Drilling Work Plan for Regional Aquifer Well R-57

Primary Purpose	Los Alamos National Laboratory (the Laboratory) will install regional aquifer well R-57 to satisfy a New Mexico Environment Department (NMED) requirement to install a supplemental monitoring well near well R-22. The primary purpose of R-57 is to monitor regional groundwater downgradient of Material Disposal Area (MDA) G at the eastern end of Technical Area 54 (TA-54). The proposed site for well R-57 is on Mesita del Buey about 300 ft east of MDA G and 200 ft northwest of R-22 (Figure 1). Well R-57 will supplement groundwater monitoring for MDA G provided by wells R-23, R-39, R-41, and R-49. Water-level data collected at R-57 will also be used to optimize the location of proposed well R-55 that is also being installed downgradient of MDA G. The depth to the top of regional saturation is expected to be approximately 888 to 951 ft. The target depth for the R-57 borehole is 150 ft into the regional zone of saturation. Given the uncertainties about the depth to water, the initial target for total borehole depth is provisionally set at approximately 1101 ft. However, the target depth may be adjusted once the water depth is determined at this location. The well is tentatively designed with two screens within the regional aquifer (Figure 2). It is anticipated that the upper screen will be placed near the top of regional saturation in Cerros del Rio volcanic deposits; the deeper screen will target a productive zone in the underlying sedimentary deposits approximately 100 ft below the water table. Actual well-screen lengths and positions will be based on data collected during drilling, including information from lithologic logs of cuttings, water-level measurements, video logs, geophysical logs, and driller's observations. Figure 2 shows the predicted geology and proposed well design for well R-57. A final well design will be based on hydrogeological conditions encountered during drilling and a revised well design document will be submitted to NMED for approval.
Conceptual Model	There are some uncertainties in the depth to water at the proposed R-57 well location. Near MDA G, water levels observed in the Cerros del Rio basalt are higher than the levels observed in the sedimentary deposits beneath the basalts. This phenomenon is observed in multiscreen wells with screens placed both in the basalts and the underlying sediments (e.g., at R-22 [head difference ~60 ft], R-20 [~30 ft], R-32 [~4 ft], and R-49 [~24 ft]). The water-level differences indicate relatively poor hydraulic connection between the basalts and sediments. This stratification of the regional aquifer may be caused by low-permeability zones within the basalts or low-permeability units at the contact between the basalts and the sediments. At R-41, the Cerros del Rio basalts appear to be either very tight (low permeability) or unsaturated (above the regional water table). The R-41 water level measured in the sediments (~5699 ft) is similar to the water level observed in R-22 screen 3 (~5699 ft), R-23 (~5697 ft), and R-16r (~5692 ft); all these screens are in sediments. Taken together, the observed data indicate steep gradients in the basalts and the sediments to the northwest of MDA G and relatively flat gradients to the southeast of MDA G. The proposed location of R-57 is intended to monitor regional aquifer groundwater immediately southeast of MDA G. In addition to water table uncertainties, the lithologic nature of rock units at the water table is also uncertain at the R-57 site. Well R-57 lies between R-39 to the south and R-41 to the north (Figure 1). Projection of geologic contacts from R-39 to R-41 indicates the base of the Cerros del Rio basalt should occur at a depth of 920 ft, close to the depth range expected for the water table (888 to 951 ft). However, at R-22, 200 ft to the southeast, the base of the basalt occurred at a depth of 1163 ft, leading to the possibility that both R-57 well screens may be located within basalt. For planning purposes, the basalt contact data derived from the R-39 and R-41 projection are used because they are more consistent with geologic data from other nearby wells such as R-23 and R-49. However, it is possible deep basaltic structures encountered at R-22 may extend beneath the R-57 location.

Drilling Approach	Drilling will be conducted with methods selected to optimize the potential of completing 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 employed. Each interval of open-hole or casing-advance will be optimized to meet well objectives. Casing will be used to advance the borehole when open-hole drilling is not possible and to secure the borehole through unstable zones or through significant perched-groundwater intervals.
Potential Drilling Fluids, Composition, and Use	Fluids and additives that may be used to facilitate drilling are consistent with those previously used in the drilling program at the Laboratory, and have been characterized geochemically. Fluids and additives previously authorized for use by NMED include • potable water, 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 borehole, and recovery volume of drilling fluid. No drilling fluids, except potable municipal water, will be used within 100 ft of the regional aquifer. If the regional aquifer cannot be reached without adding drilling fluids, the situation will be discussed with NMED. 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 regional aquifer downgradient of potential hazardous- or radioactive-chemical releases from MDA G. • A secondary objective is to establish water levels in the regional aquifer in this area for water-table maps. • Another secondary objective is to determine if perched-intermediate groundwater occurs in the vicinity of MDA G. This secondary purpose will be addressed to the extent possible, but drilling methods will be optimized to accomplish the primary objective. • A third secondary objective is to define the hydrostratigraphy of the site, characterizing rock units that can impact contaminant pathways in both the vadose and saturated intervals.
Potential Groundwater Occurrence and Detection	*Potential Perched Water:* within the Cerros del Rio basalt, occurrences of perched groundwater vary from location to location. Drilling will be halted at a depth of 788 ft, 100 ft above the regional aquifer, to evaluate whether perched groundwater is present in the basalt. *Regional:* 888 to 951 ft depth, regional groundwater is expected to occur in Cerros del Rio basalt and/or in underlying sedimentary deposits. 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 Groundwater Screening Sampling	Groundwater screening samples will be collected during drilling at any perched-groundwater zones producing sufficient water for sampling. Screening samples of groundwater will be analyzed for cations/metals (dissolved and total) and anions (dissolved) by the Earth and Environmental Sciences Division's Geochemistry and Geomaterials Research Laboratory, and for tritium and volatile organic compounds (VOCs) by off-site laboratories.

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 and analyzed for the full suite of constituents, including radionuclides, metals/cations, general inorganic chemicals, high explosives, VOCs, and stable isotopes. If R-57 is completed as a two-screen well, the first characterization samples will be collected at the end of each constant-rate pumping test through a stainless-steel discharge pipe. Subsequent groundwater samples will be collected under the Interim Facility-Wide Groundwater Monitoring Plan (IFGMP).
Geophysical Testing	The Laboratory's borehole video camera, 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 screens. 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, and formation microimager logs. In cased portions of the borehole, neutron porosity, triple lithodensity, elemental capture, natural gamma, and spectral gamma logs will be collected. These logs will be used to characterize the hydraulic properties of saturated rocks in the regional aquifer. The geophysical logs also will be used to select the well-screen depths. The suite and timing of geophysical logging will depend on borehole conditions.
Well Completion Design	The upper well screen will be placed within sediments or the most permeable lava, cinder, or volcaniclastic zone near the top of the regional aquifer and a deeper screen will be placed in Santa Fe Group (axial river deposit) sediments approximately 100 ft below the regional water table. If the Cerros del Rio volcanic series is continuous to TD, a second screen will be emplaced only if sufficiently permeable media are present. Figure 2 shows the proposed well design and predicted geology for well R-57.
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 clays 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 cannot bring the water-quality parameters to measure within the limits specified below, the use of chemical well development may be discussed with NMED. No chemicals will be added without approval from NMED. • Chemical means that may be used include sodium acid pyrophosphate and AQUACLEAR PFD to remove clays 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 less than 2 parts per million, and other parameters stable.
Hydraulic Testing	Hydraulic testing will be considered if a significant water-producing horizon is encountered. The most likely tests will be 24-h, constant-rate, with the two screens isolated from one another.

Investigation-Derived Waste Management	Investigation-derived waste (IDW) will be managed in accordance with Standard Operating Procedure (SOP) EP-SOP-5238, Characterization and Management of Environmental Program Waste (available at 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 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 (NOI) Decision Tree for Land Application of IDW Solids from Construction of Wells and Boreholes (November 2007). Drilling, purge, and development waters will be managed in accordance with the NMED-approved NOI Decision Tree for Drilling, Development, Rehabilitation, and Sampling Purge Water (November 2006). 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 to 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 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 of the media with which it came in contact.
Schedule	Well R-57 is proposed for completion on June 30, 2010. In its October 14, 2009, letter, the Laboratory proposed a completion date of July 30, 2010, for well R-57. However, following receipt of an email from NMED dated February 15, 2010, agreeing it would be prudent for the Laboratory to install R-57 before R-56 (Dale 2010, 108708), the new proposed date for installing R-57 is June 30, 2010. The new proposed completion date for R-56 is July 30, 2010. This proposed date for R-57 will allow the Laboratory to collect key water-level information from the R-57 borehole that can be used to optimize the siting of R-55, which is scheduled to be completed by September 30, 2010. Monitoring conducted subsequent to installation of R-57 will be implemented under the IFGMP and will support investigations and potential corrective actions at TA-54 and other upgradient sites.

REFERENCE

The following list includes all documents cited in this report. 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.

Dale (NMED), M., February 15, 2010. RE: Swap R-57 and R-56 in schedule. E-mail message to M. Everett (LANL) from M. Dale (NMED), Santa Fe, New Mexico. (Dale 2010, 108708)

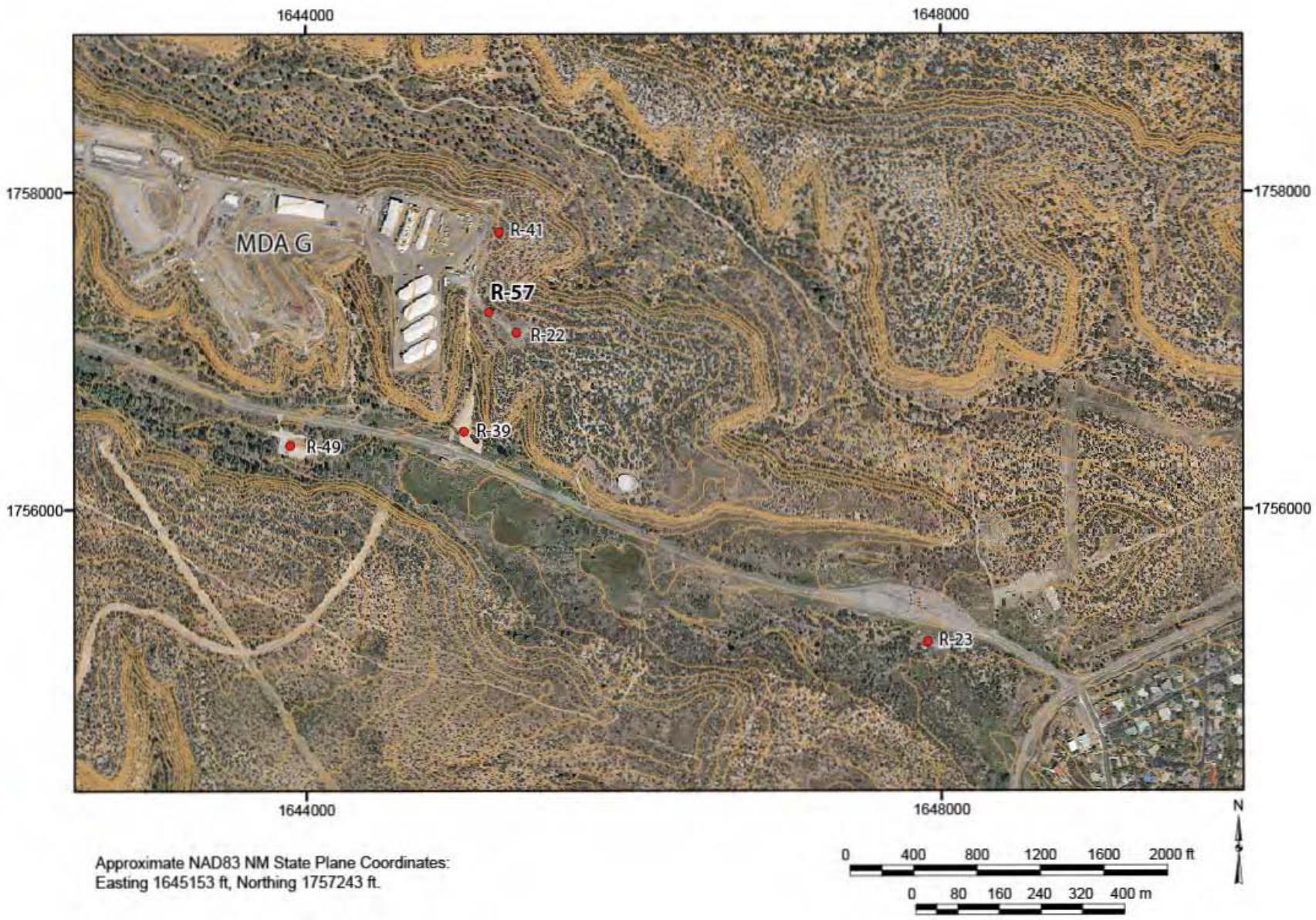

Figure 1 Proposed location of well R-57

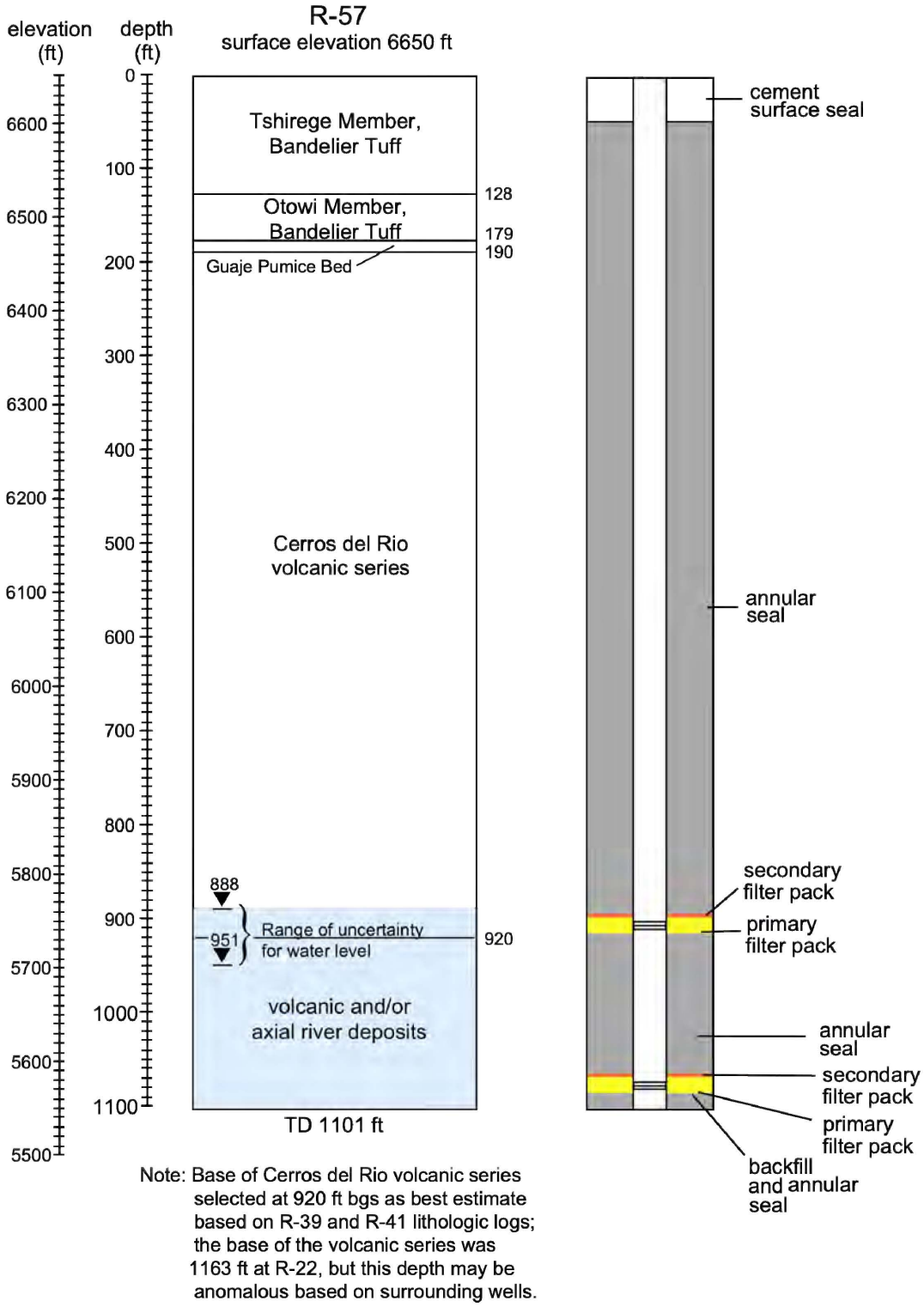

Figure 2 Predicted geology and proposed well design for well R-57