Drilling Work Plan for Regional Aquifer Well R-36

Primary Purpose	Well R-36 is being installed to satisfy requirements in two letters from the New Mexico Environment Department (NMED). The first letter, entitled "Direction to Rehabilitate Wells, Pilot Well Rehabilitation Study Summary Report," dated April 27, 2007, directed Los Alamos National Laboratory (LANL) to plug, abandon, and replace well R-12, screen #3. The second letter, "Denial of Extension Request for Replacement of Monitoring Well R-12 Screen #3," dated June 8, 2007, specified a deadline of July 1, 2007, for a drilling work plan for a new regional aquifer well. The proposed site for the new well, R-36, is an area between wells R-12 and R-35 as shown in Figure 1. R-36 is proposed to act as a LANL boundary well; it will have one screen monitoring the uppermost regional aquifer within sediments above the Miocene age basalt (Figures 2 and 3). In addition, R-36 may increase our understanding of the distribution of chromium, molybdenum, and other contaminants within the regional aquifer. Figure 2 shows the stratigraphy, lithology, and conceptual well design for R-36. Figure 3 is a geologic cross section along Sandia Canyon that shows the stratigraphy, observed chromium concentrations (in red), and a conceptual model of groundwater movement in the subsurface.
Conceptual Model	Hexavalent chromium contamination is present in the upper part of the regional groundwater system at R-11 and R-28. Molybdenum concentrations were observed above background levels in groundwater screening samples collected from wells R-35a and R-35b. Natural hydraulic gradients in the area are expected to cause the contamination to move eastward with possible local northeast gradients due to pumping of municipal water at PM-3 and PM-1. (See Figure 1 for well locations.) Thick Miocene basalt may provide a lower confining bed for the vertical movement of contamination, restricting the movement of potential contaminants to the portion of the aquifer above the basalt. Thus, the R-36 well location is moved west of well R-12 so that R-36 can target the sedimentary deposits on top of the Miocene basalts for groundwater monitoring. These sedimentary deposits are more likely to be hydraulically connected with contaminant pathways from western contaminant sources. Well R-36 is situated to intercept potential contaminants within the regional aquifer before they reach the LANL boundary.
Drilling Approach	Drilling will be conducted with methods selected to optimize the potential of completing the well without the use of any drilling additives in the zone of saturation. Specifically, air-rotary casing advance will be used in an effort to meet the targeted top of Miocene basalt at a depth of approximately 980 ft or 205 ft into the regional aquifer. Following is a summary of the proposed methods by depth interval: • A 16–in. surface casing will be advanced with fluid assisted air-rotary through the Bandelier tuff and the Guaje pumice to 160 ft below ground surface (bgs). • A 15–in. open borehole will be advanced with fluid assisted air-rotary through the Cerros del Rio basalts and any associated perched water to 650 ft bgs. • If perched water is present, bentonite will be tremied into the borehole, and a 12–in. casing will be lowered and sealed in place. • If no perched water is encountered, the 12–in. casing will be lowered into the open borehole and rotated into the bottom of the borehole. • A 10–in. casing will be advanced to target depth = 980 ft without the use of drilling fluid additives. Municipal water may be added to cool the drill bit as needed.
Potential Drilling Fluids, Composition, and Use	The following fluids and additives that may be used at R-36 have been characterized geochemically and are consistent with those previously used in the drilling program at LANL: • potable water from the municipal water supply to cool the drill bit and to aid in delivery of other drilling additives; • QUIK-FOAM™, a blend of alcohol ethoxy sulfates, to be used as a foaming agent; and • AQF-2™, an anionic surfactant, to be used as a foaming agent.

Hydrogeologic and Geochemical Objectives	On the basis of water level data and the lack of response to pumping in PM-1, it appears that R-12 screen #3 is hydrologically isolated within the Miocene basalt. Well R-36 will be screened within the sediments overlying the basalt so that it can monitor water levels and pumping influences near the LANL boundary more effectively. Well R-12 screen #3 currently provides chromium concentrations that appear to be below background, possibly because of the presence of residual drilling fluids. The proposed location for R-36 may provide chromium data more representative of the regional aquifer in lower Sandia Canyon. Another objective is to determine whether there is perched-intermediate water in the area between R-12 and R-35. This purpose will be addressed to the extent allowed by borehole conditions, but drilling methods will be optimized to accomplish the goals listed in the two paragraphs above.
Potential Groundwater Occurrence & Detection	*Perched:* 180-to-600-ft-deep perched water was encountered in the lower part of the Cerros del Rio basalt and in underlying sediments at nearby wells R-12 and PM-1. The perching horizon is clay- and silt-rich lake beds in both boreholes. *Regional:* At 775 ft, regional groundwater is expected to occur within the Totavi Lentil and underlying Santa Fe Group 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.
Groundwater Screening Sampling	Screening water samples will be collected during drilling at any perched horizon producing sufficient water for sampling and at the top of the regional aquifer. A screening water sample will be collected from the screen at the end of development. Screening samples of groundwater will be analyzed for cations/metals (dissolved and total) and anions (dissolved) by the Earth and Environmental Sciences Division (Group EES-6) chemistry laboratory.
Groundwater Characterization Sampling	Groundwater samples will be collected from the completed well between 10 and 60 days after well development in accordance with the Consent Order. These samples will be analyzed for the full suite of constituents including: radioactive elements, metals/cations (including total dissolved chromium), general inorganic chemicals, volatile organic compounds, and stable isotopes. Subsequent groundwater samples will be collected as specified in the "Interim Measures Work Plan for Chromium Contamination in Groundwater" and the "Interim Facility-Wide Groundwater Monitoring Plan."
Geophysical Testing	LANL's borehole video camera, natural gamma, and induction tools will be used in the 15-in. open borehole before the 12–in. casing is lowered, conditions permitting. Borehole conditions permitting, the 10–in. casing also will be pulled up above the regional aquifer, and a full suite of geophysical logs will be run in the open borehole. The logs will be collected by Schlumberger, Inc., and will include accelerator porosity sonde (neutron porosity), array induction, combined magnetic resonance, natural and spectral gamma, and formation micro-imager logs. If the casing cannot be retracted for logging, the accelerator porosity sonde, elemental capture sonde, triple litho-density, natural 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 will also be used to select the well screen depth. The suite and timing of geophysical logging will depend on borehole conditions.

Well Completion Design	One well screen will be placed in the most productive interval identified within the upper 100 feet of the regional aquifer.
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 sodium acid pyrophosphate or AQUA-CLEAR PFD™ to remove natural and added clays and/or the use of chlorination to kill bacteria introduced during well completion. Chemical means will not be employed before further discussion with and approval by NMED. Target water-quality parameters are as follows: turbidity <5 nephelometric turbidity units, total organic carbon <2 parts per million, other parameters stable.
Hydraulic Testing	Because of the close proximity to R-35, no aquifer tests are planned.
Investigation-Derived Waste Management	Fluids produced during drilling will be managed and disposed of in accordance with the NMED-approved Notice of Intent Decision Tree: Drilling, Development, Rehabilitation, and Sampling Purge Water (November 2006). Cuttings produced during drilling will be managed and disposed of in accordance with the Decision Tree for Management of Investigation-Derived Waste Solids from Drilling Operations, which is pending review and approval from the NMED.

R-36 Tentative Drill Schedule
Proposed Start of Field Preparations: September 25, 2007

Activity	Duration (days)	Target Completion Date
Drilling of Borehole (includes mobilization, site preparation, geophysics work, and well design)	63	November 13, 2007
Installation of Well in Borehole R-36	18	December 2, 2007
Development of R-36	7	December 10, 2007
Characterization Sampling of R-36	10 to 60 following development	December 21, 2007 to February 13, 2008
Site Restoration at R-36	7	To Be Determined

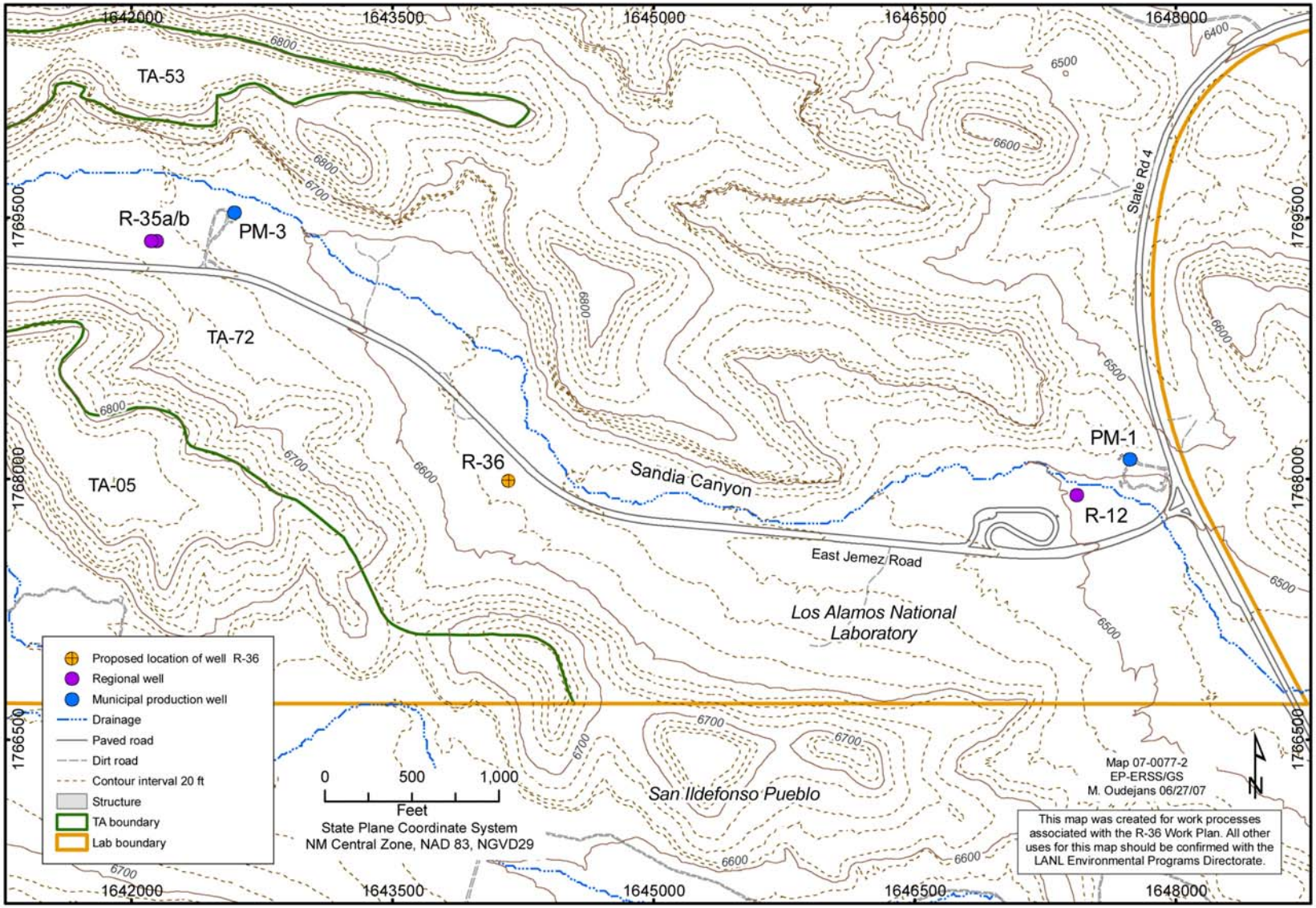

Figure 1 Proposed R-36 location

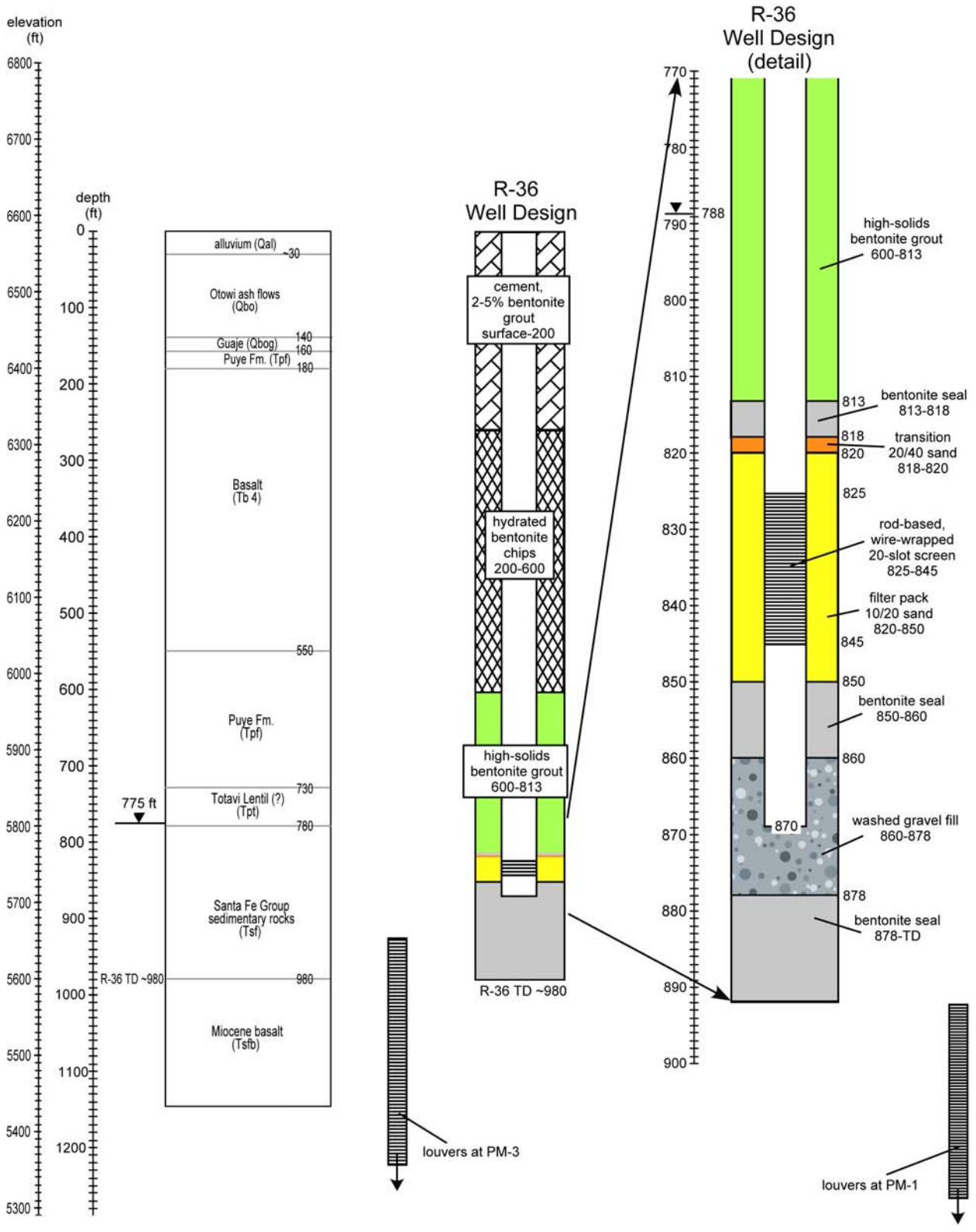

Figure 2 Proposed R-36 well design shown relative to the top of louvers at PM-1 and PM-3

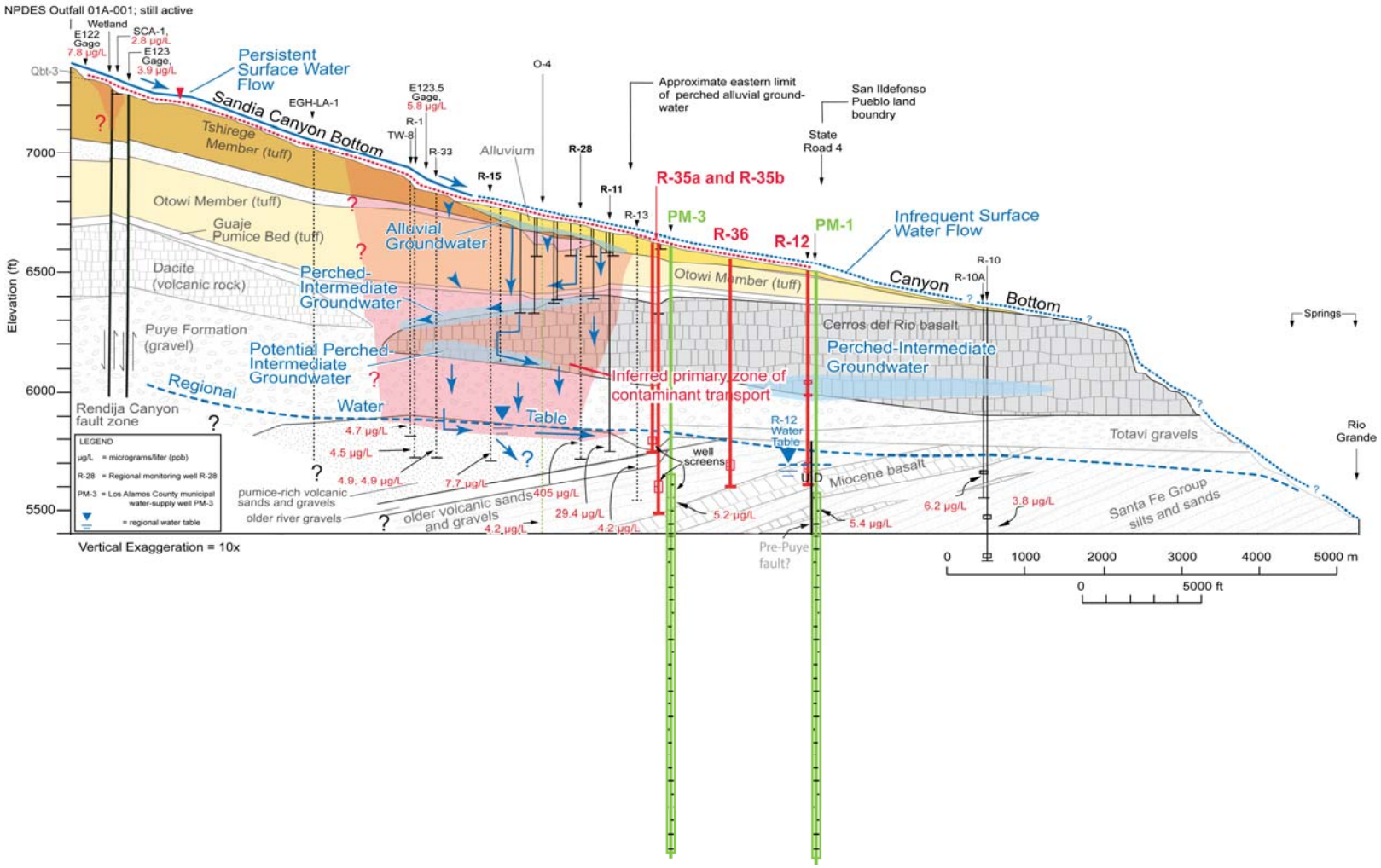

Figure 3 Sandia Canyon conceptual diagram