Drilling Work Plan for Perched Intermediate Well SCI-3

Primary Purpose	Perched intermediate well SCI-3 is be installed to monitor water quality in perched intermediate groundwater beneath Sandia Canyon and to help define the extent of chromium contamination in perched groundwater within the Cerros del Rio basalt, as required by the New Mexico Environment Department's (NMED's) Approval with Modification, Investigation Report for Sandia Canyon, Los Alamos National Laboratory, dated February 9, 2010 (NMED 2010, 108683). The proposed location for well SCI-3 is shown in Figure 1. Well SCI-3 will target perched intermediate groundwater between depths of approximately 550 and 660 ft within basaltic rocks of the Cerros del Rio volcanic series. The proposed total depth is 685 ft. The well will be completed with a single screen set within the zone of intermediate saturation (Figure 2). Figure 2 shows the predicted geology and conceptual well design for well SCI-3. 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 revised well design document will be submitted to NMED for approval.
Conceptual Model	Elevated chromium concentrations detected in the regional aquifer beneath Sandia and Mortandad canyons is attributed to releases that occurred in the headwaters of Sandia Canyon. The likely source of the chromium was steam plant effluent and 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 to 72,000 kg of hexavalent chromium, Cr(VI), was released into upper Sandia Canyon. Surface water flow carried dissolved chromium downcanyon to the vicinity of wells SCI-1 and R-43 before infiltrating canyon-floor sediments and recharging perched alluvial groundwater (Figure 1). 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. Dipping geologic surfaces diverted perched intermediate groundwater southward, causing breakthrough in the regional aquifer near Mortandad Canyon. Well SCI-3 targets chromium-contaminated perched intermediate groundwater that was encountered beneath Sandia Canyon at well SCI-2. The purpose of well SCI-3 is to further define the nature and extent of this perched groundwater zone and to determine if leakage of perched groundwater could result in future higher chromium concentrations in the regional aquifer. Water-quality data from SCI-3 will be compared with data from other wells in the area to evaluate the conceptual model that perched intermediate groundwater beneath Sandia Canyon is diverted southward toward Mortandad Canyon. If the target perched intermediate zone is absent at the SCI-3 location, the borehole will be plugged and abandoned.
Drilling Approach	Drilling will be conducted with methods selected to optimize the potential to complete the well without the use of drilling additives in, or immediately above, the target zone of saturation. A combination of open-hole and casing-advance methods will be employed. Each open-hole or casing-advance interval will be optimized to meet well objectives. Casing will be used to secure the borehole through unstable zones or to isolate the upper perched groundwater interval (see Potential Groundwater Occurrence and Detection below).

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, depth of drilling fluid added to the borehole, amount in storage in the borehole, and recovery volume of drilling fluid. No chemicals, other than those listed above, will be added without approval from NMED. No drilling fluids will be used within 100 ft of the target perched zone except potable municipal water.
Hydrogeologic and Geochemical Objectives	• The primary objective is to define the nature and extent of perched groundwater beneath Sandia Canyon. • A second primary objective is to monitor water quality of perched groundwater, with an emphasis on determining if leakage of perched groundwater could result in higher chromium concentrations in the regional aquifer in the future. • A third primary objective is to establish water levels for perched groundwater in this area. • A fourth primary objective is to determine if perched intermediate groundwater at SCI-3 is related to other groundwater occurrences beneath Sandia and Mortandad canyons. This will be addressed by comparing the geochemistry of groundwater at SCI-3 with that of surrounding perched intermediate wells.
Potential Groundwater Occurrence and Detection	Based on observations from nearby wells and boreholes, an upper and lower zone of perched intermediate groundwater may be encountered at well SCI-3. The lower zone of perched intermediate groundwater is the primary target for this well. The upper zone of the perched intermediate zone may occur in Puye Formation sediments above the Cerros del Rio basalt. This upper perched intermediate zone was encountered in nearby wells SCI-1 and TA-53i (Figure 1). If present at SCI-3, the saturated thickness of this zone is likely to be approximately 10 to 25 ft. A decision to seal off this zone before drilling deeper to the lower perched zone will be made in the field after more information is available about whether the upper zone is present and productive. The lower perched intermediate zone targeted by well SCI-3 was encountered at well SCI-2, located approximately 1000 ft to the southeast (Figure 1). At SCI-2, perched groundwater occurs within fractured lavas and interflow breccias in the lower part of the Cerros del Rio volcanic series. The thickness of the perched zone at SCI-2 is uncertain but probably ranges from 45 to 110 ft. Methods for groundwater detection may include driller's observations, water-level measurements, borehole video, and borehole geophysics.
Core Sampling	Coring is not proposed for the SCI-3 location. Coring was proposed in the Phase II Investigation Work Plan for Sandia Canyon; however, the well location has now been moved from the canyon axis to the canyon edge, thereby significantly reducing the value of core data. Additionally, the new location is within 350 ft of the previously cored SCI-1 well, further reducing the likelihood that core at SCI-3 would provide any data resulting in changes to the conceptual model.

Groundwater Screening Sampling	No groundwater screening samples will be collected from the borehole during drilling because water samples collected from the completed well are more representative and reliable of groundwater conditions.
Groundwater Characterization Sampling	Groundwater samples will be collected from the completed well between 10 and 60 d 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. The suites run and timing of geophysical logging will depend on borehole conditions.
Well Completion Design	Figure 2 shows the proposed well design for well SCI-3.
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 introduced as annular fill and/or chlorination to kill bacteria 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 the addition of sodium acid pyrophosphate and AQUACLEAR PFD to remove clay minerals and/or chlorination to kill bacteria introduced during well completion. Well development will be considered complete when target water-quality parameters are met. The target water-quality parameters are turbidity <5 nephelometric turbidity units, TOC <2 ppm, and other parameters stable.
Hydraulic Testing	Hydraulic testing will be considered if the well is in a significant water-producing horizon. The most likely test will be a 24-h constant-rate pump test.

Investigation-Derived Waste Management	Investigation-derived waste 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." Drilling, purge, and development waters will be managed in accordance with ENV-RCRA-QP-010.2, Land Applications 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 d 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 SCI-3 is proposed for completion on July 31, 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)

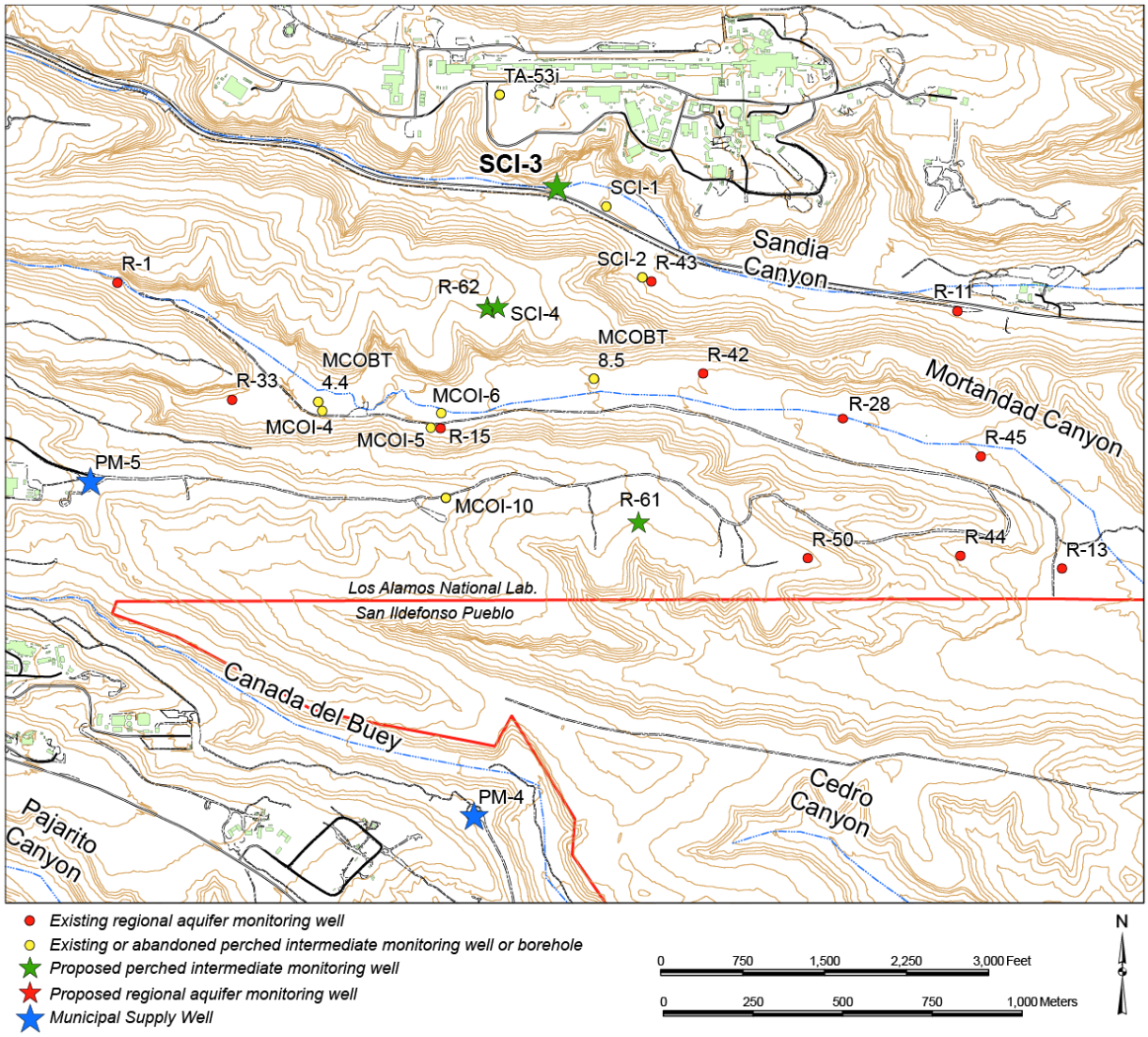

Figure 1 Proposed location for well SCI-3

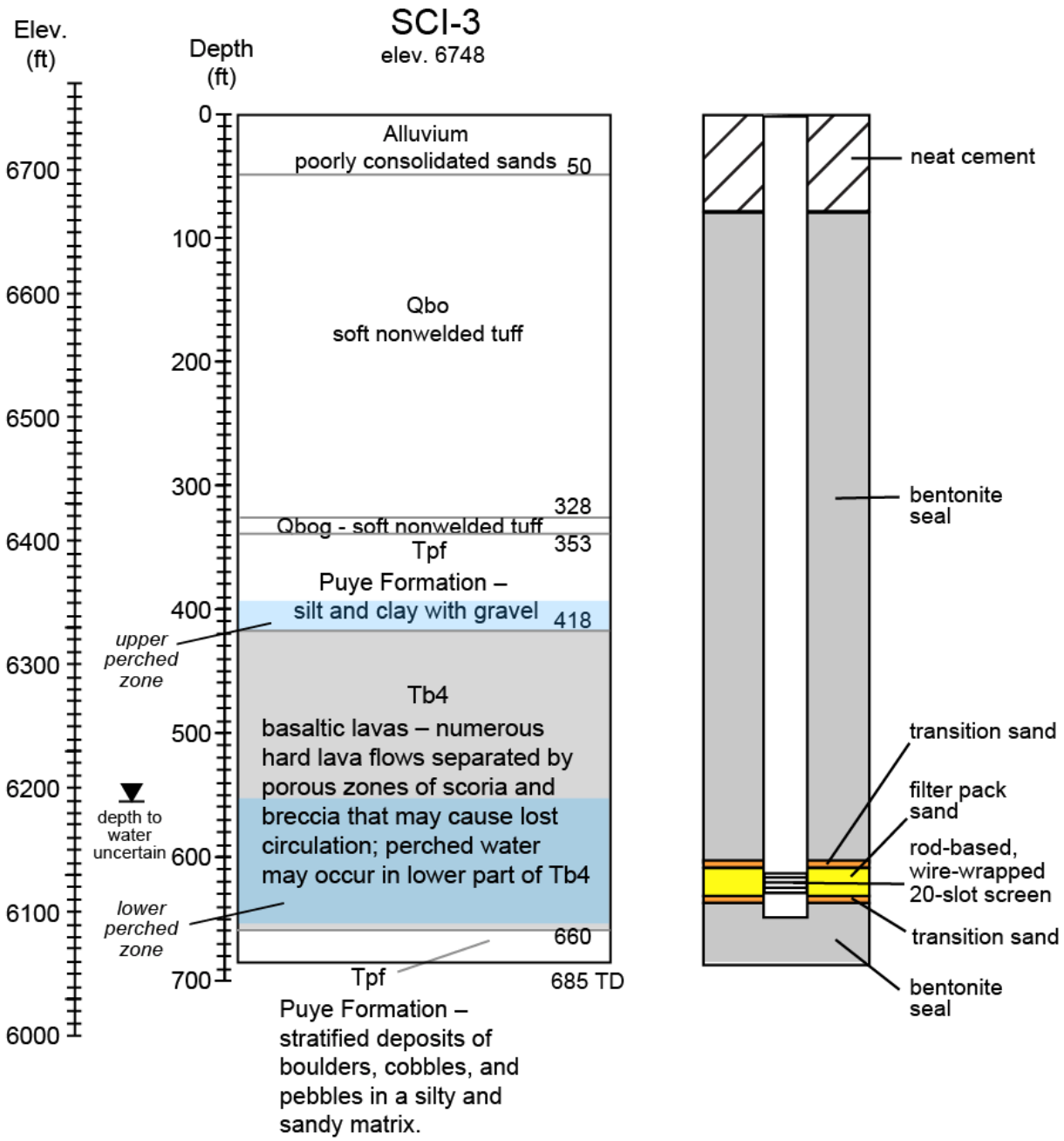

Figure 2 Predicted geology and conceptual well design for well SCI-3