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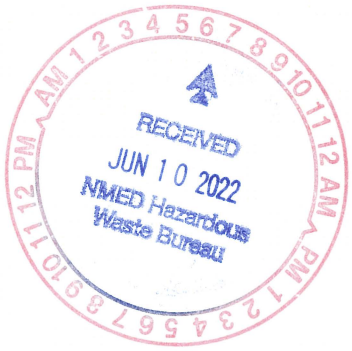
DEPARTMENT OF ENERGY
Environmental Management Los Alamos Field Office (EM-LA)
Los Alamos, New Mexico 87544



EMLA-2022-BF102-02-001

June 10, 2022

Mr. Rick Shean
Bureau Chief
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Drive East, Building 1
Santa Fe, NM 87505-6313

Subject: Submittal of the Drilling Work Plan for Groundwater Regional Aquifer Monitoring Well R-76 (Replacement of Groundwater Regional Aquifer Monitoring Well R-28), Revision 1, and Comment Response

Dear Mr. Shean:

Enclosed please find two hard copies with electronic files of the "Drilling Work Plan for Groundwater Regional Aquifer Monitoring Well R-76 (Replacement of Groundwater Regional Aquifer Monitoring Well R-28), Revision 1." Enclosure 1 includes an electronic copy of a redline strikeout version of the report that incorporates all changes made in response to the New Mexico Environment Department's review comments dated March 2022 (Enclosure 2).

If you have any questions, please contact Joseph Sena at (505) 551-2964 (joseph.sena@em-la.doe.gov) or Cheryl Rodriguez at (505) 414-0450 (cheryl.rodriguez@em.doe.gov).

Sincerely,

ARTURO DURAN

Digitally signed by ARTURO DURAN
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Arturo Q. Duran
Compliance and Permitting Manager
U.S. Department of Energy
Environmental Management
Los Alamos Field Office

Enclosure(s):

1. Two hard copies with electronic files (including a redline strikeout version) – Drilling Work Plan for Groundwater Regional Aquifer Monitoring Well R-76, Revision 1 (EM2022-0340)
2. U.S. Department of Energy Responses to New Mexico Environment Department Draft Comments on Drilling Work Plan for Groundwater Regional Aquifer Monitoring Well R-76, Dated March 2022 (EM2022-0274)

cc (letter and enclosure[s] emailed):
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Raymond Martinez, San Ildefonso Pueblo, NM
Dino Chavarria, Santa Clara Pueblo, NM
Steve Yanicak, NMED-DOE-OB
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Enclosure 1

Drilling Work Plan for Groundwater Regional Aquifer Monitoring Well R-76 (Replacement of Groundwater Regional Aquifer Monitoring Well R-28), Revision 1

Drilling Work Plan for Groundwater Regional Aquifer Monitoring Well R-76 (Replacement of Groundwater Regional Aquifer Monitoring Well R-28), Revision 1

Primary Objectives and Purpose	This work plan presents the objectives, drilling approach, and conceptual design for groundwater monitoring well R-76. The primary objective for R-76 is to replace the monitoring capability historically provided by groundwater monitoring well R-28. In accordance with a July 2017 work plan approved by the New Mexico Environment Department (NMED), Los Alamos National Laboratory (LANL or the Laboratory) conducted a study at R-28 of the potential for molasses to be applied in the aquifer as an agent for initiating geochemical reduction that would result in in situ conversion of hexavalent chromium to trivalent chromium (LANL 2017, 602505; NMED 2017, 602546). Data collected from R-28 as part of the study showed that intended chromium reduction was achieved; however, geochemically reducing conditions have persisted in the aquifer around the well, yielding it currently unusable for water-quality monitoring, especially for reduction/oxidation-sensitive constituents such as chromium and nitrate. Replacement of R-28 will provide for monitoring in an important area of the chromium plume where chromium concentrations in R-28 have historically been in the 400 ppb range. R-76 will also provide for long-term performance monitoring for chromium and related constituents as part of future remediation efforts. An additional objective for R-76 is to characterize the vertical extent of contamination in the same area of the plume by including a second screened interval at a depth within the Chamita formation (Tcar). Characterization and monitoring within Tcar will help address uncertainties of whether the Tcar is a preferential pathway for chromium contamination that might originate within the plume centroid. Monitoring within the Tcar in this area of the plume will also inform whether groundwater flow within the Tcar is uniquely influenced by pumping of Los Alamos County water-supply wells, particularly well PM-3. The deeper screen at R-76 will complement a series of wells, including R-77 and R-73 that will characterize the Tcar from west to east along the general direction of groundwater flow. The two-screen configuration will also help characterize the vertical gradient in the regional aquifer in the central portion of the plume. Two considerations drive the proposed location for R-76 (Figure 1). First, the primary objective of R-76 as a replacement for R-28 supports a location close to R-28. Second, the location needs to be off-gradient from aquifer sediments and groundwater potentially influenced by the residual effects of molasses deployed at R-28, and potential effects of tracer deployments into CrPZ-2a. There is some indirect evidence that the naphthalene sulfonate tracer injected into PZ-2a (and possibly also the sulfonate tracer injected into PZ-2b) may have biodegraded in the aquifer based on its sudden shift to nondetect in monitoring data collected from CrEX-3, whereas the co-deployed perrhenate (rhenium) tracer persisted. If sulfonate degradation has occurred in the aquifer, it could result in the presence of an area with biological activity that could impact data representativeness in the upper screen interval proposed for R-76. Potential locations are also constrained by nearby existing infrastructure, including buried piping used for the chromium interim measure. The proposed location to the northwest of R-28 is shown in Figure 1 as being near an historical drainage based on the current GIS coverage, but current site conditions do not indicate that location would be susceptible to flooding. The proposed location would still need to be vetted through the United States Army Corp of Engineers (USACE) Albuquerque office to ensure that there are no Clean Water Act Section 404 constraints for construction of a drilling pad and drilling activities. The review process with the USACE will be initiated upon concurrence of NMED of the proposed location. Figure 2 presents a cross-section that extends from CrPZ-2 to CrEX-3 showing the stratigraphic sequence and screen positions of nearby wells and those proposed for R-76. Figure 3 shows the conceptual design for R-76, with the understanding that a separate and more detailed design package that reflects actual information obtained during and following drilling will be submitted to NMED for review and approval.

Drilling Approach	The proposed drilling approach for R-76 will use fluid-assisted air-rotary with casing-advance methods. Telescoping casing sizes between 24 in. and 10 in. and dual-rotary methods will be used to advance the borehole to a depth within the upper 185 ft of the regional aquifer. This approach will produce a borehole that can accommodate an approximate 3-in. annular filter pack around the 5-in.-diameter well screen. Because the deeper portion of the borehole is expected to encounter potentially unstable Tcar sediments, various techniques may be used by the drilling subcontractor to maintain borehole stability and for eventual placement of a well screen in that geologic unit. Specific techniques that may be used to manage conditions in the Tcar are not provided in this work plan. The U.S. Department of Energy and the selected drilling subcontractor will have the responsibility to use drilling and well-completion methods that are best suited for the conditions encountered. Well completion will follow New Mexico Office of the State Engineer regulations concerning well construction including, but not limited to (1) the hanging of the casing throughout well construction and (2) industry standard centralizers allowing for a minimum 2-in. annular space in a vertical well. Drilling subcontractors are required to have a New Mexico Well Driller's License.
Drilling Fluids, Composition, and Use	Fluids and additives will be used to facilitate drilling and may include those previously authorized for use by NMED, including the following: • Potable water, municipal water supply, to aid in delivery of other drilling additives and to cool the drill bit, • QUIK-FOAM, a blend of alcohol ethoxy sulfates, used as a foaming agent to lift cuttings, and • AQF-2, an anionic surfactant, used as a foaming agent to lift cuttings. The goal is to stop use of drilling fluids and additives 100 ft above the regional aquifer, but use of additives may be necessary to advance drilling and maintain borehole integrity. Complete records will be maintained detailing the type, amount, and volume of fluid and additives used and the depth at which fluids or additives were added to the borehole.
Potential Groundwater Occurrence and Detection	Although perched-intermediate groundwater was not observed during drilling of nearby wells R-28 and CrEX-3, perched-intermediate groundwater may be present in the vicinity of the proposed location for R-76. Methods used to identify perched-intermediate groundwater during drilling will include driller's observations, water-level measurements, and borehole video, if appropriate. If perched-intermediate groundwater is encountered, measures will be taken to seal the zone before advancing drilling to ensure that the perched water does not follow the drilling downhole. The top of the regional aquifer is projected to occur at approximately 895 ft below ground surface.
Geophysical Testing	Geophysical logging will be conducted through the saturated interval in the regional aquifer when the borehole has been drilled to total depth. Neutron and gamma logs will be run to refine estimates of the top of regional saturation, to identify geologic contacts, and to characterize the hydraulic properties of strata beneath the water table. The neutron log measures the amount of hydrogen in the formation in either a water- or air-filled borehole. The hydrogen content typically provides a good measure of moisture content in the unsaturated zone and porosity in the saturated zone. The gamma survey employs a scintillation detector to measure the gross gamma radiation activity of the formation. Naturally occurring gamma radiation comes from the decay of potassium-40 plus the uranium and thorium decay series. Typically, these elements occur in varying concentrations within different strata, and the gamma log can be used to estimate porosity and relative content of fine-grained material. The geophysical data will be used in conjunction with drill cuttings and driller's observations to identify intervals within the aquifer that are suitable for screen placement.

Cuttings Characterization	Cuttings will be collected from the length of the borehole. Cuttings collection and characterization methods will attempt to optimize representative retention of the fine-grained fraction, particularly within the regional aquifer. Split samples of all cuttings collected during drilling will be provided to NMED.
Well Development	The well filter pack may be developed by both mechanical and chemical means. Mechanical means may include airlift swabbing, bailing, and pumping. Chemical means include the use of additives to remove clays and/or chlorination to kill bacteria that may be introduced during well completion. Filter pack development during placement will be considered complete when less than 1/10 ml/L of sand is passing through the well screen. A submersible pump will be used in the well development process following construction of the well. Sand production will be measured with a Rossum Sand Tester. The key parameters to be monitored for well development include turbidity measured in the field and total organic carbon (TOC), which will be measured at an analytical laboratory. If these water-quality parameters cannot be brought to within the target values specified below during well development, the use of chemical well development may be discussed with NMED. No chemicals will be added without NMED's approval. Chemical development methods that may be used include AQUA-CLEAR PFD or a similar product to remove clays, and/or chlorination with sodium hypochlorite. Well development will be considered complete when target water-quality parameters and sand production quantities are met and a volume of water equivalent to that which was introduced into the aquifer during drilling and construction is removed. The target water-quality parameters are turbidity <5 nephelometric turbidity units and TOC <2 ppm. The target sand production quantity is less than 1 mg/L.
Step-Drawdown Testing	Step-drawdown testing will be performed to investigate and record each well screen interval's performance under controlled discharge conditions. Initial specific capacity will be determined for each screen interval and the data will be used to help select a suitable permanent pump for the dedicated sampling system. Specific pumping rates for each step test will be determined in the field.

Water-Quality Sampling	If perched-intermediate groundwater is encountered, attempts will be made to collect screening-level samples using air-lifting or bailing methods. Screening samples from perched-intermediate groundwater will be analyzed for metals, semivolatile organic compounds, and general inorganic compounds. Water-quality samples will be collected at 20-ft intervals during advancement through the regional aquifer. Borehole water will be air lifted to the surface while each new section of 20-ft drill casing is welded at the surface. Each sample will be collected from the air-lifted water just before continuing advancement of the casing string. These screening-level samples will be analyzed for anions and metals with fast turnaround at the Laboratory's Geochemistry and Geomaterials Research Laboratory (GGRL). This practice may not be conducted within the Tcar if circulation borehole water during the welding phase causes borehole instability. After total depth at approximately 185 ft into the regional aquifer has been established, a series of "temporary wells" will be constructed in the 10-in. borehole. A well string with a 5-ft stainless-steel screened interval will be lowered into the drill casing to total depth, and the annular space around the well screen will be filled with 10/20 filter-grade silica sand (adjacent to screen slots) extending 1 ft to 2 ft above and below the screened interval and with 20/40 transition sand emplaced 5 ft above and below the primary filter pack interval. The 10-in. drill casing will then be retracted to expose the screen interval to the native formation. A 4-in. submersible pump will be deployed in the temporary well on stainless-steel drop pipe to purge and sample. The well construction and purging/sampling procedure will be repeated in 20-ft intervals up through the interval targeted for the upper screen. The purge volumes for each sampling interval will follow this approach: 20 casing volumes for 10-in. casing at a (nominal) length of 10 ft plus introduced water volume for the 20-ft drilling interval being sampled + 10%. [For example: 1 casing volume: (4.1 gal./ft)(10 ft) = 41 gal.; (41 gal.)(20) = 820 gal.; 820 gal. + introduced volume = X; (X)(1.1) = purge volume.] Samples from each of these intervals will be analyzed at the GGRL for anions and metals. Samples will also be made available to NMED upon request. These geochemistry data along with the geophysics data, and information from drill cuttings and driller's observations, will be used for the well-design package submitted to NMED for review and approval. The first groundwater samples from the completed well will be collected at the end of the step-drawdown testing conducted in each of the two screens. These samples will be analyzed for metals, general inorganic chemicals (including nitrate, perchlorate, sulfate, etc.), semivolatile organic compounds, volatile organic compounds, and radionuclides (including low-level tritium). Subsequent samples will be collected from the dedicated sampling system described below.
Sampling System Installation	A two-screen Baski sampling system will be installed in the well. The system will use a typical 3- or 4-in. pump and motor to maintain sampling purge rates at or near 5 gal. per minute.

Investigation-Derived Waste Management	Investigation-derived waste will be managed in accordance with Standard Operating Procedure (SOP) N3B-EP-DIR-SOP 10021, "Characterization and Management of Environmental Programs Waste." This SOP incorporates the requirements of applicable U.S. Environmental Protection Agency and NMED regulations, U.S. Department of Energy orders, and Newport News Nuclear BWXT-Los Alamos, LLC (N3B) requirements. The primary waste streams will include drill cuttings, drilling water, drilling fluids and additives, development water, purge water generated during step-drawdown testing, decontamination water, and contact waste. 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 Drilling, Development, Rehabilitation, and Sampling Purge Water" (November 2016). Initially, drill cuttings and drilling fluids will be stored in a lined pit. Representative samples of the drill cuttings and drilling fluids will be collected and analyzed, and waste determinations will be made from validated data. If validated analytical data show these wastes cannot be land-applied, they will be removed from the pit, containerized, and placed in accumulation areas appropriate for the type of waste. Development and aquifer testing water that meets the requirements to be treated and land-applied will be managed under Discharge Permit 1793. Decontamination water will be containerized separately at the point of generation, placed in an accumulation area appropriate to the type of waste, and directly sampled. Contact waste will be containerized at the point of generation, placed in an appropriate accumulation area, and characterized using acceptable knowledge or the media with which it came in contact.
Schedule	Documentation of completion of the replacement well for well R-28 (R-76) and collection of first samples is a proposed fiscal year 2023 Appendix B target.

REFERENCES

The following reference list includes documents cited in this plan. Parenthetical information following each reference provides the author(s), publication date, and ERID, ESHID, or EMID. 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).

LANL (Los Alamos National Laboratory), July 2017. "Pilot-Scale Amendments Testing Work Plan for Chromium in Groundwater beneath Mortandad Canyon," Los Alamos National Laboratory document LA-UR-17-25406, Los Alamos, New Mexico. (LANL 2017, 602505)

NMED (New Mexico Environment Department), July 31, 2017. "Approval, Pilot-Scale Amendments Testing Work Plan for Chromium in Groundwater beneath Mortandad Canyon," New Mexico Environment Department letter to D. Hintze (DOE-EM) and B. Robinson (LANL) from J.E. Kieling (NMED-HWB), Santa Fe, New Mexico. (NMED 2017, 602546)

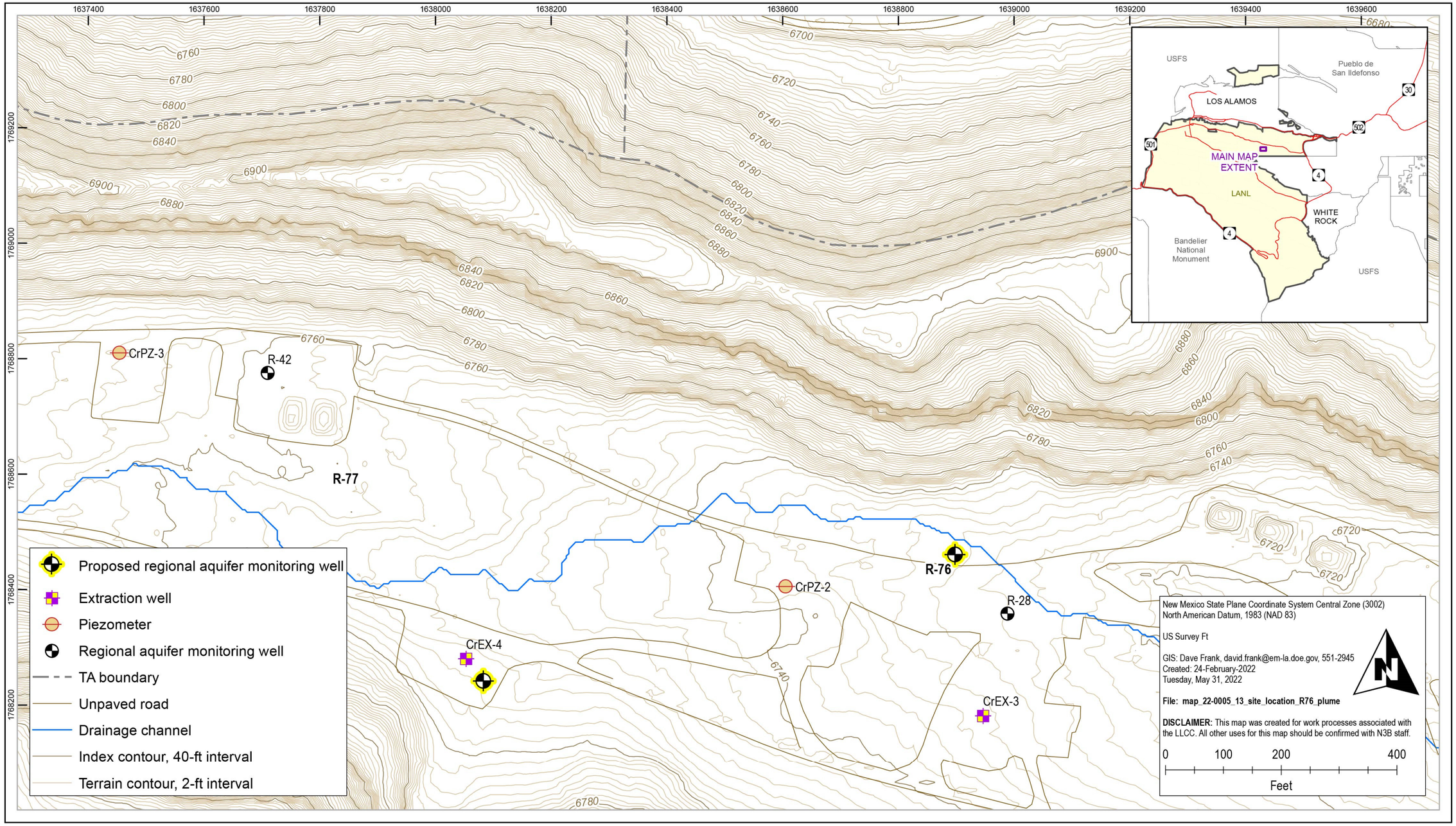

Figure 1 Proposed location for R-76

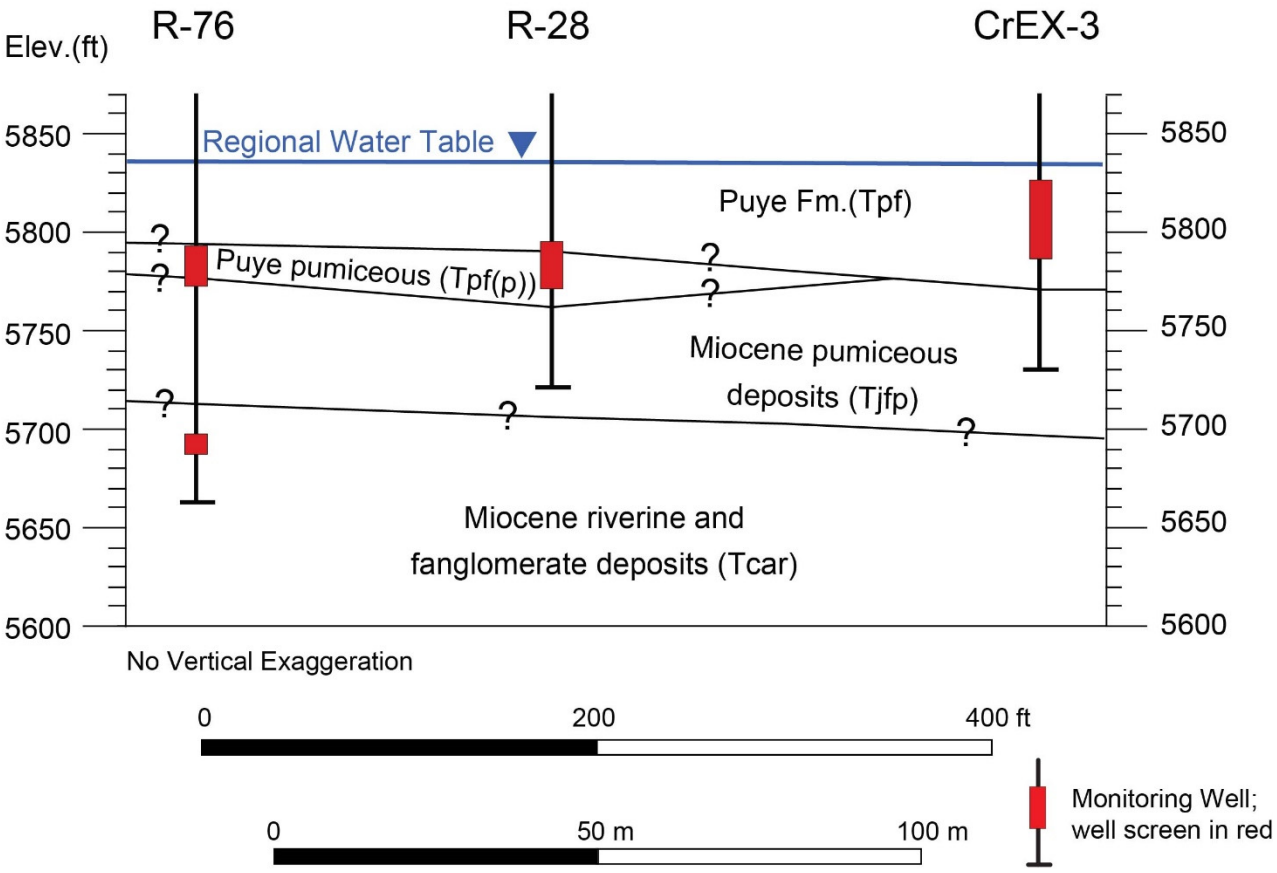

Figure 2 **Stratigraphy in the proposed R-76 area showing stratigraphic relations of the primary geologic units and well screens in nearby wells CrPZ-2, R-28, and CrEX-3. Conceptual well-screen positions for R-76 are also shown.**

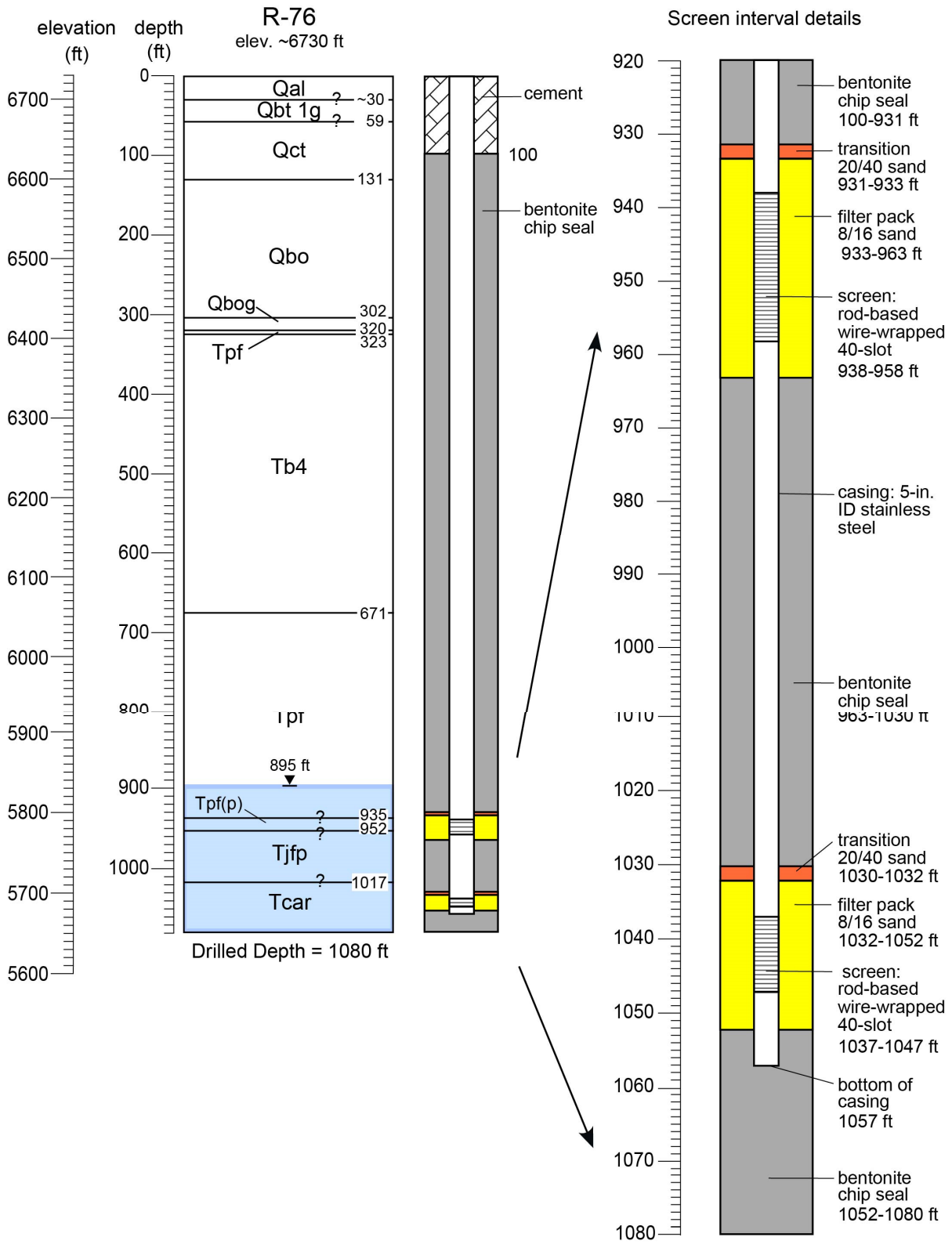

Figure 3 Conceptual well design for R-76

Enclosure 2

U.S. Department of Energy Responses to New Mexico Environment Department Draft Comments on "Drilling Work Plan for Groundwater Regional Aquifer Monitoring Well R-76" Dated March 2022

U.S. Department of Energy Responses to New Mexico Environment Department Draft Comments on "Drilling Work Plan for Groundwater Regional Aquifer Monitoring Well R-76" (Replacement of Groundwater Regional Aquifer Monitoring Well R-28), Dated March 2022

INTRODUCTION

To facilitate review of this response, the New Mexico Environment Department's (NMED's) comments are included verbatim. The U.S. Department of Energy (DOE) Environmental Management Los Alamos Field Office responses follow each NMED comment.

SPECIFIC COMMENTS

NMED Comment

1. Primary Objectives and Purpose, Page 1.

DOE Statement: *"Characterization and monitoring within Tcar will help address uncertainties of whether the Tcar is a preferential pathway for chromium contamination that might originate within the plume centroid. …The deeper screen at R-76 will complement a series of wells, including R-77 and R-73 that will characterize the Tcar from west to east along the groundwater flow path."*

NMED Comment: *This last statement of this paragraph needs some clarification, specifically the last five words. NMED interprets this portion of the statement to either indicate that the Tcar may behave as a potential preferential pathway between the chromium plume centroid and PM-3 as previously mentioned or that a groundwater flow path i.e., vector flow along the deeper hydraulic gradient between these two points is believed to be present. Preliminary mapping of the deeper heads in the chromium plume by NMED indicates a groundwater flow path between CrEX-4 and R-28 is present but does not extend to R-70 and PM-3. If the statement was meant to read "preferential pathway" as previously mentioned instead of "groundwater flow path", then NMED concurs with the statement. The statement should be clarified in a revision to the Drilling Work Plan for Groundwater Regional Aquifer Monitoring Well R-76 (Replacement of Groundwater Regional Aquifer Monitoring Well R-28) (Workplan) to indicate whether a flow path or a preferential pathway may exist.*

DOE Response

1. The wording has been changed to "along the general direction of groundwater flow" to address NMED's comment.

NMED Comment

2. Drilling Approach, Page 2.

DOE Statement: *''The proposed drilling approach for R-76 will use fluid-assisted air-rotary with casing-advance methods. Telescoping casing sizes between 24 in. and 10 in., and dual-rotary methods will be used to advance the borehole to a depth within the upper 185 ft of the regional aquifer. This approach will produce a borehole that can accommodate an approximate 3-in. annular filter pack around the 5-in.-diameter well screen."*

NMED Comment: *Revise the Workplan to include a description on how DOE plans to address the potential for encountering flowing sands that have occurred during past deeper drilling operations at the Los Alamos National Laboratory (LANL). In the Workplan revision, also provide the centralizer specifications that will be used to ensure a sufficient annulus that complies with the State engineer's specifications and whether the driller will "hang" the well to aid in well plumbness to further ensure that a 3-inch annulus develops for emplacement of filter pack, bentonite seal and cement grout. This is crucial to ensure that an adequate seal is installed between the two well screens for subsequent vertical hydraulic gradient and geochemical profiling evaluations.*

DOE Response

2. DOE and the drilling subcontractor will be prepared to deal with the potential for borehole instability during drilling and well completion in the Tcar as such conditions arise. Language in the work plan has been changed to describe this perspective but does not include specific approaches that a drilling subcontractor may use. Additionally, the final well design will conform with applicable New Mexico Office of the State Engineer requirements, as noted in the Drilling Approach section.

NMED Comment

3. Potential Groundwater Occurrence and Detection, Page 2.

DOE Statement: *"Although perched-intermediate groundwater was not observed during drilling of nearby wells R-28 and CrEX-3, perched-intermediate groundwater is known to be present in the vicinity of the proposed location for R-76."*

NMED Comment: *In the revision, clarify this statement because it contradicts itself i.e., justify how perched-intermediate groundwater can be 'known to be present' in the vicinity of proposed monitoring well R-76 but was not observed during drilling of nearby R-28 and CrEX-3. If perched-intermediate groundwater is encountered with a sufficient quantity and yield (i.e., 250 milliliter per minute or more at three well volumes) while drilling R-76, NMED will require that a separate perched-intermediate aquifer monitoring well be installed at the R-76 location.*

DOE Response

3. The text in the work plan has been changed to "Although perched-intermediate groundwater was not observed during drilling of nearby wells R-42 and CrEX-4, perched-intermediate groundwater may be present in the vicinity of the proposed location for R-76."

NMED Comment

4. Geophysical Testing, Page 2.

DOE Statement: *"Geophysical logging will be conducted through the saturated interval in the regional aquifer when the borehole has been drilled to total depth. Logging data will be used to refine estimates of the top of regional saturation and to characterize the hydraulic properties of strata beneath the water table."*

NMED Comment: *Provide in the revision to the Workplan the specific geophysical logs that DOE will run, and the information DOE expects to obtain from each log to achieve the stated hydrogeological characterization.*

DOE Response

4. Additional detail has been provided on the specific logs (gamma and neutron) and their purpose.

NMED Comment

5. Cuttings Characterization, Page 2

DOE Statement: *"Cuttings will be collected from the length of the borehole."*

NMED Comment: *Revise the Workplan to include that DOE will provide NMED with split samples of all cuttings collected during the drilling of R-76.*

DOE Response

5. The work plan has been revised to include a statement to that effect.

NMED Comment

6. Hydraulic Testing, Page 3.

DOE Statement: *"Both screened intervals will be hydraulically tested following development."*

NMED Comment: *Hydraulic testing must be removed from the Workplan revision. Appendix C, Appendix E Section II and Appendix F Section I.B.6.c of the 2016 Order on Consent (CO) provides the appropriate investigations, standards, and reports where hydraulic testing are to be conducted and presented. NMED requires a specific workplan for all aquifer and well hydraulic tests that are in accordance with the CO and provides the rationale for the test including the purpose, goals, objectives, needs, methods, and the intended use for the acquired data including the proposed hydraulic test at R-76. If NMED concurs with the need, DOE shall provide a separate workplan prepared in accordance with NMED HWB's Aquifer Testing Guidance Document (pending) and is conducted as part of an RCRA Facility Investigation (RFI) or Interim Measure (IM) in accordance with the CO and subject to NMED review, comment, and approval. NMED stresses the value in a singular, large-scale, long-term, multi-well aquifer performance test at the chromium plume over the individual limited tests typically performed at LANL. NMED will not accept any data derived from, or report that contains the hydraulic testing methodology, rationale and analyses used at monitoring well R-70.*

DOE Response

6. The hydraulic testing section has been replaced by a section on step-drawdown testing for the purpose of sizing the pump in the dedicated sampling system and determining the specific capacity of the well.

NMED Comment

7. Water-Quality Sampling, Page 3.

DOE Statement: *"If perched-intermediate groundwater is encountered, attempts will be made to collect screening-level samples using air-lifting or bailing methods. During drilling of the well, an investigation method (not yet determined) will be used to collect discrete-interval samples to help identify vertical extent of contamination. Such data may provide useful estimates of the vertical extent*

of chromium and, along with other lines of evidence, will be used for the well-design package submitted to NMED for review and approval.

The first groundwater samples from the completed well will be collected at the end of the hydraulic test in each of the two screens."

NMED Comment: *Include in the revision to the Workplan that screening-level samples will also be collected from the regional aquifer and that split samples will be provided to NMED under NMED chain of custody protocol or that DOE will make the drill site safe and accessible for two NMED personnel at a time to collect their own screening-level groundwater samples during active drilling operations. Revise the Workplan to provide a detailed suitable investigation method. NMED would like to point out the method used during drilling of both R-35a and R-35b be considered to collect these groundwater samples during the drilling operation to install R-76. NMED analyte suites for collected groundwater samples shall consist of major cations and anions, fluoride, metals, tritium, low-level perchlorate, and nitrate. If groundwater is not encountered in the perched intermediate aquifer, NMED will not request to be on site until regional aquifer groundwater is encountered. All groundwater quality data collected by DOE shall be provided to NMED upon receipt from the laboratory.*

See NMED specific comment no. 6 regarding hydraulic testing. Refrain from referring to DOE's post development extended purging and collection of "first samples" as a hydraulic test as it does not conform to standard hydraulic well testing methods that are accepted and understood worldwide.

DOE Response

7. DOE response: A description of the sampling and characterization process has been added to the document, along with a statement (in the Cuttings Characterization section) affirming NMED's access to split samples. References to "hydraulic tests" have been removed throughout the document.