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DEPARTMENT OF ENERGY
Environmental Management Los Alamos Field Office (EM-LA)
Los Alamos, New Mexico 87544

EMLA-24-BF8-2-1

October 27, 2023

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NMED Hazardous Waste Bureau

Mr. Rick Shean
Designated Agency Manager
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Drive East, Building 1
Santa Fe, NM 87505-6313

Subject: Submittal of the Drilling Work Plan for Groundwater Regional Aquifer Monitoring Well SIMR-3

Dear Mr. Shean:

Enclosed please find two hard copies with electronic files of the "Drilling Work Plan for Groundwater Regional Aquifer Monitoring Well SIMR-3." Submittal of this work plan fulfills proposed fiscal year 2024 Milestone 5 of Appendix B of the 2016 Compliance Order on Consent. A pre-submittal meeting and site walk for the SIMR-3 drilling work plan was held between the Pueblo de San Ildefonso and the U.S. Department of Energy Environmental Management Los Alamos Field Office (EM-LA) on August 22, 2023.

If you have any questions, please contact Amanda White at (505) 309-1336 (amanda.white@em-la.doe.gov) or Cheryl Rodriguez at (505) 414-0450 (cheryl.rodriguez@em.doe.gov).

Sincerely,

Digitally signed by BRIAN HARCEK
Date: 2023.10.27 09:31:35 -06'00'

Arturo Q. Duran For
Compliance and Permitting Manager
U.S. Department of Energy
Environmental Management
Los Alamos Field Office

Enclosure(s):

1. Two hard copies with electronic files – Drilling Work Plan for Groundwater Regional Aquifer Monitoring Well SIMR-3 (EM2023-0617)

cc (letter and enclosure[s] emailed):
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Raymond Martinez, San Ildefonso Pueblo, NM
Dino Chavarria, Santa Clara Pueblo, NM
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Drilling Work Plan for Groundwater Regional Aquifer Monitoring Well SIMR-3

Primary Objectives and Purpose	This drilling work plan presents the objectives, drilling approach, and conceptual design for groundwater monitoring well SIMR-3. The primary objective for SIMR-3 is to provide additional monitoring for chromium and other constituents in the groundwater beneath Pueblo de San Ildefonso, west of monitoring well SIMR-2 (LANL 2016, 601081) and approximately 750 ft south of the Los Alamos National Laboratory (LANL or the Laboratory) and Pueblo de San Ildefonso boundary. SIMR-3 is proposed to be located approximately 2200 ft to the west of SIMR-2 (Figure 1). Since the discovery of chromium concentrations exceeding groundwater standards at well R-28 in Mortandad Canyon in 2005, a network of monitoring wells has been installed to define the chromium plume extent and concentrations of other constituents in groundwater (e.g., perchlorate, major anions and cations, etc.). In 2018, an interim measure was implemented to extract chromium-contaminated water, removing the chromium using ion exchange technology, and injecting the treated groundwater at the periphery of the chromium plume for hydraulic plume control. The primary purpose of the interim measure was to control chromium migration in groundwater while long-term corrective action remedies were being evaluated; with the principal objective of achieving and maintaining the 50-ppb New Mexico groundwater standard for chromium at the plume edge within the LANL boundary (LANL 2015, 600458). SIMR-2 chromium concentrations have not exceeded background at that location, while operation of the interim measure succeeded in receding the 50-ppb plume boundary to the north of the boundary by approximately 500–1000 ft. The installation of a second well will provide additional characterization data, providing additional support on plume extent beyond what is possible with only a single monitoring well on Pueblo de San Ildefonso land. The proposed location of SIMR-3 to the west of SIMR-2 will enable water quality to be monitored in a region not covered by the existing network. Specifically, chromium concentrations at well R-61 screen 1 have recently increased to values greater than 50 ppb, and perchlorate concentrations at that well have been near or in excess of groundwater standards. Influences from extraction at well CrEX-2 and injection at CrIN-5 are possibly influencing plume behavior in this region. The SIMR-3 location is designed to investigate if these concentration trends also occur to the south of the LANL boundary. The two-screen design, with an upper screen near the water table targeting the depth of R-61 screen 1 and a deeper screen targeting the elevation of R-61 screen 2, can monitor groundwater at discrete depths within the aquifer. A secondary objective of SIMR-3 is to improve the characterization of the potentiometric surface in this portion of the aquifer. Shallow and deep flow paths within the aquifer are very uncertain at this location. Whereas the existing potentiometric surface maps indicate an easterly and slightly northerly gradient, the addition of water-level measurements at this location will greatly improve the estimate of flow direction. In addition, the second screen will provide important information on deeper flow paths, including identification of possible differences in shallow and deep flow paths. Potential locations are constrained by surface restrictions. The proposed location of SIMR-3 is shown in Figure 1 as being adjacent to the 100-yr floodplain. Per 10 Code of Federal Regulations 1022, the proposed action will be evaluated to determine the potential impacts to the floodplain and implement best management practices to ensure impacts are mitigated. The proposed action will also be vetted to ensure compliance with the Clean Water Act Section 401 and 404 requirements. Figures 2 and 3 present cross-sections for PM-4 and SIMR-2 and for R-61 and SIMR-2, respectively. Each figure shows the stratigraphic sequence and screen positions of nearby wells and the screen proposed for SIMR-3. Both proposed 20-ft screens are located within the Puye Formation, one approximately 20 ft below the water table, and a second approximately 90 ft below the water table. Figure 4 shows the conceptual design for SIMR-3, with the understanding that a separate and more detailed design package that reflects actual information obtained from drilling will be submitted to the New Mexico Environment Department (NMED) and Pueblo de San Ildefonso for review and approval.

Drilling Approach	The proposed drilling approach for SIMR-3 will use fluid-assisted air-rotary with casing-advance methods. Telescoping casing sizes between 24 in. and 10 in. and dual-rotary methods will be used to advance the borehole to a depth within the upper 185 ft of the regional aquifer. This approach will produce a borehole that can accommodate a minimum 2-in. annular filter pack around the 5-in.-diameter well screen. The base of the Puye Formation is estimated at approximately 1066 ft below ground surface (bgs), which overlies the Miocene Pumiceous deposits (Tjfp). The total depth is planned for 1100 ft bgs within the Tjfp, which is estimated to be 29 ft above the Chamita Formation. When the depth of the borehole reaches the saturated Puye Formation, the recommended drilling method is to use flooded-reverse circulation rather than conventional circulation. This will allow hydrostatic pressure(s) and water level(s) across the formations to remain stable (maintain static water level) controlling heave, while allowing the borehole to advance to total depth. Beyond the requirement to use flooded-reverse circulation, the selected drilling subcontractor will be responsible for using drilling and well-completion methods that are best suited for the conditions encountered. All drilling and completion operations will conform to the guidance provided in Appendix F of the 2016 Compliance Order on Consent (Consent Order). Well completion will follow New Mexico Office of the State Engineer (NMOSE) regulations concerning well construction including, but not limited to (1) hanging of the casing throughout well construction and (2) industry standard centralizers allowing for a minimum 2-in. annular space in a vertical well. Drilling subcontractors are required to have a New Mexico Well Driller’s License. Because this well is located on Pueblo de San Ildefonso land, an NMOSE drilling permit is not required.
Drilling Fluids, Composition, and Use	Fluids and additives will be used to facilitate drilling and may include those previously authorized for use by NMED, including the following: • Potable water, municipal water supply, to aid in delivery of other drilling additives and to cool the drill bit, • QUIK-FOAM, a blend of alcohol ethoxy sulfates, used as a foaming agent to lift cuttings, and • AQF-2, an anionic surfactant, used as a foaming agent to lift cuttings. Use of additives may be necessary to advance drilling and maintain borehole integrity throughout the regional aquifer. Complete records will be maintained detailing the type, amount, and volume of fluid and additives used and the depth at which fluids or additives were added to the borehole.
Potential Groundwater Occurrence and Detection	Although perched-intermediate groundwater was not observed during drilling of nearby well SIMR-2, perched-intermediate groundwater may be present in the vicinity of the proposed location for SIMR-3. Methods used to identify perched-intermediate groundwater during drilling will include drillers’ observations and water-level measurements. If perched-intermediate groundwater is encountered, then measures will be taken to seal the zone before advancing the borehole to ensure that the perched water does not follow the drilling downhole. The top of the regional aquifer is projected to occur at approximately 917 ft bgs.

Geophysical Testing	Neutron logging measures the amount of hydrogen in the formation in either a water- or air-filled borehole. The hydrogen content typically provides a good measure of moisture content in the unsaturated zone and porosity in the saturated zone. Gamma surveys employ a scintillation detector to measure the gross gamma radiation activity of the formation. Naturally occurring gamma radiation comes from the decay of potassium-40 plus the uranium and thorium decay series. Typically, these elements occur in varying concentrations within different strata, and the gamma log can be used to estimate porosity and relative content of fine-grained material. Geophysical logging will be conducted through the saturated interval in the regional aquifer when the borehole has been drilled to total depth. Neutron and gamma surveys will be executed to quantify the top of regional saturation, identify geologic contacts, and identify zones of higher permeability for well screen placement. The geophysical data will be used in conjunction with drill cuttings, drillers’ observations, and screening/zonal water-quality samples to identify intervals within the aquifer that are suitable for screen placement.
Cuttings Characterization	Cuttings will be collected from the length of the borehole. Cuttings collection and characterization methods will attempt to optimize representative retention of the fine-grained fraction, particularly within the regional aquifer. Split samples of all cuttings collected during drilling will be provided to NMED.
Well Development	The well filter pack may be developed by both mechanical and chemical means. Mechanical means may include airlift swabbing, bailing, and pumping. Chemical means include the use of additives to remove clays and/or chlorination to kill bacteria that may be introduced during well completion. Filter pack development during placement will be considered complete when less than 1/10 ml/L of sand is passing through the well screen as determined by an Imhoff cone. A submersible pump will be used in the well development process following construction of the well. Sand production will be measured with a Rossum Sand Tester. The completion of well development will be determined by monitoring groundwater parameters (pH, specific conductance, dissolved oxygen, turbidity, and oxidation-reduction potential [Eh]) and total organic carbon (TOC). During development activities, water samples will be collected in the field and submitted to an analytical laboratory to determine turbidity and TOC. The target water-quality parameters are turbidity at less than 5 nephelometric turbidity units and TOC at less than 2 mg/L. The target sand production quantity is less than 1 mg/L. Chemical development methods that may be used include AQUA-CLEAR PFD (or a similar product to remove clays) and/or chlorination with sodium hypochlorite, unless chlorination is prohibited by NMED. Well development will be considered complete when • groundwater parameters have stabilized according to the U.S. Environmental Protection Agency (EPA) method (Yeskis and Zavala 2002, 204429) per the Consent Order, • target water-quality parameters and sand production quantities are met, and • 200% of the volume of water introduced into the aquifer during drilling and well construction activities (minus the amount of water removed during these same activities) has been pumped from the well.
Single-Well Aquifer Testing	An aquifer test plan for conducting single-well aquifer tests using the NMED Hazardous Waste Bureau's aquifer test guidance as a reference will be submitted for NMED's review and comment before conducting NMED-approved hydraulic testing.

Water-Quality Sampling	If perched-intermediate groundwater is encountered, attempts will be made to collect screening-level samples using airlifting or bailing methods. Screening samples from perched-intermediate groundwater will be analyzed for dissolved major cations and anions, fluoride, bromide, low-level perchlorate, TOC, low-level tritium, and metals/trace elements. While the borehole is advanced using the flooded-reverse drilling method, there will be minimal migration of formation waters to the borehole because the formation water pressures are stable. Hence, any water samples collected during drilling will not be representative of formation waters so water-quality sampling will occur after reaching total depth. When the regional aquifer depth has been established at approximately 917 ft bgs, the borehole will be drilled to total depth of approximately 1100 ft bgs and a series of temporary wells will be constructed in the approximate 11.75-in. borehole to collect zonal samples. Stainless-steel well casing with a 10-ft stainless-steel screen interval will be lowered into the drill casing to total depth of 1100 ft bgs, and the annular space around the well screen will be filled with 10/20 (or similarly sized) filter-grade silica sand (adjacent to screen slots) extending 1 to 2 ft above and below the screened interval and with 20/40 transition sand emplaced 5 ft above and below the primary filter pack interval. The 10-in. drill casing will be retracted just enough to expose the screen interval to the native formation, and this zone will be developed and sampled. Once water-quality sampling has been completed, the temporary, stainless-steel well casing will be retracted approximately 20 ft above the last sampling zone within the 10-in. drill casing, and another temporary well will be completed with filter pack and transition sand (as noted above). This next zone will be developed and sampled. This process will continue up through the regional aquifer borehole depth of approximately 183 ft. To collect a sample in each zone, a 3- or 4–in. submersible pump will be deployed in the temporary well on stainless-steel drop pipe to purge and sample. The well construction and purging/sampling will be repeated in 20-ft intervals up through the interval targeted for the upper screen. For example, samples will likely be taken starting at 1095 to 1085 ft (lowest screen interval placement with a 5-ft well sump), then 1075 ft to 1065 ft (pulled up 20 ft), then 1055 to 1045 ft, etc., until there is no longer enough submergence to support pumping water to surface or up to eight possible sampling zones. After the zonal sampling is completed, the remaining temporary well casing will be removed and the borehole will be drilled back down to a total depth of 1100 ft bgs. With the data collected from drilling, zonal sampling, and geophysical surveys, the screen location will be determined, and the bottom of the borehole will be plugged and abandoned with bentonite pellets or neat cement up to approximately 20 ft below the bottom of the designed screen interval. The purge volumes for each sampling interval will follow this approach: 5 casing volumes for 11.75-in. borehole at a (nominal) length of 10 ft plus introduced water volume for the 20-ft drilling interval being sampled plus 10%. For example, 1 casing volume: 5.6 gal./ft × 10 ft = 56 gal.; 56 gal. × 5 = 280 gal.; 280 gal. + introduced volume = X; X × 1.1 = purge volume. Samples from each of these zones will be analyzed for dissolved major cations and anions, fluoride, bromide, low-level perchlorate, TOC, low-level tritium, and metals/trace elements. These samples also will be provided to NMED, managed under NMED chain-of-custody protocols. These geochemistry data along with the geophysics data, and information from drill cuttings and drillers' observations, will be used for the well-design package submitted to NMED and Pueblo de San Ildefonso for review and approval. After final well development with a temporary pumping system, the first groundwater samples from the completed well will be collected at the end of the single-well aquifer testing conducted in the installed screens. These samples will be analyzed for metals, general inorganic chemicals (including nitrate, perchlorate, sulfate, etc.), semi-volatile organic compounds, volatile organic compounds, and radionuclides (including low-level tritium). Subsequent samples will be collected from the dedicated sampling system that will be installed in the well.

Water-Quality Sampling (cont.)	All groundwater chemistry results for samples collected during drilling, well development, and hydraulic testing of regional aquifer well SIMR-3 will be shared with Pueblo de San Ildefonso as soon as results are received from analytical laboratories.
Sampling System Installation	A two-screen Baski sampling system will be installed in the well. The system will use a typical 3- or 4-in. pump and motor to maintain sampling purge rates at or near 5 gal. per minute.
Investigation-Derived Waste Management	Investigation-derived waste will be managed according to Administrative Procedure (AP) N3B-AP-TRU-2150, “Waste Characterization Strategy Form.” This AP incorporates the requirements of applicable EPA and NMED regulations, U.S. Department of Energy orders, and Newport News Nuclear BWXT-Los Alamos, LLC (N3B) requirements. The primary waste streams will include drill cuttings, drilling water, drilling fluids and additives, development water, purge water generated during single-well aquifer testing, decontamination water, and contact waste. Drill cuttings will be managed in accordance with the NMED-approved “Decision Tree for the Land Application of Drill Cuttings” (April 2016). Drilling, purge, and development waters will be managed in accordance with the NMED-approved “Decision Tree for Land Application of Drilling, Development, Rehabilitation, and Sampling Purge Water” (November 2016). Initially, drill cuttings and drilling fluids will be stored in a lined pit. Representative samples of the drill cuttings and drilling fluids will be collected and analyzed, 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 for the type of waste. Development and aquifer testing water that meets the requirements to be treated and land-applied will be managed under Discharge Permit 1793. Decontamination water will be containerized separately at the point of generation, transported to an accumulation area on the LANL site appropriate to the type of waste, and directly sampled. Contact waste will be containerized at the point of generation, transported to an appropriate accumulation area at LANL, and characterized using acceptable knowledge or the media with which it came in contact.
Schedule	Completion and collection of first samples for well SIMR-3 is currently a proposed fiscal year 2025 Consent Order Appendix B target.
NMED / Pueblo de San Ildefonso Communication	Pueblo de San Ildefonso will receive daily reports, including weekends and holidays. Weekly meetings with NMED and Pueblo de San Ildefonso will include updates and planned activities on the drilling status, from initiation of drilling operations to collection of initial groundwater samples from either the vadose zone or the regional aquifer. Pueblo de San Ildefonso and NMED will receive a 15-day written advance notice of the collection of initial groundwater samples to facilitate their observation of initial sample collection. A driller’s well record and log will be included in the well completion report.

REFERENCES

The following reference list includes documents cited in this plan. Parenthetical information following each reference provides the author(s), publication date, and ERID, ESHID, or EMID. ERIDs were assigned by the Laboratory's Associate Directorate for Environmental Management (IDs through 599999); ESHIDs were assigned by the Laboratory's Associate Directorate for Environment, Safety, and Health (IDs 600000 through 699999); and EMIDs are assigned by N3B (IDs 700000 and above).

LANL (Los Alamos National Laboratory), May 2015. "Interim Measures Work Plan for Chromium Plume Control," Los Alamos National Laboratory document LA-UR-15-23126, Los Alamos, New Mexico. (LANL 2015, 600458)

LANL (Los Alamos National Laboratory), January 2016. "Completion Report for Regional Aquifer Well SIMR-2," Los Alamos National Laboratory document LA-UR-15-29666, Los Alamos, New Mexico. (LANL 2016, 601081)

Yeskis, D., and B. Zavala, May 2002. "Ground-Water Sampling Guidelines for Superfund and RCRA Project Managers," a *Ground Water Forum Issue Paper*, EPA 542-S-02-001, Office of Solid Waste and Emergency Response, Washington, D.C. (Yeskis and Zavala 2002, 204429)

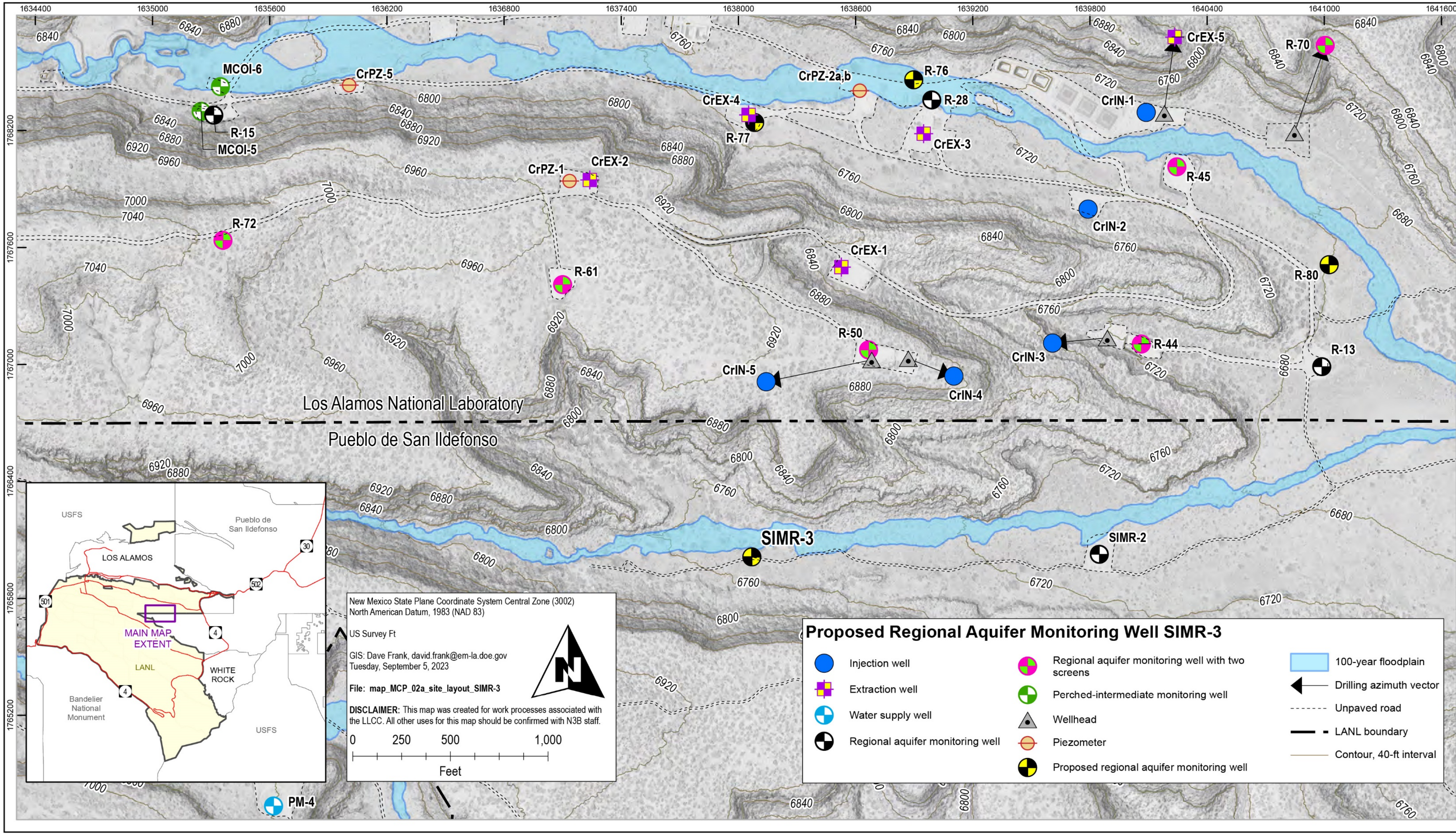
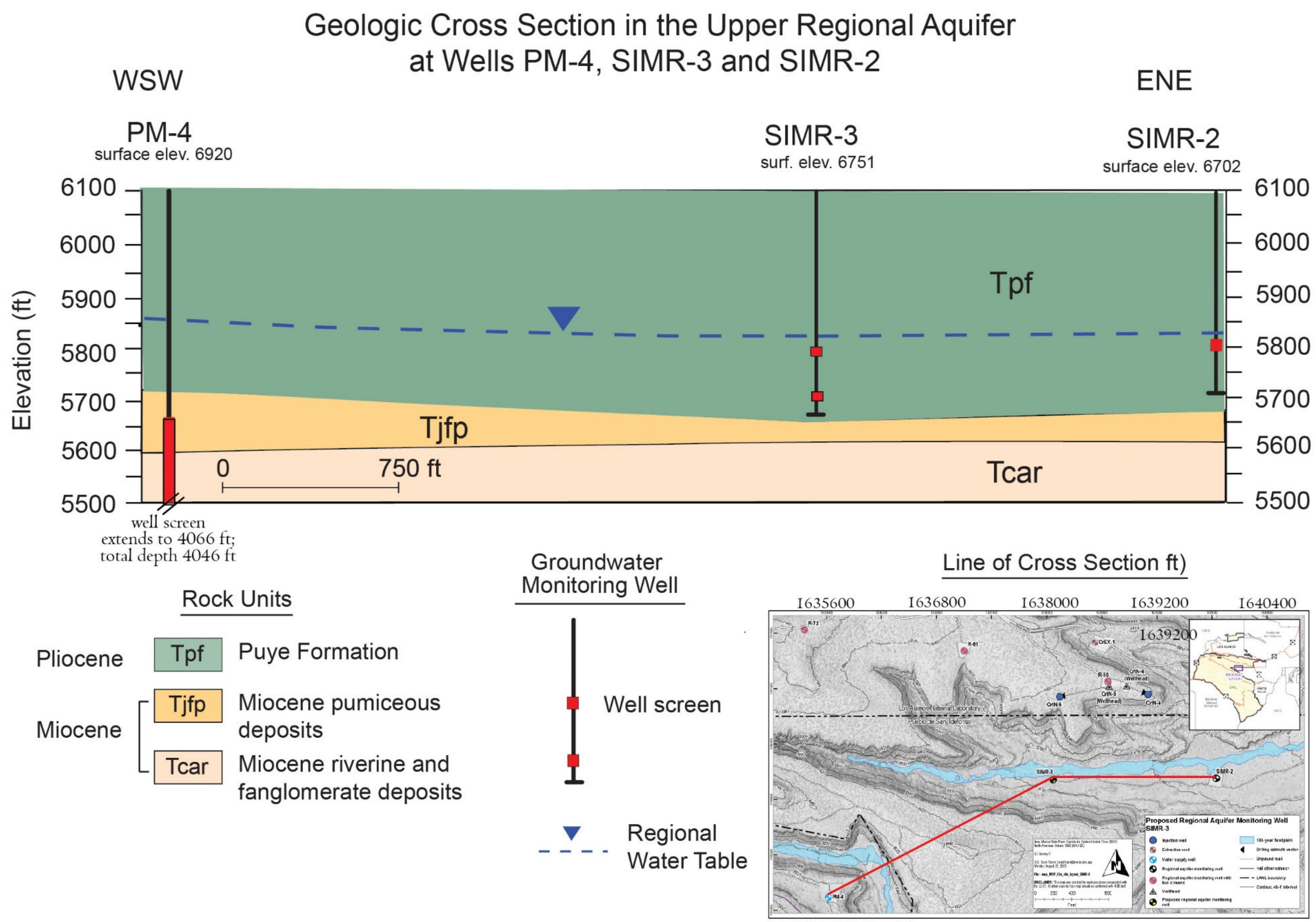
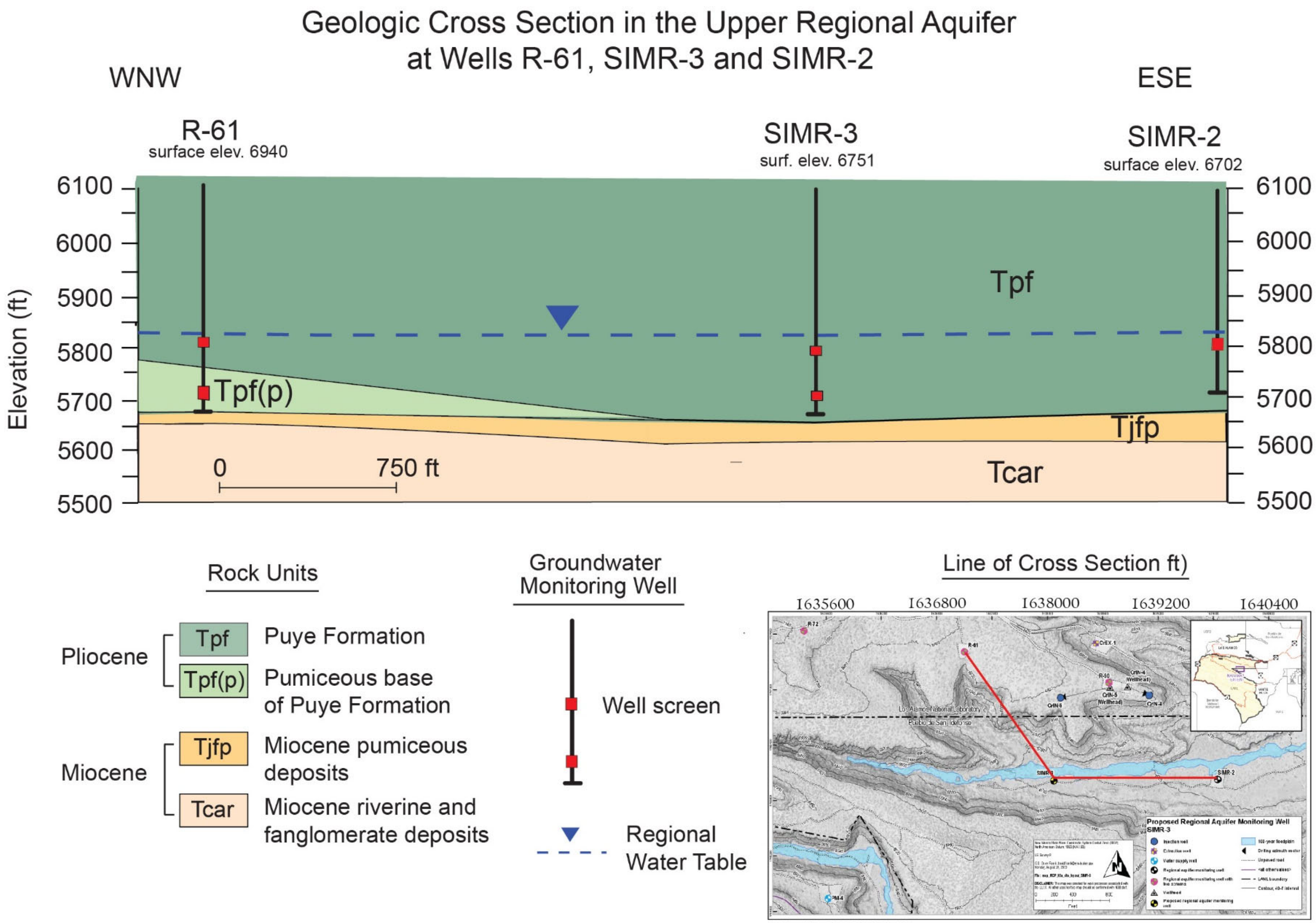


Figure 1 Proposed location for well SIMR-3



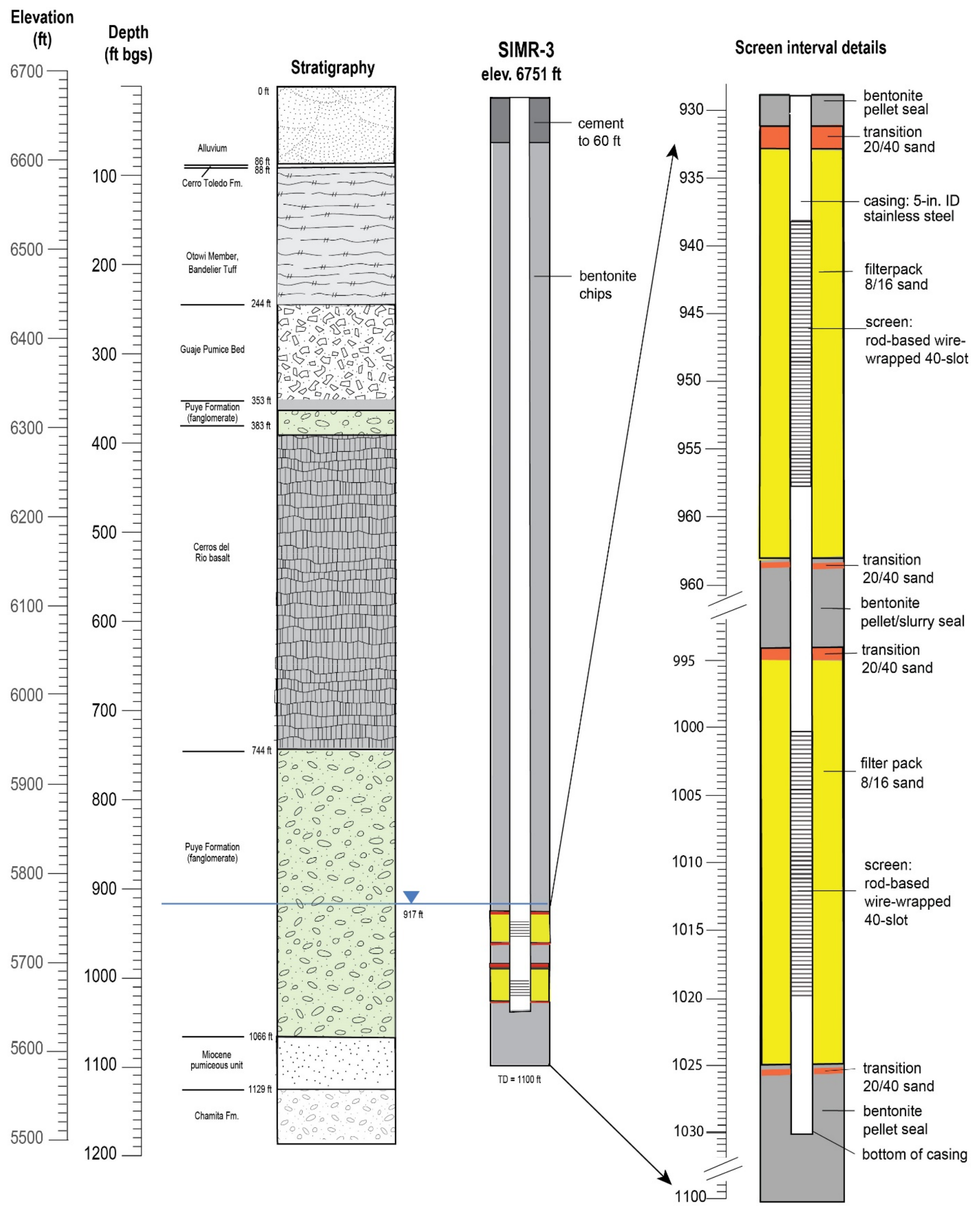
Note: Conceptual well-screen positions for SIMR-3 are also shown.

Figure 2 **Stratigraphy in the proposed SIMR-3 area showing stratigraphic relations of the primary geologic units and well screens in nearby wells PM-4 and SIMR-2**



Note: Conceptual well-screen positions for SIMR-3 are also shown.

Figure 3 **Stratigraphy in the proposed SIMR-3 area showing stratigraphic relations of the primary geologic units and well screens in nearby wells R-61 and SIMR-2**



Note: Geologic contacts are based on the WC18 geologic framework model and are preliminary.

Figure 4 Conceptual well design for SIMR-3