Work Plan for Regional Aquifer Groundwater Monitoring Well R-22, Revision 1

Introduction	This work plan describes the rationale for the recommended disposition of regional aquifer monitoring well R-22, located in Technical Area 54 (TA-54) at Los Alamos National Laboratory (LANL or the Laboratory) and the approach and design for the reconfigured well. The Laboratory's recommendation is to install a dedicated sampling system that monitors groundwater from screen 3. Screen 3 was selected to provide a deep regional aquifer groundwater monitoring location to supplement the existing monitoring network at TA-54. The regional groundwater monitoring network at TA-54 focuses on monitoring the upper regional aquifer zones closest to the water table. Reconfiguring R-22 as a single-screen well in screen 3 is not driven by a specific monitoring gap but is intended to add a deep monitoring point to the network at TA-54 while R-22 is placed in a stable configuration suitable for long-term monitoring.
Background	In 2000, R-22 was drilled to a total depth (TD) of 1489 ft using fluid-assisted air-rotary and conventional mud-rotary techniques and was completed with five screened intervals in the regional aquifer: screen 1 from 872.3 ft to 914.2 ft (Cerros del Rio basalt), screen 2 from 947.0 to 988.9 ft (Cerros del Rio basalt), screen 3 from 1272.2 to 1278.9 ft (Puye Formation), screen 4 from 1378.2 to 1384.9 ft (Santa Fe Group basalt), and screen 5 from 1447.3 to 1452.3 ft (Puye Formation). A dedicated Westbay sampling system was installed in R-22 after well completion. In May 2009, the Westbay system was removed as part of an effort to collect groundwater samples following redevelopment and purging from screens 1 and 5. Each of these screens showed what are believed to be spurious detections of constituents, either at the time they were installed (screen 1) or consistently over time (screen 5), from the Westbay sampling system. A summary report presenting details of the field activities and analytical results was submitted to the New Mexico Environment Department (NMED) on August 31, 2009 (LANL 2009, 106796). Immediately following the redevelopment activities, four TAM SD inflatable packers were installed at the following depths: packer 1 at 938.6 ft, packer 2 at 1113.2 ft, packer 3 at 1329.3 ft, and packer 4 at 1417.2 ft. Packers 1 and 2 were connected in series to a single supply line and nitrogen tank, while packers 3 and 4 were connected in series to another supply line and nitrogen tank. All four packers were suspended in the well on 2-in. mild steel drop pipe. In October 2009, following pressure failure of the lower packer set, the temporary packer system in R-22 was removed for repairs. The lower two packers were found to be damaged and were replaced with two new TAM SD packers. In February 2010, the upper packer set failed and was repaired shortly thereafter. In December 2011, the lower packer set failed again, and by February 2012, neither packer system was able to hold pressure, and no screen isolation was occurring.
Well Reconfiguration and Rationale	The temporary configuration of R-22 is not suitable for long-term monitoring because of ongoing problems with maintaining hydraulic isolation between the five screened intervals. A new single-completion well is proposed to be installed within the 4.5-in. casing of R-22 to monitor groundwater from screen 3 as a deep monitoring point. The well will be configured with a dedicated sampling system suitable for long-term monitoring of this zone. The casing beneath screen 3 will be abandoned. A packer will be placed above the top of screen 3 to isolate it from screens 1 and 2. Either sample tubing or stainless-steel casing that serves as a sampling conduit will pass through the packer to access screen 3. A low-volume pump (estimated 0.1–1 gallons per minute [gpm]) will be installed for sampling purposes. Screen 3 was selected because it represents the deepest monitoring interval in R-22 that is a potential groundwater flow pathway for contaminants possibly originating from TA-54 or Pajarito Canyon. Nearby monitoring well R-57 has two screens completed at depths comparable with screens 1 and 2 in R-22. Although R-22 screen 3 shows relatively low hydraulic conductivity compared with screens 4 and 5, it is considered the best screen for a deep monitoring point at TA-54, and it is recommended that screen 3 be retained over the deeper screens for reasons described below.

	Screen 4 is not considered a candidate monitoring screen because of its location within the Miocene Santa Fe Group basalt. This basalt is considered likely to be part of a large-scale westward-dipping unit that likely compartmentalizes groundwater flow within the regional aquifer. Observations of this basalt were made during drilling of water-supply well PM-2, located in Pajarito Canyon 1.8 mi northwest of R-22. Screen 5 is situated deep below the Santa Fe Group basalt and is relatively hydrologically isolated from the uppermost portion of the regional aquifer. For this reason, screen 5 is not considered a good candidate for long-term monitoring. Historical groundwater data from R-22 screen 5 collected using the Westbay sampling system showed consistent tritium activities and sporadic low detections of toluene. However, data collected during the R-22 redevelopment activities in May 2009 confirmed these constituents are not groundwater contaminants. A considerable number of groundwater samples were collected from screen 5 during the redevelopment pumping, and all samples showed no detections of tritium (Figure 1). The tritium previously detected at screen 5 before redevelopment in 2009 was believed to have been introduced through cross-contamination during the drilling and well installation at R-22 (LANL 2009, 106796). Most samples collected from screen 5 during redevelopment also showed no detections of toluene; however, toluene was detected in several samples before specific capacity testing and purging of cross-flow from this screen or after periods of inactivity (Figure 1). More significantly, toluene was not detected in several samples from screen 5 following specific capacity testing and final purging of this screen after completion of all redevelopment activities. The toluene previously detected at low levels in screen 5 was believed to have been introduced during the well drilling and/or well construction activities and is not related to contamination from material disposal areas located at TA-54. The absence of cocontaminants, especially the nondetections of tritium or other volatile organic compounds, is additional evidence indicating sporadic detections of toluene at screen 5 are not associated with a release from TA-54 or other upgradient sources.
Redevelopment and Conversion Activities	The following steps describe the sequence of activities that will be conducted as part of completion of R-22 as a single-screen well. *Remove Temporary Packer System* The existing packer string will be removed from the well. The pipe and packers will be decontaminated by high-pressure washing, air dried, and covered with plastic sheeting. Decontamination water will be collected and stored on-site for characterization for final disposition. *Conduct Downhole Video Logging* The well will be video-logged to document screen and casing conditions. *Abandon Lowermost Screens* The lowermost two screens (screens 4 and 5) will be abandoned by emplacing bentonite sealing material from TD to 1310 ft. Above the bentonite seal, from 1310 to 1290 ft, 10/20 filter-grade sand will be emplaced. A 4.5-in.-diameter K-packer will be set above the filter-grade sand. *Redevelop the Well* Screen 3 will be redeveloped using a combination of swabbing, surging, and pumping. Swabbing will be conducted using a swabbing tool constructed on a rigid piece of pipe with nylon (or similar) discs mounted to the pipe. Surging of the well screen will be performed by rapidly moving the swab up and down the screened interval. The well will be pumped to remove excess sediment following the swabbing and surging.

	Measure Field Parameters Field parameters will be measured during redevelopment using a flow-through cell and multiparameter meter in data-logging mode. The discharge from the screened interval will be monitored for pH, temperature, conductivity, oxidation-reduction potential, and dissolved oxygen using a YSI 556 MPS multiparameter meter or equivalent unit. Turbidity samples will be collected at periodic intervals using a Hach 2100P Turbidimeter or equivalent. *Set Packer and Sampling System* Depending on the nature of the final selected sampling system, either a Baski-type system will be installed, or a stainless-steel casing, likely 1–2 in. diameter, will be set through the packer to access screen 3.
Dedicated Sample System Installation	Screen 3 of R-22 will be outfitted with a dedicated sampling pump. The projected yield of the formation at screen 3 is very low, with an estimated specific capacity of 0.0062 gpm/ft for this screen. The redevelopment efforts described above are not expected to significantly increase this specific capacity; and the yield is still likely to be fairly low. Therefore, the dedicated sampling pump will be designed to pump at low rates in the range of 0.1–1 gpm. A dedicated pressure transducer for monitoring screen 3 water levels will be Installed.
Waste Management	Fluids produced during development and purging will be managed in accordance with the NMED-approved Notice of Intent to Discharge Decision Tree.
Reporting	The well will be constructed by September 31, 2012. A completion report will be prepared 150 d following completion of field activities. The report will document field activities, redevelopment, and sampling activities and will contain an as-built drawing of the final well configuration and sampling system.

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.

LANL (Los Alamos National Laboratory), August 2009. "R-22 Well Redevelopment Phase I Summary Report," Los Alamos National Laboratory document LA-UR-09-4936, Los Alamos, New Mexico. (LANL 2009, 106796)

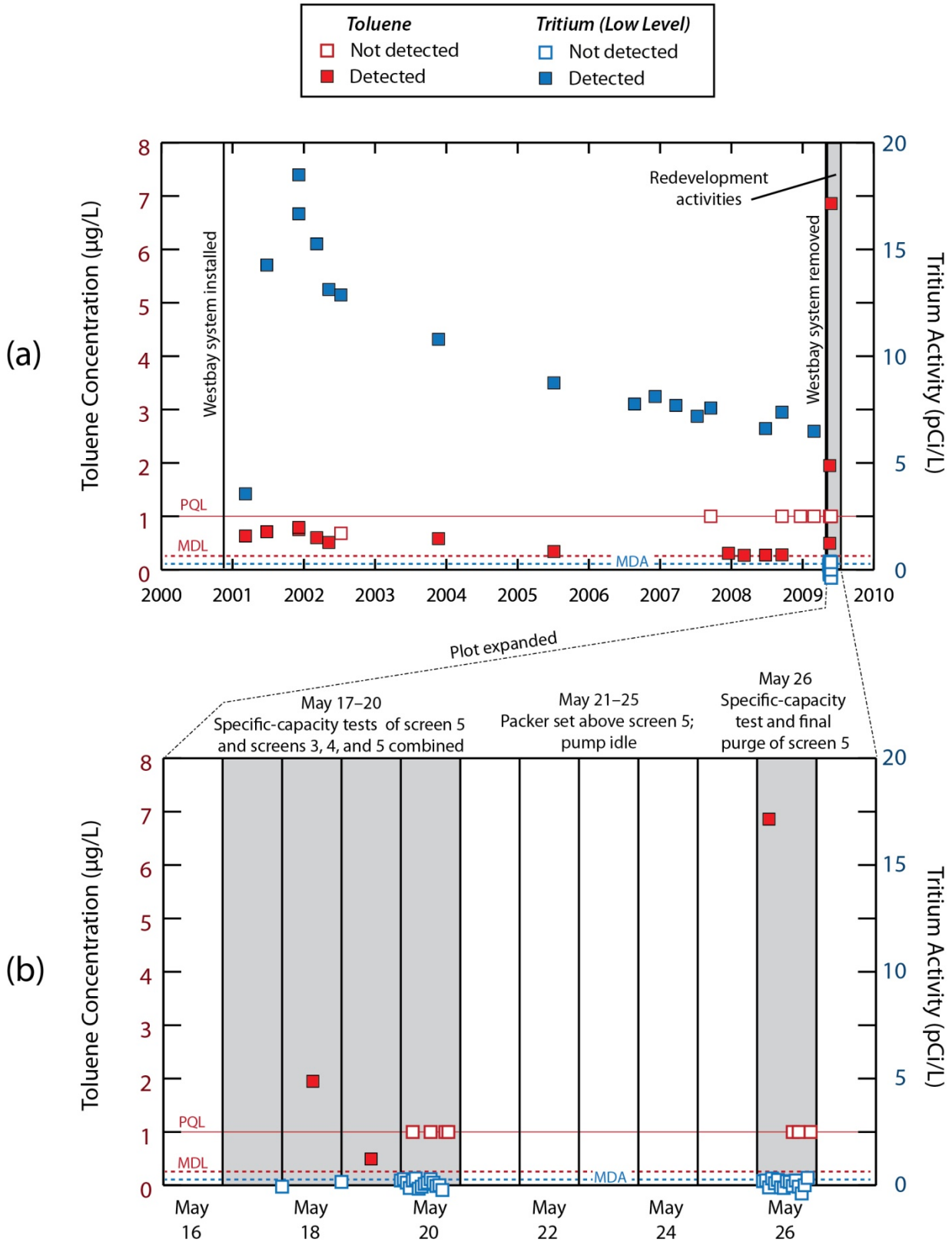

Figure 1 Toluene concentrations in R-22 screen 5: (a) March 2001 to May 2009 and (b) during redevelopment (May 16 to 26, 2009)