Drilling Work Plan for Regional Aquifer Well R-53

Primary Purpose	Regional aquifer well R-53 is being installed to satisfy a requirement by the New Mexico Environment Department (NMED) to install a regional aquifer monitoring well downgradient of Material Disposal Area (MDA) L at Technical Area 54. The proposed site for well R-53 is located in Cañada del Buey, north of MDA L (Figure 1). The target depth for the R-53 borehole is 1000 ft, which is within the Puye Formation. The R-53 borehole is expected to penetrate the top of regional saturation in the basal section of the Cerros del Rio basalts at about an 824-ft depth. 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 within Cerros del Rio basalt; the deeper screen will target a productive zone within the underlying Puye Formation. Figure 2 shows the predicted stratigraphy for well R-53. The well design will be based on hydrogeologic conditions encountered during drilling and a proposed well-design document will be submitted to NMED for approval.
Conceptual Model	Recent groundwater maps of this area indicate a sharp bend in equipotential lines in the vicinity of MDA L. The bend suggests that groundwater flow could have a northerly component in addition to the primary easterly flow direction. Locating R-53 as proposed is intended to monitor regional aquifer groundwater to the north of MDA L.
Drilling Approach	Drilling will be conducted with methods selected to optimize the potential of completing 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 interval of open-hole or casing-advance 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 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 Los Alamos National Laboratory (LANL), 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 will be used within 100 ft of the regional aquifer, except potable municipal water. 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	• Primary objectives are to monitor water quality in the regional aquifer downgradient of potential hazardous- or radioactive-chemical releases from MDA L and to establish water levels and flow characteristics in the regional aquifer. • A secondary objective is to determine if perched-intermediate water zones occur in the area downgradient from MDA L. This secondary purpose will be addressed to the best extent possible, but drilling methods will be optimized to accomplish the primary objective. • A tertiary 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:* • 138–174 ft, within the Cerro Toledo interval • 268–279 ft, within the Guaje Pumice Bed and underlying Puye Formation • Within the Cerros del Rio basalt, the occurrence of perched groundwater varies from location to location. Drilling will be halted at a depth of 720 ft to evaluate whether perched groundwater is present in the basalt. • *Regional:* 824 ft, regional groundwater is expected to occur in the basal section of the Cerros del Rio basalts, about 67 ft above the Puye Formation. Methods for groundwater detection may include driller's observations, water-level measurements, borehole video, and borehole geophysics.
Core Sampling	No core collection is planned.
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 days after well development, in accordance with the Compliance Order on Consent (Consent Order). These samples will be analyzed for the full suite of constituents including: radiochemistry, metals/cations, general inorganic chemicals, high explosives, VOCs, and stable isotopes. If R-53 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	• LANL'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 micro-imager 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 depth. The suite and timing of geophysical logging will depend on borehole conditions.
Well Completion Design	A screen will be placed within Cerros del Rio basalt near the top of the regional aquifer and a deeper screen will be placed within the Puye Formation. Figure 2 shows the predicted geology for well R-53.

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 LANL is unable to 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 AQUA-CLEAR 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 <2 ppm, 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 (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 LANL 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 days 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-53 is proposed for NMED completion on March 30, 2010. This date is consistent with LANL's October 14, 2009, letter to NMED proposing an integrated well-installation schedule for wells including R-53, which is specifically applicable to the collection of key groundwater data for MDA L. Monitoring conducted subsequent to installation of R-53 will be implemented under the IFGMP and will support investigations and potential corrective actions at MDA L and other sites in the vicinity as applicable.

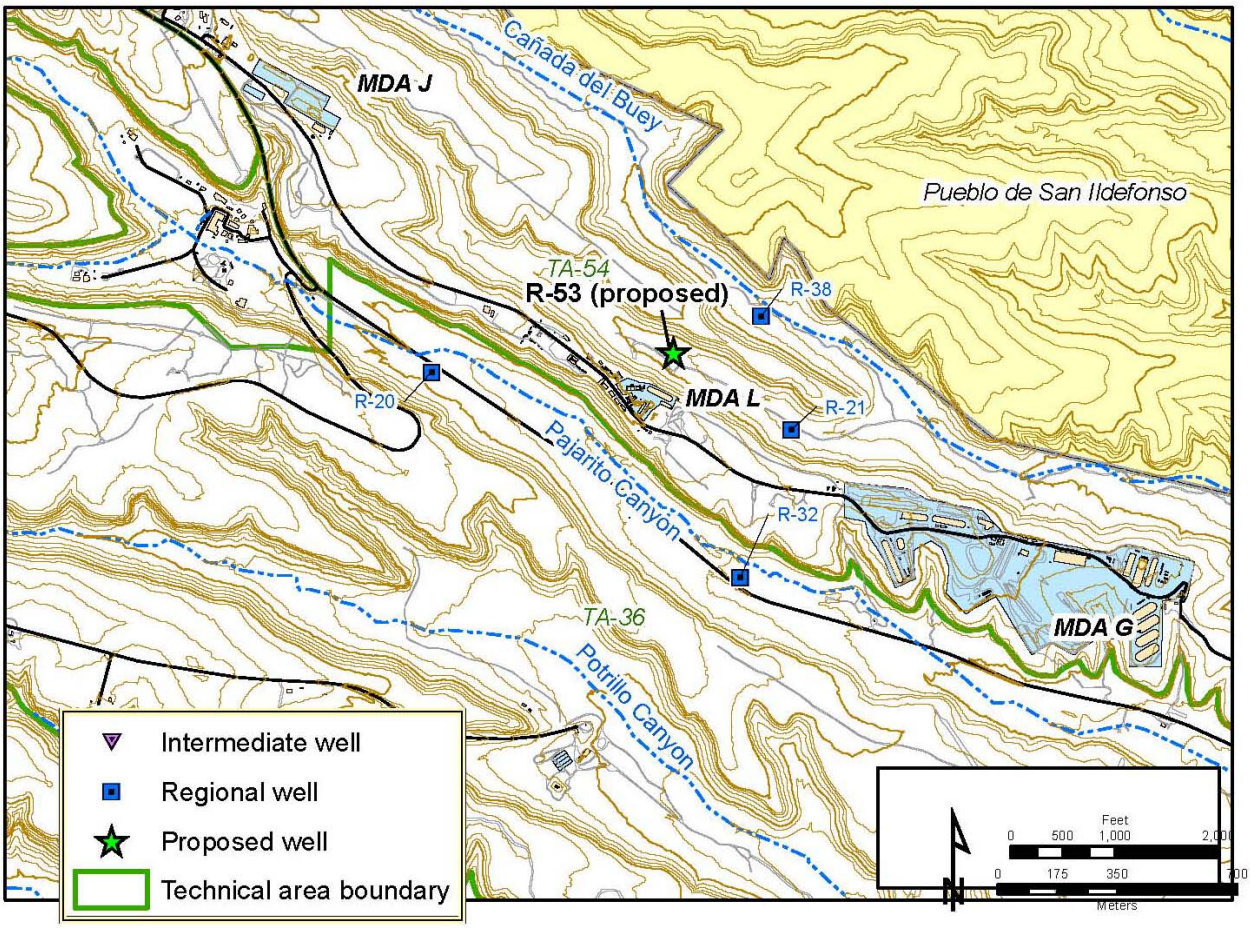

Figure 1 Map of R-53 location

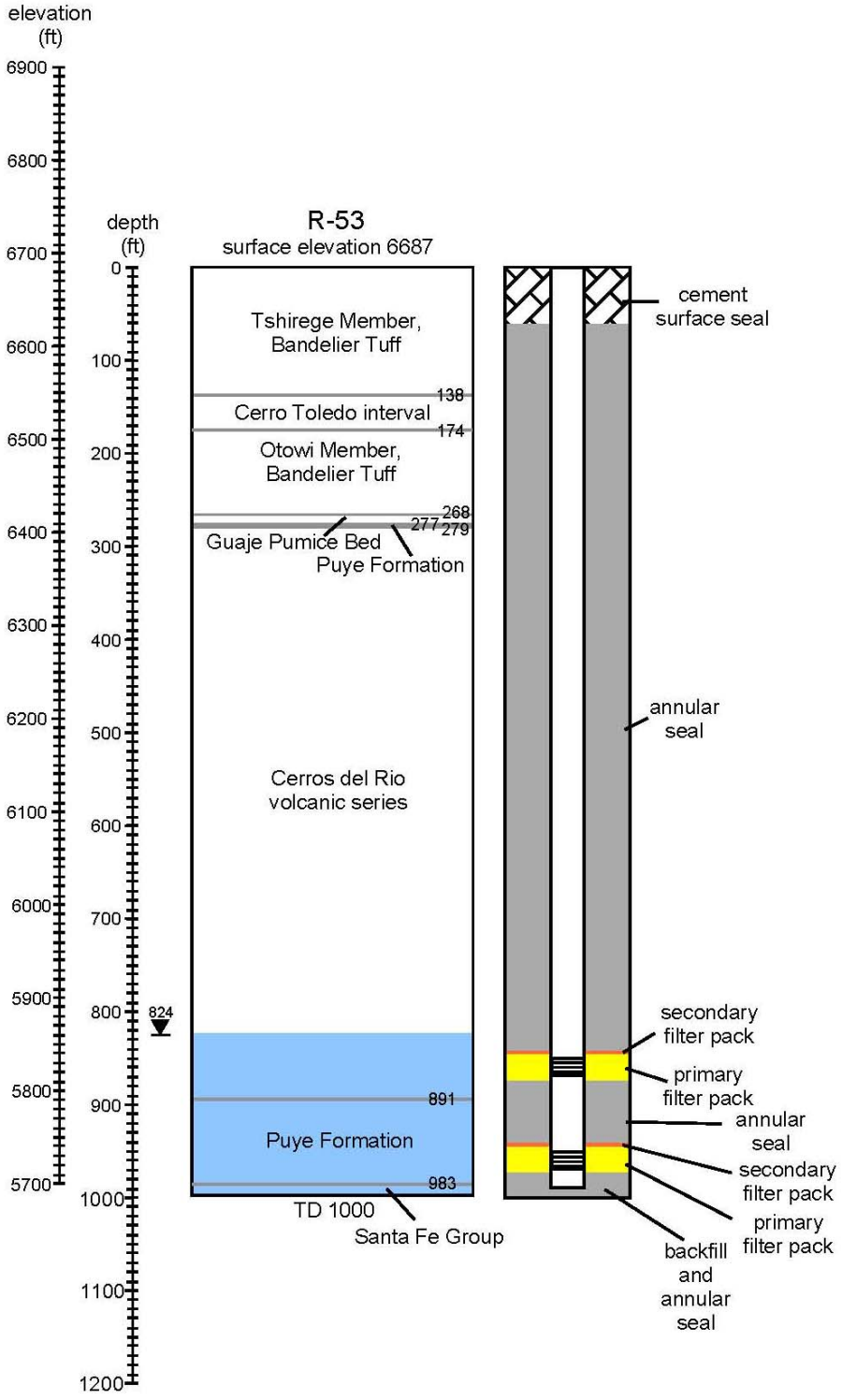

Figure 2 Predicted geology and well schematic for R-53