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NOV 16 2018

Dear Mr. Kieling:

Subject: Submittal of the Annual Progress Report for the Corrective Measures Evaluation for the Deep Groundwater Investigation for Consolidated Unit 16-021(c)-99

Enclosed please find two hard copies with electronic files of the "Annual Progress Report for the Corrective Measures Evaluation for the Deep Groundwater Investigation for Consolidated Unit 16-021(c)-99." This report summarizes activities Los Alamos National Laboratory and Newport News Nuclear BWXT – Los Alamos, LLC, completed from October 2017 to September 2018 related to the deep groundwater investigation corrective measures evaluation for Consolidated Unit 16-021(c)-99, the Technical Area 16 260 Outfall.

If you have any questions, please contact Patrick McGuire at (315) 420-5629 (patrick.mcguire@em-la.doe.gov) or Cheryl Rodriguez at (505) 665-5330 (cheryl.rodriguez@em.doe.gov).

Sincerely,

Arturo Q. Duran
Designated Agency Manager
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Enclosures:

1. Annual Progress Report for the Corrective Measures Evaluation for the Deep Groundwater Investigation for Consolidated Unit 16-021(c)-99 (EM2018-0095)

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PRS Database

EM-LA-40AD-00356


Annual Progress Report for the Corrective Measures Evaluation for the Deep Groundwater Investigation for Consolidated Unit 16-021(c)-99

Newport News Nuclear BWXT – Los Alamos, LLC (N3B), under the U.S. Department of Energy Office of Environmental Management Contract No. 89303318CEM000007 (the Los Alamos Legacy Cleanup Contract), 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. The U.S. government has rights to use, reproduce, and distribute this document. The public may copy and use this document without charge, provided that this notice and any statement of authorship are reproduced on all copies.


Annual Progress Report for the Corrective Measures Evaluation for the Deep Groundwater Investigation for Consolidated Unit 16-021(c)-99

November 2018

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1.0 INTRODUCTION

This report serves as the third annual progress report for the corrective measures evaluation (CME) and deep groundwater investigation for Consolidated Unit 16-021(c)-99. The report summarizes activities Los Alamos National Laboratory (LANL or the Laboratory) and Newport News Nuclear BWXT – Los Alamos, LLC (N3B) completed from October 2017 to September 2018 (fiscal year [FY] 2018) related to the deep groundwater investigation for Consolidated Unit 16-021(c)-99, the Technical Area 16 (TA-16) 260 Outfall (Figure 1.0-1). This report replaces the annual progress report for the CME/corrective measures implementation (CMI) and deep groundwater investigation for Consolidated Unit 16-021(c)-99. In September 2017 the New Mexico Environment Department (NMED) received the “Remedy Completion Report for Corrective Measures Implementation at Consolidated Unit 16-021(c)-99” (LANL 2017, 602597), documenting the activities conducted that completed the surface CMI at Consolidated Unit 16-021(c)-99. In November 2017 NMED issued approval of the report with modifications (NMED 2017, 602758). In the approval letter NMED acknowledged the completion of activities for the surface CMI at Consolidation Unit 16-021(c)-99 and starting on September 30, 2018, and subsequent years thereafter, approved the replacement of the annual CME/CMI progress report with an annual progress report for the CME for the deep groundwater investigation for Consolidated Unit 16-021(c)-99.

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). 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 and N3B have conducted additional characterization of perched-intermediate and regional groundwater in recent years, including installing additional wells; conducting single-well and multiwell aquifer tests and tracer tests; and conducting geochemical, bioremediation, and natural attenuation studies. The deep groundwater investigation activities conducted during FY 2018 are discussed in this report.

2.0 DEEP GROUNDWATER INVESTIGATION ACTIVITIES

During the FY 2018 reporting period, activities conducted related to the ongoing investigation of the nature and extent of RDX (Royal Demolition Explosive) contamination in perched-intermediate groundwater and the regional aquifer included the following:

- installation of regional monitoring well R-69 to assess the nature and extent of RDX in perched-intermediate groundwater and the regional aquifer,
- review of geologic information to improve the site geologic model and to update the TA-16 hydrogeological conceptual model,
- submittal of a compendium of technical reports that described investigation activities since the NMED NOD was issued,
- sampling at TA-16 260 monitoring group wells in accordance with the Interim Facility-Wide Groundwater Monitoring Plan (IFGMP),
- continued sampling to monitor tracer breakthrough in the intermediate and perched zones, and
- development of the deep groundwater investigation report.

These activities are discussed below.

2.1 Monitoring Well Installation

A regional aquifer monitoring well, R-69 (Figure 1.0-1), is being installed 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. 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).

Regional monitoring well R-69 activities started on July 23, 2018, to address remaining uncertainties identified in the groundwater investigation work plan (LANL 2016, 601779). R-69 is located north of Cañon de Valle between R-68 and R-18 screens.

At the end of FY 2018, drilling activities at R-69 were ongoing and continuing into FY 2019. From the start of R-69 installation until the end of FY 2018, drilling activities went as follows:

- July 28, 2018: Drilling activities at R-69 began.
- July 30, 2018: At 763.5 ft below ground surface (bgs) (elevation 6671 ft), drilling stopped because of a hole obstruction. Borehole recovery options were discussed on August 4; on August 12 a decision was made to plug and abandon the borehole.
- August 18, 2018: Drilling began on a second borehole at R-69.
- September 4, 2018: Regional aquifer was contacted at 1300 ft bgs (approximate elevation 6135 ft) with no sign of perched groundwater.
- September 17, 2018: Total depth was reached at 1445 ft bgs (elevation 5990 ft) with a depth to water at 1295.5 (elevation 6139.5 ft).
- Final depth to water is at elevation 6140 ft.
- September 22, 2018: Primary filter pack installation began.
- September 24, 2018: Transition sand and annular seal to surface was installed in screen 2.

The new regional well R-69 will have two screens. The upper screen, screen 1, will be completed just below the regional aquifer water table and at the same approximate elevation as the R-68 well screen to assess contaminant concentrations at the top of the regional aquifer. The lower screen, screen 2, will be completed at approximately the same depth as the R-18 screened interval. Both completion zones will be hydraulically isolated using a Baski inflatable packer system. A 72-hr aquifer test will be conducted on each screen to assess aquifer parameters and horizontal and vertical anisotropy in the aquifer; groundwater samples will be taken at the end of each test. Additional details on the continuation of 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).

A report documenting R-69 well completion and first sample collection, will be submitted to NMED on or before December 14, 2018. A well completion report will be submitted to NMED by March 2019. The data from R-69 are expected to 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.

2.2 Review of Geologic Data

Data compilation in support of the deep groundwater investigation entails the review of geologic data. The focus of the geologic studies is to improve the site geologic model and to provide a summary of geologic conditions at TA-16. Emphasis is placed on geologic features that influence groundwater pathways and flow directions, such as fractures, structures, stratigraphic contacts, and bedding orientations.

Geologic studies conducted in FY 2018 included a detailed examination of the R-69 drill cuttings, updating the stratigraphic contacts within the Bandelier Tuff based on the R-69 borehole data, and comparing the results with those of 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 FY 2016 and early FY 2017. These cross-sections are an important component of the updated TA-16 hydrogeologic conceptual model and will be included in the deep groundwater investigation report (DGIR) due to NMED in August 2019.

2.3 Interim Facility-Wide Monitoring Plan Sampling

Four groundwater sampling campaigns were conducted for the TA-16 260 monitoring group during FY 2018 in accordance with the “Interim Facility-Wide Groundwater Monitoring Plan for the 2018 Monitoring Year, October 2017–September 2018” (LANL 2017, 602406). The Interim Facility-Wide Groundwater Monitoring Plan sampling campaigns were conducted December 1, 2017, to January 8, 2018; February 6, 2018, to March 5, 2018; May 25, 2018, to June 14, 2018; and August 7, 2018, to September 3, 2018. The analytical data from these sampling campaigns are available in Intellus New Mexico and are presented in the annual periodic monitoring reports for the TA-16 260 Monitoring Group. Using the water level information collected during the May 25, 2018, to June 14, 2018, sampling event, a water level contour map for the perched intermediate and regional water bearing units is provided in Figure 2.3-1. The overall flow direction of both perched intermediate groundwater and the regional aquifer is east. Locally, the flow direction in the vicinity of R-68 and the R-18 groundwater flow is northeast; initial water level measurements taken from R-69 support this interpretation of groundwater flow.

2.4 Compendium of Technical Reports

The Laboratory, in March 2018, submitted a “Compendium of Technical Reports Related to the Deep Groundwater Investigation for the RDX Project at Los Alamos National Laboratory” to NMED (LANL 2018, 602963). The compendium presented technical reports on studies related to the RDX contamination of groundwater at the Laboratory and summarized the results of studies on the hydrology, geology, and geochemistry of TA-16 conducted to support the deep groundwater investigation of RDX contamination at the site.

The compendium consisted of the nine following attachments:

2017 Update of the RDX Inventory Report

The objective of this study was to present an updated estimate of the mass of RDX in the subsurface environment in the vicinity and downgradient of the 260 Outfall in Cañon de Valle. This estimate was developed based on the latest characterization results from recently installed monitoring wells and boreholes in TA-16 and TA-9. The revised estimate indicated there may be substantially lower total inventory of RDX in the environment than the previous 2005 estimate, which was based on limited data. In the deep groundwater, the RDX inventory was reduced in the perched intermediate zone by 45% to 82% and the regional groundwater reduction ranged from 74% to 93%. This refined estimate of RDX

inventory in each of the zones will be used for the planned groundwater risk assessment section of the DGIR to evaluate the potential effects of RDX on the regional aquifer.

Geology of Technical Area 16 and Vicinity, Los Alamos National Laboratory

This report described the recent geologic investigations undertaken to support the investigation of RDX-contaminated groundwater in the vicinity of TA-16. This study focused on gathering and evaluating new information on geologic contacts, internal bedding features, and structural controls for the study area, based on data collected during the drilling of monitoring wells and boreholes over the last decade. The data also update the hydrogeochemical conceptual model for the study area.

A Refined Hydrogeochemical Conceptual Model for the RDX Project

Six different studies using isotope data, geochemistry, and field measurements were conducted to update the hydrogeochemical conceptual model (HGCM) for the RDX study area. The updated HGCM provides the framework for the groundwater flow and contaminant transport models and allows more accurate simulations of RDX concentrations in the perched-intermediate zone and the regional aquifer. These studies significantly improved how the HGCM for the area is understood and indicate that the mountain block recharge has a profound influence on the concentrations of HE in the perched-intermediate and regional groundwater.

Fate and Transport of RDX and its Degradation Products in Sedimentary and Volcanic Rocks, Los Alamos, New Mexico

The objective of this study was to better understand the extent of adsorption/desorption and transport of RDX and its degradation products in the perched-intermediate and regional aquifers at TA-16. This report summarizes the results of laboratory batch and column studies conducted to measure contaminant retardation factors and partitioning coefficients for RDX and its degradation products. The results of the study showed low partitioning coefficients for RDX sorption to tuff and sediment core material and low retardation factors. The study also showed there are no major differences between the transport of RDX and its degradation byproducts. The data collected during this study will be used as input parameters to RDX fate and transport models in the groundwater risk assessment for the DGIR.

Biostimulation and Microbial Community Profiling Reveal Insights on RDX Transformation in Groundwater

The objective of this study was to assess the potential for RDX natural biodegradation in groundwater at TA-16. This report summarized (1) the characterization of the microbiome in the perched-intermediate zone and the regional aquifers and (2) the response of the microbial population to biostimulation under varying geochemical conditions. The study also presented biostimulation studies that establish the conditions that are conducive to RDX biodegradation. The data from this study improved the understanding of the biogeochemical conditions in the perched-intermediate zone and the regional aquifers. The data will be used to evaluate potential corrective actions for RDX in groundwater, if a CME is required.

Characterization of the Microbial Population and RDX Degradation in Groundwater at Technical Area 16

The objective of this study was to evaluate (1) the microbiome in the alluvial groundwater and the perched-intermediate and the regional aquifers at TA-16 and (2) the parameters that control RDX degradation in groundwater. The study revealed a diverse microbial population at all locations tested and identified microbes that may potentially degrade RDX under appropriate conditions. Environmental parameters controlling RDX degradation in TA-16 groundwater were also evaluated. Data from this study will be used during the evaluation of the fate and transport of RDX from the alluvial groundwater to

deeper perched-intermediate and regional aquifer groundwater in the groundwater risk assessment for the DGIR.

RDX Degradation in Sediments Treated Both Chemically and with Biostimulant Amendments

The objective of this study was to evaluate the potential of chemical and biological treatment technologies that could be used to stimulate RDX degradation under TA-16 site-specific conditions. The report summarized the results of exploratory laboratory experiments conducted in batch and column conditions to characterize the rate of RDX degradation under conditions representative of the TA-16 site. This data will be useful as initial screening options during consideration of potential treatment technologies, if a CME is required.

Hydrogeology and Model Calibration for Contaminant Fate and Transport at Technical Area 16

The objective of this report was to summarize the groundwater flow and transport models developed to evaluate fate and transport of RDX. This attachment presented a calibrated three-dimensional vadose zone/saturated zone model that incorporates the results of the recent geologic characterization and the updated geologic framework model. This model will be used for the groundwater risk assessment for the DGIR to simulate the transport of the RDX subsurface inventory to the regional aquifer.

2017 Status Report: Tracer Tests at Consolidated Unit 16-021(c)-99, Technical Area 16

The overarching objective for the tracer tests being conducted at TA-16 was to test the hydraulic connectivity of the various hydrogeologic strata at TA-16. This report updated and summarized the monitoring results of these tracer tests, initiated in November 2015, through December 2017. As described in section 2.5, the tracer test is ongoing and the results will feed into the DGIR.

2.5 Tracer Test Update

Tracer deployments were made in October and November 2015, and in February 2017, the Laboratory submitted a status report on the results from tracer monitoring. The status report concluded that most of the tracers had not yet fully moved beyond the vicinity of the screens where they were deployed and no cross-well detections have occurred. As of the end of FY 2018 there has been no observation of tracers beyond the injection wells. However, long-term tracer breakthrough monitoring will continue and the results of the tracer test will be reported in the DGIR.

2.6 Deep Groundwater Investigation Report

Preparation of the DGIR has begun and will address the data gaps identified by NMED in the NOD related to the deep groundwater CME report (NMED 2008, 101311). The DGIR will present updates on investigations related to RDX nature and extent, an updated conceptual model that incorporates detailed technical studies conducted over the past several years, and a groundwater risk assessment to evaluate fate and transport of RDX concentrations in the regional aquifer.

3.0 REGULATORY, PUBLIC, AND STAKEHOLDER INVOLVEMENT

In FY 2018 the Laboratory continued to perform activities to characterize the perched-intermediate and regional groundwater to address NMED's NOD. Communication with the NMED Hazardous Waste Bureau and the NMED DOE Oversight Bureau were held throughout the year to discuss the installation of R-69.

The first technical meeting to discuss the DGIR is scheduled for November 14, 2018.

4.0 WORK PLANNED FOR FY 2019

In FY 2019 deep groundwater investigation CME activities will include the following:

- Complete construction and installation of monitoring well R-69, conduct two 72-hr aquifer tests, install sampling system, and begin collecting groundwater samples. Prepare and submit to NMED the R-69 completion report.
- Prepare and submit to NMED the DGIR in accordance with FY 2019 Milestone 13. A final DGIR will be submitted to NMED by August 31, 2019.
- Perform Interim Facility-Wide Monitoring Plan sampling.

A summary of the FY 2019 activities will be reported in the fourth annual progress report and submitted to NMED by November 2019.

5.0 REFERENCES

5.1 References

The following reference list includes documents cited in this report. Parenthetical information following each reference provides the author(s), publication date, and ERID, ESHID, or EMID. This information is also included in text citations. ERIDs were assigned by the Laboratory's Associate Directorate for Environmental Management (IDs through 599999); ESHIDs were assigned by the Laboratory's Associate Directorate for Environment, Safety, and Health (IDs 600000 through 699999); and EMIDs are assigned by N3B (IDs 700000 and above). IDs are used to locate documents in N3B's Records Management System and in the Master Reference Set. The NMED Hazardous Waste Bureau and N3B maintain copies of the Master Reference Set. The set ensures that NMED has the references to review documents. The set is updated when new references are cited in documents.

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NMED (New Mexico Environment Department), September 27, 2016. "Approval, Groundwater Investigation Work Plan for Consolidated Unit 16-021(c)-99, Including Drilling Work Plans for Wells R-68 and R-69," New Mexico Environment Department letter to D. Hintze (DOE-EM-LA) and M. Brandt (LANL) from J.E. Kielling (NMED-HWB), Santa Fe, New Mexico. (NMED 2016, 601855)

NMED (New Mexico Environment Department), November 27, 2017. "Approval with Modifications, Remedy Completion Report for Corrective Measures Implementation at Consolidated Unit 16-021(c)-99," New Mexico Environment Department letter to D. Hintze (DOE-NA-LA) and B. Robinson (LANL) from J.E. Kielling (NMED-HWB), Santa Fe, New Mexico. (NMED 2017, 602758)

5.2 Map Data Sources

Hillshade; Los Alamos National Laboratory, ER-ES, As published;
\\slip\gis\Data\HYP\LiDAR\2014Bare_Earth\BareEarth_DEM_Mosaic.gdb; 2014.

Structures; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 29 November 2010.

Unpaved road; Los Alamos National Laboratory, ER-ES, As published, GIS projects folder;
\\slip\GIS\Projects\14-Projects\14-0062\project_data.gdb; digitized_site_features; digitized_road; 2017.

Paved Road Arcs; Los Alamos National Laboratory, FWO Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 29 November 2010.

Drainage Channel; Los Alamos National Laboratory, ER-ES, As published, GIS projects folder;
\\slip\GIS\Projects\11-Projects\11-0108\gdb\gdb_11-0108_generic.mdb; drainage; 2017.

TA-16 260 Outfall, As Published, GIS project folder: Q:\14-Projects\14-0080\project_data.gdb\
polygon\outfall_260

M Wall-PRB, As Published, GIS project folder: Q:\14-Projects\14-0080\project_data.gdb\line\wall_PRB

Connector piping, As Published, GIS project folder: Q:\14-Projects\14-
0080\project_data.gdb\line\connector_piping

Tech areas; Los Alamos National Laboratory, Database
Connections\GIS.PUB.PRD1.sde\PUB.Boundaries\PUB.tecareas

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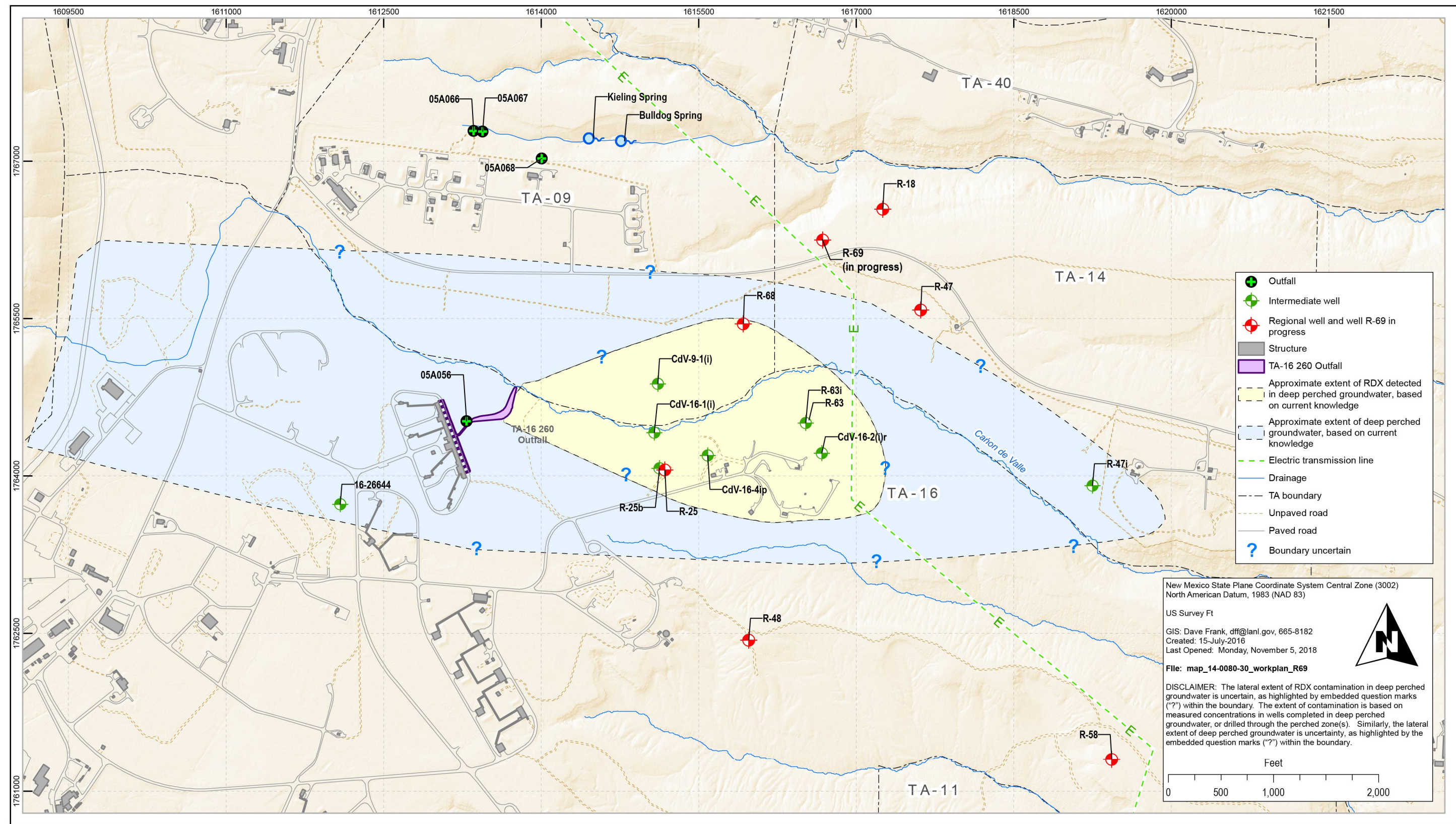


Figure 1.0-1 Deep groundwater investigation monitoring wells near the 260 Outfall and location of proposed regional monitoring well R-69 (installation in progress)

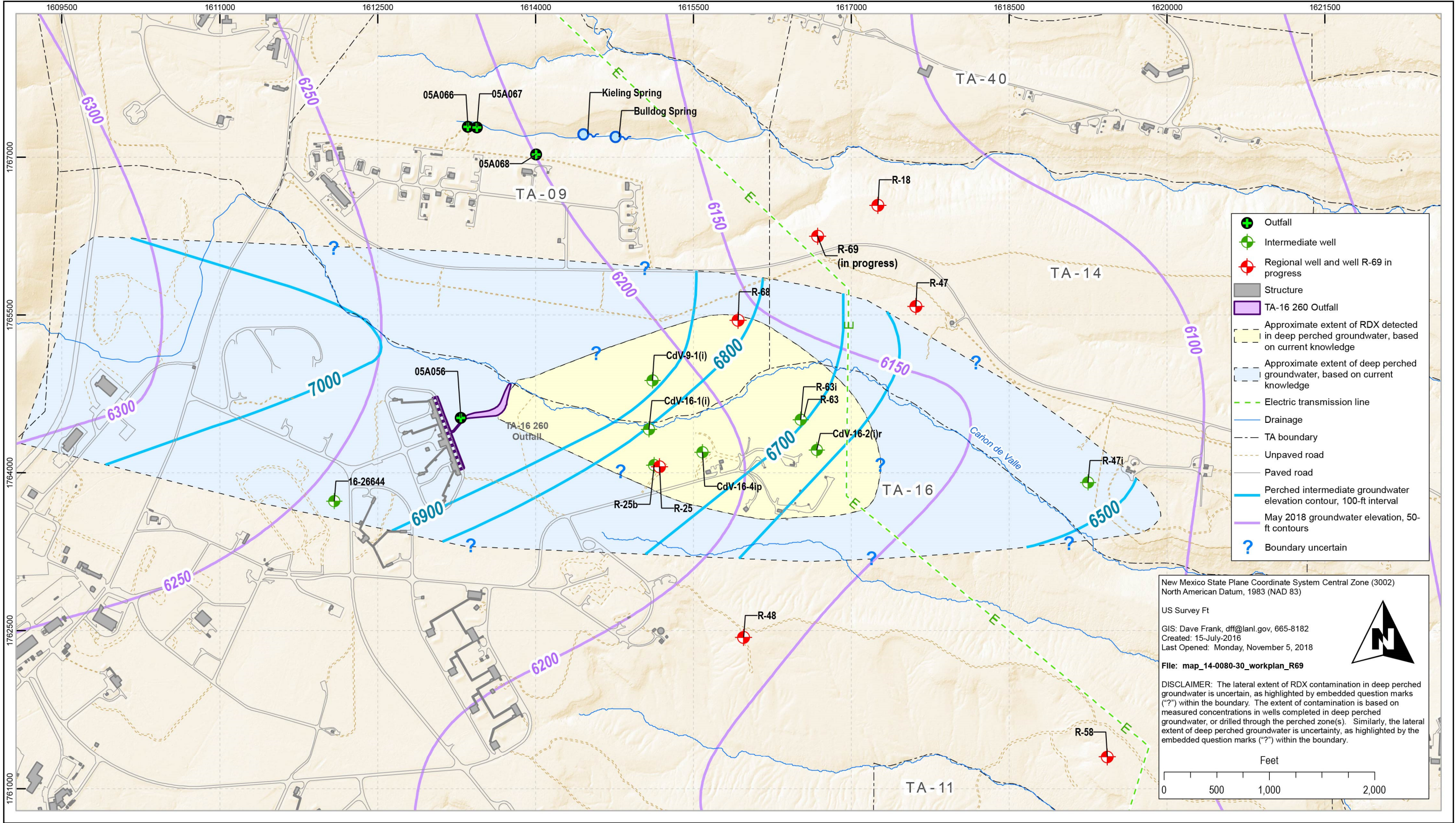


Figure 2.3-1 Water-level contour map for both the perched-intermediate groundwater and the regional aquifer