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Environmental Programs
P.O. Box 1663, MS M991
Los Alamos, New Mexico 87545
(505) 606-2337/FAX (505) 665-1812

National Nuclear Security Administration
Los Alamos Site Office, MS A316
Environmental Restoration Program
Los Alamos, New Mexico 87544
(505) 667-4255/FAX (505) 606-2132

Date: April 30, 2008
Refer To: EP2008-0197

James P. Bearzi, 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 Nature and Extent of Chromium Contamination in Groundwater Investigations

Dear Mr. Bearzi:

Enclosed please find two hard copies with electronic files of the Drilling Work Plan for Nature and Extent of Chromium Contamination in Groundwater Investigations. This work plan is submitted on schedule pursuant to a requirement of the New Mexico Environment Department's (NMED's) letter dated March 18, 2008, that requires two additional wells for investigating chromium contamination. This work plan also includes an update to a previously submitted work plan (dated December 17, 2007) for drilling of perched-intermediate well SCI-2. The update included in this work plan addresses NMED's requirement in the March 18, 2008, letter to potentially advance SCI-2 to the regional aquifer based on real-time collection of geochemical data from the SCI-2 borehole.

If you have any questions, please contact Danny Katzman at (505) 667-6333 (katzman@lanl.gov) or Mat Johansen at (505) 665-5046 (mjohansen@doeal.gov).

Sincerely,

Susan G. Stiger, Associate Director
Environmental Programs
Los Alamos National Laboratory

Sincerely,

David R. Gregory, Project Director
Environmental Operations
Los Alamos Site Office

30116



SS/DG/PH/DK:sm

Enclosures: 1) Two hard copies with electronic files – Drilling Work Plan for Nature and Extent of Chromium Contamination in Groundwater Investigations (EP2008-0197)

Cy: (w/enc.)

Danny Katzman, EP-LWSP, MS M992 (*14 additional copies*)
RPF, MS M707 (with two CDs)
Public Reading Room, MS M992

Cy: (Letter and CD only)

Laurie King, EPA Region 6, Dallas, TX
Steve Yanicak, NMED-OB, White Rock, NM
Mat Johansen, DOE-LASO, MS A316
Neil Weber, San Ildefonso Pueblo
Peggy Reneau, WES-DO, MS M992
EP-LWSP File, MS M992

Cy: (w/o enc.)

Tom Skibitski, NMED-OB, Santa Fe, NM
Melanie Skeet, DOE-LASO (date-stamped letter emailed)
Susan G. Stiger, ADEP, MS M991
Paul R. Huber, EP-LWSP, MS M992
Alison M. Dorries, WES-DO, MS M992
IRM-RMMSO, MS A150

Drilling Work Plan for Nature and Extent of Chromium Contamination in Groundwater Investigations

<p>Primary Purpose</p>	<p>Regional wells NMED-1 and NMED-2 (temporary names to be replaced with “R-well designators”) are being installed to satisfy a requirement in the New Mexico Environment Department (NMED) letter dated March 18, 2008, “Investigation of Chromium Contamination in Regional Groundwater, Los Alamos National Laboratory” (NMED 2008, 100964), to investigate the lateral and vertical extent of chromium contamination in the vicinity of R-28. These two regional wells are being installed in addition to a regional aquifer well (R-42) and a perched-intermediate/regional aquifer well (SCI-2) planned for Mortandad and Sandia Canyons, respectively. Separate work plans submitted earlier for R-42 and SCI-2 have been approved with modifications by NMED.</p> <p>NMED-1, located on the mesa south of R-28 (Figure 1), is intended to define the southern limit of chromium contamination in the vicinity of R-28. NMED-2, located east of R-28 and south of R-11 (Figure 1), will investigate and characterize the downgradient nature and extent of the chromium contamination. Each well is designed with two well screens to evaluate water quality and measure water levels at two discrete depth intervals within the regional groundwater system. The upper screen in each well will be 20 ft long and will monitor water quality near the regional water table and will target the uppermost productive zone in the aquifer. The lower screen in each well will be 10 ft long and will target sedimentary deposits, approximately 100 ft deeper than the upper screen, to determine the vertical extent of chromium contamination (Figures 2 and 3). Depths of the screen intervals will be selected based on field observations of hydrology and stratigraphy during drilling. Well screens will be separated by packers and constructed in such a way to ensure isolation of each groundwater-bearing zone. A sampling system capable of effectively purging groundwater from the screened intervals will be installed in each well.</p> <p>The two wells will be drilled deep enough to collect representative samples from permeable Miocene deposits that may be groundwater pathways in this area. Cuttings will be chemically analyzed to assess properties of chromium/rock interactions. This information will be useful to support remedy selection when conducting the corrective measures evaluation. The target depths for the NMED-1 and NMED-2 boreholes are approximately 1200 ft and 1120 ft, respectively.</p>
<p>Conceptual Model</p>	<p>The current conceptual model for chromium contamination at R-28 in Mortandad Canyon implicates potassium dichromate used to treat cooling-tower water at Technical Area 03 (TA-03) that was released to the headwaters of Sandia Canyon. Other chromium sources at Los Alamos National Laboratory (the Laboratory) are believed to be of insufficient mass to result in the high level of chromium contamination at R-28. Other contaminants, including nitrate, perchlorate, sulfate, chloride, and tritium, suggest mixed Mortandad and Sandia sources at R-28 and R-11 (Figure 1). Based on water-table maps, the groundwater flow direction is toward the east and/or east-southeast. Recently installed wells R-35a, R-35b, and R-36 containing background concentrations of dissolved chromium demonstrated that elevated chromium concentrations do not extend as far east as water-supply wells PM-3 and PM-1. NMED-1 and NMED-2 will be installed to better define the lateral and vertical extent of the chromium contamination in proximity to R-28. The two-screen approach for each well is designed to determine the vertical extent of possible chromium contamination so that pathways and potential future impacts to deep municipal well screens can be assessed. Water-level transducers will be placed in upper and lower well screens to evaluate hydraulic connections between these monitoring wells and nearby water-supply wells. This evaluation will be accomplished by measuring water-level responses due to municipal pumping.</p>

<p>Drilling Approach</p>	<p>The following drilling methods will be used for regional wells NMED-1 and NMED-2.</p> <ul style="list-style-type: none"> • A 16-in. surface casing will be advanced with fluid-assisted air-rotary methods through the alluvium and/or Bandelier Tuff, the Guaje Pumice Bed, and upper Puye Formation sediments to the top of the Cerros del Rio basalt. • A 15-in. open borehole will be advanced with fluid-assisted air-rotary methods through the Cerros del Rio basalts and any associated perched water. • 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 advanced to refusal. Introduction of drilling additives (e.g., foam) will stop 100 ft above the regional aquifer. This corresponds to about 807 ft below ground surface (bgs) at NMED-1 and about 763 ft bgs at NMED-2. • A 10-in. casing will be advanced to a maximum depth of 1200 ft at NMED-1 and 1120 ft at NMED-2 to accommodate a range of possible two-screen well configurations and to ensure that representative cuttings are collected for geochemical characterization from the deepest NMED-specified target formation (older river deposits). The casing will be advanced within the regional aquifer without the use of drilling fluid additives. Municipal water may be added to cool the drill bit as needed. • Each well will be completed with two screens. The upper well screen will be submerged within the uppermost 100 ft of the aquifer in the most productive zone. Every effort will be made to place the screen near the top of the regional aquifer; however, final screen placement will be based on the geology encountered. The lower screen in each well will be placed approximately 100 ft below the bottom of the upper screen. Final placement will depend upon the geology encountered.
<p>Potential Drilling Fluids</p>	<p>The following fluids and additives that may be used have been characterized geochemically and are consistent with those previously used in the drilling program at the Laboratory:</p> <ul style="list-style-type: none"> • potable water from the municipal water supply to cool the drill bit and to aid in delivering other drilling additives • QUIK-FOAM, a blend of alcohol ethoxy sulfates, to be used as a foaming agent • AQF-2, an anionic surfactant, to be used as a foaming agent
<p>Potential Groundwater Occurrence and Detection</p>	<p>Regional groundwater is expected to occur in Miocene sediments at about 907-ft depth in NMED-1 and at about 863-ft depth in NMED-2. Based on nearby wells, perched-intermediate groundwater is not expected to occur at either borehole location. Nonetheless, the drilling approach allows for the identification of perched groundwater, if present.</p> <p>Methods for groundwater detection include driller's observations, water-level measurements, borehole video, and borehole geophysics.</p>
<p>Cuttings Collection</p>	<p>Cuttings will be collected at 5-ft increments for geologic characterization throughout both boreholes.</p> <p>In addition, large-volume cuttings samples for geochemical characterization will be collected from each borehole at the target horizons in the regional aquifer specified by NMED. The target horizons for geochemical characterization are the sedimentary rocks that make up the upper part of the regional aquifer, including (1) fanglomerates, (2) pumice-rich deposits, and (3) river gravels. Core will not be collected at NMED-1 and NMED-2 because attempts to collect core at R-35a and R-35b in similar aquifer materials were unsuccessful because of the poorly consolidated nature of the saturated rock units. Instead, extra time and care will be taken at the target intervals to collect a cuttings sample that is fully representative of grain-size distribution.</p>

<p>Cuttings Analysis</p>	<p>Samples of the cuttings collected from within the regional aquifer will be analyzed for cations, anions, and metals/trace elements using both deionize water leach at the Earth and Environmental Sciences (EES-6) chemistry laboratory by the U.S. Environmental Protection Agency (EPA) Method 3050 partial digestion at an off-site laboratory. These analyses will only be run if total dissolved chromium is detected above the background level of 3 to 6 ppb in groundwater-screening samples collected during drilling.</p>
<p>Groundwater-Screening Sampling</p>	<p>Groundwater-screening samples will be collected during drilling at any perched horizon producing sufficient water for sampling, at the top of the regional aquifer, and every 20 ft within the regional aquifer.</p> <p>Screening samples of groundwater will be analyzed for dissolved cations/metals and anions by the EES-6 chemistry laboratory. The screening samples collected from any perched horizon and the top of the regional aquifer will be analyzed for tritium by the University of Miami.</p>
<p>Groundwater Characterization Sampling</p>	<p>Groundwater samples will be collected from the completed wells between 10 and 60 d after well development in accordance with the March 1, 2005, Compliance Order on Consent Order (the Consent Order). These samples will be analyzed for a suite of constituents, including radionuclides; target analyte list metals; general inorganic chemicals; total organic carbon (TOC); volatile and semivolatile organic compounds; hexavalent chromium (at EES-6); and stable isotopes of hydrogen, nitrogen, oxygen, and chromium.</p> <p>Subsequent groundwater samples will be collected as specified in the "Interim Measures Work Plan for Chromium Contamination in Groundwater" (LANL 2006, 091987) and the "2007 Interim Facility-Wide Groundwater Monitoring Plan" (LANL 2007, 096665).</p>
<p>Geophysical Testing of Wells</p>	<p>The suite and timing of geophysical logging will depend on borehole conditions.</p> <p>The borehole may be characterized numerous times with the Laboratory's natural gamma, induction (conductivity), caliper, and downhole video tools. Critical times for running these tools may occur after the open hole is advanced through the Cerros del Rio basalt before the 12-in. casing is introduced, at any time that perched groundwater is suspected, and at any time that drilling operations allow access to the borehole.</p> <p>Upon reaching total drilling depth, borehole conditions permitting, the drill casing(s) 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 Microimager logs. If the casing cannot be retracted for logging, the accelerator porosity sonde, elemental capture sonde, triple lithodensity, and natural and spectral gamma logs will be collected. These logs will be used to characterize the hydrogeologic properties of saturated rocks in the regional aquifer. The geophysical logs will also be used in conjunction with information from drill cuttings, driller's observations, and water-level measurements to select the well screen depth.</p>
<p>Well Completion Design</p>	<p>For each well, the upper 20-ft well screen will be placed in the most productive interval identified within the upper 100 ft of the regional aquifer. The deeper 10-ft screen will be placed approximately 100 ft below the upper screen. Conceptual well designs are shown in Figures 2 and 3.</p>
<p>Well Development</p>	<p>The wells will be developed by mechanical means, including swabbing, bailing, and pumping. The well screens will be isolated by packers during pumping development.</p> <p>Screening samples will be collected to guide adequacy of development. Target water-quality parameters used to evaluate development are turbidity (<5 nephelometric turbidity units [NTUs]), TOC <2 ppm, and stability of other field parameters.</p>
<p>Hydraulic Testing</p>	<p>Hydraulic testing will be considered if a significant water-producing horizon is encountered.</p>

<p>Investigation-Derived Waste Management</p>	<p>All investigation-derived waste (IDW) generated during implementation of this work plan will be managed in accordance with applicable EP-ERSS and ENV-RCRA standard operating procedures (SOPs). These SOPs incorporate the requirements of all applicable EPA and NMED regulations, U.S. Department of Energy (DOE) orders, and Laboratory requirements. SOPs applicable to the characterization and management of IDW are the following:</p> <ul style="list-style-type: none"> • EP-ERSS-SOP-5022, Characterization and Management of Environmental Restoration Project Waste (http://int.lanl.gov/environment/all/docs/qa/ep_qa/EP-ERSS-SOP-5022.pdf) • ENV-RCRA-SOP-010, Land Application of Groundwater (http://int.lanl.gov/orgs/env/rcra/qa.shtml?6), which implements the NMED-approved notice of intent (NOI) decision tree for drilling, development, rehabilitation, and sampling purge water • ENV-RCRA-SOP-011, Land Application of Drill Cuttings (http://int.lanl.gov/orgs/env/rcra/qa.shtml?6), which implements the NMED-approved NOI decision tree for IDW solids from construction of wells and boreholes <p>The primary waste streams include drill cuttings, purge water generated during drilling, water generated during development of the well, contact waste, and decontamination water. Data from the existing wells indicate that the wastes generated should be nonhazardous and nonradioactive. Therefore, all wastes will initially be managed as nonhazardous. All waste streams will be characterized with direct sampling following generation and waste determinations made from validated data. Drill cuttings and purge water will initially be stored in aboveground- or belowground-lined pits. If validated analytical data show these wastes are hazardous, they will be excavated and placed in a registered accumulation area for shipment to an authorized treatment, storage, or disposal facility (TSDF) within 90 d.</p>
<p>Schedule</p>	<p>Data from new wells SCI-2 and R-42 (and existing wells) will be used to optimize the locations and technical goals of wells NMED-1 and NMED-2. Analytical results from SCI-2 and R-42 are expected to be available for evaluation in the last quarter of calendar year 2008. In order to take advantage of the new groundwater data and updated vadose-zone and groundwater modeling, the Laboratory proposes to complete NMED-1 and NMED-2 during the first quarter of calendar year 2009.</p>

SCI-2 Revised Drilling Plan Based on NMED Letter Dated March 18, 2008

<p>General Location and Purpose</p>	<p>A regional aquifer well or a perched-intermediate well is planned for Sandia Canyon to augment the existing groundwater-monitoring system that is used to characterize chromium contamination in the area. The well will be installed with one well screen and sampled with a submersible pump.</p> <p>Figure 1 shows the location of the proposed well SCI-2. Figure 4 is a generic well completion diagram showing the preliminary design for completing SCI-2 as a perched-intermediate aquifer well. Similarly, Figure 5 is a generic diagram showing the preliminary design for completing SCI-2 as a regional aquifer well.</p>
<p>Purpose and Design of New Intermediate Monitoring Well</p>	<p>Well SCI-2 is being drilled to obtain core samples of the Guaje Pumice Bed, upper Puye Formation, Cerros del Rio lavas, and lower Puye Formation beneath Sandia Canyon to investigate the contaminant distributions in rocks of the vadose zone and water quality of perched groundwater, if present. Several factors, including the presence or absence of perched-intermediate groundwater, the nature and distribution of chromium in pore water, and the results of a screening sample obtained from the top of the regional aquifer, will be evaluated to determine if the well should be completed in the perched-intermediate zone or in the regional aquifer.</p>

<p>Purpose and Design of New Intermediate Monitoring Well (cont.)</p>	<p>Nearby boreholes (SCI-1, SCC-2, and SCC-3) encountered limited perched saturation at the top of the Cerros del Rio lavas; however, these boreholes were not deep enough to determine if significant zones of perched groundwater are present deeper within this lava series (Figure 1). This information is important because significant zones of perched water in the basalt may provide a southward migration pathway that could carry chromium-contaminated water between Sandia and Mortandad Canyons before it reaches the regional aquifer. This pathway might explain the presence of elevated chromium concentrations at well R-28 in Mortandad Canyon from a suspected Sandia Canyon chromium source.</p> <p>SCI-2 may penetrate perched saturation above the Cerros del Rio lavas similar to that encountered at adjacent core hole SCC-2 and screened by well SCI-1, which is located 600 ft to the northwest. However, the main goal for SCI-2 is to determine if perched groundwater occurs in substantial quantities within the interior of the basalt. The base of the basalt is predicted to be at approximately 625-ft depth. The depth to possible top of perched saturation within the basalt is unknown, but perched groundwater occurs near the base of the basalts to the south in Mortandad Canyon.</p> <p>Another goal of SCI-2 is to collect core samples from the lower vadose zone to investigate the contaminant distributions in the lower part of the vadose zone. Previous investigations have shown that little chromium mass remains in the upper vadose zone beneath Sandia Canyon. This investigation will determine if significant chromium contamination is present in the lower part of the vadose zone and is a potential secondary source of chromium for contamination of the regional aquifer.</p> <p>Figures 4 and 5 show the stratigraphy and proposed well designs for SCI-2. Figure 6 is a set of comparative borehole profiles, including gamma logs, showing the distribution of hydrostratigraphic units near SCI-2. The upper two perched zones predicted for SCI-2 (at 54 to 60 ft and 356 to 377 ft) are based on information from adjacent core hole SCC-2; the deeper perched zone shown near the base of the basalts is hypothetical.</p> <p>Drilling at SCI-2 will consist of advancing a core hole and then completing a well in an adjacent borehole. The core hole will be drilled to the top of regional saturation. Any perched groundwater encountered is likely to be located in Cerros del Rio basalt. If significant perched water is encountered, well screen intervals will be determined based on conditions found during drilling but will probably range from 20 to 40 ft in length. Coring may be terminated higher in the stratigraphic sequence if significant perched water is encountered and cannot be sealed from entering the borehole through the use of drill casing.</p>
<p>Conceptual Model of Hydrogeology</p>	<p>The current conceptual model for chromium contamination at R-28 in Mortandad Canyon implicates chromate used to treat cooling-tower water at TA-03 that was released to the headwaters of Sandia Canyon. Other chromium sources at the Laboratory are believed to be of insufficient mass to result in the high level of contamination at R-28. Other contaminants, including nitrate, perchlorate, sulfate, chloride, and tritium, suggest mixed Mortandad and Sandia sources at R-28 and/or possible east-northeastward communication from Mortandad to Sandia Canyons as sampled at R-11 (Figure 1). Data from new well R-42 will test these assumptions.</p> <p>Persistent surface-water flow along Sandia Canyon ends to the west of SCI-2 but feeds an alluvial aquifer that extends east of SCI-2; the saturated alluvium could feed a deeper perched system. Data from adjacent core hole SCC-2 provided evidence of saturation near the top of the Cerro Toledo interval and at the top of the Cerros del Rio lavas. At SCI-2, possible perched saturation may occur within or near the base of the Cerros del Rio lavas at a depth that has not previously been reached by drilling in this part of the canyon (Figure 2). The possible occurrence of perched groundwater within or at the base of the Cerros del Rio basalt is based on known occurrences in this setting from wells in Sandia Canyon (e.g., R-12) and Mortandad Canyon (e.g., MCOI-5 and MCOI-6).</p>

<p>Drilling Approach for Intermediate Aquifer Well</p>	<p>A two-hole drilling approach will be used at SCI-2.</p> <p>Using a drill rig specifically designed for coring with casing advance, an approximately 6-in.-diameter hole will be drilled using fluid-assisted casing advance through the Bandelier Tuff, the Guaje Pumice Bed, and upper Puye Formation sediments to the top of the Cerros del Rio basalt.</p> <p>Starting at the top of the Cerros del Rio basalts, the core hole will be advanced with a combination of core collection and casing advance. The interval from the top of the Guaje Pumice Bed to the regional aquifer will be continuously cored, and casing will be advanced as needed to maintain hole stability. Core will be approximately 3.5-in.-diameter). No drilling fluids will be used, and only potable water may be used as needed to cool the drill bit and lift cuttings. However, additional drilling additives (air-foam) may be required to advance the casing to the planned depths.</p> <p>If conditions allow, the casing will be pulled back so Laboratory geophysics and video can be run and water-producing zones can be characterized within the basalts.</p> <p>The core hole will be completely plugged to the surface with bentonite or cement-bentonite mixture in compliance with plugging requirements given in the Consent Order.</p> <ul style="list-style-type: none"> • A larger drill rig will advance a new borehole with 16-in. surface casing with fluid-assisted air-rotary methods through the Bandelier Tuff, the Guaje Pumice Bed, and upper Puye Formation sediments to the top of the Cerros del Rio basalt. • A 15-in. open borehole will be advanced with air-rotary methods through the Cerros del Rio basalts and any associated perched water. Potable water will be used as needed to cool the drill bit and lift cuttings. However, an air-foam mixture may be used if necessary to advance the 15-in. open borehole to 20 ft above the target depth for the well screen; the screen interval will be drilled using only potable water, if possible. • A 12-in. casing-advance may be used to complete the borehole if needed. Only potable water (no drilling additives) will be used in the saturated interval. • The well screen will be set at the previously identified zone that produces the most water within the Cerros del Rio basalt. • If no water-producing zones are encountered above the regional aquifer, the borehole will be advanced either with the 12-in. or a 10-in. drill casing to a target depth of 150 ft (1030 ft bgs) into the regional aquifer.
<p>Potential Drilling Fluids</p>	<p>Fluids and additives, which may be used have been characterized geochemically and are consistent with those previously used in the drilling program at the Laboratory, include</p> <ul style="list-style-type: none"> • 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.
<p>Potential Groundwater Occurrence and Detection</p>	<p>Perched-Intermediate Groundwater</p> <p>Groundwater may occur in the Cerros del Rio basalt at SCI-2, as found in wells MCOI-5 and MCOI-6, to the south in Mortandad Canyon. Likely depth of encounter is approximately 580 to 625 ft.</p> <p>Regional Aquifer Groundwater</p> <p>Regional groundwater is expected to occur in the lower Puye Formation at ~880-ft depth.</p> <p>Methods for groundwater detection may include driller's observations, water-level measurements, borehole video, and borehole geophysics.</p>

<p>Core Sampling</p>	<p>Intermediate Well</p> <p>Approximately 513 ft of continuous core will be collected from the top of the Guaje Pumice Bed, through the Cerros del Rio basalt (approximately 377-ft depth), and into the Puye Formation to a target depth of about 890 ft (10 ft into the regional water table). Additional core samples will be collected from the Otowi Member. Coring may be terminated if significant perched groundwater is encountered and if the producing zone cannot be isolated from the advancing core hole using drill casing.</p>
<p>Core Analysis</p>	<p>Samples of the core will be analyzed or tested for selected properties. Within the Cerros del Rio basalt, the samples will be selected from fractured zones and interflow zones. The analyses conducted will include cations, anions, and metals/trace elements using both deionize water leach and EPA 3050 partial digestion. The analysis of pore water obtained from core and perched-intermediate groundwater (if present) will be conducted by the EES-6 chemistry laboratory to determine the distribution of chromium (and other) contaminants. This evaluation is key to deciding whether to complete SCI-2 as a perched-intermediate well or as a regional well.</p>
<p>Groundwater-Screening Sampling</p>	<p>Screening water samples will be collected during drilling of the core hole at any perched horizon producing sufficient water for sampling and at the top of the regional aquifer. Analysis of the groundwater and evaluation of the data will determine the level of contamination in the perched water, if present.</p> <p>A screening water sample will be collected from the well at the end of development.</p> <p>Screening samples of groundwater will be analyzed for dissolved cations/metals and anions by the EES-6 chemistry laboratory.</p>
<p>Groundwater Characterization Sampling</p>	<p>Groundwater samples will be collected from the completed well between 10 and 60 d after well development in accordance with the Consent Order. This sample will be analyzed for the full suite of constituents, including radionuclides; metals/cations; general inorganic chemicals; volatile and semivolatile organic compounds; and stable isotopes of hydrogen, nitrogen, and oxygen.</p> <p>Subsequent groundwater samples will be collected as specified in the "Interim Measures Work Plan for Chromium Contamination in Groundwater" (LANL 2006, 091987) and the "2007 Interim Facility-Wide Groundwater Monitoring Plan" (LANL 2007, 096665).</p>
<p>Geophysical Testing of Wells</p>	<p>The suite and timing of geophysical logging will depend on borehole conditions.</p> <p>Intermediate Well</p> <p>The Laboratory's borehole video camera, natural gamma, and induction (conductivity) tools will be used to log the core hole or the borehole if open-hole conditions allow. This may include parts of the core hole/borehole where casing can be retracted without causing hole stability problems. A gamma log will be collected in cased portions of the borehole.</p> <p>If it is decided to advance the large diameter hole into the regional aquifer and if the borehole conditions permit, the drill casing 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 MicroImager logs. If the casing cannot be retracted for logging, the accelerator porosity sonde, elemental capture sonde, triple lithodensity, and natural and spectral gamma logs may be collected. These logs will be used to characterize the hydrogeologic properties of saturated rocks in the regional aquifer. The geophysical logs will also be used in conjunction with information from drill cuttings, driller's observations, and water-level measurements to select the well screen depth.</p>

<p>Well Completion Design</p>	<p>The decision of whether to complete a perched-intermediate or regional well will be determined from several factors as described above.</p> <p>After the core hole reaches total depth, it will be plugged and abandoned using a bentonite or cement-bentonite mixture in accordance with plugging requirements in the Consent Order.</p> <p>Intermediate Well</p> <p>If significant perched water is present in the basalts, a second larger-diameter borehole will be drilled to place one well screen in the uppermost perched interval that has any indication of lateral hydrologic connectivity, if present.</p> <p>Regional Well</p> <p>If a regional well is completed, one well screen will be placed in the most productive interval identified within the upper 150 ft of the regional aquifer.</p>
<p>Well Development</p>	<p>Intermediate Well</p> <p>To the extent possible, the perched-intermediate well will be developed by mechanical means, including swabbing, bailing, and pumping.</p> <p>Regional Well</p> <p>The well will be developed by mechanical means, including swabbing, bailing, and pumping.</p> <p>Target water-quality parameters are turbidity <5 NTUs, TOC <2 ppm, and stability of other field parameters.</p>
<p>Hydraulic Testing</p>	<p>Intermediate Well</p> <p>Intermediate zones generally do not produce sufficient water to allow hydrologic testing. If sufficient water is present, a constant rate-pumping test will be conducted.</p> <p>Regional well</p> <p>Hydraulic testing will consist of a 24-hr constant-rate pumping test.</p>
<p>Investigation-Derived Waste Management</p>	<p>All IDW generated during implementation of this work plan will be managed in accordance with applicable EP-ERSS and ENV-RCRA SOPs. These SOPs incorporate the requirements of all applicable EPA and NMED regulations, DOE orders, and Laboratory requirements. SOPs applicable to the characterization and management of IDW are the following:</p> <ul style="list-style-type: none"> • EP-ERSS-SOP-5022, Characterization and Management of Environmental Restoration Project Waste (http://int.lanl.gov/environment/all/docs/qa/ep_qa/EP-ERSS-SOP-5022.pdf) • ENV-RCRA-SOP-010, Land Application of Groundwater (http://int.lanl.gov/orgs/env/rcra/qa.shtml?6), which implements the NMED-approved NOI decision tree for drilling, development, rehabilitation, and sampling purge water • ENV-RCRA-SOP-011, Land Application of Drill Cuttings (http://int.lanl.gov/orgs/env/rcra/qa.shtml?6), which implements the NMED-approved NOI decision tree for IDW solids from construction of wells and boreholes <p>The primary waste streams include drill cuttings, purge water generated during drilling, water generated during development of the well, contact waste, and decontamination water. Data from the existing wells indicate that the wastes generated should be nonhazardous and nonradioactive. Therefore, all wastes will initially be managed as nonhazardous. All waste streams will be characterized with direct sampling following generation and waste determinations made from validated data. Drill cuttings and purge water will initially be stored in aboveground- or belowground-lined pits. If validated analytical data show these wastes are hazardous, they will be excavated and placed in a registered accumulation area for shipment to an authorized TSDF within 90 d.</p>

Schedule	This chromium drilling program is anticipated to begin in June 2008. Coring will begin at SCI-2 first. Once the core hole is completed and the data from the pore water, perched-intermediate groundwater (if present), and the regional groundwater are evaluated, the Laboratory will propose a target monitoring depth and monitoring well design to NMED. Samples of core will be analyzed as obtained. Expected completion of the core hole is approximately 30 d. Several additional days will be required to complete analysis of samples and to synthesize the data to support a recommendation for the well. Drilling and completion of the well may take up to 60 d from the time drilling of the well begins. This approximate schedule results in an estimated completion date of August 31, 2008. The Laboratory will regularly review the progress of work with NMED as information is obtained during drilling.
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REFERENCES

The following list includes all documents cited in this report. Parenthetical information following each reference provides the author(s), publication date, and ER ID number. This information is also included in text citations. ER ID numbers 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; the DOE-Los Alamos Site Office; the EPA, Region 6; 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), March 2006. "Interim Measures Work Plan for Chromium Contamination in Groundwater," Los Alamos National Laboratory document LA-UR-06-1961, Los Alamos, New Mexico. (LANL 2006, 091987)

LANL (Los Alamos National Laboratory), May 2007. "2007 Interim Facility-Wide Groundwater Monitoring Plan," Los Alamos National Laboratory document LA-UR-07-3271, Los Alamos, New Mexico. (LANL 2007, 096665)

NMED (New Mexico Environment Department), March 18, 2008. "Investigation of Chromium Contamination in Regional Groundwater," New Mexico Environment Department letter to D. Gregory (DOE-LASO) and D. McInroy (LANL) from J.P. Bearzi (NMED-HWB), Santa Fe, New Mexico. (NMED 2008, 100964)

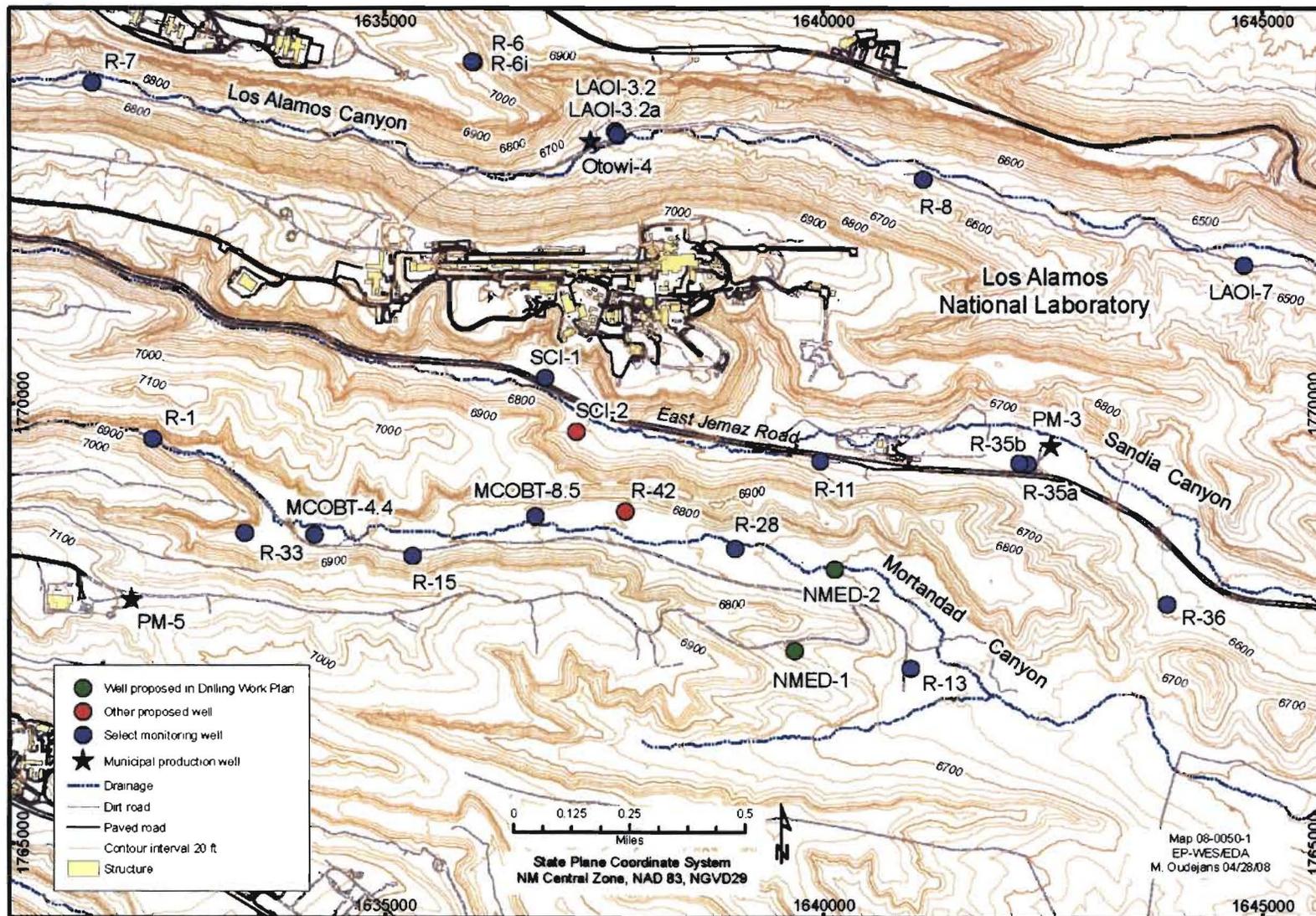


Figure 1 Locations of water-supply wells, selected monitoring wells, wells R-42 and SCI-2 planned for installation in 2008 and wells NMED-1 and NMED-2 planned for installation in 2009

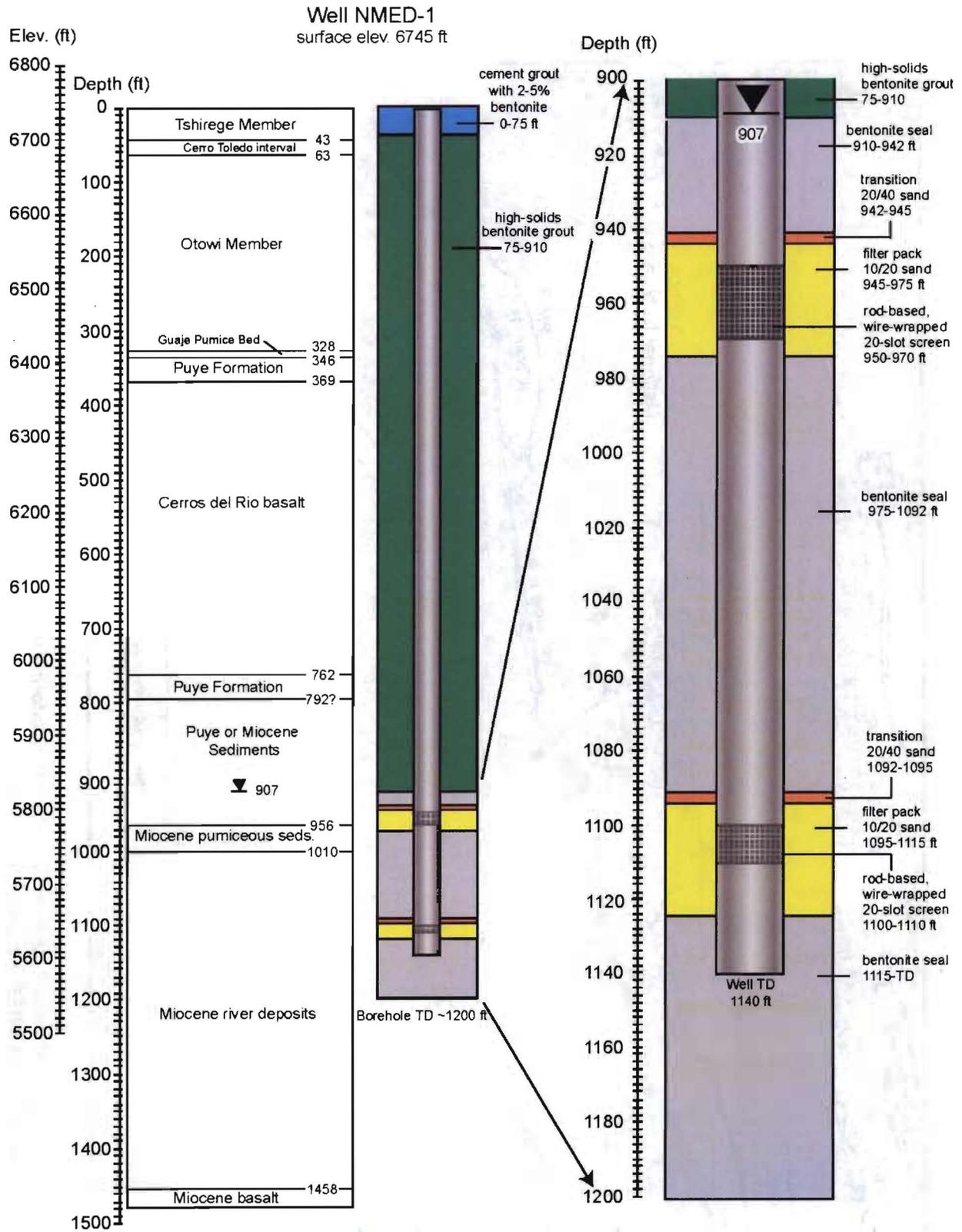


Figure 2 Proposed well design for NMED-1. All depths and elevations are shown in feet.

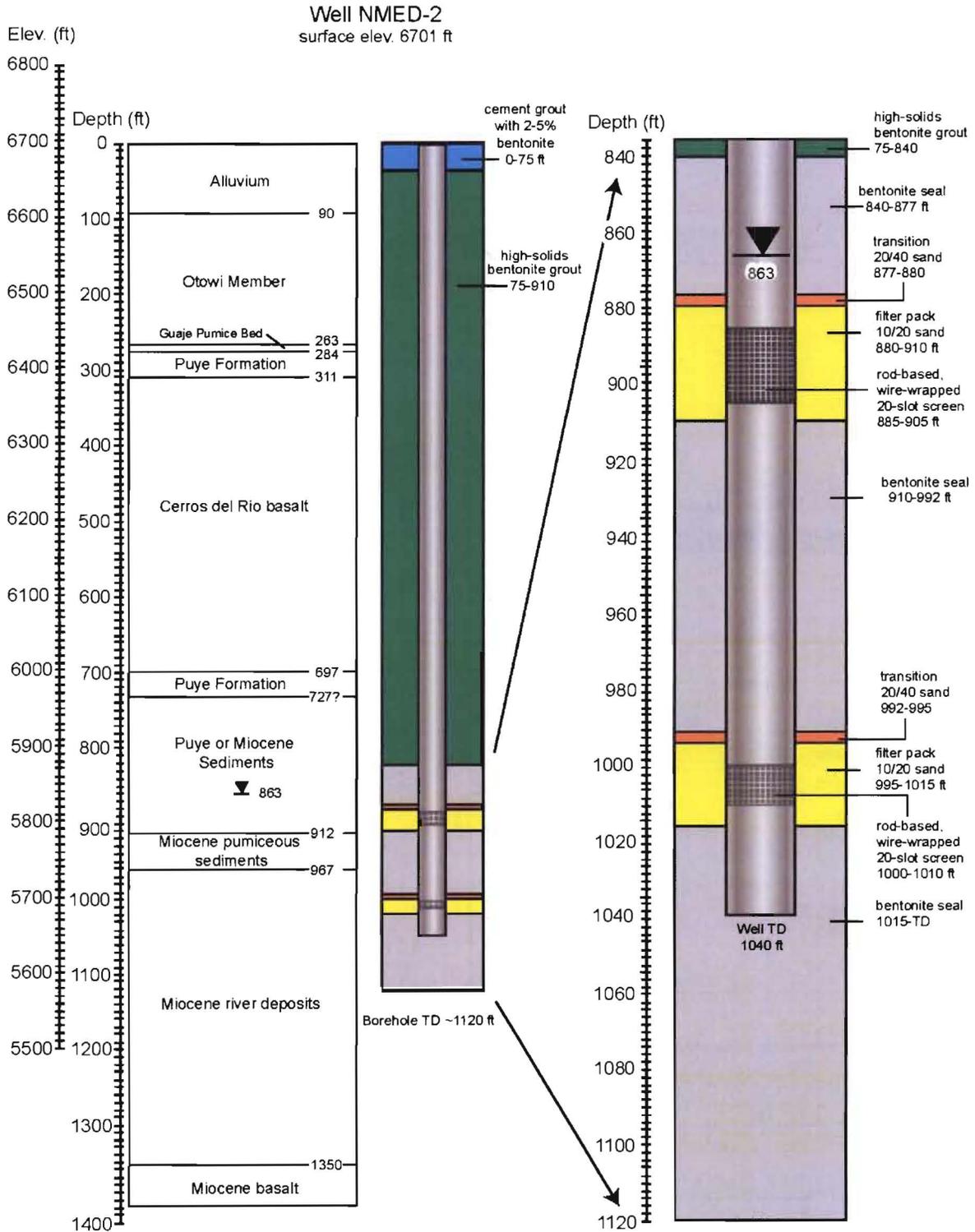


Figure 3 Proposed well design for NMED-2. All depths and elevations are shown in feet.

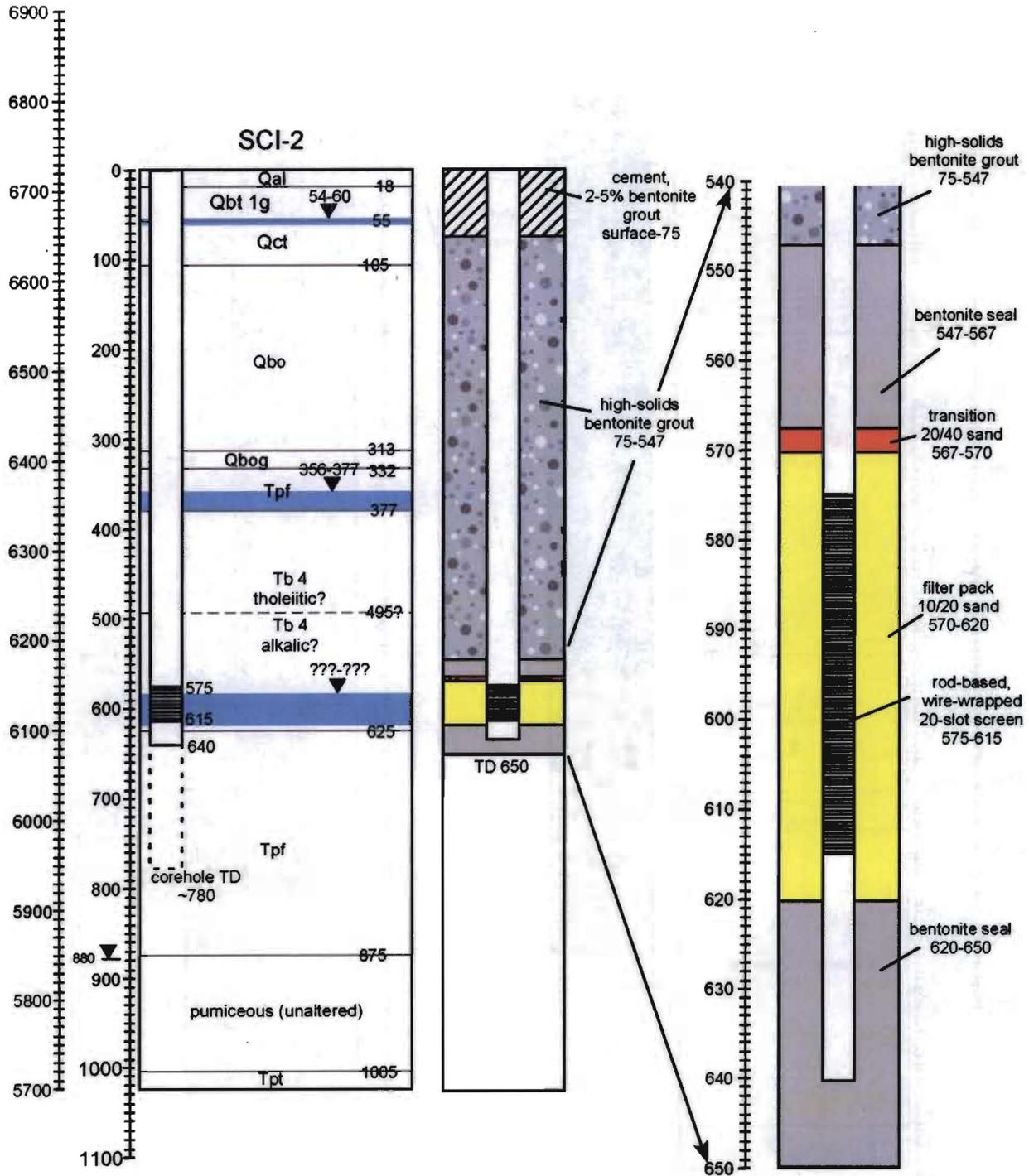


Figure 4 Proposed well design for a typical perched-intermediate well, represented by the possible design for SCI-2

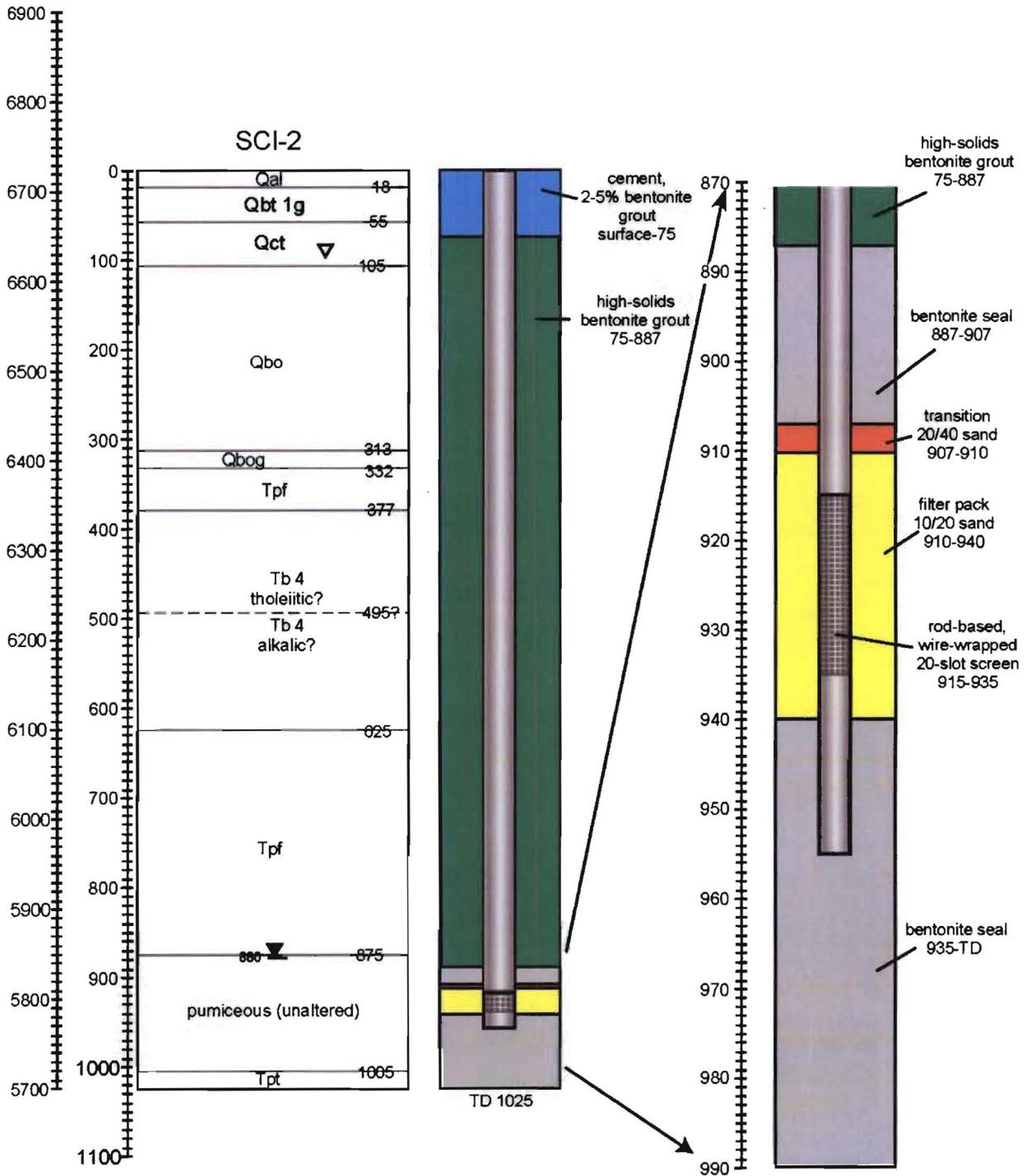
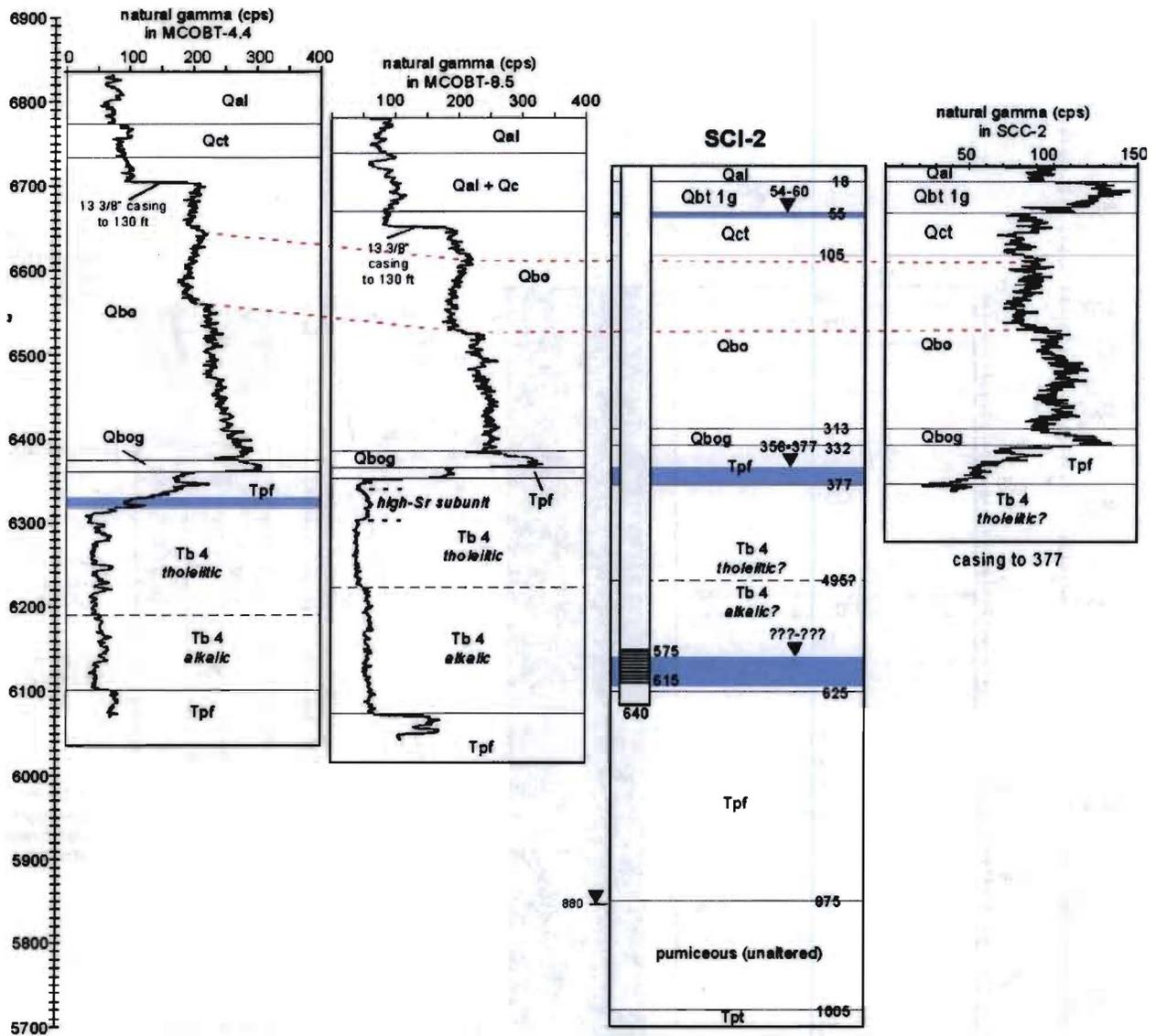


Figure 5 Proposed well design for a typical regional well, represented by the possible design for SCI-2



Notes: Blue fields represent perched saturation. The two uppermost perched intervals at SCI-2 are based on information from core hole SCC-2; a possible deeper perched interval at the base of the Cerros del Rio lavas is targeted by SCI-2. Qal = alluvium, Qc = colluvium; Qbt 1g = unit 1g of the Tshirege Member of the Bandelier Tuff; Qct = Cerro Toledo Interval; Qbo = Otowi Member of the Bandelier Tuff; Qbog = Guaje Pumice of the Otowi Member of the Bandelier Tuff; Tpf = Puye Formation, Tb4 = Cerros del Rio lavas; Tpt = Totavi-like river gravels; cps = count per second. Scale on left is elevation in feet; depths shown for SCI-2 are also in feet.

Figure 6 Direct-line borehole-to-borehole cross section (crossing mesas and canyons) from MCOBT-4.4 to MCOBT-8.5 in Mortandad Canyon to the SCI-2/SCC-2 location in Sandia Canyon