilling fluids (composite)	Fluid
10849	WSTMO-16-124364	07/25/2016	Drilling fluids (composite)	Fluid
10849	WSTMO-16-124365	07/25/2016	Drilling fluids (composite) field duplicate	Soil
10647	WSTMO-16-115223	04/01/2016	Drill cuttings (top)	Soil
10647	WSTMO-16-115228	04/01/2016	Drill cuttings (top) trip blank	Soil
10647	WSTMO-16-115224	04/15/2016	Drill cuttings (middle)	Soil
10647	WSTMO-16-115226	04/15/2016	Drill cuttings (middle) trip blank	Soil
10647	WSTMO-16-115225	05/11/2016	Drill cuttings (bottom)	Soil
10647	WSTMO-16-115227	05/11/2016	Drill cuttings (bottom) trip blank	Soil
10848	WSTMO-16-124362	07/25/2016	Drill cuttings (composite)	Soil

Table 8.6-5
Chromium Injection Well CrIN-5 Sample Information

Event ID	Sample ID	Date Collected	Description	Sample Matrix
10749	WSTMO-16-122902	06/13/2016	Drilling fluids (top)	Fluid
10749	WSTMO-16-122905	06/13/2016	Drilling fluids (top) field duplicate	Fluid
10749	WSTMO-16-122908	06/13/2016	Drilling fluids (top) trip blank	Fluid
10749	WSTMO-16-122903	06/21/2016	Drilling fluids (middle)	Fluid
10749	WSTMO-16-122906	06/21/2016	Drilling fluids (middle) field duplicate	Fluid
10749	WSTMO-16-122909	06/21/2016	Drilling fluids (middle) trip blank	Fluid
10749	WSTMO-16-122904	07/01/2016	Drilling fluids (bottom)	Fluid
10749	WSTMO-16-122907	07/01/2016	Drilling fluids (bottom) field duplicate	Fluid
10749	WSTMO-16-122910	07/01/2016	Drilling fluids (bottom) trip blank	Fluid
10558	WSTMO-16-124558	08/01/2016	Drilling fluids (composite)	Fluid
10558	WSTMO-16-124559	08/01/2016	Drilling fluids (composite)	Fluid
10558	WSTMO-16-124560	08/01/2016	Drilling fluids (composite) field duplicate	Fluid
10748	WSTMO-16-122893	06/13/2016	Drill cuttings (top)	Soil
10748	WSTMO-16-122896	06/13/2016	Drill cuttings(top) field duplicate	Soil
10748	WSTMO-16-122894	06/21/2106	Drill cuttings (middle)	Soil
10748	WSTMO-16-122748	06/21/2016	Drill cuttings (middle) field duplicate	Soil
10748	WSTMO-16-122895	07/01/2016	Drill cuttings (bottom)	Soil
10748	WSTMO-16-122898	07/01/2106	Drill cuttings (bottom) field duplicate	Soil
10859	WSTMO-16-124562	08/01/2016	Drill cuttings composite	Soil