Drilling Work Plan for Regional Aquifer Well R-62

Primary Purpose	Regional aquifer well R-62 is being installed to monitor water quality in the regional aquifer and to help define the vertical and lateral extent of chromium contamination known to exist in the vicinity of wells R-28, R-42, and R-50, as required by the New Mexico Environment Department's (NMED's) "Approval with Modification, Investigation Report for Sandia Canyon," dated February 9, 2010 (NMED 2010, 108683). Regional aquifer well R-62 will be located on a narrow ridge that separates Sandia and Mortandad Canyons at the east end of Sigma Mesa and on the same drill pad as proposed perched-intermediate well SCI-4 (Figure 1). Well R-62 is being installed to reduce uncertainty about the upgradient extent of chromium contamination in the area west-northwest of wells R-42 and R-28. Data collected during R-62 drilling will be used to assess the presence or absence of perched groundwater, which will determine the need for perched-intermediate well SCI-4. The R-62 borehole is expected to penetrate the top of regional saturation at a depth of approximately 1138 ft within Miocene pumiceous sedimentary rocks. The target borehole total depth (TD) is approximately 1238 ft (Figure 2). The well is proposed to be completed with one screen placed near the regional water table within the Miocene pumiceous sediments. Installation of a single-screen well represents a deviation from the Sandia Canyon Phase II Work Plan that stated well R-62 would be completed with two well screens. A single-screen completion is proposed in this drilling work plan because the primary objective, determining the western extent of chromium contamination detected at wells R-28, R-42, and R-50 can be accomplished by monitoring water quality in a well screen placed near the regional water table. Because of its close proximity to Sandia Canyon, a single-screen R-62 well should readily detect chromium contamination in the regional aquifer that originates from canyon infiltration north and west of the proposed well site. A single-screen well has additional advantages of (1) simpler well construction, (2) use of less complex sampling systems, and (3) reduced risk of cross flow within the aquifer during drilling and in the completed well. Figure 2 shows the predicted geology and proposed well design for well R-62. A final well design will be based on data acquired during drilling, including information from lithological logs of cuttings, water-level measurements, video logs, geophysical logs, and driller's observations. A well design document will be submitted to NMED for approval.
Conceptual Model	Elevated chromium concentrations detected in the regional aquifer at wells R-28, R-42, and R-50 are attributed to releases that occurred in the headwaters of Sandia Canyon. The likely source of the chromium was cooling tower blowdown from the Technical Area 03 (TA-03) power plant. From 1956 to 1972, potassium dichromate was used as a corrosion inhibiter, and approximately 31,000–72,000 kg of hexavalent chromium, Cr(VI), were released into the upper Sandia Canyon. Surface-water flow carried dissolved chromium downcanyon to the vicinity of SCI-1 and R-43 before infiltrating canyon-floor sediments and recharging perched alluvial groundwater. Percolation of the contaminated alluvial groundwater into bedrock units of the vadose zone recharged perched-intermediate groundwater at wells SCI-1 and SCI-2 and eventually entered the regional aquifer. The primary purpose of well R-62 is to determine if significant chromium contamination is present in the regional aquifer in the area west and northwest of the contaminant plume that is defined by the existing network of monitoring wells. The location of R-62 will test an important aspect of the conceptual model by determining if infiltration in upper reaches of Sandia Canyon contributes to elevated levels of chromium found in the regional aquifer in the vicinity of wells R-28 and R-42. Data from well R-62 will also be used in conjunction with information from other monitoring wells in the area to assess whether two distinct sources of chromium (from Sandia and Mortandad Canyons) are impacting the regional aquifer.

Drilling Approach	Drilling will be conducted with methods selected to optimize the potential to complete the well without using drilling additives in, or immediately above, the target zone of saturation. A combination of open-hole and casing-advance methods will be used. Each interval of open-hole or casing-advance drilling will be optimized to meet well objectives. Casing will be used to protect open-hole intervals above, to advance the borehole when open-hole drilling is not possible, and to secure the borehole through unstable zones or through the perched groundwater interval.
Potential Drilling Fluids, Composition, and Use	Fluids and additives may be used to facilitate drilling. These fluids and additives are consistent with those previously used in the drilling program at Los Alamos National Laboratory (LANL or the Laboratory), and have been characterized geochemically. Fluids and additives previously authorized for use by NMED include • potable water from the municipal water supply to aid in delivery of other drilling additives and cool the drill bit; • QUIK-FOAM, a blend of alcohol ethoxy sulfates, used as a foaming agent; and • AQF-2, an anionic surfactant, used as a foaming agent. Complete records will be maintained detailing the type, amount, and volume of drilling fluid used, depths at which drilling fluid was added to the borehole, amount of drilling fluid in storage in the borehole, and recovery volume of drilling fluid. No drilling fluids will be used within 100 ft of the regional aquifer except potable municipal water. No chemicals, other than those listed above, will be added without approval from NMED.
Hydrogeologic and Geochemical Objectives	• The primary objective is to monitor water quality in the upper part of the regional aquifer and to define the western extent of chromium contamination known to exist in the vicinity of wells R-28, R-42, and R-50. • Another primary objective is to determine if perched-intermediate groundwater occurs beneath the mesa separating Sandia and Mortandad Canyons, providing information about the need for perched-intermediate well SCI-4. • A secondary objective is to establish water levels and gradients in the regional aquifer in this area for water table maps, and thereby optimize the monitoring network. • Another secondary objective is to define the hydrostratigraphy of the site, characterizing rock units that can impact contaminant pathways in the vadose zone and the regional aquifer.
Potential Groundwater Occurrence and Detection	*Potential Perched Water:* Perched-intermediate groundwater may be encountered while drilling the R-62 borehole, but its presence cannot be predicted with certainty. If perched groundwater is encountered, it may be necessary to seal off the zone before drilling ahead in order to prevent potentially contaminated perched groundwater from entering the regional aquifer. Decisions about sealing off perched zones will be made in the field after more information is available about whether the perched groundwater is present and productive. Perched-intermediate groundwater occurs within sedimentary deposits of the Puye Formation atop the Cerros del Rio volcanic series at wells SCI-1 and TA-53i in and north of Sandia Canyon and at wells MCOI-4 (near MCOBT-4.4) and MCOBT-4.4 in Mortandad Canyon (Figure 1). The saturated thickness of these perched zones ranges from a few feet to approximately 25 ft. Perched-intermediate groundwater occurs within fractured lavas and interflow breccias in the lower part of the Cerros del Rio volcanic series at well SCI-2 in Sandia Canyon and at wells MCOI-5, MCOI-6, and R-15 in Mortandad Canyon (Figure 1). The saturated thicknesses of these perched groundwater occurrences range between 20 ft and 110 ft.

Potential Groundwater Occurrence and Detection (continued)	*Regional Groundwater:* The regional groundwater is expected to occur at a depth of 1138 ft within Miocene pumiceous sediments. Methods for groundwater detection may include driller's observations, water-level measurements, borehole video, and borehole geophysics.
Core Sampling	No core collection is planned.
Perched-Intermediate Groundwater Characterization Sampling	Groundwater screening samples will not be collected because well SCI-4 will be installed on the same drill pad if perched-intermediate groundwater is encountered at well R-62.
Regional Groundwater Characterization Sampling	Groundwater samples will be collected from the completed well between 10 days and 60 days after well development in accordance with the Compliance Order on Consent. These samples will be analyzed for the full suite of constituents, including radionuclides, metals/cations, general inorganic chemicals, high explosives, volatile organic compounds, and stable isotopes. Subsequent groundwater samples will be collected under the Interim Facility-Wide Groundwater Monitoring Plan.
Geophysical Testing	The Laboratory's borehole video camera and natural gamma and induction tools will be used in the open borehole if conditions allow. A full suite of geophysical logs will be run, if required, for proper placement of the screen. The logs will be collected by Schlumberger, Inc., and for open-hole conditions will include accelerator porosity sonde (neutron porosity), array induction, combined magnetic resonance, natural and spectral gamma logs, and formation micro-imager logs. In cased portions of the borehole, neutron porosity, triple lithodensity, elemental capture, and natural and spectral gamma logs will be collected. These logs will be used to define the top of regional saturation and to characterize the hydraulic properties of saturated rocks in the regional aquifer. The geophysical logs will also be used to select the well-screen depth. The suites run and timing of geophysical logging will depend on borehole conditions.
Well Completion Design	Figure 2 shows the conceptual well design for well R-62.
Well Development	The well may be developed by both mechanical and chemical means. Mechanical means include swabbing, bailing, and pumping. Chemical means include the use of additives to remove clay minerals that were introduced as annular fill, and/or chlorination to kill bacteria that were introduced during well completion. • After initial swabbing and bailing, a submersible pump will be used to complete the development process. • Water-quality parameters will be measured in a flow-through cell. The parameters to be monitored are pH, specific conductance, dissolved oxygen, temperature, turbidity, oxidation-reduction potential, and total organic carbon (TOC). • If the Laboratory is unable to bring the water-quality parameters within measurement limits specified below, the use of chemical well development may be discussed with NMED. No chemicals will be added without approval from NMED. • Chemicals that may be used include sodium acid pyrophosphate and AQUACLEAR PFD to remove clay minerals, and/or chlorination to kill bacteria that were introduced during well completion.

Well Development (continued)	Well development will be considered complete when target water-quality parameters are met and a volume of water equivalent to that introduced into the monitored zone during drilling and construction is removed. The target water-quality parameters are turbidity <5 nephelometric turbidity units, TOC <2 ppm, and stability in the other parameters. If the target parameters cannot be met, the Laboratory will propose an alternative to NMED for consideration.
Hydraulic Testing	Hydraulic testing will take place if the well screen is within a significant water-producing horizon. The most likely test will be a 24-hour constant-rate pump test.
Investigation-Derived Waste Management	Investigation-derived waste (IDW) will be managed in accordance with Standard Operating Procedure (SOP) 5238, Characterization and Management of Environmental Program Waste (http://www.lanl.gov/environment/all/qa/adep.shtml). This SOP incorporates the requirements of applicable U.S. Environmental Protection Agency and NMED regulations, U.S. Department of Energy orders, and Laboratory requirements. The primary waste streams will include drill cuttings, drilling water, development water, purge water, decontamination water, and contact waste. Drill cuttings will be managed in accordance with the NMED-approved "Notice of Intent to Discharge and Response to Comments: Decision Tree for Management of Investigation-Derived Waste Solids from Drilling Operations" (November 2007). Drilling, purge, and development waters will be managed in accordance with ENV-RCRA-QP-010.2, Land Application of Groundwater. Initially, drill cuttings and drilling water will be stored in lined pits. The cuttings may or may not contain residue of drilling/well completion additives (e.g., drilling foam and bentonite clay). The contents of the pits will be characterized with direct sampling following completion of drilling activities, 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. Cuttings, drilling water, development water, and purge water that cannot be land applied and are designated as hazardous waste will be sent to an authorized treatment, storage, or disposal facility within 90 days of containerization. Development water, purge water, and decontamination water will be containerized separately at their points 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 of the media with which it came in contact.
Schedule	Well R-62 will be completed by June 30, 2011.

REFERENCE

The following list includes all documents cited in this plan. Parenthetical information following each reference provides the author(s), publication date, and ER ID. This information is also included in text citations. ER IDs are assigned by the Environmental Programs Directorate's Records Processing Facility (RPF) and are used to locate the document at the RPF and, where applicable, in the master reference set.

Copies of the master reference set are maintained at the NMED Hazardous Waste Bureau and the Directorate. The set was developed to ensure that the administrative authority has all material needed to review this document, and it is updated with every document submitted to the administrative authority. Documents previously submitted to the administrative authority are not included.

NMED (New Mexico Environment Department), February 9, 2010. "Approval with Modification, Investigation Report for Sandia Canyon," New Mexico Environment Department letter to G.J. Rael (DOE-LASO) and M. Graham (LANL) from J.P. Bearzi (NMED-HWB), Santa Fe, New Mexico. (NMED 2010, 108683)

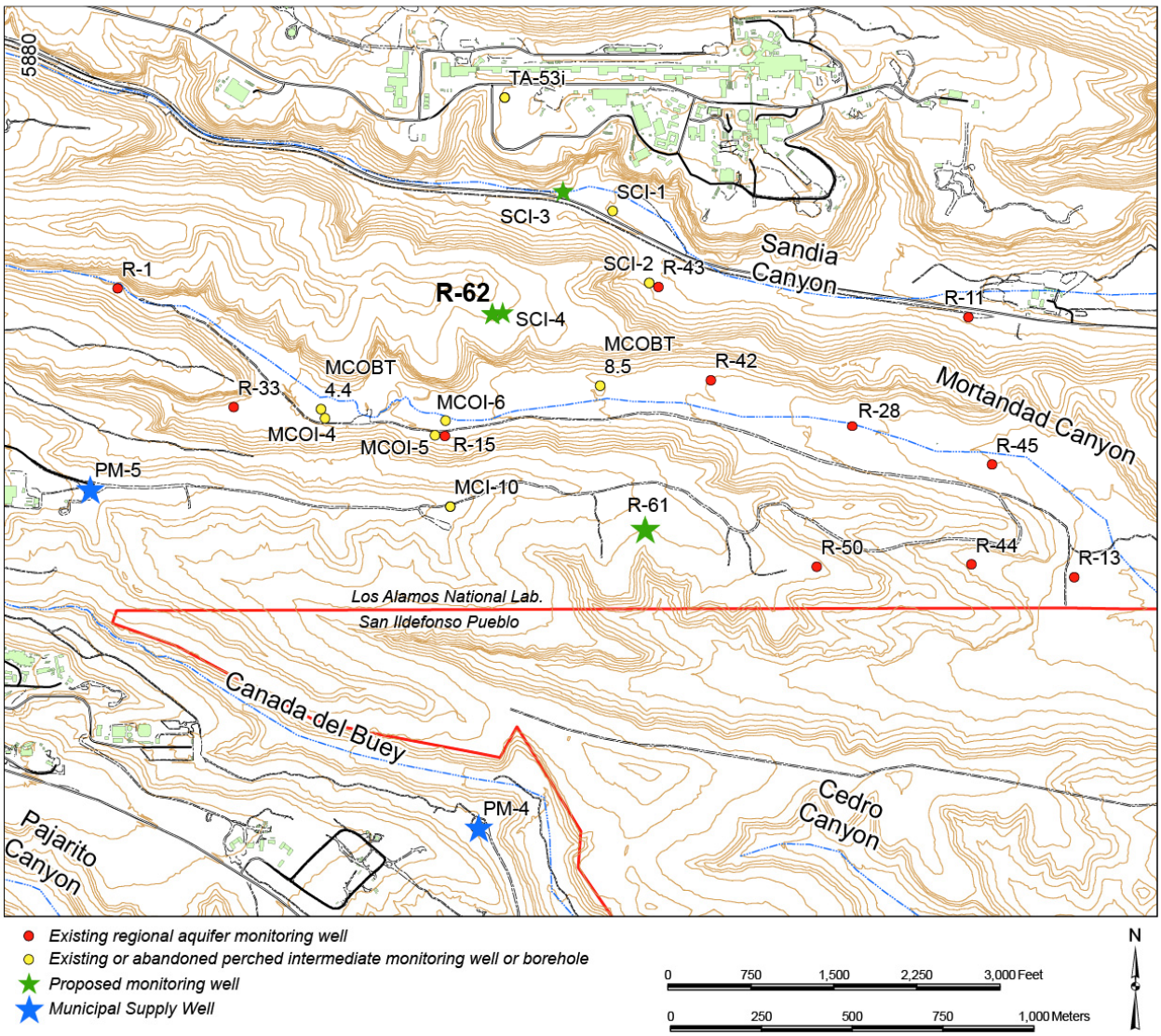

Figure 1 Proposed location for well R-62

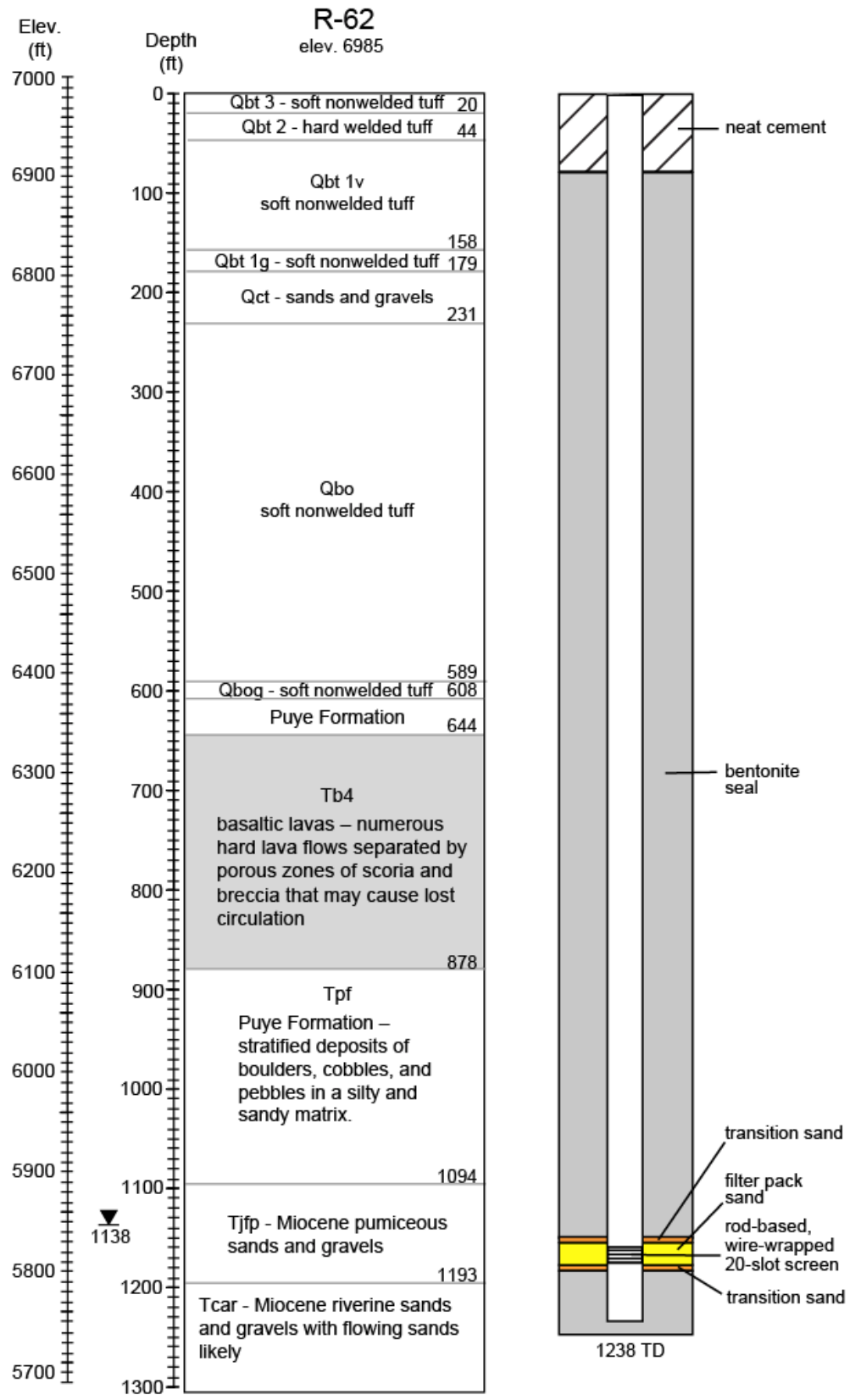

Figure 2 Predicted geology and proposed well design for well R-62