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Date: DEC 15 2015
Refer To: ADESH-15-182
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John Kieling, Bureau Chief
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Drive East, Building 1
Santa Fe, NM 87505-6303

Subject: Submittal of the Drilling Work Plan for Chromium Plume Control Interim Measure and Plume-Center Characterization Injection Wells CrIN-1 through CrIN-6

Dear Mr. Kieling:

Enclosed please find two hard copies with electronic files of the Drilling Work Plan for Chromium Plume Control Interim Measure and Plume-Center Characterization Injection Wells CrIN-1 through CrIN-6.

This submittal fulfills a requirement of the New Mexico Environment Department in its approval with modifications for the Interim Measures Work Plan for Chromium Plume Control, dated October 15, 2015, to submit a drilling work plan for the installation of injection wells no later than December 31, 2015.

If you have any questions, please contact Stephani Swickley at (505) 606-1628 (sfuller@lanl.gov) or Cheryl Rodriguez at (505) 665-5330 (cheryl.rodriguez@em.doe.gov).

Sincerely,

Bruce Robinson, Program Director
Environmental Remediation Program
Los Alamos National Laboratory

Sincerely,

David S. Rhodes, Supervisor
Environmental Management
Los Alamos Field Office

37343

BR/DR/SF/SS:sm

Enclosures: Two hard copies with electronic files – Drilling Work Plan for Chromium Plume Control Interim Measure and Plume-Center Characterization Injection Wells CrIN-1 through CrIN-6 (EP2015-0204).

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Drilling Work Plan for Chromium Plume Control Interim Measure and Plume-Center Characterization Injection Wells CrIN-1 through CrIN-6

Primary Purpose	In accordance with the New Mexico Environment Department's (NMED's) approval with modifications for the interim measures work plan for chromium plume control, dated October 15, 2015 (NMED 2015, 600959), Los Alamos National Laboratory (LANL or the Laboratory) proposes the following drilling and preliminary design information for injection wells CrIN-1 through CrIN-6. As stated in the Interim Measures Work Plan for Chromium Plume Control, dated May 2015 (LANL 2015, 600458), the primary purpose of the injection wells is to achieve hydraulic control of off-site plume migration. Plume control would be implemented using a method of hydraulic capture that utilizes existing extraction well CrEX-1 and a configuration of the injection wells to control the migration of chromium-contaminated groundwater. Six injection wells are proposed to support plume control and provide operational flexibility during maintenance downtime. The proposed locations are shown in Figure 1. Existing modeling analyses suggest that the hydraulic capture of the contaminated groundwater at extraction well CrEX-1 will be substantially aided by siting injection wells at the downgradient plume edge. The two injection well locations situated along the Laboratory boundary west and east of R-50 have a specific role in helping to control chromium plume migration to the south by establishing a hydraulic barrier. The two injection wells at the plume edge west of R-45 address the potential advancement of the plume in that area. The injection well situated at the plume edge west of R-44 helps ensure the plume does not advance to the southeast in that area. A sixth injection well is currently planned in the plume centroid near R-42. This location was selected as an injection-well location not only to provide an additional disposition location but also to test how injection of treated water may enhance diffusive processes of chromium in the aquifer. The injection wells will be completed with screens in the upper portion of the regional aquifer. Data from existing monitoring wells and from the corehole drilling campaign indicate contamination is predominantly within the upper 50 ft of the aquifer; therefore, injection-well screens will be targeted for that interval. Specific hydraulic performance will vary between injection wells depending on the geology encountered, but the basic assumption is that injection wells will be able to accept injection rates comparable with the rates of extraction. Because of terrain constraints and the large number of cultural sites in the project area, angled drilling will be used to achieve target locations in the aquifer for some of the injection wells. Angled drilling will utilize existing monitoring well pads. Two typical injection well designs are shown in Figures 2 and 3. The initial design for all injection wells consists of an 8-in.-diameter casing with a 40-slot screen placed within the top 50 to 80 ft of the regional aquifer. Final designs will be based on data obtained during drilling, including information from lithologic logs of cuttings, water-level measurements, video logs, geophysical logs, and field team observations. Well-design recommendations will be submitted to NMED for approval before construction.
Drilling Approach	The proposed drilling approach for the injection wells will utilize fluid-assisted air-rotary with casing-advance methods. Telescoping casing sizes between 40 in. and 14 in. and dual-rotary methods will be used to advance the boreholes to depths within the upper 100 ft of the regional aquifer. This approach will produce boreholes that can accommodate an approximately 3-in. annular filter pack around the 8-in. well screen. The final details of the drilling method will be included in the drilling work plan provided by the subcontractor selected to drill the wells.

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. • EZ-MUD, a polymer emulsion to help improve the carrying capacity of air/foam injection fluids. 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.
Geophysical Testing	Geophysical logs may be collected when the boreholes have been drilled to total depth. The suite of geophysical logs will depend on conditions in the borehole and whether logs are run in an open hole or inside the casing. Logging data will be used to refine estimates of the top of regional saturation and to characterize the hydraulic properties of saturated strata beneath the water table. Location surveys will be made for angled boreholes at several points during drilling (e.g. just below the top of basalt and at prescribed depths within the basalt) in order to ensure aquifer intersection targets are met.
Well Completion Design	Figures 2 and 3 show conceptual well designs for vertical and angled injection wells, respectively. Screen placement and length will depend upon the geophysical logs, water levels, and field observations. Proposed well designs will be submitted to NMED for approval before well construction.
Well Development	The wells will be developed by mechanical means, and chemical means will be used only if necessary. Mechanical development includes swabbing, bailing, jetting/air-lifting, and pumping. Chemical methods may include chemicals to disperse bentonite, which is used as annular seal, or other methods. Chemicals that may be used to aid in the development and disinfection of the well screen and filter pack include the following: • Sodium hypochlorite and • AQUA-CLEAR PFD Water-quality parameters will be measured in a flow-through cell during the pumping phase of development. The parameters to be monitored are pH, specific conductance, dissolved oxygen, temperature, turbidity, and oxidation-reduction potential. Samples will be collected daily for total organic carbon (TOC) and analyzed at the Laboratory's Geology and Geochemistry Research Laboratory. Well development will be considered complete when target water-quality parameters are met, sand content averages less than 5 mg/L over a 2-h pumping period, and specific capacity no longer increases. The target water-quality parameters are turbidity <5 nephelometric turbidity units, TOC <2 ppm, and other parameters stable.
Hydraulic Testing	Step-drawdown tests will be conducted on the wells to determine the sustainable yield for the wells. Constant rate testing may also be conducted to assess near-well aquifer characteristics. Following the pumping phase of testing, LANL will conduct step-injection tests using treated groundwater to obtain information about water-level responses in the injection wells. Data from these tests will provide substantial additional information to refine the knowledge of the hydrology at each of the locations and will also be used to select the initial injection rates to meet project objectives.

Water-Quality Sampling	Each of the injection wells will be sampled for metals, general inorganics, and tritium after completion of the pumping phase of hydraulic testing. These sampling data will provide additional information to reduce uncertainties of chromium and related contaminants at each of the locations and will further delineate the downgradient edge of the plume.
Injection/Pumping System Installation and Operational Practice	Injection and pumping systems will be designed and installed in each well. The systems will be capable of delivering water to the screen intervals during injection and pumping water from the screen intervals for periodic well maintenance. Water injection will be managed with flow-control valves. Flow-control valves provide controlled, noncavitating head loss from the column (supply) pipe. Because of the design of the flow-control valves and their submerged position in the wells, injected water will enter the wells under low-pressure gravity feed. The flow control valves also include a lower check valve that can be shut in (zero-injection flow) to allow pumping with a single column pipe. The injection wells may require pumping, or back-flushing periodically to prevent and/or remedy well-screen plugging. A submersible pump will be installed inside a pump shroud beneath the flow control valve. Because the pumps will likely be located within the screen intervals, pump shrouds will be used to ensure adequate pump motor cooling. Pumps are anticipated to be 6-in. models from the Grundfos 85S family.
Investigation-Derived Waste Management	Investigation-derived waste (IDW) will be managed in accordance with Standard Operating Procedure (SOP) 10021, Characterization and Management of Environmental Program Waste (http://www.lanl.gov/community-environment/environmental-stewardship/plans-procedures.php). This SOP incorporates the requirements of applicable U.S. Environmental Protection Agency and NMED regulations, U.S. Department of Energy orders, and Laboratory requirements. The primary waste streams will include drill cuttings, drilling water, drilling fluids and additives, development water, purge water generated during hydraulic testing, decontamination water, and contact waste. Drill cuttings with residual additives will be managed in accordance with the NMED-approved 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 Decision Tree for Drilling, Development, Rehabilitation, and Sampling Purge Water (November 2006). Initially, drill cuttings and drilling fluids will be stored in lined pits. 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. Cuttings, drilling fluids, 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 d of containerization. Decontamination water will be containerized separately at the 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 or the media with which it came in contact. Water generated from future injection well maintenance activities will be managed with applicable permits.
Schedule	The drilling and installation of the injection wells is anticipated to start in early 2016. All six injection wells are anticipated to be completed by the summer of 2017. The goal will be to have sufficient injection capacity to enable continuous pumping by winter of 2016–2017.

REFERENCES

The following list includes all documents cited in this plan. Parenthetical information following each reference provides the author(s), publication date, and ER ID or ESH ID. This information is also included in text citations. ER IDs were assigned by the Environmental Programs Directorate's Records Processing Facility (IDs through 599999), and ESH IDs are assigned by the Environment, Safety, and Health (ESH) Directorate (IDs 600000 and above). IDs are used to locate documents in the Laboratory's Electronic Document Management System and, where applicable, in the master reference set.

Copies of the master reference set are maintained at the NMED Hazardous Waste Bureau and the ESH 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), July 2015. "Work Plan for Chromium Plume Center Characterization," Los Alamos National Laboratory document LA-UR-15-24861, Los Alamos, New Mexico. (LANL 2015, 600615)

NMED (New Mexico Environment Department), October 15, 2015. "Approval with Modifications, Work Plan for Chromium Plume Center Characterization," New Mexico Environment Department letter to D. Hintze (DOE-NA-LA) and M. Brandt (LANL) from J.E. Kieling (NMED-HWB), Santa Fe, New Mexico. (NMED 2015, 600958)

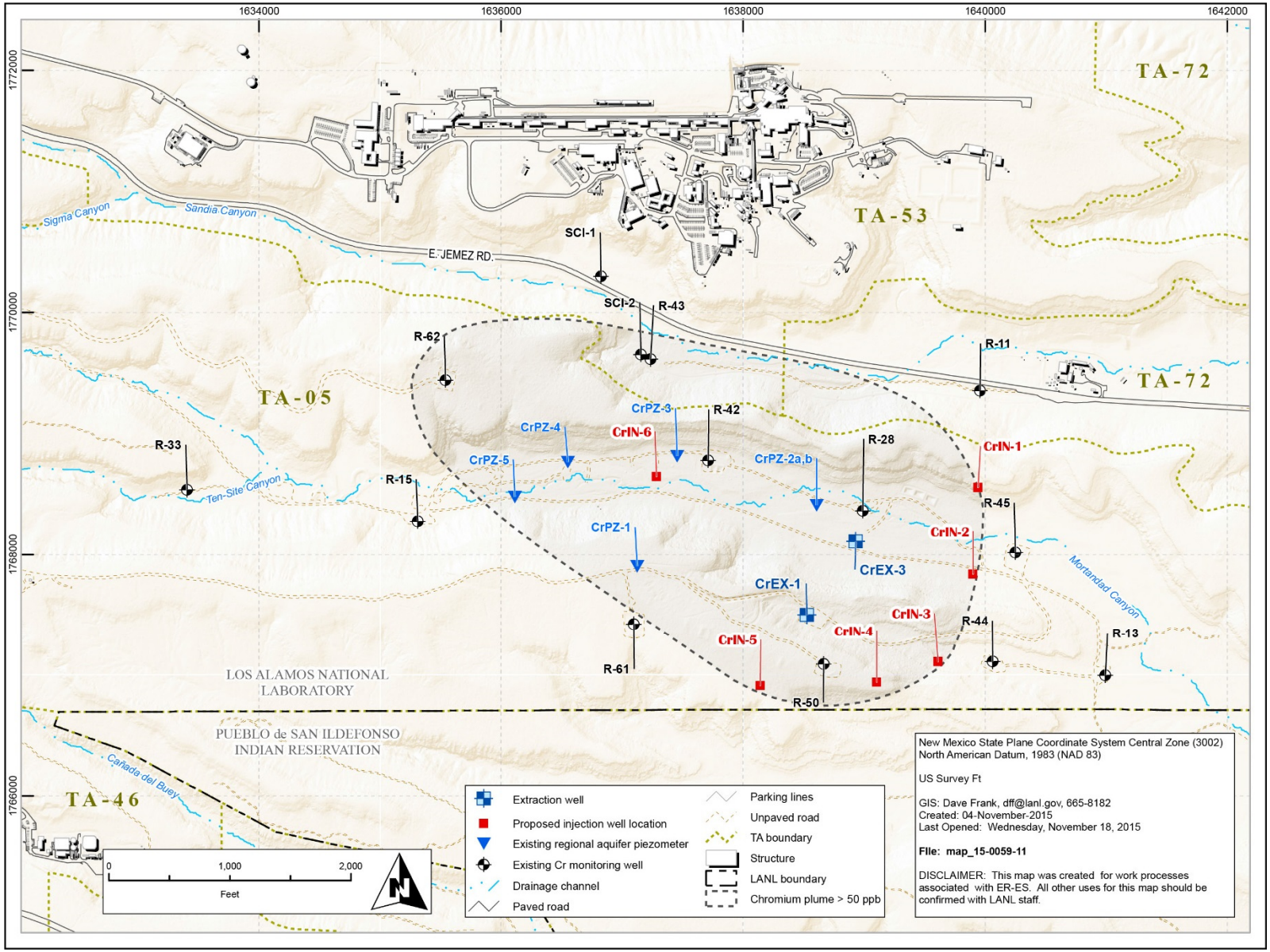
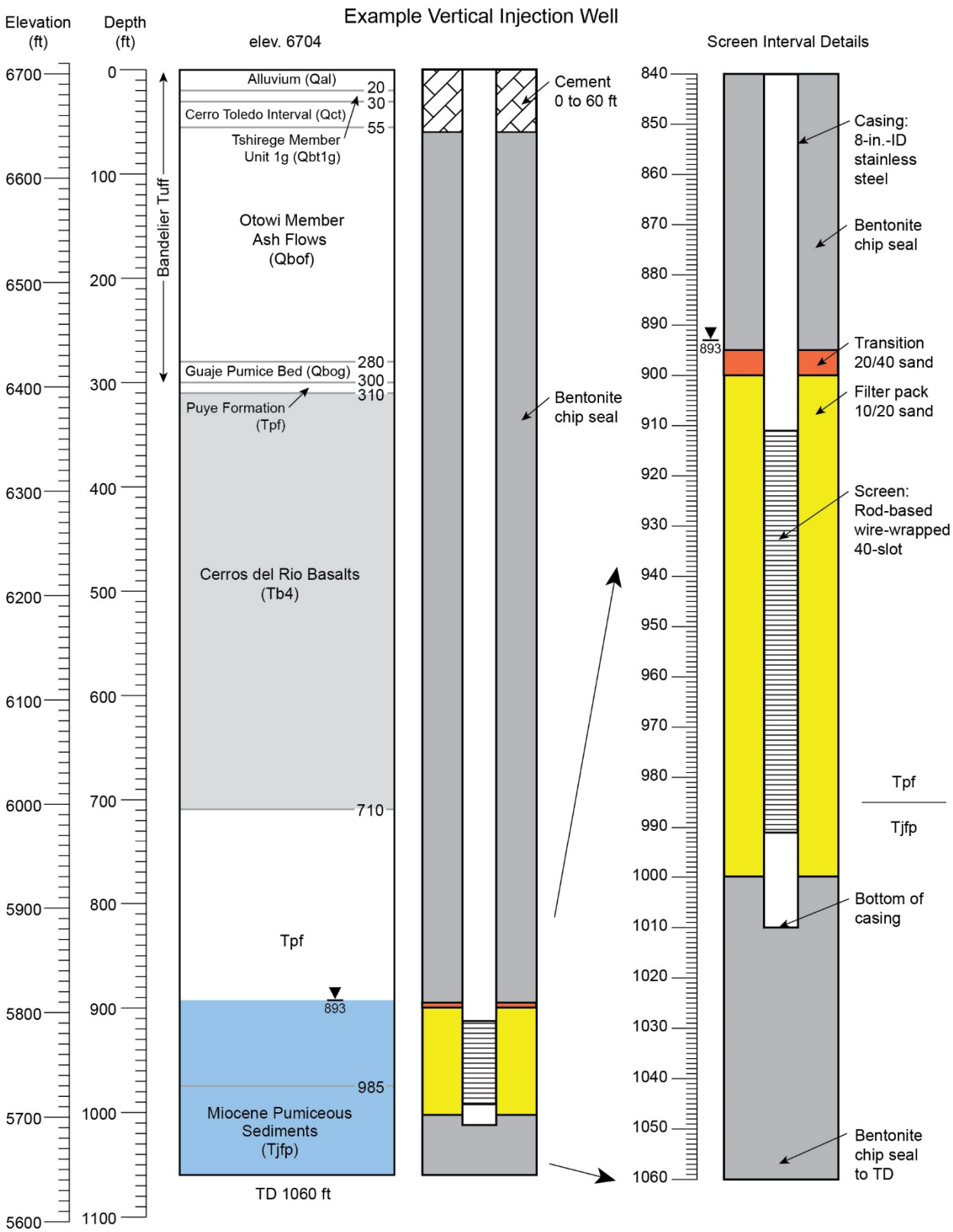
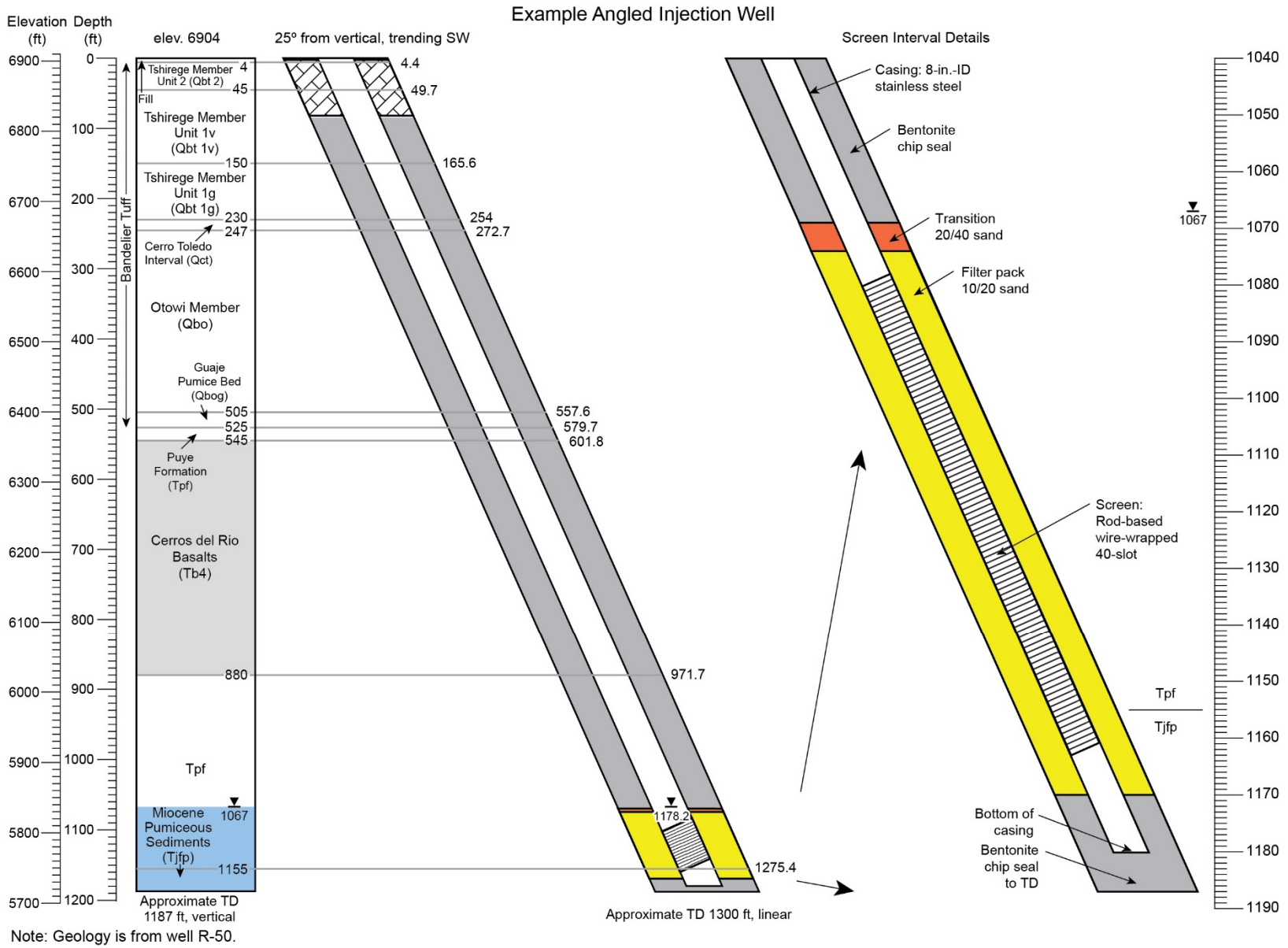


Figure 1 Proposed locations for injection wells



Note: Geology was estimated from wells R-44 and R-45.

Figure 2 Conceptual well design for vertical injection well



Note: Geology is from well R-50.

Figure 3 Conceptual well design for angled injection well