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John Kieling, Bureau Chief
Hazardous Waste Bureau
New Mexico Environment Department
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Santa Fe, NM 87505-6303

Subject: Annual Progress Report for Corrective Measures Implementation and Deep Groundwater Investigations for Consolidated Unit 16-021(c)-99

Dear Mr. Kieling:

Enclosed please find two hard copies with electronic files of the Annual Progress Report for Corrective Measures Implementation and Deep Groundwater Investigations for Consolidated Unit 16-021(c)-99. This report summarizes activities Los Alamos National Laboratory completed from October 2016 to September 2017 related to the corrective measures implementation and deep groundwater investigations for Consolidated Unit 16-021(c)-99, the Technical Area 16 260 Outfall.

If you have any questions, please contact Steve Paris at (505) 606-0915 (smparis@lanl.gov) or Cheryl Rodriguez at (505) 665-5330 (cheryl.rodriguez@em.doe.gov).

Sincerely,

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Sincerely,

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Enclosures: Two hard copies with electronic files – Annual Progress Report for Corrective Measures Implementation and Deep Groundwater Investigations for Consolidated Unit 16-021(c)-99 (EP2017-0152)

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LA-UR-17-30538
November 2017
EP2017-0152

Annual Progress Report for Corrective Measures Implementation and Deep Groundwater Investigations for Consolidated Unit 16-021(c)-99

Los Alamos
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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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EP2017-0152

Annual Progress Report for Corrective Measures Implementation and Deep Groundwater Investigations for Consolidated Unit 16-021(c)-99

November 2017

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EXECUTIVE SUMMARY

Significant achievements accomplished during fiscal year (FY) 2017 include installing regional monitoring well R-68 north of Cañon de Valle; removing the permeable reactive barrier and closing out the remaining surface corrective measures implementation (CMI) activities; and submitting the "Remedy Completion Report for Corrective Measures Implementation at Consolidated Unit 16-021(c)-99" to the New Mexico Environment Department (NMED). Other achievements were analysis of the cross borehole aquifer testing data collected during extended testing in FY2016 and submitting a report on the results; conducting quarterly tracer breakthrough sampling and submitting a tracer status report; preparing a summary report on R-68 and a revised drilling work plan for regional well R-69 to assess RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine) contamination in groundwater north of Cañon de Valle; further development of a three-dimensional groundwater model; and completing studies on the geochemistry, geohydrology, and RDX degradation at Technical Area 16.

With the closeout of surface CMI activities at Consolidated Unit 16-021(c)-99 and the transition to long-term monitoring for alluvial wells and springs, future efforts will focus on the deep groundwater investigation of RDX. The goals for FY2018 include installation of regional monitoring well R-69 to address data needs regarding the nature and extent of RDX contamination in the regional aquifer. In addition, a compendium of RDX technical reports that document work conducted over the last 2 years will be submitted to NMED by March 31, 2018, and Los Alamos National Laboratory will prepare a deep groundwater investigation report (IR) for submittal to NMED by March 31, 2019. The IR will present updates on investigations related to nature and extent, an updated conceptual model that incorporates detailed technical studies conducted over the past several years, and an evaluation of potential impacts of RDX to the regional aquifer that might result from transport of the RDX inventory in the overlying vadose zone and perched-intermediate groundwater.

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1.0 INTRODUCTION

This report serves as the second annual progress report for the corrective measures evaluation/corrective measures implementation (CME/CMI) activities for Consolidated Unit 16-021(c)-99 [now retitled the "Annual Progress Report for Corrective Measures Implementation and Deep Groundwater Investigations for Consolidated Unit 16-021(c)-99"]. It summarizes activities Los Alamos National Laboratory (LANL or the Laboratory) completed from October 2016 to September 2017 (fiscal year [FY] 2017) related to the CMI and deep groundwater investigations for Consolidated Unit 16-021(c)-99, the Technical Area 16 (TA-16) 260 Outfall.

The U.S. Department of Energy (DOE) and Los Alamos National Security, LLC (LANS) submitted the "Corrective Measures Evaluation Report, Intermediate and Regional Groundwater, Consolidated Unit 16-021(c)-99" (hereafter, the CME report) in August 2007 (LANL 2007, 098734). New Mexico Environment Department (NMED) issued a notice of disapproval (NOD) in April 2008 (NMED 2008, 101311), requesting additional characterization to evaluate the feasibility of the remedial alternatives proposed in the groundwater CME report and to assess the extent of contamination in perched-intermediate groundwater and in the regional aquifer.

To address the data needs identified by NMED, the Laboratory has conducted additional characterization of perched-intermediate and regional groundwater in recent years, including installing additional wells, conducting single-well and multi-well aquifer tests and tracer tests; and conducting geochemical, bioremediation and natural attenuation studies. The deep groundwater investigation activities conducted during fiscal year FY2017 are discussed in this report.

2.0 SURFACE CMI ACTIVITIES

During the FY2017 reporting period, activities conducted related to the surface CMI included

- submittal of the "Remedy Completion Report for Corrective Measures Implementation at Consolidated Unit 16-021(c)-99" (LANL 2017, 602597) and
- inspections of best management practices (BMPs).

These are discussed below.

2.1 Remedy Completion Report

In 2016, an "Evaluation Report for Surface Corrective Measures Implementation Closure, Consolidated Unit 16-021(c)-99" was submitted to the NMED (LANL 2016, 601837) with recommendations regarding closing out the surface CMI for the RDX project. The evaluation report was approved by NMED on October 21, 2016 (NMED 2016, 601914). The report presented plans for plugging and abandonment of permeable reactive barrier (PRB) alluvial monitoring wells, removal of Cañon de Valle PRB debris, and installation of one additional alluvial monitoring well in Cañon de Valle.

The report Included an assessment of the long-term trends in RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine) concentrations in alluvial groundwater downgradient of Sanitary Wastewater Systems Consolidation (SWSC), Burning Ground, and Martin Springs. RDX concentrations in alluvial groundwater have declined over the years, and are currently at or near the NMED tap water screening level of 7.02 µg/L. Based on these concentrations and the long-term declining trends, the Laboratory recommended that the carbon filtration treatment systems installed at the springs be removed. The spring treatment boxes were never activated, because of National Pollutant Discharge Elimination System (NPDES) permitting difficulties in 2009 and 2010.

During FY2017, recommendations presented in the "Evaluation Report for Surface Corrective Measures Implementation Closure, Consolidated Unit 16-021(c)-99" (LANL 2016, 601837) were implemented. To close out the CMI, the Laboratory removed the pilot PRB (damaged during flooding in 2011); plugged and abandoned the PRB wells in Cañon de Valle; replaced an alluvial monitoring well in Cañon de Valle with a new monitoring well (CdV-16-02657r); and removed the spring treatment boxes at SWSC, Burning Ground, and Martin Springs. These actions were documented in a CMI remedy completion report.

On September 8, 2017, the Laboratory submitted the Remedy Completion Report (LANL 2017, 602597) to NMED, and approval of the report is anticipated before the end of December 2017. The report documents the closeout of all remaining corrective actions for the surface CMI. The report included a discussion of the fate and transport of RDX and barium. It evaluated the need for additional PRBs to remove RDX and barium from shallow groundwater, and concluded that low concentrations and declining trends of RDX and the limited mobility of barium in groundwater precluded the need for PRBs to protect intermediate and regional groundwater.

The remedy completion report recommended continued long-term monitoring of springs, base flow, and alluvial groundwater to monitor trends in RDX and barium in Cañon de Valle and Martin Spring Canyons. A long-term monitoring and maintenance plan was included in the report as Appendix A. Long-term monitoring will be conducted to evaluate the fate of residual contamination and the effectiveness of the corrective actions. In addition, the low-permeability cap above the settling pond at the 260 Outfall will be inspected and maintained as necessary. Water levels in a surge bed monitoring well near the settling pond will be monitored to ensure that the low-permeability cap remains protective of the underlying surge bed, which still has residual contamination.

2.2 BMPs

Inspection of BMPs associated with Consolidated Unit 16-021(c)-99 continued in FY2017. Inspection of BMPs is conducted under the Individual Storm Water Permit, pursuant to the requirements of NPDES Permit No. NM0030759 (hereafter, the Individual Permit), as authorized by the U.S. Environmental Protection Agency (EPA).

Current BMPs, called controls in the Individual Permit, include a low-permeability cap consisting of a 20-in.-thick crushed tuff/bentonite cap installed on top of the former settling pond, five earthen berms and one rock check dam installed to control run-on/runoff, riprap within the former channel to control runoff, and established vegetation to control erosion from the site. Controls are inspected annually and following a significant rain event of 0.25 in. or greater within 30 min, as measured at rain gage RG257, per the Individual Permit.

During the period from October 1, 2016, to September 30, 2017 the following significant rain events were recorded at rain gage RG257:

Date	30-min Maximum Intensity	24-h Total	BMP Inspection Date	BMP Maintenance Date
06/06/2017	0.35	0.7	06/19/2017	—*
06/25/2017	0.63	1.17	06/27/2017	—
07/12/2017	0.31	0.51	07/21/2017	—
07/18/2017	0.31	0.35		
07/29/2017	0.31	0.46	08/01/2017	—

*— = No maintenance required.

Per the Individual Permit, if several storms exceeding the intensity threshold of 0.25 in. in 30 min occur over a period not to exceed 15 d from the first event, a single inspection is sufficient to achieve compliance (hence the number of events may differ from the number of inspections). Inspection results will be reported in the "Storm Water Individual Permit Annual Report, Reporting Period: January 1–December 31, 2017," and submitted to the EPA Region 6 Enforcement Division as well as to NMED Surface Water Quality Bureau (NMED-SWQB) in February 2018.

3.0 DEEP GROUNDWATER INVESTIGATION ACTIVITIES

During the FY2017 reporting period, activities conducted related to the ongoing investigation of the nature and extent of RDX contamination in perched-intermediate groundwater and the regional aquifer included

- installation of regional monitoring well R-68;
- preparation of a summary report on R-68 and a drilling work plan for regional monitoring well R-69;
- routine Interim Facility-Wide Groundwater Monitoring Plan (IFGMP) sampling at TA-16 260 monitoring group wells;
- continued monitoring for tracers in select monitoring wells in TA-09 and TA-16, and preparation of a tracer status report summarizing the results from FY2016 sampling for tracers;
- refinement of the site conceptual model for deep groundwater contamination through groundwater flow and transport modeling, and laboratory bench-scale studies.

These activities are discussed below.

3.1 Monitoring Well Installation

A regional aquifer monitoring well, R-68, was completed in TA-09. The well was installed on the mesa north of Cañon de Valle, approximately 500 ft northeast of CdV-9-1(i), as shown in Figure 3.1-1. The well was installed to address data needs identified based on emerging information from characterization activities at TA-09 and TA-16 related to Consolidated Unit 16-021(c)-99. These data needs are discussed in the "Groundwater Investigation Work Plan for Consolidated Unit 16-021(c)-99, Including Drilling Work Plans for Wells R-68 and R-69" (LANL 2016, 601779). The work plan proposed the installation of up to two regional aquifer monitoring wells, R-68 and R-69, north of Cañon de Valle, and was approved by NMED on September 27, 2016 (NMED 2016, 601855).

The recommendation for new regional wells R-68 and R-69 were based on continuing increases in RDX concentrations in R-18, along with unique ratios of high explosives– (HE-) degradation products, indicating contamination in this well may originate from a source other than the 260 Outfall, with one possibility being historical releases from TA-09. In addition, screening data collected during drilling of CdV-9-1(i) showed the presence of a thick, high-RDX zone at a depth of ~650 to ~900 ft, indicating a significant zone of contaminated perched-intermediate groundwater north of Cañon de Valle.

Monitoring well R-68 was drilled in accordance with the NMED-approved drilling work plan (LANL 2016, 601779); (NMED 2016, 601855) between January 9 and February 2, 2017, and was completed on February 27, 2017 (LANL 2017, 602539). The well was drilled to a total depth of 1422.8 ft below ground surface (bgs), and is screened between 1340 and 1360.4 ft bgs within the Puye Formation. The static depth to water after well installation was measured at 1325.7 ft bgs, within 1 ft of the predicted elevation of 1325 ft bgs (LANL 2016, 601779).

The water level information from R-68 helps constrain the groundwater flow direction and gradient in the area north of Cañon de Valle, thus meeting one of the primary objectives of the Groundwater Investigation Work Plan (LANL 2016, 601779). The water level data from R-68 indicate no change from the inferred flow direction presented in the Groundwater Investigation Work Plan (LANL 2016, 601779), which suggests flow in the R-68 area is generally to the north-northeast. Figure 3.1-2 shows a water level contour map for both the perched-intermediate groundwater and the regional aquifer.

Regional groundwater characterization samples were collected from R-68 on March 20, June 2, July 13, and September 6, 2017. Samples were analyzed off-site at GELC Laboratories, LLC, Charleston, SC for a full suite of constituents, including HE compounds and degradation products, volatile organic and semi-volatile organic compounds, metals, low-level tritium, and general inorganics. The analytical results from R-68 were screened against the lowest applicable screening value, and RDX was detected above the NMED tap water screening level of 7.02 µg/L. RDX was detected at concentrations ranging from 8.08 µg/L to 17.1 µg/L, with the highest value measured in the September 6, 2017, sample.

3.2 R-68 Summary Report and Drilling Work Plan for R-69

A report summarizing the geochemical and hydrologic data from R-68 was submitted to NMED on September 28, 2017 (LANL 2017, 602646). The “Summary Report for R-68 and Drilling Work Plan for R-69, Revision 1” was approved by NMED on October 23, 2017. The report recommended installation of a second regional monitoring well, R-69, to address uncertainties related to the relation between RDX in R-68 and R-18, and the vertical hydraulic head and contaminant concentration gradients in the distal portion of the RDX plume. It is anticipated that data from R-69 will provide a better understanding of the northern extent of perched-intermediate groundwater and whether the perched zone is hydrologically connected to the regional aquifer north of R-68.

The proposed new regional well R-69 will be located between R-68 and R-18 (Figure 3.1-1), and will have two screens. The upper screen will be completed just below the regional aquifer water table to assess contaminant concentrations at the top of the regional aquifer. The lower screen will be completed at approximately the same depth as the R-18 screened interval (the screen of R-18 is located between 69 ft and 92 ft below the water table). Both completion zones will be hydraulically isolated using a Baski inflatable packer system. Additional details on R-69 are included in the revised drilling work plan for R-69, included as an appendix to the “R-68 Summary Report” (LANL 2017, 602646).

3.3 Routine IFGMP Sampling

Four groundwater sampling campaigns were conducted for the TA-16 260 monitoring group during FY2017 in accordance with the IFGMP for the 2017 Monitoring Year, October 2016 to September 2017 (LANL 2016, 601506). The IFGMP sampling campaigns were conducted December 1, 2016 to January 12, 2017; February 27 to March 23, 2017; May 31, 2017 to June 15, 2017; and August 29, 2017 to September 18, 2017. The analytical data from these sampling campaigns are available in the Environmental Information Management System and are presented in the annual Periodic Monitoring Reports for the TA-16 260 Monitoring Group.

3.4 Tracer Breakthrough Sampling and Submittal of the Tracer Status Report

Tracer breakthrough sampling continued during FY2017 at select wells in TA-16 and TA-19. The tracers were initially deployed in perched-intermediate groundwater in November 2015 in monitoring wells R-25b, CdV-16-1(i), and in CdV-9-1(i) screen 1, and in piezometers CdV-9-1(i) PZ1 and CdV-9-1(i) PZ2 (LANL 2017, 602161). Tracer breakthrough sampling in FY2016 was conducted quarterly in perched-intermediate wells CdV-16-2(i)r, CdV-16-4ip, and R-47i and in regional aquifer wells R-18, R-47, R-48, R-58, and R-63.

A summary report of the tracer test and the relevant test data was submitted to NMED on February 14, 2017 (LANL 2017, 602161) in accordance with Appendix B of the June 2016 Compliance Order on Consent (the Consent Order).

Pump tests in CdV-9-1(i) and CdV-16-1(i) in 2016 (LANL 2017, 602288) affected the deployed tracers in these wells, removing some of the mass from the groundwater in the vicinity of these wells. The effects in CdV-9-1(i) were minor in terms of mass removed and affected only bromide and the tracers introduced into the piezometers. The pump test in CdV-16-1(i) removed an estimated 29% of the original tracer mass during the aquifer test. Tracers from both CdV-9-1(i) piezometers have been detected in CdV-9-1(i) screen 1, demonstrating vertical flow path connections.

The estimated linear flow rates based on data from tracer dilution tests (conducted before tracer deployment) were 0.05 m/d in R-25b and 3.1 m/d in CdV 9 1(i) screen 1. The large tracer tests showed clear dilution effects in all three deployment wells, but implied rates based on concentration differences suggest the groundwater flow velocity at R-25b is much lower than the flow velocity at CdV-16-1(i), and flow velocity in CdV-9-1(i) is greater than the flow velocity at CdV-16-1(i).

Cross-well tracer transport has not been detected yet, and continued tracer monitoring is necessary to realize the full benefits of the TA-16 tracer study. Monitoring for tracers is conducted at minimal additional cost during routine groundwater monitoring activities at TA-16. Quarterly monitoring for tracers should continue for at least several more years to further quantify dispersal behavior from the injection wells and to monitor for any cross-well transport (i.e., verify lateral transport pathways).

3.5 Report on Perched-Intermediate Groundwater Zone Aquifer Testing

Cross-well pumping tests were conducted in FY2016 and early FY2017 at monitoring wells CdV-9-1(i), CdV-16-1(i), and CdV-16-4ip, completed in perched-intermediate groundwater at TA-16. A report summarizing the results of cross-borehole aquifer testing was submitted to the NMED on April 7, 2017 (LANL 2017, 602288).

The primary objectives of the testing were to evaluate the degree of hydraulic connectivity within the perched groundwater system and to improve the understanding of contaminant transport pathways. Monitoring wells CdV-9-1(i), CdV-16-1(i), and CdV-16-4ip were pumped for approximately 30 d each, and potentiometric responses were monitored in nearby perched-intermediate and regional wells. To assess transient responses in RDX concentrations, samples were collected from test wells during pumping and recovery.

The pumping tests provided valuable information regarding vertical and horizontal connectivity within perched-intermediate groundwater at TA-16. Hydraulic communication was observed between screens relatively proximal to each other and completed in the upper Puye Formation. The primary area of hydraulic communication is a laterally continuous saturated zone within the upper Puye Formation that is at least as large as the triangle formed by CdV-9-1(i), CdV-16-4ip, and R-25 screen 2. The preferential communication across the upper Puye Formation is likely driven by stratification (i.e., high anisotropy) within Puye strata.

Pumping from wells within the upper Puye caused little or no response in monitored screens within the lower Puye Formation and Otowi Member, including monitoring points that are very close to the pumping locations. In one case, limited hydraulic communication may have been observed across the Otowi/Puye boundary, based on apparent water level responses in CdV-9-1(i) PZ-2 as a result of pumping at CdV-16-1(i). These observations indicate apparent high lateral to vertical anisotropy and a potentially important hydrostratigraphic characteristic of the Otowi/Puye contact.

Because of the relatively low sustainable pumping rates at CdV-16-1(i), CdV-9-1(i), and CdV-16-4ip, the total mass of RDX removed during 90 d of pumping was an estimated 0.17 kg, representing approximately 0.02% to 0.08% of the estimated RDX inventory believed to be present in perched-intermediate groundwater beneath the TA-16/TA-09 area. These findings provide a basis for updating the conceptual model for the perched-intermediate zone in the RDX project area. Geologic cross-sections incorporating the revised understanding of perched-intermediate groundwater and the laterally continuous zone within the upper Puye Formation where hydraulic communication was observed were presented in the report.

3.6 Site Conceptual Model Refinement

During FY2017, characterization activities were conducted at TA-09 and TA-16 to further refine the site conceptual model, including geochemical studies; review of geologic data, bioremediation and natural attenuation studies; review of geologic data and further improvements to the groundwater flow and contaminant transport models for TA-16. Additional details regarding these activities are provided below.

3.6.1 Geochemical Studies

Geochemical studies conducted in FY2017 included additional statistical evaluations of the geochemistry of alluvial, upper and lower perched-intermediate groundwater, and the regional aquifer. Discharge behaviors of RDX, barium, and major ion concentration at SWSC, Burning Ground, Martin Springs, and in Cañon de Valle stream flow were studied to better understand the contaminant source in the vadose zone. Barium and RDX were found to behave chemostatically (concentrations remain relatively stable regardless of discharge), with important implications regarding contaminant residence time in the vadose zone. Isotope data and transient recharge events were studied to understand groundwater flow paths and hydrological connectivity, and the relative percentages of mountain front- versus local-recharge were calculated using mixing models.

3.6.2 Review of Geologic Data

Most of the geological studies to compile data in support of the deep groundwater investigation were completed in FY2016. The focus of the geologic studies was to improve the site geologic model and to provide a summary of geologic conditions at TA-16. Emphasis was placed on geologic features that influence groundwater pathways and flow directions, such as fractures, structures, stratigraphic contacts, and bedding orientations.

Geologic studies conducted in FY2017 included a detailed examination of the R-68 drill cuttings and updating the stratigraphic contacts within the Bandelier Tuff based on the data from R-68 and comparing the results with nearby wells. In addition, vertical cross-sections were updated and new cross-sections were developed to incorporate the observations related to the water-level responses observed during the extended cross-borehole hydraulic testing that was conducted in FY2016 and early FY2017. These cross-sections are an important component of the updated TA-16 hydrogeologic conceptual model.

3.6.3 Natural Attenuation and Bioremediation Studies

During FY2017, the transport of RDX and its degradation products (hexahydro-1-nitroso-3,5-dinitro-1,3,5-triazine [MNX]; hexahydro-1,3-dinitro-5-nitro-1,3,5-triazine [DNX]; 2,4,6-trinitroxylene [TNX]) under conditions relevant to TA-16 was investigated. Batch and column experiments were conducted to determine the extent of adsorption-desorption and transport of RDX and its degradation products ([MNX], hexahydro-DNX, and TNX]) in major rock types in which the RDX plume is located. Retardation factors and partitioning coefficient (K_d) values for RDX were calculated from batch experiments. Additionally, retardation factors and K_d values for RDX and its degradation products were calibrated from column experiments using a one-dimensional transport model with equilibrium sorption (linear isotherm).

Microbial diversity in groundwater at TA-16 was evaluated, and the potential for natural attenuation of RDX under varying biogeochemical conditions was assessed. Microbial diversity results show that the groundwater microbiome was dominated by *Actinobacteria* and *Proteobacteria.* No direct evidence indicating that RDX is biodegraded by these microbes under the geochemical conditions in the perched-intermediate aquifer was found. Similarly, no evidence that biodegradation under the regional aquifer conditions was found. However, groundwater data and a survey of historical monitoring data at TA-16 suggest that RDX is degraded in the alluvial system. This may be attributed to transient anoxic conditions that are created by microbial activity.

Alternative chemical and biological treatment options were evaluated to determine their potential to accelerate the degradation of RDX. The permanganate and alkaline treatments showed very efficient RDX degradation in batch reactors but were not effective in flow-through systems. However, a treatment of the sediment with sodium dithionate was effective in both batch and flow-through systems. Biostimulation using molasses was determined to be effective as well, but required more frequent reintroduction of molasses.

3.6.4 Groundwater Flow and Transport Modeling

During FY2017, additional refinements were made to the analytical and numerical models of groundwater flow and contaminant transport in the subsurface at the RDX site (TA-16, TA-9). The three-dimensional vadose zone and regional aquifer model of the RDX site continues to be refined. The model accounts for water-levels observed along the perched horizons in the vadose zone as well as RDX transients overserved at the site monitoring wells. In the future, the 3-D site model will be coupled with the large (Pajarito Plateau) scale regional aquifer model currently used for the Chromium project. Analyses of the cross-hole aquifer test data was conducted and was included in the “Summary Report for Intermediate Groundwater System Characterization Activities at Consolidated Unit 16-021(c)-99” (LANL 2017, 602288) (see Section 3.5).

In addition, blind source separation (BSS) techniques were used to analyze the site geochemical data. The analyses provided robust and objective evaluation of the possible mixtures of different groundwater types with distinctive geochemical signatures. The different groundwater types are indicative of (1) different groundwater recharge sources, (2) different subsurface flow paths through the complex site system of perched zones from the ground surface, through the vadose zone and to the regional aquifer (the different flow paths are impacted by different groundwater-rock interactions), and (3) contamination sources. Geochemical data from the new regional monitoring well R-68 are currently being evaluated using BSS.

4.0 REGULATORY, PUBLIC, AND STAKEHOLDER INVOLVEMENT

Technical meetings with the NMED-Hazardous Waste Bureau (HWB) and the NMED DOE Oversight Bureau (NMED DOE-OB) were held throughout the year to discuss RDX project activities. These meetings are summarized below:

11/15/2016 Pre-submission review meeting with NMED to discuss the "Annual Progress Report for Corrective Measures Evaluation/Corrective Measures Implementation for Consolidated Unit 16-021(c)-99."

1/11/2017 Pre-Submission review meeting with NMED to discuss the "Status Report for the Tracer Tests at Consolidated Unit 16-021(c)-99, Technical Area 16."

1/30/2017 RDX technical team meeting with NMED. Key topics included surface CMI closure update, R-68 drilling status, remediation alternative studies update, and BSS.

2/27/2017 Pre-submission review meeting with NMED to discuss the "Summary Report for Intermediate Groundwater System Characterization Activities at Consolidated Unit 16-021(c)-99."

3/3/2017 Tour of TA-16 and TA-09 with NMED HWB and DOE-OB. Sites visited included the 260 Outfall and Material Disposal Area (MDA) R, the 90's Line Pond, the HE Treatment Facility, MDA P, CdV-16-4ip, Burning Ground, and SWSC springs, and the R-68 drilling site.

5/8/2017 RDX Technical Team meeting with NMED. Key topics included updates on R-68, discussion of the Cañon de Valle recharge pulse observed at CdV-9-1(i) and other nearby wells, and an update on the hydrogeochemical conceptual model.

6/29/2017 Pre-submission review meeting with NMED to discuss the Remedy Completion Report (LANL 2017, 602597).

8/28/2017 RDX technical team meeting with NMED. Key topics discussed were the ongoing TA-16 hydrogeochemistry studies, including the chemostatic behavior of RDX in spring discharge, and mixing model calculations of mountain block recharge.

5.0 WORK PLANNED FOR THE NEAR FUTURE

5.1 Surface CMI Activities

Pending approval of the Remedy Completion Report (LANL 2017, 602597) by NMED, monitoring of shallow groundwater and baseflow locations will transition to long-term monitoring. Sampling activities will be planned in the IFGMP, and no changes in sampling frequency or analytes are planned for FY2018.

The Laboratory will continue to conduct routine inspections of the low-permeability cap above the former settling pond. If inspections indicate maintenance of the cap is required, maintenance will be conducted to ensure the cap remains protective of the underlying contaminated surge bed and it continues to minimize infiltration of water into the subsurface. Long-term monitoring of water-levels will be conducted at the surge-bed monitoring well adjacent to the low-permeability cap via pressure transducer. If sufficient water is found to be present, the well will be sampled.

A long-term monitoring and maintenance report is planned for annual submittal to NMED after the Remedy Completion Report (LANL 2017, 602597) is approved and long-term monitoring is initiated. The report will include data plots and analysis of the results. The report will also discuss any maintenance and repair of the low-permeability cap, and will provide recommendations to NMED regarding potential changes or refinements to future monitoring and maintenance activities.

5.2 Deep Groundwater Investigation

5.2.1 Installation of Regional Monitoring Well R-69

Regional monitoring well R-69 is planned for installation in the near future (LANL 2017, 602646) to address remaining uncertainties identified in the Groundwater Investigation Work Plan (LANL 2016, 601779). R-69 will be located north of Cañon de Valle between R-68 and R-18, and will have two well screens. A 72-h aquifer test will be conducted on each screen to assess aquifer parameters and horizontal and vertical anisotropy in the aquifer.

The proposed location for R-69 is within the core habitat of a threatened or endangered species. Therefore, most drilling-related work is prohibited after February and extending into May of each year. The goal is to have the well pad completed by the end of February 28, 2018, to allow drilling to begin in early June 2018, once the threatened and endangered species restrictions are lifted. If drilling of R-69 commences in June 2018, the estimated completion date for the well would be September 30, 2018.

5.2.2 Submittal of a Compendium of RDX Technical Reports

The Laboratory plans to submit a compendium of technical reports for work conducted over the last several years. The reports present updated information on the hydrogeochemical conceptual model for TA-16, the hydrology and geology of the area, the estimated inventory of RDX in the subsurface environment, and studies related to the degradation and treatment of RDX. The RDX compendium will be submitted to NMED by March 31, 2018.

5.2.3 RDX Investigation Report

After submittal of the RDX reports, a final deep groundwater investigation report (IR) will be prepared and submitted to NMED by March 31, 2019. The schedule for the report to NMED should allow sufficient time for several rounds of sampling from the new regional well R-69.

The IR will address the data gaps identified by the NMED in the NOD related to the deep groundwater CME report(NMED 2008, 101311), and the data gaps identified in the Groundwater Investigation Work Plan (LANL 2016, 601779) and the “R-68 Summary Report” (LANL 2017, 602646). The IR will present updates on investigations related to nature and extent, an updated conceptual model that incorporates detailed technical studies conducted over the past several years, and will also include an evaluation of potential impacts of RDX to the regional aquifer that might result from transport of the RDX inventory in the overlying vadose zone and perched-intermediate groundwater.

6.0 REFERENCES

The following list includes all documents cited in this report. Parenthetical information following each reference provides the author(s), publication date, and ER ID 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.

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LANL (Los Alamos National Laboratory), September 2016. "Evaluation Report for Surface Corrective Measures Implementation Closure, Consolidated Unit 16-02l(c)-99," Los Alamos National Laboratory document LA-UR-16-27153, Los Alamos, New Mexico. (LANL 2016, 601837)

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LANL (Los Alamos National Laboratory), July 27, 2017. "Completion Report for Regional Aquifer Well R-68," Los Alamos National Laboratory document LA-UR-17-26063, Los Alamos, New Mexico. (LANL 2017, 602539)

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LANL (Los Alamos National Laboratory), September 2017. "Summary Report for R-68 and Drilling Work Plan for R-69, Revision 1," Los Alamos National Laboratory document LA-UR-17-28551, Los Alamos, New Mexico. (LANL 2017, 602646)

NMED (New Mexico Environment Department), April 22, 2008. "Notice of Disapproval Corrective Measures Evaluation Report, Intermediate and Regional Groundwater Consolidated Unit 16-021(c)-99," New Mexico Environment Department letter to D. Gregory (DOE-LASO) and D. McInroy (LANL) from J.P. Bearzi (NMED-HWB), Santa Fe, New Mexico. (NMED 2008, 101311)

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NMED (New Mexico Environment Department), October 21, 2016. "Approval, Evaluation Report for Surface Corrective Measures Implementation Closure, Consolidated Unit 16-021(c)-99," 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, 601914)

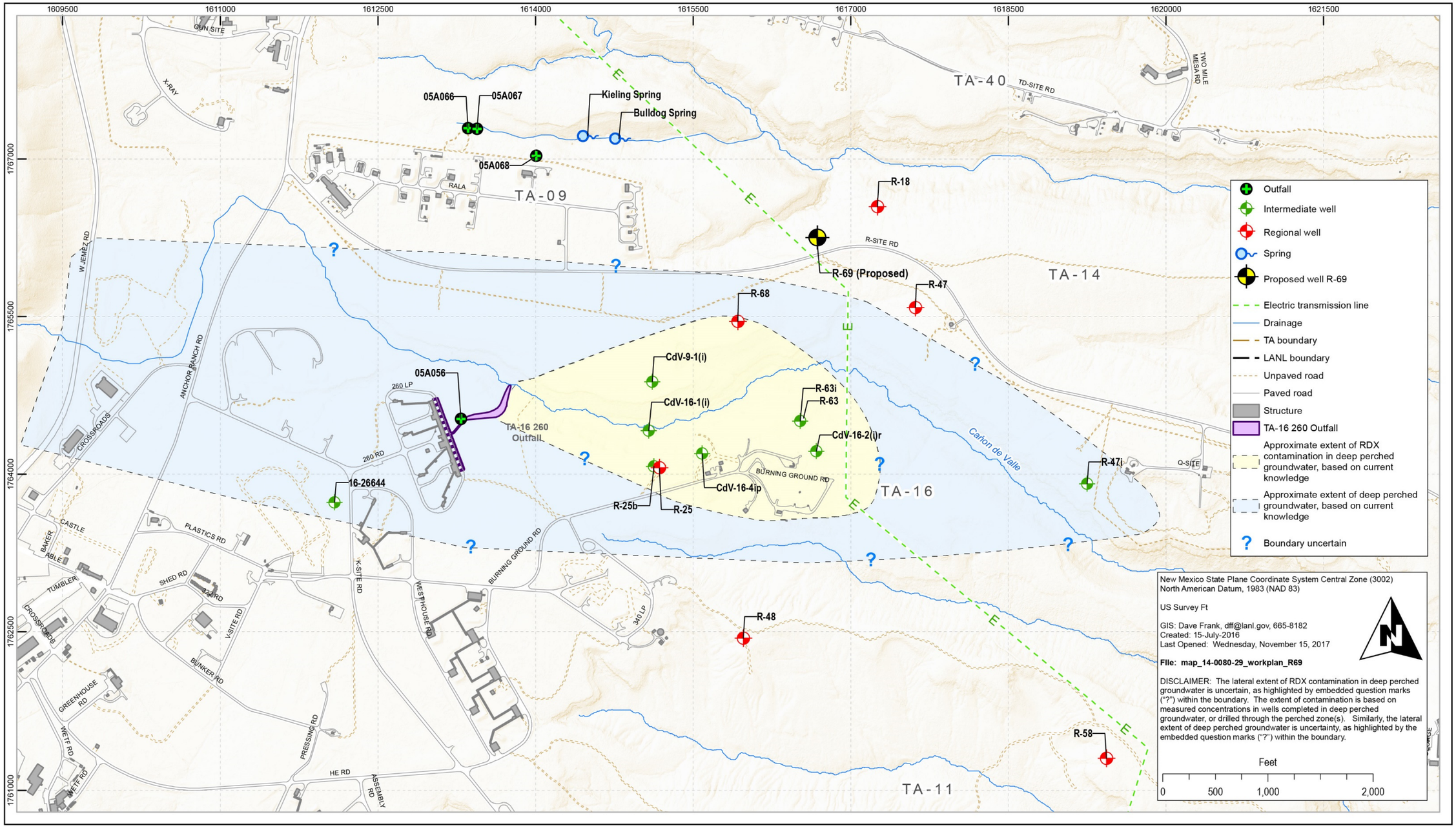


Figure 3.1-1 Deep groundwater investigation monitoring wells near the 260 Outfall and location of proposed regional monitoring well R-69

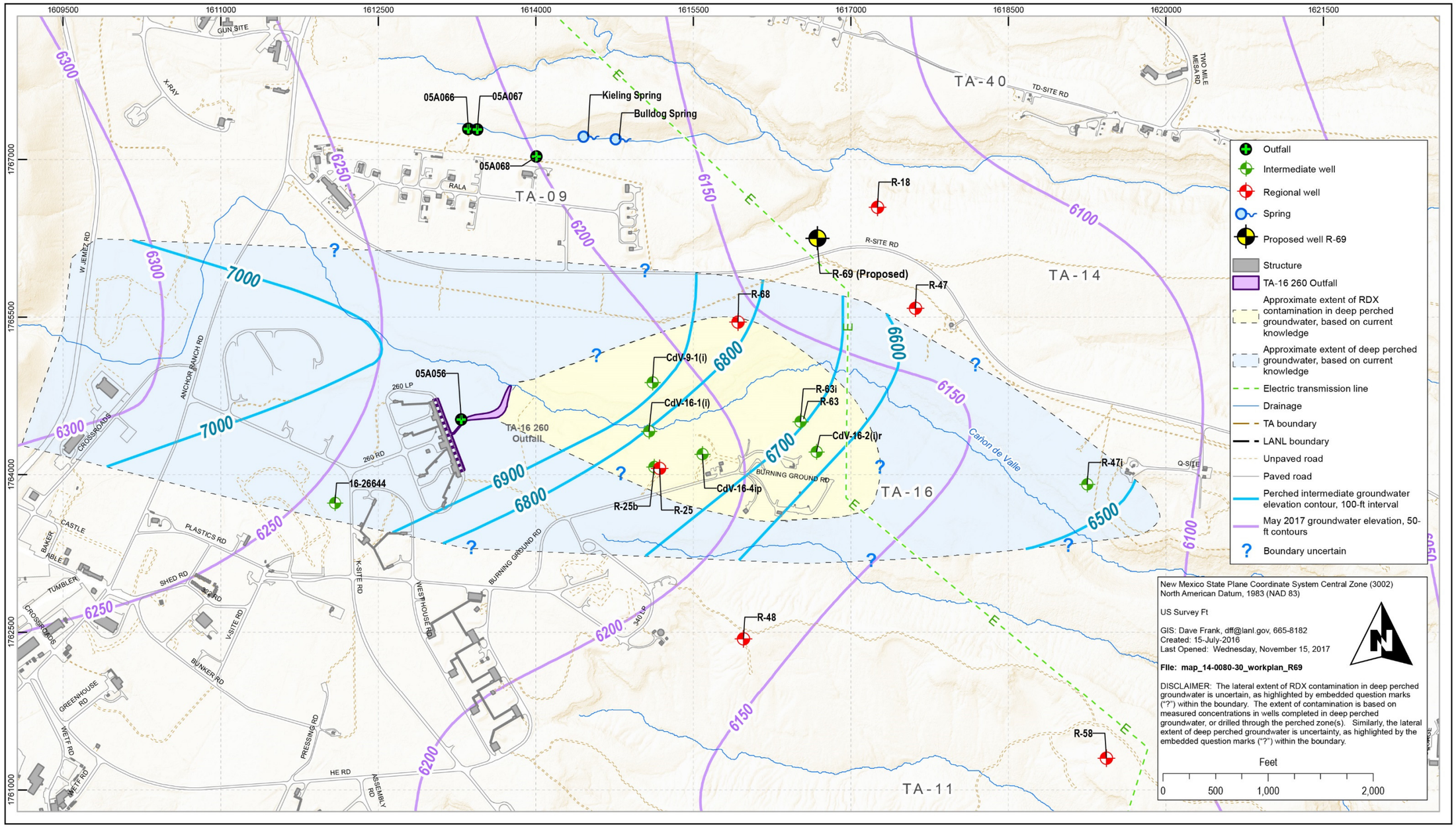


Figure 3.1-2 Water-level contour map for both the perched-intermediate groundwater and the regional aquifer