Work Plan for Regional Aquifer Groundwater Monitoring Well R-22

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 is focused 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 opportunistically add a deep monitoring point to the network at TA-54 while placing R-22 into a stable configuration suitable for long-term monitoring.
Background	In 2000, R-22 was drilled to a total depth 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 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 had shown what is believed to be spurious detections of constituents, either at the time of installation (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 at1329.3 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 are 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 was removed from R-22 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 upper packer set failed again, and by February 2012, neither packer system was able to hold pressure, and no screen isolation was occurring.
Well Design and Rationale	The temporary configuration of R-22 is not suitable for long-term monitoring because of the 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 in the TA-54 monitoring well network. The well will be configured with a dedicated low-flow sampling system suitable for long-term monitoring of this zone. The new well will be completed by installing a 2-in. monitoring well within the existing 4.5-in.–inside diameter (I.D.) well casing. Specifics of the design are shown in Figure 1. Screen 3 was selected because it represents the deepest monitoring interval in R-22 that is a potential groundwater flow pathway for contaminants that could originate from TA-54 or Pajarito Canyon. The new well completion will abandon screens 1 and 2 because the nearby monitoring well R-57 has two screens completed at similar depths, and these monitoring efforts would be redundant (see Figure 2). 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 a 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 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 3). 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 3). 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 (MDAs) at TA-54. The absence of co-contaminants, 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. The 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 placement of cement sealing materials at selected depths (Figure 1). To keep sealing materials, such as cement, contained within the well casing, 10/20 filter-grade sand will be emplaced within the R-22 screened intervals planned for abandonment. The 10/20 filter-grade sand will be placed to a level of a minimum of 5 ft above the slotted screen sections. A 5-ft interval of fine 20/40 filter-grade sand will be installed above the 10/20 sand. Cement will be placed between screens 4 and 5 and between screens 3 and 4 to isolate and abandon the lower screens. A 4.5-in.-diameter K-packer will be set above the cement placed between screens 3 and 4 to separate the cement from the 10/20 sand planned for the screen 3 interval and to minimize the potential for contamination of screen 3 by cement.

	Redevelop the Well A specific capacity test will be performed on screen 3 before redevelopment to provide a baseline of hydraulic parameters data. The initial specific capacity test will consist of installing an inflatable packer/pump assembly as well as a pressure transducer in that interval. The test will be followed by 1 h of equilibration time, pumping the isolated interval for a minimum of 3 h, and allowing a minimum of 3 h of recovery following pumping. Following the specific capacity testing, screen 3 will be redeveloped using a combination of swabbing, jetting, and pumping, as described below. 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. Jetting and simultaneous pumping will then be conducted using a jetting tool just above the pump discharge that will direct a portion of the pump output through the screen openings to deliver energy to the filter pack and formation. The remainder of the pump output will be discharged to the surface to effect the net removal of water and sediment from the well during the jetting process. The design of the jetting tool used in the development process will be based on the measured specific capacity of the screened zone. Following redevelopment, a second specific capacity test will be performed to evaluate the effectiveness of the redevelopment effort. *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. *Install Inner Casing* A 2-in. nominal I.D. inner casing consisting of 304 stainless steel will be installed within the 4.5-in. casing of R-22 to build a single-completion “inner well” within the existing R-22 well (essentially a well within a well), as shown in Figure 1. This configuration will allow screen 3 to be sampled with a dedicated pump, while permanently sealing screens 1 and 2 using a combination of bentonite and sand as described below. The 2-in. nominal I.D. inner casing will terminate in a 5-ft length of 2-in. nominal I.D. well screen, located at the same elevation as the current R-22 screen 3, as shown in Figure 1. The inner casing well screen will consist of rod-based, wire-wrapped #10 slotted screen, completed at a depth of 1273 to 1278 ft below ground surface. A 5-ft sump will be installed at the base of the inner well screen (Figure 1). To properly complete the inner well casing within screen 3, the screened interval within the 4.5-in. outer casing will be filled with 10/20 filter-grade sand. The 10/20 filter sand will be emplaced above the K-packer across the full screen 3 interval to a level at least 5 ft above screen 3. A 5-ft interval of fine 20/40 filter-grade sand will be installed as a secondary filter pack above the 10/20 filter-grade sand in screen 3. *Abandon Uppermost Screens* The uppermost two screens (screens 1 and 2) will be abandoned by placement of sand and bentonite sealing materials at selected depths (Figure 1). To keep the bentonite within the well casing but outside the screened intervals, 10/20 filter-grade sand will be emplaced throughout the screened intervals to a level a minimum of 5 ft above the slotted screen sections. A 5-ft interval of fine 20/40 filter-grade sand will be installed above the 10/20 sand. Bentonite will be placed between screens 2 and 3 and between screens 1 and 2 to hydraulically isolate and abandon the upper screens of R-22, as shown in Figure 1.

Dedicated Sample System Installation	Screen 3 of R-22 will be outfitted with a dedicated low-flow sampling pump. The projected yield of the formation at screen 3 is very low, with an estimated specific capacity of 0.0062 gal. per min/ft for this screen. It is anticipated that the redevelopment efforts described above may increase this specific capacity somewhat, but the final yield is still likely to be fairly low. For this reason, a low-flow pump is proposed for permanent installation in screen 3, and low-flow sampling techniques will be utilized during future sampling events at screen 3. The low-flow pump will be installed in the 2-in. nominal I.D. inner casing, with the pump intake located at the approximate midpoint of the screen.
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	It is anticipated that the well will be constructed by May 31, 2012, assuming material and equipment are readily available to support this completion date. 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)

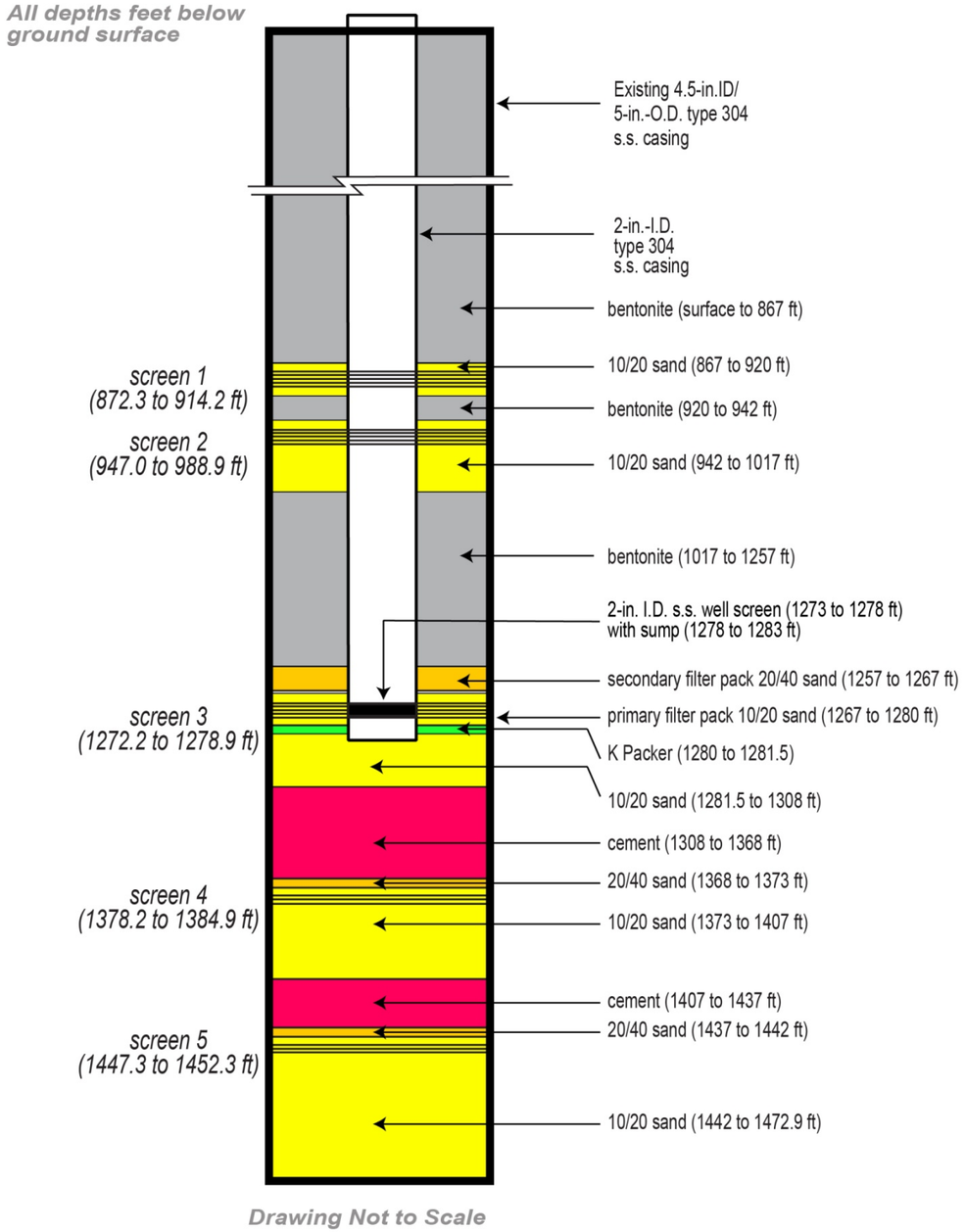

Figure 1 R-22 well design showing proposed 2-in.-I.D. well and annular fill installed in the existing 4.5-in.-I.D. well casing

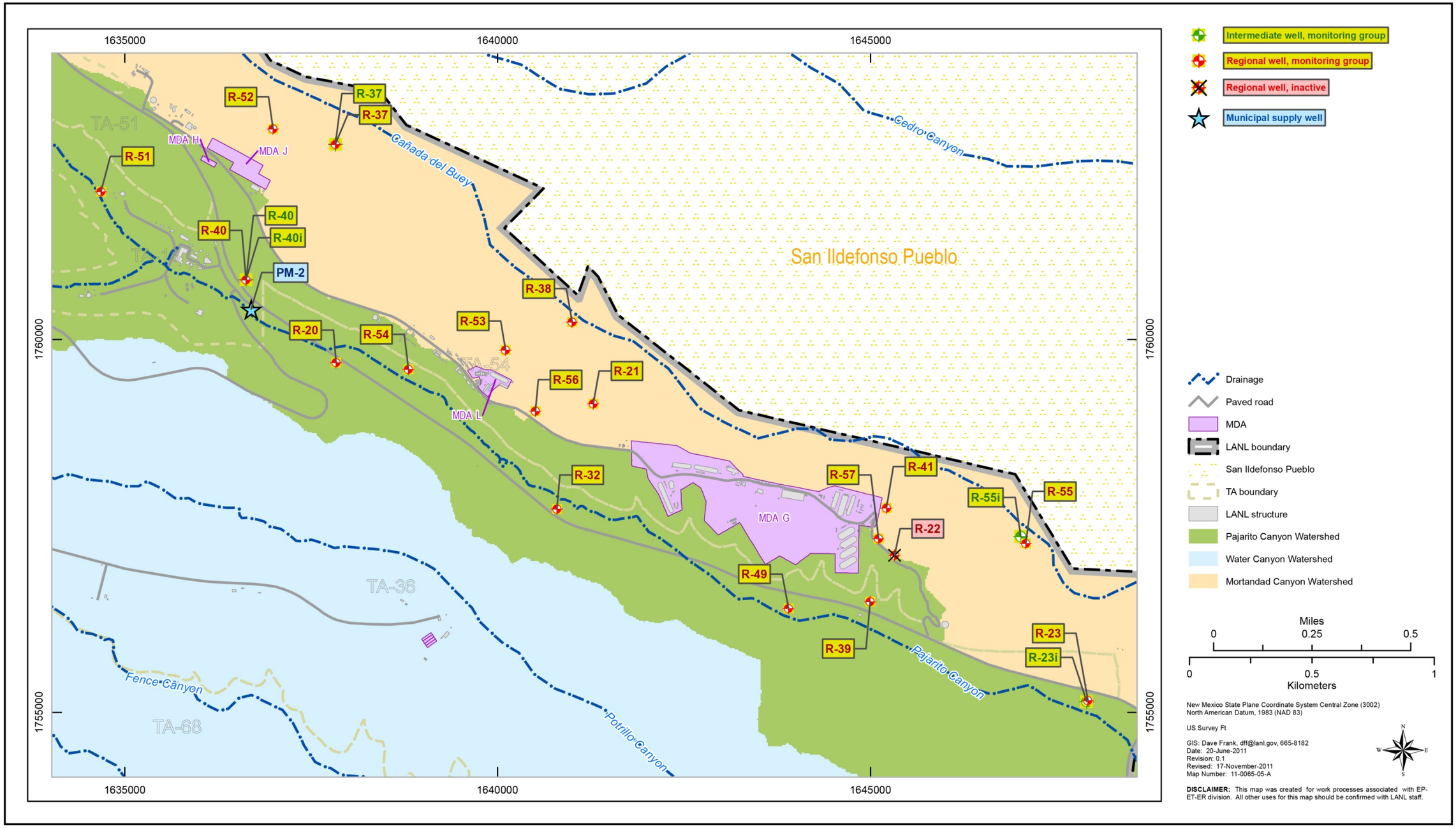

Figure 2 Monitoring well network of TA-54 MDAs H, L, and G

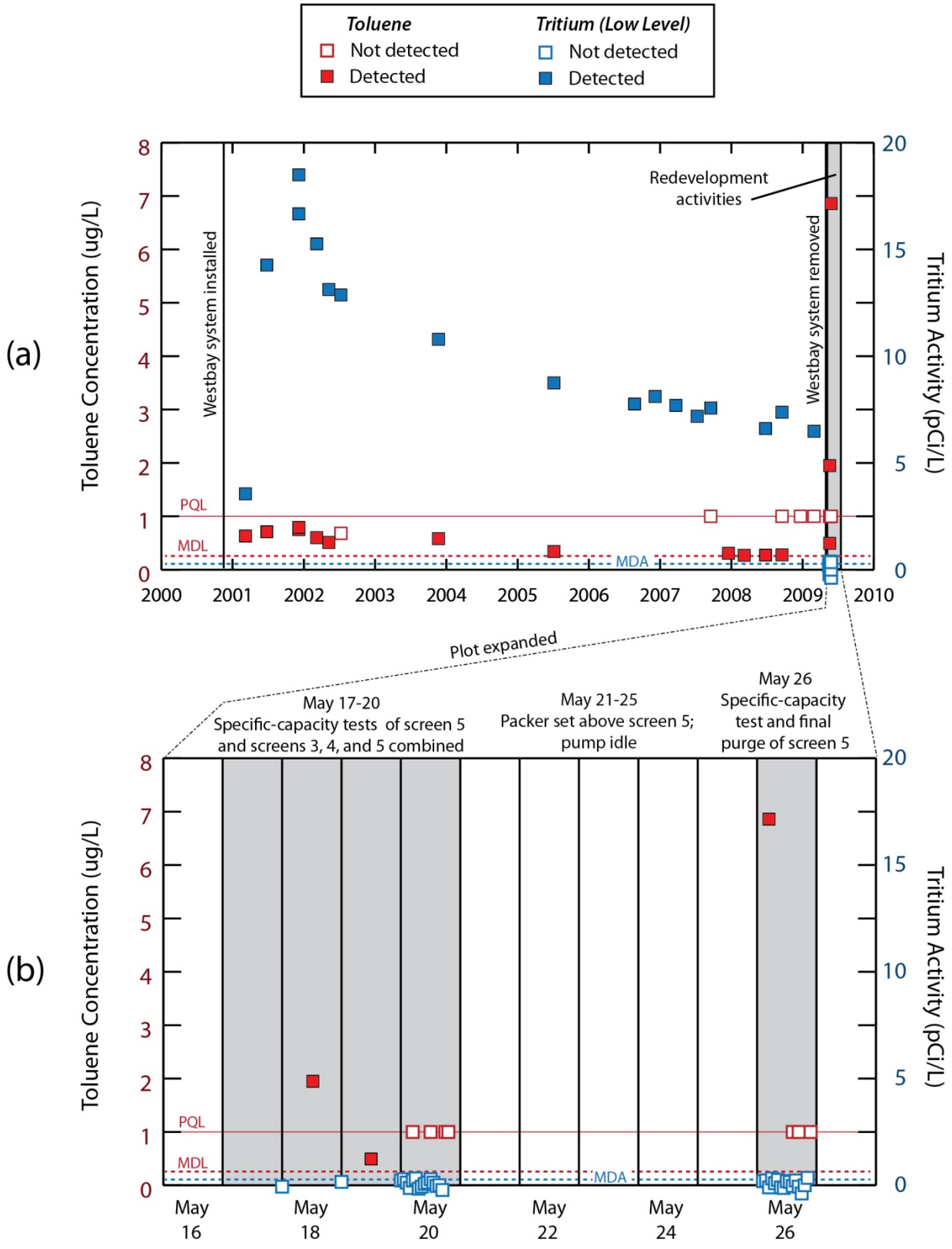

Figure 3 Toluene concentrations in R-22 screen 5: (a) March 2001 to May 2009 and (b) during redevelopment (May 16 to 26, 2009)